

Text No.6

INDUSTRIAL POWER DEMAND AND ELECTRIC UTILITY INDUSTRY IN JAPAN

産業分野における電力需給状況

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I . Deregulation on Electricity Supply Industry

During last decade, Japanese economy has experienced many challenges. The rapid appreciation of the yen had made the gap between Japanese and overseas electricity rates more pronounced than ever, prompting efforts to enhance the operating efficiency of electric utilities and to create a less expensive power supply system.

In this connection, Japanese legislature (Diet) amended in 1995 and 1999 the Electric Utilities Law of 1951. Diet is expected to amend the law in 2003 for establishing the ways towards full retail liberalization.

1. Amendment of the Electric Utilities Law

The amended Electric Utilities Law was promulgated on April 21, 1995 and taken effect in December 1995. Main points of the amendment are as discussed below.

1-1. Encouraging wholesale electricity suppliers

The amended law defined three types of electricity supplier - general, wholesale and special supplier. General suppliers mean ten investor-owned, vertically integrated utilities often called as ten EPCos.

" Wholesale activity " is defined as the supply of electricity to general suppliers. Wholesaler owning facility exceeding 2,000 MW continues to be subject to the regulations for wholesale electric utilities. Any wholesale suppliers owning facility with a total capacity of up to 2,000 MW is exempt from these regulations.

The law revised in 1995 also introduced the new category of special suppliers, who are allowed to supply electricity in a limited, designated area. This category was expected to apply to suppliers that are equipped with cogeneration facilities supplying both heat and electricity to two or more buildings in urban redevelopment areas. Under the law amended in 1999, another two types of suppliers were defined which will be discussed later.

1-2. Introducing a bidding system on generating field

Bidding for new electric power sources is conducted in a manner determined by ministerial ordinance. The methods of determining avoided costs that represent the upper cost limit to be offered, and operating conditions are also stipulated by ministerial ordinance. Successful bidders must submit the conditions of supply to the Minister of METI.

This new bidding system is expected to apply to small or medium-sized thermal power plant with a lead-time of less than seven years.

Six EPCos announced their first solicitations in 1996, totaling generating capacity of 2,655 MW and selected 20 projects totaling 3,047 MW. In 1997, seven EPCos announced their solicita-

tions totaling 2,855 MW and selected 3,118 MW. In 1998, two projects totaling 215 MW, and five projects totaling 1,004 MW were selected.

Due to the lower growth of power demand, any EPCo did not make solicitation after FY 1999(see Table 1).

Tabel 1: Results of Biddings

FY	Total capacity (MW)	Fuels used	Biding / selected Number of firms
1996	3,046.9	oil 26.8%; coal 57.4%; gas 13.6%	93 / 20(iron & steel ect)
1997	3,118.3	oil 40.2%; coal 46.8%; gas 13.0%	92 / 16(iron & steel etc)
1998	215.0	coal 100.0%	6 / 2(cement)
1999	1,004.3	oil 39.4%; coal 60.0%	11 / 5(iron & steel;trading ect)
total	7,384.5	oil 33.8%; coal 54.4%; gas 10.9%	191 / 38

(source) Current Situations of Electricity Supply Industry 2001(Denkijigyou no genjou)

1-3. Establishing a wholesale wheeling system

With the establishment of a wholesale wheeling system, any entity possessing power generating facility is allowed to enter into a supply contract with any general supplier to transport electricity to its factories using the power company's transmission lines. All supply contracts must be made public after notifying to Minster of International Trade and Industry (now METI).

In March 1997, five electric power companies (EPCOs) revealed their programs to lease their transmission lines to industrial companies. The lease arrangement will apply only to the industrial customers who meet the following conditions as well as technical guideline, 1) having generating facility, and 2) having a current contract with 500 kW or more within the service area of specific utility. Wheeling charges will vary according to EPCo.

1-4. Adapting a flexible contract system for load-leveling

To facilitate load-leveling by encouraging a faster, more flexible response to the diverse needs of customers, an approval system for individual contracts was replaced with a notification system covering many types of electric power supply agreement, thus giving customers a wide variety of choices.

1-5. Easing safety regulations

As one of the efforts to improve the operating efficiency of power companies, safety regulations were eased through minimizing government regulation and shifting safety-maintenance responsibilities to the electric power companies. These deregulation-measures apply to generating facilities (except nuclear), transmission facilities, sub-stations, and privately owned facilities.

As a result, the number of applications for approval is expected to decrease by 90%. Moreover, the total number of applications and notifications for construction projects, submitted to METI, is expected to decline by more than 50%.

2. Reassessing Electricity Rate System

Japan's electricity rate system has been changed to promote operating efficiency as well as an inexpensive and stable power supply system.

On July 24, 1995, the Rate System Committee of the Electric Utility Industry Council, an advisory organ for then Minister of International Trade and Industry (MITI, now METI), completed a report outlining measures for the introduction of a yardstick formula and a fuel-cost-adjustment system. The Committee also recommended that these measures be adopted as quickly as possible after implementation of the amended Electricity Utilities Law.

2-1. Yardstick formula

In line with the recommendation, yardstick competition was introduced for the retail rate revision of ten general utilities, which took effect in January 1996. While the traditional cost-of-supply (or rate-of-return) regulation is retained under the new system, electricity rates are adjusted by means of yardstick performance indicators in order to improve each utility's operating efficiency and to ensure transparency in rate setting.

Performance indicators are measured in three cost areas; generating cost as measured per kWh produced and other facilities-related costs and general operating costs as measured per kWh sold. The current unit cost and its reported rate of change are assessed for each of these cost areas, taking into accounts such factors as each company's demand density and generating mix.

Based on their comparative performance, the companies are grouped into 3 categories, which are then made public. Because companies fallen in worst performance group are given severe assessment for cost curtailing, the yardstick system is expected to provide incentive for power companies to improve their operating efficiency. (under the Electricity Utilities Law amended in 1999, rate decreases are exempt from yardstick formula or subject to notification to METI) .

2-2. Fuel-Cost-Adjustment System

Fuel-cost-adjustment system is expected to ensure the fluctuations in the prices of fossil fuels (crude oil, LNG, and coal) to be properly reflected in retail electricity rates. Japan imports almost all the fossil fuels.

An adjusted-unit-price of each company is calculated base on the three-month average-fuel-price (AFP) derived from custom clearance statistics. No rate adjustment is made, however, if changes in AFP fall within a certain range (+5% to -5%).

A ceiling is set for adjusting unit price to ensure that power companies do not simply pass on all the higher cost to their customers in the event of sharp fuel price increases. When AFP increases more than 50%, adjusted-unit-price is increased by 50% (see Fig.1 and Fig.2). First adjustment was effective in billing of July 1996

Fig. 1 : Fuel-Cost-Adjustment System

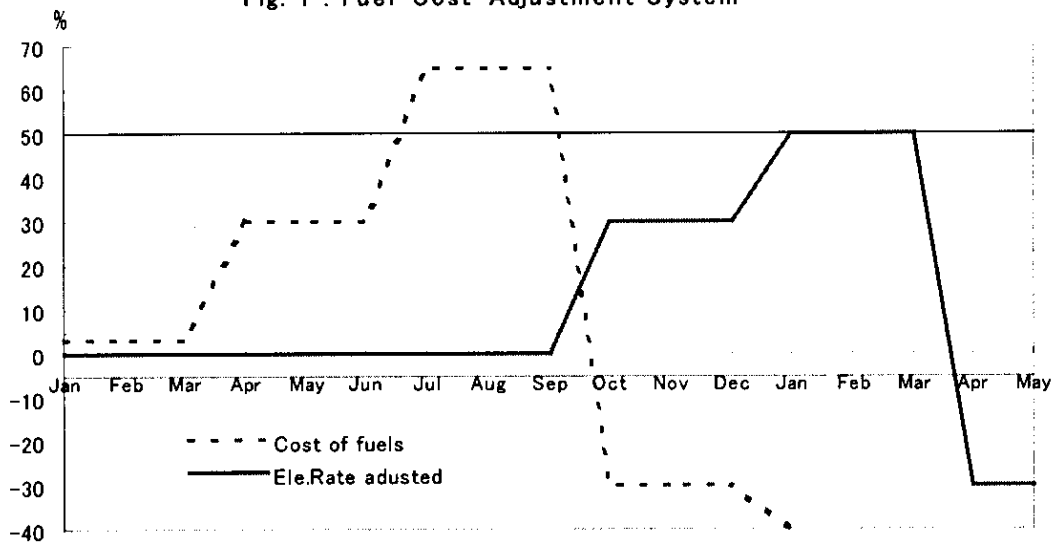
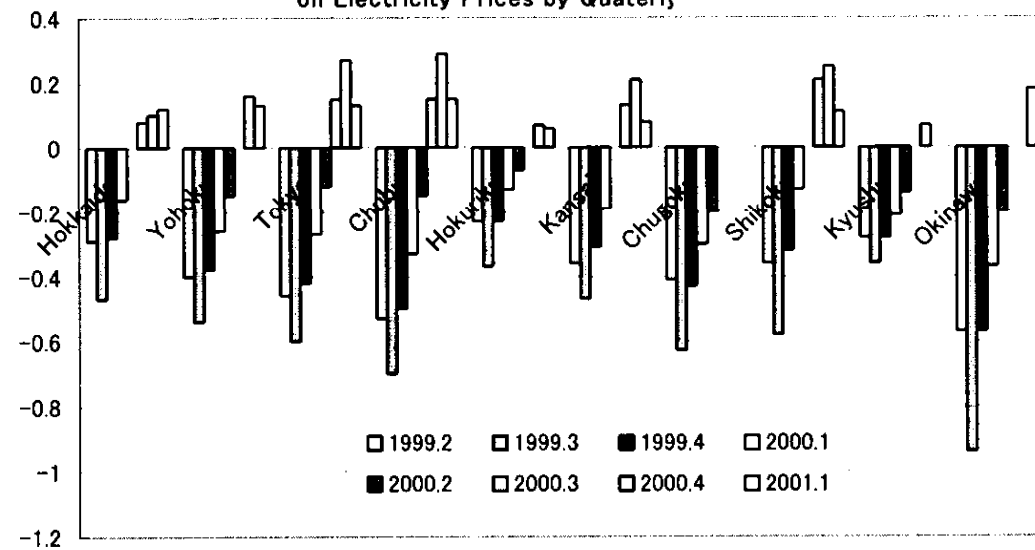


Fig.2 : Effects Fuel-Cost-Adjustment on Electricity Prices by Quarterly



2-3. Process of Electricity Rate Increase

Under the new system, electricity rate schedules of each General Electric Supplier (GES) are changed according to the following steps.

- (1) GES prepares its operational efficiency targets and makes it public.

Main targets announced by Tokyo EPCo. in 1997 are followings, 1) curtailing 850 MW of peak load during next 5 years, 2) curtailing 240 billion yen of plant and equipment investment during next two years, 3) curtailing 1,300 of man-power during next two years, and keeping a zero growth of general expenditures during next two years.

- (2) GES calculates its cost-of-supply on the basis of some assumptions (electricity

sales, yen exchange rate, cost of imported fuels and etc. during test year) and applied the proposal of new electricity rate schedules to METI.

(3) METI holds public meeting on the proposal.

3. Partial Liberalization Started in March 2000

On December 11, 1998, an adhoc committee of Electricity Utility Industry Council received a report outlining the partial liberalization provided by its working group. After revision of Electricity Utilities Law in 1999, eligible customers are allowed to "shop around " their suppliers since March, 2000. They are defined as " special high-tension " customers supplied at exceeding 22 kV , and with contract demand exceeding 2,000 kW (see Table 2).

Table 2 : Electricity sales and Customers by supplying voltages (ten EPCOs/ FY 2001)

Supplying Voltage		Scale of Demand	Commercial	Industrial	Typical Customers	Liberalized
			Sales & Number of contract	Sales & Number of contract		
Special High-Tension	>66kV	>10,000kW	212.2 bil.kWh (share:26%) 9,000 contracts		Large office building; factory	From March 2002
	22kV or 33kV	10,000kW ~2,000kW			Large office building; factory	
High-Tension	6kV	2,000kW ~50kW	142.5 bil.kWh (18%) 290,000 contracts	159.2 bil.kWh (19%) 450,000 contracts	small or midium office buiding; factory	By April 2005
Low-Tension	100V 200V	< 50kW	Residential	254.5 bil.kWh(31%) 70 million contracts	house;	To be discussed on full Liberali-zation by April 2007
			Others	42 bil. KWh (5%) 6.4 million contracts	Shop	

3-1 Entrants into Competitive Market

Competition between EPCOs and New Players

Competition is increasing in the power sector, since the deregulation took place in March 2000.

Diamond Power Corp, a wholly owned subsidiary of Mitsubishi Corp, outbid utility firms to win contracts to supply electricity to several clients, including then MITI (now METI), and department store. Ennet Corp, an alliance of Nippon Telegraph and Telephone (NTT), and big two gas retailers (Tokyo Gas and Osaka Gas), won a supply contract from the Osaka prefectural government, while Nippon Steel signed up the Fukuoka prefectural government.

However, the deregulation has so far had limited effects on a nationwide basis, with newcomers accounting for a mere 0.4 % of the entire liberalized market. They are

handicapped by limited output. Non-utility firms are vying to offer competitive prices by buying surplus electricity generated by captive generators at steel and chemical firms, instead of their own. In order to increase market share, non-utilities will need their own generating facilities. On March 28, 2001, a power-retailing subsidiary of US's Enron submitted an application for building a large-scale LNG-fired power plant in Aomori Prefecture. In addition, Enron planned to build and operate coal-fired plant in Yamaguchi Prefecture. But these projects were canceled after Enron's bankruptcy in last December.

In addition, newcomers claim that the fees to lease utilities' power lines are too high to enter in the retail market.

EPCOs are becoming increasingly sensitive toward the new providers, prompting them to announce an average 5% price cut in October 2000.

Competition among EPCOs

Heightened concern about competition is most clearly evident in Tokyo EPCo. (Tepco), which serves the greater Tokyo area. In April 2002, Tepco carried out a major rate cut ahead of the nine other utilities. The unilateral rate cut of the average 7% was the first since 1988 among 10 EPCOs, which have so far implemented simultaneous cuts. Tepco has been accelerating cost-cutting efforts, freezing a program to build power plants in February 2001 and implementing a plan to cut over 2,000 jobs by FY 2003. (Japanese fiscal year from April 1 to March 31 of next year)

The combined market share of the new entrants to the electricity market, after the deregulation in greater Tokyo area, has reached an estimated 5% -- higher than elsewhere in Japan.

Ten EPCOs are expected to see competition intensify among themselves, rather than with new players. Tepco plans to encroach on the territories of other EPCOs. In March 2002, it lost a bid to supply the Tohoku region to Tohoku EPCo. To catch up with Tepco, Tohoku EPCo plans to slash power prices by around 5.7% in July, while Chubu EPCo will implement a 5-6% cut in September, and Kansai EPCo, a 4.2% cut in October.

Many manufacturers believe their weakened global competitiveness is partly due to higher power prices in Japan. With continued production cuts and output shifts overseas amid the economic slump, power demand from the manufacturing sector registered the 14th consecutive month of year-on-year drop in March 2002. Electricity demand fell on the year in major manufacturing industries in FY2001, with the steel and nonferrous metal industries both showing drops of nearly 10%.

3-2 Discussions on Full Liberalization

Toward Partial Liberalization

Followings are some past discussions on liberalization of electricity supply.

In December 1996, Japanese government announced its economic-restructuring pledge, which included " lowering the costs of energy (electricity and gas), transportation and telecommunications to internationally competitive levels by 2001".

In December 1997, Administrative Reform Committee, an adhoc advisory organ for Prime Minister, urged the government to expedite the structural reform of the power industry. The advisory panel called for early liberalization of supply to large customers as a first step toward free retailing of electricity (partial liberalization).

Separately, an advisory committee for Minister of International Trade and Industry reached a conclusion in May 1998 on liberalizing retail sales of electricity in an attempt to help lower electricity charges.

Many issues including following points were discussed there.

1) universal service as a public service : start-ups may only concentrate on the market for large customers , giving a chance to small or residential customers in near future.

2) long-term energy security and environmental protection: If newcomers / new entrants use fossil fuels especially of oil and coal, the consequent damage to the global environment will be huge(see Table1).

As mentioned above, partial liberalization started in March 2002, after Electricity Utilities Law was amended in 1999.

Road Map toward Full Liberalization

In March 2000, the government liberalised retailing to large-lot business users (extra high tension customers), accounting for 26 % of the entire electricity market. Deregulation will be expanded to include sales to midsize factories and supermarkets (high tension customers), accounting for 37 % of the market, by April, 2005.

Regarding liberalizing the low tension customers such households and small stores which make up 37 %, disucussion will started by April, 2007.

METI also plans to set up an power exchange for power entities to buy and sell surplus electricity, as well as an independent regulatory agency to handle disputes between the power firms and new entrants, by FY 2003.

Although they have accepted these government proposals, ten EPCos have not agreed to accept the idea of separating transmission business and generation business.

To realize the road map, it is necessary to amend the Electricity Utilities Law in 2003.

II . Summary of Electric Utilities

Electric Utilities Law amended in 1999 describes five types of the electric entities : general electric utilities, wholesale electric utilities, wholesale suppliers, special electric suppliers and non-franchise electric suppliers. The Law does not describe the unbundling.

1. General Electricity utilities (Regional Electric Utilities)

The Regional Electric Utility is a vertically integrated one that has all the functions from generation to distribution and has a legal obligation to provide electricity to almost all retail customers in defined supply territory. There are altogether 10 utilities including Okinawa that is rather a small one. Other 9 Electric Power Companies (called Kyu-Denryoku) supply to the mainland of Japan – Hokkaido, Honshu, Shikoku, and Kyushu (Table 3). Electricity is supplies at various voltages; 22 kW, 33 kV or higher for large customers, 6 kV for medium sized ones and 100 V and 200 V for smaller one such residential (Fig 3).

BOX 1 : Short History of Electric Utilities in Japan

In the beginning of electric power industry, main electric utilities in western Japan had Employed European system of 60 Hz, while many eastern utilities 50 Hz system. Tokyo Electric Lighting Co., the predecessor of Tokyou Electric Power Co., was established in 1886 as first Japan's electric utility.

Under the wartime laws, the then central government had formed a state-run electric Monopoly, Japan Electric Generation and Transmission Co.(JEGTCO), which enabled it easy to unify frequencies.

By 1944, almost the eastern and western systems were standardized into 50 Hz and 60 Hz networks respectively. In Japan, electric energy have been supplied by privately owned companies except in WW II .

By the end of the war in 1945, Japan's generating facilities were devastated from overuse and bombing damage suffered during the conflict. Growing concerns over the reconstruction of reliable power sources led to extensive debates on the restructuring of the electric power industry. The resulting establishment of nine vertically integrated utilities (nine EPCos) in 1951 remain to this day. Before 1960', almost all enectricity had been generated by using such domestic energy as hydro and coal.

With the restoration of Okinawa (Ryukyu) to Japanese sovereignty in 1972, Okinawa EPCo joined electric power industry as the tenth regional vertically Integrated company.

2. Wholesale Electric Utilities

As of the end of March 2001, there are 54 Wholesale Electric Utilities which supply electricity to the Regional Electric Utility by operating their own power plants. These wholesalers may be categorized into next 3 types.

First type of wholesalers is relatively large - Electric Power Development Company (EPDC)

and Japan Atomic power Company (JAPC). EPDC was established in 1952 as a quasi-governmental utility and its main aims are to promote the development of large scale electric and coal-fired power plants using domestic energy as well as trunk transmission lines, which enable to interconnect the regional electric utilities. EPDC will be fully privatized by 2003. JAPC was established in 1957 as a subsidiary of regional utilities to develop the nuclear power plant at an initial stage.

Second type is a local governmental or municipal utility. 34 prefectures and one city wholesalers develop and operate small scale hydro plants in their administrative areas.

Third type is wholesaler chiefly owned by Regional Electric Utility and such a big energy-intensive industrial customer as iron and steel company.

3. Wholesale Suppliers

This type of suppliers is the operator of thermal plant who are selected through a bidding process implemented by the individual EPCo to supply each EPCo. As of October 2001, nine entities operate in this field.

4. Special Electric Suppliers

As a first special electric supplier, Amagasaki Utility Service began supplying electric power in the city of Amagasaki, Hyogo prefecture, in August 1998. Established as a joint venture by two chemicals, Amagasaki Utility Service operates cogeneration facility with a maximum output of 12,500 kW. Suwa Energy Service in Nagano prefecture became the second special supplier to come on line in October 1998. Established by a regional city gas provider, it utilizes a cogeneration system with an output of 3,000 kW to supply electricity and heat to a hospital and nursing home for the senior persons. In addition, JR Eastern entered in this field to supply electricity to its offices in Tokyo using its thermal power plant (198.4 MW) located in Kawasaki.

5. Non-franchise Electric Suppliers

With the implementation of Revised Electricity Utilities Law on March 21, 2000, this new type of suppliers were granted permission to use the transmission networks of 10 EPCos to engage in retail sales activities directed at deregulated / eligible customers. As of October 2001, nine entities enter in this field using total generating capacity of 1,089 MW from captive or self-generators.

6. Electric Power System

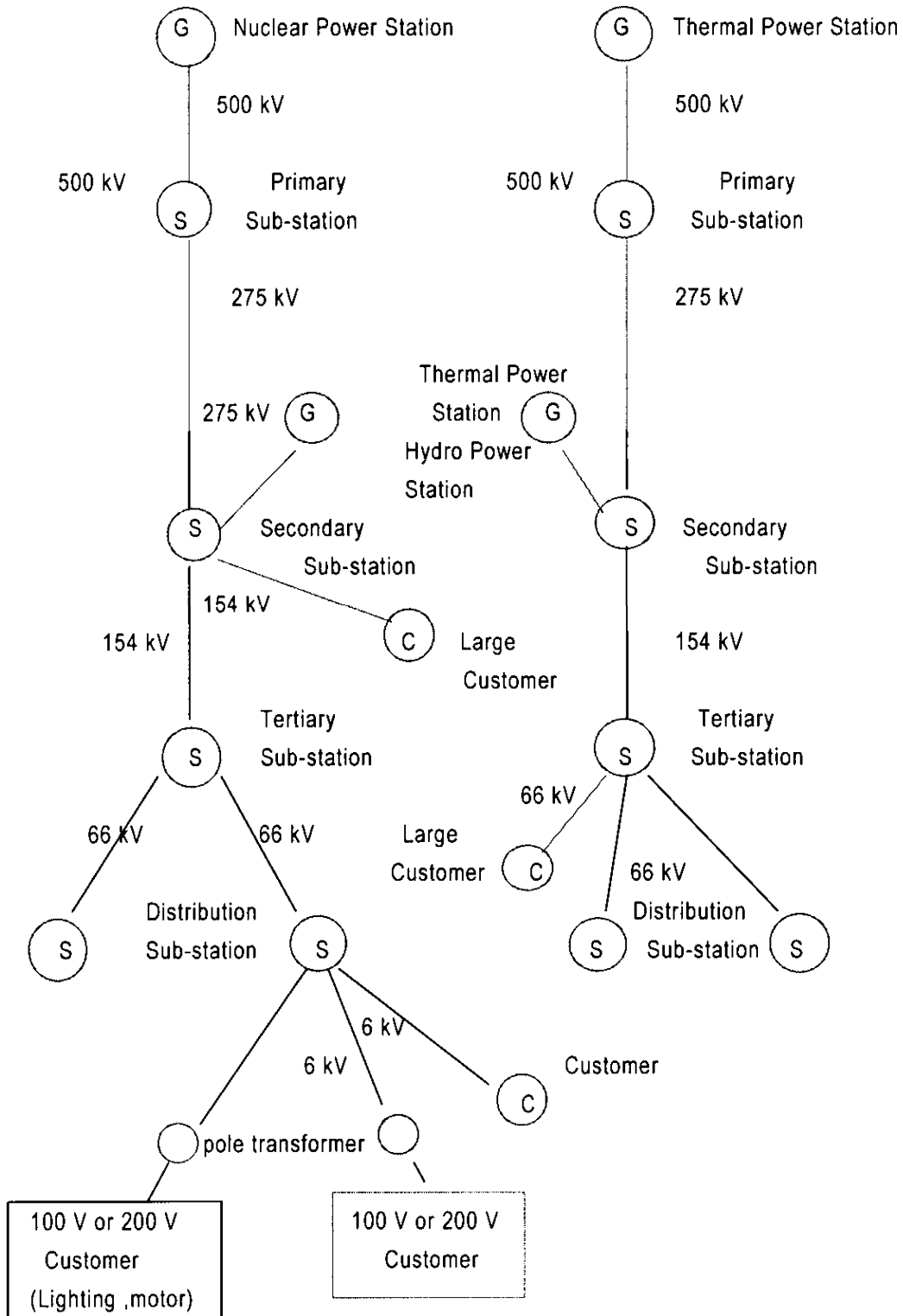
All the Japanese electric power systems are interconnected, except Okinawa and other small islands. Regarding 60 Hz areas, main 500 kV and 275 kV trunk transmission lines run through the central and western part of Japan. The system of Shikoku EPCo is interconnected through a 187 kV line run over the Seto Inland Sea to the system of Chugoku EPCo.

The 50 Hz systems of Tokyo EPCo and Tohoku EPCo are interconnected through a 275 kV line. To interconnect between the systems of Hokkaido EPCo and Tohoku EPCo, EPDC constructed a DC undersea cable (overhead line on land), Kamikita sub-station in Aomori Prefecture.

re and Hakodate sub-station in Hokkaido Prefecture. Each substation has a capacity of 300 MW.

In order to interconnect 50 Hz and 60 Hz areas, two frequency-converter stations - Shin-Shinano of Tokyo EPCo and Sakuma of EPDC with a capacity of 300MW each - are now in operation.

Fig.3 : Typical Power Flow to Customers



III . Retail Electricity Rate

Electricity rate schedules of each regional electric utility (general electric utilities) have been subject to approval by Minister of MITI (now METI). The rate schedule specifies the tariff and supply conditions for each service category.

Considering the cost-of-supply for each service category, the rate schedule classifies the services into some categories which include fixed-rate residential lighting; residential lighting A, B, and C; public street lighting; commercial power; low-voltage power; high-voltage power A and B; extra-high-voltage power; temporary lighting/power; agricultural lighting/power and night-only power. (Since in March 2000, some customers of extra-high-voltage power and commercial power are allowed to select their suppliers.)

During last decade, Japanese economy and electricity supply industry have experienced the drastic challenges. In the circumstances, rate schedule system was also changed mentioned as following.

1. Seasonal and Time-of-Use Rate

In January 1988, the Seasonal and Time-of-Use Rate System was employed to promote the load leveling for commercial and industrial customers. The night-only service was also effective as one designed for load-leveling. The electricity rates are determined independently by each utility, reflecting its cost-of-supply and demand composition. Therefore, the electricity rates are different from company to company.

2. Rate Reform in 1989

On April 1, 1989, the new rate schedules of the nine electric power companies came into effect. Following is the outline of and reasons for the revision.

2-1. Tax Reform-Introduction of Consumption Tax and Repeal of Electricity Tax

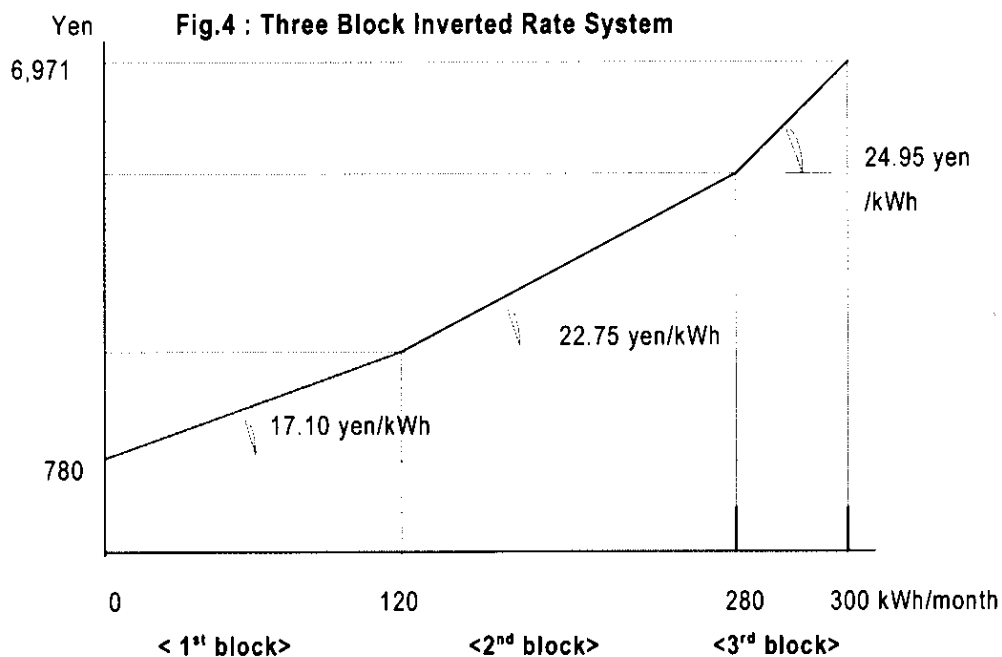
As a part of Tax Reform, a national Consumption Tax was introduced on April 1989. In accordance with Consumption Tax Act, electric power companies were to pass the tax burden (tax rate 3 %) to customer's bill. In exchange for the introduction of the tax, local Electricity Tax (tax rate 5 %) was repealed. In April 1997, consumption tax rate was increased by 2 % to 5 %.

2-2. Change in Inverted Rate System for Residential Tariff

The inverted rate system was moderated, taking account of the actual conditions about cost-of-supply, customer requests and recommendation of the Electric Utility Industry Council , advisory organ for Minister of MITI (now METI).

The Three-Block Inverted Rate System had been in effect since in 1974. The system was developed to adopt an idea of "national minimum" from a point of view that electricity is fundamental and indispensable for human life (see reference and Fig 4 on next page).

- 1) for the 1st block : lower rate is applied from the welfare point of view.
 - 2) for the 2nd block (120 - 250 kWh/ month): rate reflecting the average cost-of-supply is applied to secure the cost-of -supply, and
 - 3) for the 3rd block (250 kWh and over /month) : rate reflecting the increasing trend in marginal cost-of-supply is applied to meet the social request for energy conservation.
- Under the electricity rate revision taking effect in January 1996, upper of the second block was extended to 280 kWh from 250 kWh reflecting the increase of power consumption in typical household.



<reference> Electricity bill calculation under Three-Block Inverted Rate System			
Residential customers who use 300 kWh per month will pay their bills calculated as follows (without fuel-cost-adjustment for simplifying).			
1) Basic charge (30 A) :			780 Yen
2) Energy charge :	17.10 Yen/kWh x 120 kWh		= 2,052 Yen
	22.75 Yen/kWh x (280 kWh - 120 kWh)		= 3,640 Yen
	24.95 Yen/kWh x (300 kWh - 280 kWh)		= 499 Yen
3) Basic charge + energy charge :			6,971 Yen
4) Consumption tax :	6,971 Yen x 5%		= 349 Yen
5) Electricity bill :		3) + 4)	= 7,320 Yen
Unit price :	7,320 Yen / 300 kWh		= 24.40 Yen/kWh

2. Temporary Rate Reduction from 1993 to 1995

Because the yen had been sharply appreciated since the first half of 1993, ten electric utilities decided to return the cost savings to their customers including industrial ones. In Japan, almost all thermal power plants are burning the imported fossil fuels.

This took the form of reduced rates during the 11-months period from November 1993 through September 1994. The reduced-rate period was extended for one more year, through September 1995, because the yen was expected to remain.

However, the base rates permitted in 1988 were not changed until January 1996, when the new rates were taken effect. This move was based both on revisions of the Electricity Utilities Law and on a review of the rate system.

3. Rate Reduction in 1998

On February 10, 1998, the new rate schedules of the ten EPCOs came into effect with an approval of the Minister of MITI (now METI). Monthly bill of typical household was cut by 4.1 %, and industrial customers 5.0 %.

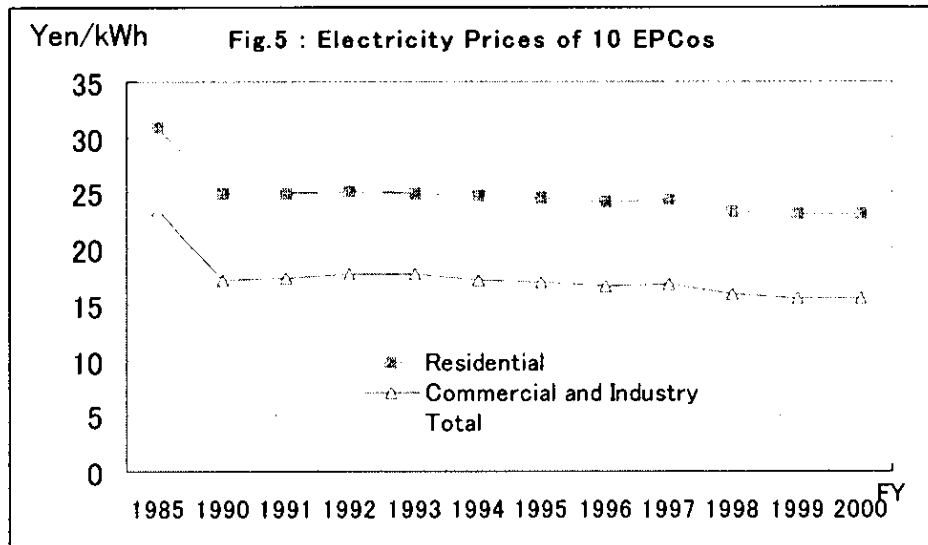
4. Rate Changes in 2000

The Japanese Diet passed a bill in May 1999, which amended the Electric Utilities Law to allow a partial opening to competition. Beginning in March 2000, above 8,000 large industrial and commercial consumers comprising roughly one-third of the retailing market have been able to choose their electricity suppliers. Regional utilities currently are obligated to allow power from other suppliers to transit their grids to the large consumers.

In October 2000, EPCOs announced an average 5% price cut. Under the new rate system, EPCOs can freely reduce their rates or prices. However, they must apply to get METI's permission in case of rate increase.

As a result, approximately 25 % was cut in average price during last 15 years (see Table 4 and Fig. 5). In FY 2000, revenues per kWh for ten EPCOs averaged ¥17.76 per kWh.

Table 5 shows the selected electricity tariffs of Kansai Electric Power Co., which was effect on October 2000.



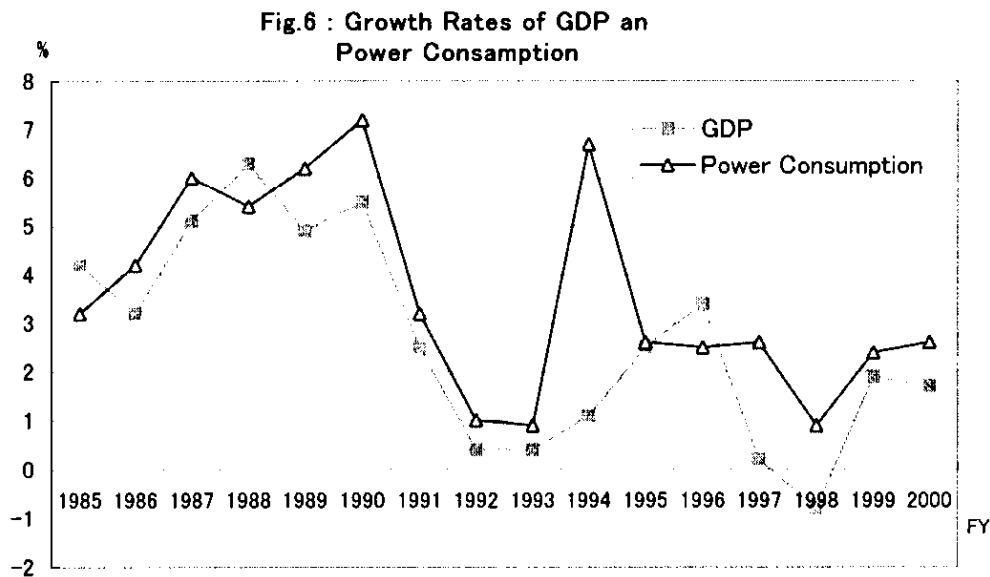
IV. Electric Power Supply and Demand

1. Power Generation and Consumption

Power Generation: A total of 1,091.5 TWh was generated in Japan in FY 2000, representing an increase of 2.4% from the previous year. Of this amount, 798.4 TWh, or 73 % of the total, was generated by ten EPCOs, an decrease of 0.1% over the previous year.

A braeakdown of the overall power-source mix is followings. Hydropower increased to 96.8 TWh by 1.3% from the previous year due to the higher flow rate. Nuclear power increased by 1.7 % to 322.1TWh due to returning survices after long-term regulatory inspection of some plants. And, thermal power increased by 2.9 % to 669.2 TWh.

Power Consumption: The Japanese economy had continued slump following the bursting of economic bubble (see Fig.6). In FY 2000, the growth rate of GDP was 1.7%. In spite of the business slump, total electricity consumption increased by 2.2% to 978.3 TWh as compared with the previous year. Ten EPCOs supplied 837.9 TWh, or 85.7% of this total, an increase of 2.6% from the previous year (Table 6). Total combined peak load for 10 EPCOs rose 2.6% to 173,070 MW.



2. Load Curves

During last 30 years, peak load in summer has been pushed up by air-coolers' power consumption. In addition, power consumption in winter has been also pushed up by heating demand (Fig 7 and Fig 9).

During last 2 decades, the pattern of daily load curve was not changed basically (Fig 8). It seems that the power loads in nighttime were bottomed up through some measures including night-discount rate offered.

Fig 7 : Daily Load Curves (combined of ten EPCOs')

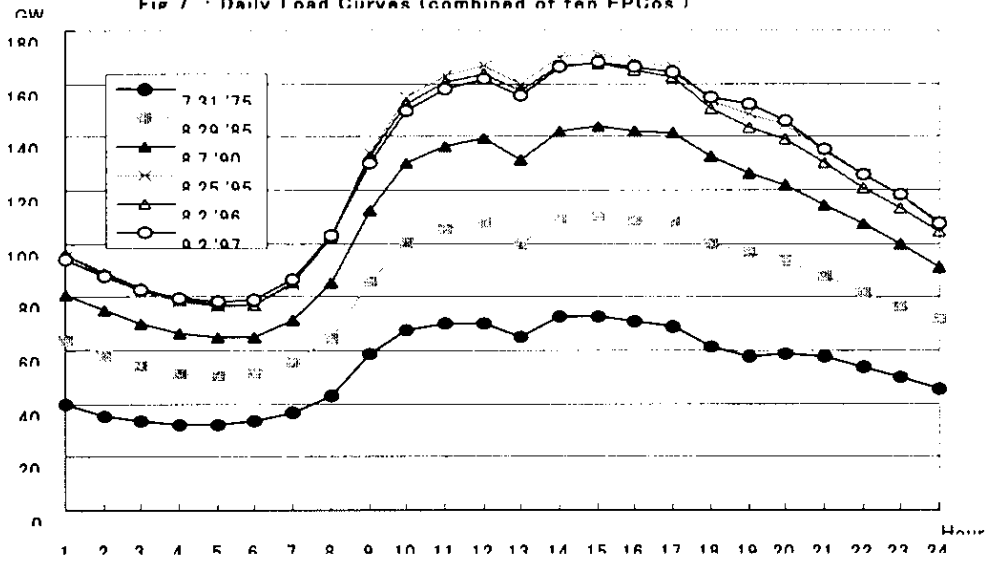


Fig 8 : Daily Load Curves (Peak Demand = 100)

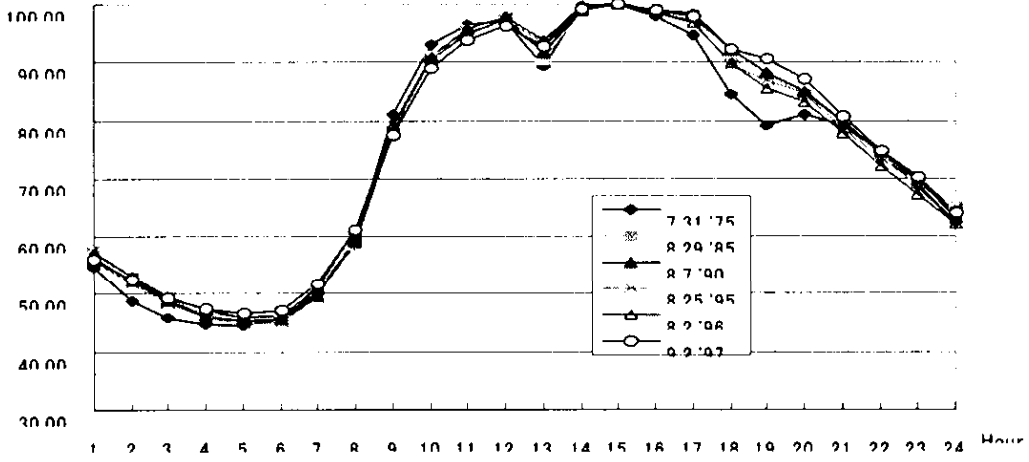
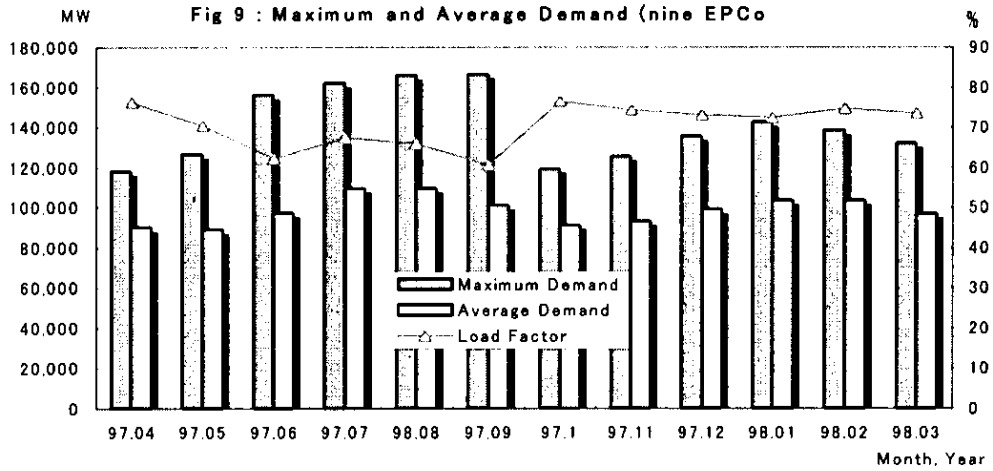


Fig 9 : Maximum and Average Demand (nine EPCo)



Ref: Typical Daily Load Curve and Supply Capacity

Run-off-river and nuclear power plants are responsible for the base load, while coal-fired and LNG-fired power plants are for middle load. As demand climbs to a peak, electricity from oil-fired thermal and pumped-storage plants is increased to maintain a consistently stable power supply.

3. Load Leveling Measures

Increased use of air-conditioners during daytime hours in summer has resulted in a long-term decline in annual load factor. The load factor at nine EPCOs averaged 55.2 % in 1995, comparing to 67.1 % in 1970.

EPCOs have identified improvement of the load factor as a top priority for their operations and have implemented various measures to realize this goal by diversifying their rate schedules and pursuing the dissemination of advanced thermal-storage equipments.

Table 8 : Annual Load Factor (Except of Okinawa EPCo)

FY	Peak Load in August: GW	Annual Electric Energy Requirement : TWh *	Reserve at peak load : GW	Reserve Margin : %	Annual Load Factor : %
1990	142.9	718.9	5.8	4.0	57.4
1991	147.0	741.4	11.2	7.6	57.4
1992	150.9	747.7	11.6	7.7	56.6
1993	143.8	751.9	27.7	19.3	59.7
1994	165.1	803.5	6.4	3.9	55.4
1995	167.7	822.1	11.2	6.7	56.0
1996	167.5	842.2	15.8	9.4	57.2
1997	166.6	858.9	22.3	13.4	58.9
1998	168.2	866.3	25.9	15.4	58.8
1999	168.0	884.2	27.8	16.6	59.9
2000	172.3	905.2	21.7	12.6	60.0

(Source) Japan Electric Power Survey Committee (Note) *at the sending end

The government also identifies load leveling as a key for supply cost reduction. It is estimated that EPCOs could cut their total costs by approximately 1 % through 1 % improvement of annual load factor. Load leveling (or DSM) is also expected as a measure to reduce CO₂, because it decreases oil-fired generation in daytime and increases nuclear or hydro generation in nighttime.

Reference : Load Leveling to Lower CO₂ Emission-FY1995 Data of nine EPCOs-

	energy input for generation	carbon emission / kWh generated
Daytime (08:00 - 22:00)	1,425 kcal/kWh	103g-c/kWh
Nighttime (22:00 - 08:00)	1,150 kcal/kWh	83g-c/kWh
Thermal power generation	2,455 kcal/kWh	178g-c/kWh

V . Development of Electric Power Plants and Environmental Measures

1. Development of Electric Power Plants

Since oil crises occurred twice in 1970s, nuclear, coal and LNG power technologies have been preferred as the alternatives to substitute oil-fired power plants. It is very important for us to attain the best mix of these various technologies, considering fuel security, economy, and environmental characteristics.

Although the world oil situations are not in tight now comparing with those in 1970', it is thought that oil supply will become short and unstable in a long term. Coal supply is most stable because deposits are very rich and deposits areas spread all over the world. Natural uranium is supplied on the basis of long-term contracts with such politically stable countries as Canada and Australia. And the supply of LNG will continue to be stable.

Speaking about the economy of each plant, nuclear is most economical in Japan and next come coal, LNG and oil. Regarding the lead-time to full operation, pumped-storage and reservoir hydro plants are shortest, and next are LNG combined-cycle, oil, coal and nuclear plants. In view of load responsibility (capability to change output within certain period of time), the order is the same as above.

Considering these characteristics, nuclear power plants are expected to play a core source together with coal-fired ones as base-load sources, while pumped-storage / reservoir hydro plants and small-scale or older oil-fired will be constructed or operated as peak-load sources.

In the future, LNG-fired and coal-fired plants will be operated to supply for base and/or middle loads. Conventional hydro and geothermal plants will be operated for base load supply. In order to achieve stable power supply, it is planned to maintain 8-10 % margin generally accepted as appropriate in Japan.

As of the end of FY 2000 (March 31, 2001), the total installed generating capacity was 258,837 MW, of which thermal power accounted for 64.4 %, hydro power 17.9 % and nuclear power 17.5 %. Ten EPCOs own 195,633 MW, wholesalers 32,947 MW, special suppliers 16 MW and self-generators 30,241 MW. Fig10 and Fig 11 show the composition of generating capacity and electric energy generated of ten EPCOs and wholesalers (see Tables 10 and 11).

According to the recent forecast, electric power sales by 10 EPCOs are predicted to grow by an average of 1.5 % to 964.4 TWh in FY 2010. During the same period, summer peak load is expected to increase at annual rate of 1.7 % to 198,970 MW.

Table 9 : Projected Generating Cost by MITI

~ in the case of commercial operation in F.Y.1992 ~

Type of Power Plant	Conventional Hydro	Thermal			Nuclear
		Oil	LNG	Coal	
Unit Construction Cost (1,000 yen/kW)	600	190	200	300	310
Generating Cost during lifetime (yen/kWh)	13	10	9	10	9

**Fig 10 : Mix of Generation Capacit
(10 EPCOs : as of the end of FY)**

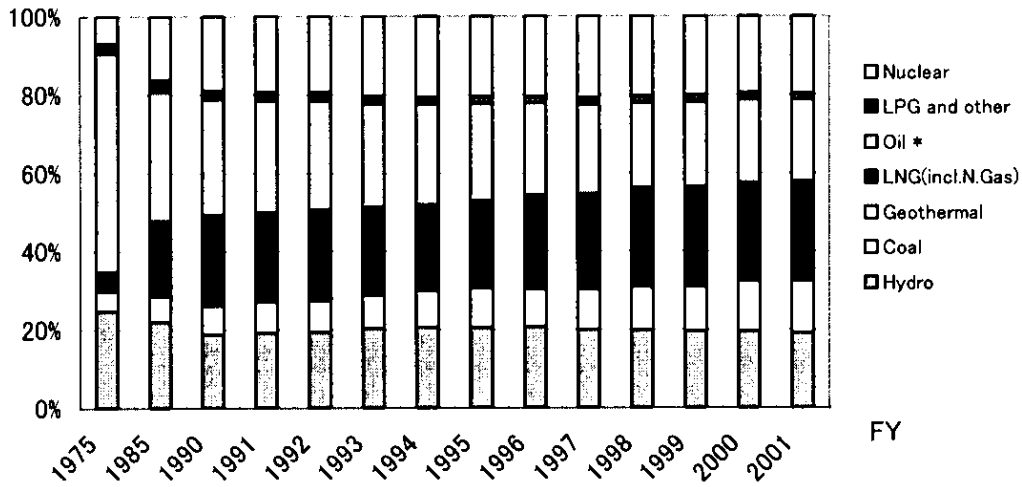
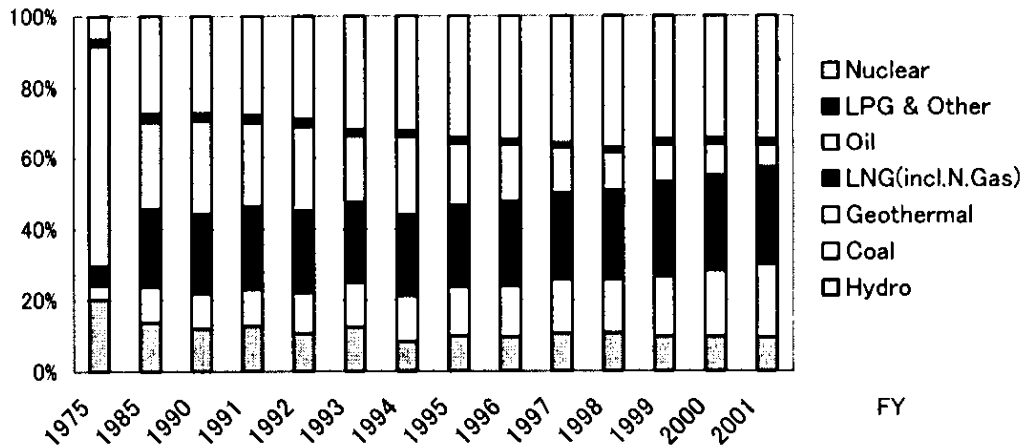


Fig 11 : Mix of Generation (10 EPCo:



2. Environmental Laws

Along with the rapid economic growth in 1960's, the public became more aware of the environmental conservation and power plant siting issues. Japanese government and the industrial circles were wrestling with these problems. Before 1974, following main national laws were enforced.

- Air-Pollution Control Law, 1963
- Noise Regulation Law, 1963
- Basic Law Concerning Countermeasures for Environmental Disruptions, 1967
- Basic Environment Law amended, 1970

- Environmental Agency (now Ministry of the Environmental Affairs) established in 1971

In fiscal 1973, a rate of the completion to the target of projects was only 44%, which was mostly ascribable to the opposition by local inhabitants against the possible environmental contamination. Therefore, no reserve was anticipated by 1977 summer.

In this circumstances, electric power companies were making efforts to overcome environmental difficulties with taking up possible remedies for anti-pollution as well as to obtain the under-standing from local autonomies and people.

Table 12 : Average SO_x, NO_x and CO₂ Emissions per kWh In Selected Industrial Countries

		CO ₂ (kg-C/kWh)	SO _x (g/kWh)	NO _x (g/kWh)
U.S.A.	Thermal Power	0.23	4.5(1995)	2.3 (1995)
	Total	0.16	-	-
U.K.	Thermal Power	0.19	6.7 (1995)	2.1 (1995)
	Total	0.13	-	-
Germany	Thermal Power	0.25	5.4 (1994)	1.4 (1994)
	Total	0.16	-	-
Canada	Thermal Power	0.22	4.9 (1994)	2.1 (1994)
	Total	0.05	-	-
France	Thermal Power	0.21	5.7 (1994)	2.3 (1994)
	Total	0.02	-	-
Italy	Thermal Power	0.17	3.4 (1992)	2.1 (1992)
	Total	0.14	-	-
Japan	Thermal Power	0.16	0.24 (1997)	0.33 (1997)
	Total	0.10	-	-

(Note) Total includes hydro and nuclear power generation CO₂ 1996; SO_x 1992-97

(Sources) Electricity Review Japan : The Federation of Electric Power Companies / Japan
OECD Energy Balance and others

To mitigate the severe siting situations, Japanese Diet promulgated in June 1974 the Electric Power Generating Plant Adjacent Area Arrangement Law, and related two laws; Electric Power Development Promotion Tax Law and Special Accounts Law on Electric Power Development Promotion Measures.

Special accounts are divided into two categories for 1) RR&D of non-petroleum power sources (energy diversification program) and 2) siting promotion. Regarding the siting promotion, the laws provide such public facilities as medical center in the vicinity of the project site.

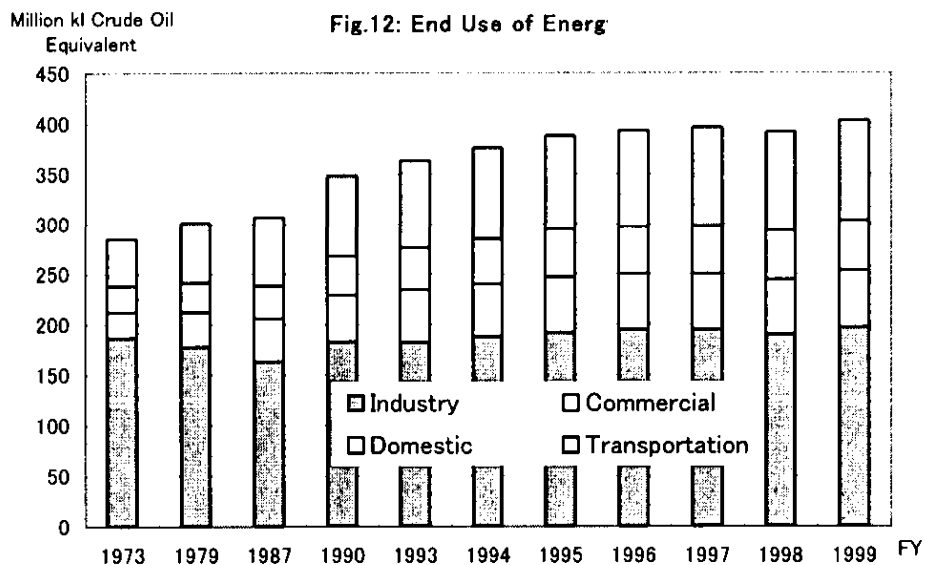
As a financial source required, Japanese central government collects the tax from electric power company (ten EPCOs). An original tax rate was 85 yen per 1,000 kWh sold and changed to recent 445 yen per 1,000 kWh sold. All customers pay their tax as a part of electricity bill to electric power company.

The Environmental Impact Assessment Law was promulgated in June 1997, and taken effect in June 1999. Under the new system, environmental Impact assessment will be required by the law rather than suggested under administrative guidance. Environmental impact assessment undertaken for power plants now fall under the jurisdiction of the law, while at the same time remaining under the jurisdiction of the Electricity Utilities Law.

3. Measures for COP3 Agreement

At UN global-warming conference held at Kyoto (COP3*) in December 1997, Japanese government promised to cut greenhouse-effect gas missions, including carbon dioxide, to 6 % below 1990's level by 2020. (* COP3: Third Conference of the Parties to the United Nations Framework Cinvention on Climate Change)

In line with the pledge, discussions were under to revise the government's long-term plan on energy supply and demand. In June 1998, the Long-Term Energy Supply and Demand Outlook was announced. The revised forecast places emphasis on efficient use of energy and on the development of nuclear power plants as an effective means of reducing CO2 emissions.



Future energy demand in the industrial sector is expected to rise only marginally. However, demand of households and transportation sector is seen to keep a relative high growthy(see Fig.12).

On the supply side, the government expects to build 20 new nuclear power plants in place by FY 2010. However, potential locations for nuclear power plants are harder to find because of strong public opposition after series of accidents at plant operated by the Power Reactor and Nuclear Fuels Development Corp (now Japan Nuclear Fuel Cycle Development Institute) and at JCO uranium processing plant.

It is also expected that coal will be presented as a fuel of lower priority, especially when compared with less-pollutant fossil fuels such as LNG.

In Japan, one fourth of CO2 emissions are coming from power generating activities. Therefore, it is very important to change the composition of power sources mix as well as to save power consumption.

According to the discussions in an advisory committee of METI, CO2 emissions in generating sector have to be cut by 9 % from 76 million tons to 69 million tons by FY 2010. In order to attain this target, the composition of power generation will be changed as follows.

FY 1996 : thermal 55 %, nuclear 35 %, hydro 10 %

FY 2010 ; thermal 41 %, nuclear 45 %, hydro 13 %

But many people do not agree with a nuclear-oriented scenario. Renewable energies and energy conservation might be prioritized.

In October 2000, the Green Power Fund was introduced to promote the use of renewable energy namely wind power. The fund allows individual consumers to contribute a fixed amount to promote the dissemination of wind power, with the EPCOs contributing matching funds. The fund also responds to the needs of companies that wish to purchase electric power generated by wind turbine.

Japanese Government sets a goal on new energy development by 2010 as following.

Solar 4,820 MW (209 MW as of March 2000); wind 3,000 MW (83 MW as of March 2000); waste burning 4,170 MW; biomass burning 330 MW and fuel cell 2,100 MW.

Reference: comparison of carbon emissions by technology (unit: g-c/kWh)

Power technology	From burning of fuel	From operating of plant	Total
Coal-fired thermal	246	24	270
Oil-fired thermal	188	12	200
LNG-fired thermal	138	40	178
Wind	-	10	10
Geothermal	-	6	6
Nuclear	-	3-6	3-6
Small-Hydro	-	5	5

Source : CRIEPI (Central Research Institute of Electric Power Industry)

Table13:CO2 emission from power generation by fuel type*

(million ton)

Year	Coal	Oil	Natural gas	Other **	Total
2000	165.02	57.52	103.36	0.05	325.96
2000/1990	+72.2%	-54.7%	+38.9%		+9.6%

Source: International Energy Agency : CO2 Emissions from Fuel Combustion (2002 Edition)

* Public Electricity and Heat Production ** includes industrial waste and non-renewable municipal waste

VI Electric Power Loss Rate

The gross loss rate of electric power has been greatly improved since 1951 when the framework of present electric supply industry was established. Recently, it has been staying on a level of 9%. The improvements were attributable to decrease of law-breaking use (all customer subject to meter-reading), the increase of efficient transformers in operation, voltage upgrading of the transmission and distribution lines, and increase of wire size and improvement in the thermal efficiency of thermal power plants.

Transmission and distribution loss rate in FY 2000 is calculated as below (except Okinawa EPCo with an isolated transmission system).

(1) Total Generation	798,385 GWh		
	(Hydro 66,471 GWh; Thermal 426,426 GWh; Geothermal 3,013 GWh; Nuclear 302,475 GWh)		
(2) Purchased Power	134,593 GWh		
(3) Use for Pumped-storage	14,763 GWh		
(4) (1) + (2) - (3)	918,215 GWh		
(5) Power plant Use	33,342 GWh		
(6) Net Supply (4) - (5)	884,872 GWh		
(7) Sub-station Use	1,141 GWh		
(8) Electric Power Demand	837,923 GWh		
(9) Transmission & distribution loss		(a) T & D loss rate	
	(6) - (7) - (8)	45,859 GWh	(9)/(6)*100 = 5.18 %
(10) Gross loss (5) + (7) + (9)	80,342 GWh	(b) Gross loss rate	
			(10)/(4)* 100 = 8.75%

Table 14 : Power Loss Rate (9 EPCOs)

FY	Gross Loss rate	Transmission & distribution loss rate	FY	Gross loss rate	Transmission & distribution loss rate
1951	26.4 %	25.3 %	1992	9.5 %	5.8%
1955	20.1	18.4	1993	9.4	5.7
1960	14.3	11.3	1994	9.4	5.5
1965	11.9	8.5	1995	9.3	5.5
1970	10.1	6.8	1996	9.1	5.3
1975	9.6	6.4	1997	9.2	5.5
1980	9.3	5.8	1998	9.2	5.5
1985	9.5	5.8	1999	9.0	5.4
1990	9.3	5.7	2000	8.7	5.2
1991	9.5	5.8	2001	8.7	5.1

VII Thermal Efficiency of Thermal Power Plants

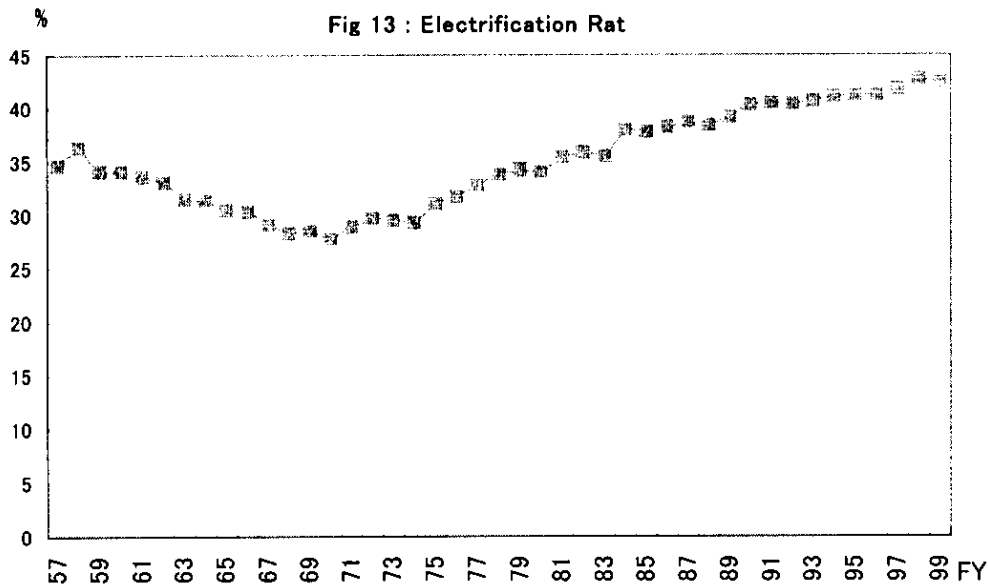
The average thermal efficiency of thermal power plant (gross output) of 9 EPCOs was greatly improved from 18.9% in 1951. After keeping about 38% level, the efficiency has been gradually improved to 40 % level because many LNG combined-cycle plants with higher efficiency have been commissioning (see Table 15).

Table 15 : Thermal Efficiency of Thermal Power Plants (averages of 9 EPCOs)

FY	For gross output	For net output	FY	For gross output	For net output
1951	18.9 %	17.2 %	1992	38.9%	37.1%
1955	24.0	22.2	1993	38.8	37.0
1960	31.9	29.8	1994	38.9	37.2
1965	37.1	34.7	1995	39.0	37.2
1970	37.8	35.9	1996	39.3	37.5
1975	38.1	36.4	1997	39.7	37.9
1980	38.1	36.4	1998	40.0	38.2
1985	38.2	34.4	1999	40.4	38.8
1990	38.8	37.1	2000	40.6	39.9
1991	38.8	37.1	2001	40.8	39.1

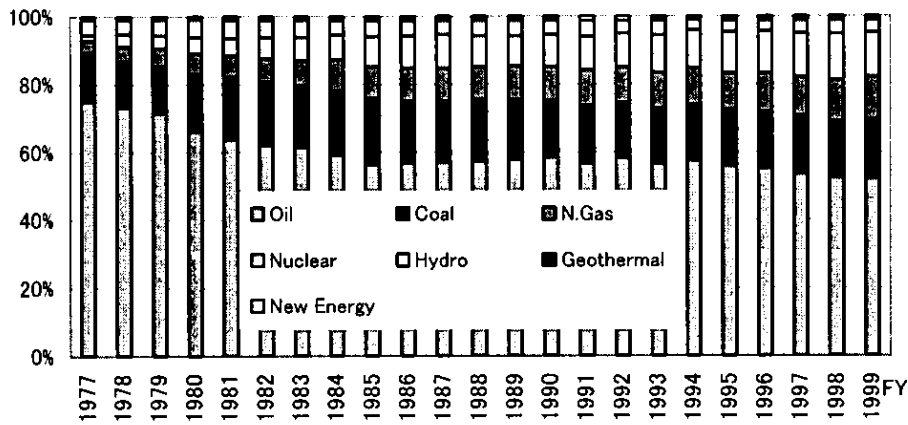
(source) Denki Jigyuu Binran (Hand Book of Electric Power Industry)

Until FY 1970, electrification rate had gone down steadily(see Fig.14). Especially during 1960s primary commercial energy consumption for heavy industries and motorization had grown higher than for power generation. FY 1970 was a turning point when Japan has an economic structure similar in the developed countries.



(Note) Electrification Rate = (Primary energy consumption for generation) / (Inland primary energy supplies) x 100

Fig. 14 :Inland Primary Energy Supp



Box 2 Internet Web Sites on electricity sector

Government of Japan

Ministry of Economy, Trade and Industry (METI)

<http://www.meti.go.jp/>

Natural Resources and Energy Agency of METI

<http://www.enecho.meti.go.jp/>

Ministry of the Environmental Affairs

<http://www.env.gov.jp/en/index.html>

Regional vertically-integrated electric utilities (10 EPCOs)

Hokkaidou EPCo

<http://www.hepco.co.jp/>

Tohoku EPCo

<http://www.tohoku-epco.co.jp/>

Tokyo EPCo

<http://www.tepco.co.jp/>

Hokuriku EPCo

<http://www.rikuden.co.jp/>

Chubu EPCo

<http://www.chuden.co.jp/>

Kansai EPCo

<http://www.kepco.co.jp/>

Chugoku EPCo

<http://www.energia.co.jp/>

Shikoku EPCo

<http://www.yonden.co.jp/>

Kyushu EPCo

<http://www.kyuden.co.jp/>

Okinawa EPCo

<http://www.okiden.co.jp/>

Federation of Electric Power Companies (FEPC)

<http://www.fepec.or.jp/english/>

Major Wholesaler

Electric Power Development Co (EPDC)

<http://www.epdc.co.jp/>

The Japan Atomic Power Co (JAPC)

<http://www.japc.co.jp/>

Additional information

Federation of Electric Power Companies, Japan

Electricity Review Japan <http://www.fepec.or.jp/erj/index-e.html>

Energy and the Environment

<http://www.fepec.or.jp/english/info/energyandenv/front.html>

New Energy Foundation (NEF)

	http://www.nef.or.jp/english/nrej2001/pdf/part01-01.pdf
International Energy Agency	
	http://www.iea.org/pubs/newslett/eneeff/table.htm
UNFCCC	http://unfccc.int/resource/natcom/nctable.html#a1

Reference Books in Japanese

Denki Jigyō Binran FY1999 (Hand Book of Electric Power Industry)

¥ 1,162 The Japan Electric Association Tel:03-3216-0555

Denryoku Jūkyū no Gaiyō 1999 (Outline of Supply and Demand of Electric Power)

¥ 2,920 Chuwa Printing Tel:03-3552-0425

Denki Jigyō no Genjō 1999 (Present Status of Electric Supply Industries)

¥ 2,800 The Japan electric Association Tel: 03-3216-0555

Sōgō Enerugi Tōkei (Annual Comprehensive Energy Statistics)

¥ 3,675 Tsusho Sangyō Kenkyūsha Tel:03-3401-6370

Reference web site in English: Federation of Electric Power Companies, Japan

"Electricity Review Japan" <http://www.fepc.or.jp/erj/index-e.html>

"Energy and the Environment" <http://www.fepc.or.jp/english/info/energyandenv/front.html>

Reference : Short History of Japan's Electric Supply Industry and Related Events

Date	Event
1870, Jan 26	Telegraph service started between Tokyo and Yokohama
1887, Nov 21	Tokyo Dentō (Lighting) Co started electric supply service in then City of Tokyo, namely downtown area using 25 kW coal-fired unit; just 5 years after operation of central power station (DC system) in New York City by Thomas A. Edison
1888	Hydro power station completed as first auto-producer at Miyagi Spinning Factory
1892, April 11	Commercial operation of 160kW Keage Hydro Power Station in Kyoto as first project for public electric supply including tramway; this plant is now owned and operated by KEPCO
1895, Feb 1	Operation of tramway in Kyoto
1911, Oct 1	Electric Utility Industry Act enforced
1912, May	First electrification of National Railway between Karuizawa and Yokokawa
1916, Nov 12	Partially operation of long-distant (228km) 115 kV transmission line between Tokyo and Inawashiro (Fukushima pref)
1926, Sept 1	Great Kanto (Tokyo metropolitan area) Earthquake ; about 100 thousands people died
1927, Dec 30	Underground subway operated between Ueno and Asakusa in Tokyo (1933, May 3 in Osaka)

1939	Japan Electric Power Generation and Transmission Company incorporated under a special law during WW II , to take over the businesses of generation and transmission from electric utilities
1942	Nine electric power distribution companies incorporated under the another special law during WW II , to take over the businesses of distribution and retail,
1945, Aug	WW II over Japan controlled under US-led international framework until 1951
1951	Under a special law aiming at decentralization of "excessive economic power", Japan Electric Power Generation and Transmission Company and nine electric power distribution companies dissolved and reorganized
1951, May 1	Nine electric power distribution companies reorganized to investor-owned nine electric power companies (called as nine EPCos) with vertically integrated function
1952, July 6	Commercial operation of 250 kV Shin-Hokuriku transmission line (KEPCO)
1952, Sept	EPDC established with most of its capital stock owned by the Government of Japan under Electric Power Development Promoting Act
1953, Nov.18	Commenced operations of Unit No. 3 (55 MW) at Ushioda Thermal Power Station, first operating unit by newly established TEPCO
1955, May 25	Operation of Kami-Shiiba Hydro Power Station(90 MW); first hydro project with arch-type dam in Japan (Kyushu EPCo)
1956, Jan	Live-wire line work vehicles first appeared, making construction without interrupting power(TEPCO)
1956, April	Operating of Sakuma Hydro power station, then largest hydro station in Japan (EPDC)
1956	Japan admitted to United Nations
1958, April 1	Commencement of wide-area operations between nine EPCos
1959, Aug, 18	With the completion of Unit No. 4 at Chiba Thermal Power Station, thermal power output exceeded hydropower output(TEPCO)
1963	Kurobegawa No.4 Hydor power plant completed after 7 years of difficult construction works (KEPCO) Air-Pollution Control Law and Noise Regulation Law enforced During 1960',heavy industries and motorization accelerated
1964, Oct 1	Shinkansen (super express) operated between Tokyo and Shin-Osaka
1964,Oct 10~	Olympic Games held in Tokyo
1964, April 28	Japan joined OECD
1964, July 11	Electric Utiliies Law enforced
1965, Oct	Commercial operation of Sakuma Frequency Converter Station (EPDC)
1965, Dec.10	Started operating Unit No. 2 (80 MW) at Yagisawa Power Station as TEPCO's first pumped-storage plant
1966, July 25	Commercial operation of Tokai Nuclear power plant (UK designed gas reactor) (Japan Atomic Power Co)

1966, Aug 10	Peak load in summer exceeded in winter (KEPCO)
1967	Basic Law Concerning Countermeasures for Environmental Disruptions enforced
1969, May 23	First White Paper on Environment published by government
1969, Aug 8	Peak load in summer exceeded in winter (TEPCO)
1970, March 14	Inauguration of Turuga nuclear power plant as first BWR (Japan Atomic Power Co)
1970, April 24	Commercial operation of Minami-Yohohama Thermal Power Station , world first LNG-fired (TEPCO)
1970, Nov 28	Inauguration of Mihama No.1 nuclear power plant (PWR) as KEPCO's first nuclear power facility Amended Basic Environment Law enforced
1971, March 26	Fukushima Daiichi Nuclear Power Station's No. 1 reactor (460MW) began operation as TEPCO's first nuclear power facility
1971	Environmental Agency (now Ministry of the Environmental Affairs) established
1972, May	<ul style="list-style-type: none"> • Okinawa Electric Power Co joined Japan's electric utility industry after the sovereignty of Okinawa (Ryukyu Islands) reversed to Japan • Vertically-integrated electric utilities including Okinawa EPCo are called as 10 EPCos.
1973, May 5	500 kV Boso transmission line operated (TEPCO)
1973, Sept 12	Operation of De-Sox plant at Nishi-Nagoya Thermal Power Station
1973, Oct 23	First oil crisis occurred
1974, June	Electric Power Generating Plant Adjacent Area Arrangement Law and related two laws (Electric Power Development Promotion Tax Law and Special Accounts Law on Electric Power Development Promotion Measures) promulgated to mitigate the severe siting situations
1974, March 29	Inauguration of Shimane No.1 nuclear power plant (BWR) as Chugoku EPCo's first nuclear power facility
1975, Oct 15	Inauguration of Genkai No.1 nuclear power plant (PWR) as Kyushu EPCo's first nuclear power facility
1976, March 17	Inauguration of Hamaoka No.1 nuclear power plant (BWR) as Chubu EPCo's first nuclear power facility
1977, Sept 30	Inauguration of Ikata No.1 nuclear power plant(PWR)as Shikoku EPCo's first nuclear power facility
1977, Dec 15	Commercial operation of Shin-Shinano Frequency converter station (TEPCO)
1979	Second oil crisis occurred Accident occurred at US Three Mile Island (TMI) Nuclear power plant
1979, Dec	Operation of Kitahon(Hokkaido to Honshu mainland) HVDC Link and 2 AC/DC converter station (EPDC: reinforced in 1993)
1980, April 19	Commercial operation of Hacchobaru Geothermal Power Station (55 MW) (Kyushu EPCo)
1981, Jan 30	No-man operation of Oyama Substation (>200 kV) (Chubu EPCo)

1983, April 1	District heating and cooling system at Hikarigaoka ,collective housing area,in Tokyo(TEPCO)
1983	Inauguration of Onagawa No.1 nuclear power plant(BWR)as Tohoku EPCo's first nuclear power facility
1985, April 1	Telecommunication Business Act enforced NTT incorporated
1985, Dec 20	Began operation of Futtsu Thermal Power Station, TEPCO's first combined cycle generators using LNG
1986	Disaster occurred at Chernobyl Nuclear power plant (Soviet Union)
1987, April 1	Japan National Railway unbundled into JR group (6 passenger companies and one freight company)
1987, Oct 1	Payment of utility bill at convenience stores launched (TEPCO)
1988, Jan	Seasonal and Time-of-Use Rate System employed to promote the load leveling for commercial and industrial customers
1988	Inauguration of TomariNo.1 nuclear power plant (PWR) as Hokkaido EPCo's first nuclear power facility
1989	Electricity Reforms started in UK
1990	Japanese economic bubble collapsed
1991	Soviet Union dissolved
1991, Dec	Maastricht Treaty signed by 12 European Community (EC) to form European Union (EU);effective in 1993 Nov
1992, March 27	Operation of Uranium Enrichment Plant in Aomori pref.
1992	Inauguration of Shika No.1 nuclear power plant(BWR)as Hokuriku EPCo's first nuclear power facility United Nations Conference on Environment and Development convened at Lio de Janeiro , Brazil
1992, Dec 25	Released its first "Environmental Action Report," which was aimed at addressing environmental issues (Since then, the report has been published annually) (TEPCO)
1995	Great Hanshin-Awaji Earthquake ;more than 6 thousands people died
1995, May 15	TEPCO's cumulative nuclear power generating output achieved one billion MWh
1995	Electric Utility Industry Law revised for first time in 31 years, enabling deregulation of wholesale power operation
1996, Jan	Yardstick competition introduced for the retail rate revision
1996, March 25	Released its "Management Plan Guideline" combining the "Management Efficiency-Enhancement Plan", "Supply Plan," and other plans to be released annually (TEPCO)
1996, July	First adjustment under fuel-cost-adjustment system effective in billing
1997, Jan 10	Determined the successful bidders to supply electricity during the three-year period from fiscal 1999, when IPP supply begins (eight companies for 1,100 MW) (TEPCO)
1997, March	Five EPCOs revealed their programs to lease their transmission lines to industrial companies

1997, June	Law on Special Measures for Promotion of Utilization of New Energy (New Energy Law) enacted
1997, June	New Environmental Impact Assessment Act enforced
1997, July	Japanese Cabinet decided EPDC to be completely privatized by 2003
1997, July 2	Initiated operation of Unit No. 7 at Kashiwazaki-Kariwa Nuclear Power Station. All units were completed for a total output of 8,200 MW, making it one of the world's largest-capacity nuclear power stations(TEPCO)
1997, Sept 16	Initiated self-wheeling services (TEPCO)
1997	<ul style="list-style-type: none"> • Third session of Conference on Parties to United Nations Framework Convention on Climate Change (COP3) held in Kyoto • Kyoto Protocol signed on reduction of greenhouse effect gas Emissions
1999, Sept 30	Accident at JCO nuclear fuel factory in Ibaraki Prefecture
1999, Dec	Connection supply services initiated
2000, March 21	Enforcement of Electric Utility Law amended for liberalizing retail service to large-demand Customers and implementing first electricity rate reductions using new rate-reporting system
2000, Oct 1	Reduced electricity rates by 5.32%(TEPCO)
2000, Oct 1	Green Power Fund initiated
2000~2001	California Energy Crisis
2001, Jan 30	Established the Mutsu Office in Aomori Prefecture. Started a feasibility study of the Interim Nuclear Waste Storage Facility.
2001, May 1	50 th founding anniversary of nine EPCOs
2001, July 24	Recorded highest system peak load in five years (64.3 GW) (TEPCO)
2001, Sept 11	World Trade Center in New York attacked
2001, Dec	US Enron Corp. bankrupted
2002, Aug-Sept	United Nations World Summit on Sustainable Development held in Johannesburg, South Africa

End

Table 3 : Indicators of Main Electric Power Companies

(As of March 31, 2001)

	Generating Capacity						Power generated (TWh)	Power Sales (TWh)	Sales Revenues (bil. Yen)	Number of Customer		Total Equity (bil. Yen)	Total Assets (bil. Yen)	Number of Employee	Service Area (k m ²)
	Hydro	Wind	Thermal	Geo-thermal	Nuclear	Total				Domestic	Others				
	(MW)									(1,000)					
General Suppliers															
Hokkaido EPCo.	1,245		3,450	50	1,158	5,904	28.6	28.8	519.9	3,453	338	331.0	1,384.6	62,759	78,416
Tohoku EPCo.	2,452		11,227	224	2,174	16,076	76.8	72.5	1,556.8	6,473	1,095	760.2	3,970.8	13,242	79,531
Tokyo EPCo.	8,519	0.5	34,545	3	17,308	60,375	259.9	275.5	5,129.6	24,229	2,761	2,005.2	14,174.8	40,624	39,496
Chubu EPCo.	5,213		23,401	--	3,617	32,231	115.6	120.9	2,148.0	8,543	1,563	1,146.2	6,129.2	18,301	39,131
Hokuriku EPCo.	1,812		4,406	--	540	6,759	25.6	25.0	482.5	1,644	329	319.0	1,522.8	5,439	12,303
Kansai EPCo.	8,130		17,687	--	9,768	35,585	122.2	139.8	2,517.8	11,491	1,398	1,337.7	7,043.4	25,563	28,700
Chugoku EPCo.	2,893		8,015	--	1,280	12,179	44.5	53.6	982.5	4,456	688	502.6	2,709.2	11,052	32,274
Shikoku EPCo.	1,125		3,730	--	2,022	6,877	28.7	25.8	552.8	2,381	473	341.2	1,427.6	6,625	18,450
Kyushu EPCo.	2,371		11,499	208	5,258	19,336	72.7	75.3	1,384.5	7,023	1,107	782.9	3,984.7	14,186	42,144
Okinawa EPCo.	--		1,676	--	--	1,675	5.9	6.9	138.6	690	68	68.8	399.0	1,550	2,268
Sub-total	33,752	0.5	119,636	485	43,125	197,008	765.8	824.1	15,403.1	70,383	9,820	7,594.9	42,746.2	142,857	372,717
Wholesale Suppliers															
EPDC	8,261		7,212	13	--	15,485	55.9							3,297	
JAPC	--		--	--	2,617	2,617	18.							1,555	
Other private wholesalers	333		11,298	--	--	11,630	3								
Municipal Wholesalers	2,535		25	--	--	2,550	69.7								
Sub-total	11,129		18,535	13	2,617	32,294	143.9								
Special Suppliers			738	--	--	737	399.0								
Total of Utilities	44,883	0.5	139,918	497	45,742	230,041	922.0								
Self-generators	1,503	174.2	29,810	36	165	30,241	150.8								
Grand-total	46,387	174.7	168,729	533	49,907	261,730	1,075.9								

(Source) Denki Jigyou Binran FY2001 (Hand Book of Electric Power Industry)

Table 4 : Electricity Prices of 10 E.P.Cos. (in nominal base)

(Unit: Yen/kWh)

E.P.Co.		Hokkaido	Tohoku	Tokyo	Chubu	Hokuriku	Kansai	Chugoku	Shikoku	Kyushuu	Okinawa	Average
Lighting (Residential)	FY1985	30.79	30.02	29.25	29.00	27.62	27.15	29.49	28.83	28.97	29.75	30.79
	FY1990	28.21	26.04	24.78	23.53	24.79	23.80	26.06	25.64	25.72	24.57	24.89
	FY1991	28.25	26.13	24.86	23.61	24.85	23.80	26.06	25.64	25.78	24.67	24.95
	FY1992	28.27	26.21	24.93	23.67	24.91	23.79	26.11	25.63	25.86	24.62	25.01
	FY1993	27.67	26.08	24.80	23.53	24.82	23.67	25.88	25.50	25.76	24.51	24.86
	FY1994	27.06	25.92	24.68	23.40	24.78	23.77	25.81	25.50	25.69	24.16	24.76
	FY1995	26.46	25.62	24.52	23.35	24.42	23.64	25.47	25.22	25.40	24.06	24.55
	FY1996	25.04	24.95	24.28	23.40	23.51	23.43	24.82	24.50	24.58	23.93	24.16
	FY1997	24.97	25.23	24.68	23.82	23.62	23.61	24.93	24.62	24.79	24.32	24.44
	FY1998	23.19	23.87	23.65	22.89	22.64	22.89	23.25	23.19	23.44	23.26	23.33
	FY1999	22.93	23.61	23.40	22.54	22.46	22.68	22.86	22.86	22.99	23.12	22.74
FY2000	22.70	23.51	23.54	22.79	22.28	22.76	22.67	22.67	23.05	22.07	23.04	23.08
Power (incl. Commercial)	FY1985	23.50	23.08	22.60	22.18	19.22	20.01	21.84	21.63	23.12	26.37	23.50
	FY1990	20.41	18.17	17.33	16.38	15.98	16.18	17.23	18.28	18.44	20.08	17.20
	FY1991	20.37	18.32	17.46	16.66	16.39	16.38	17.30	18.66	18.61	20.01	17.38
	FY1992	20.66	18.56	17.69	16.91	16.62	16.57	17.48	19.01	18.79	20.23	17.61
	FY1993	20.51	18.58	17.64	16.92	16.82	16.56	17.32	19.15	18.84	19.93	17.60
	FY1994	19.83	18.10	17.17	16.49	16.58	16.22	16.91	18.98	18.52	19.70	17.19
	FY1995	19.25	17.75	17.02	16.42	16.32	16.10	16.71	18.47	18.17	19.32	17.00
	FY1996	17.71	16.88	16.75	16.37	15.47	15.96	16.07	17.21	17.15	19.15	16.56
	FY1997	17.62	17.00	16.98	16.77	15.56	16.23	16.34	17.24	17.29	19.52	16.80
	FY1998	16.45	15.87	16.15	16.05	14.97	15.63	15.21	15.90	16.18	18.20	15.94
	FY1999	16.01	15.35	15.65	15.51	14.58	15.26	14.64	15.54	15.79	17.84	15.47
FY2000	15.46	15.23	15.73	15.55	14.16	15.39	14.38	14.38	15.51	15.52	18.17	15.44
Total	FY1985	25.85	24.95	24.38	23.59	20.85	21.80	23.67	23.51	24.86	27.70	23.74
	FY1990	23.01	20.37	19.34	18.03	17.99	18.23	19.58	20.50	20.71	21.79	19.28
	FY1991	23.12	20.55	19.53	18.19	18.22	18.40	19.60	20.81	20.85	21.80	19.45
	FY1992	23.38	20.81	19.77	18.46	18.46	18.59	19.80	21.11	21.04	21.91	19.69
	FY1993	23.14	20.84	19.73	18.49	18.69	18.58	19.66	21.22	21.08	21.69	19.68
	FY1994	22.50	20.44	19.40	18.16	18.52	18.44	19.41	21.17	20.87	21.43	19.40
	FY1995	21.95	20.13	19.28	18.15	18.29	18.36	19.24	20.76	20.55	21.18	19.25
	FY1996	20.46	19.32	18.99	18.10	17.43	18.18	18.59	19.65	19.59	21.03	18.81
	FY1997	20.34	19.47	19.27	18.50	17.53	18.41	18.80	19.69	19.73	21.37	19.05
	FY1998	19.00	18.31	18.43	17.79	16.93	17.86	17.61	18.35	18.59	20.19	18.17
	FY1999	18.60	17.86	18.02	17.31	16.62	17.56	17.07	18.05	18.24	19.77	17.78
FY2000	18.16	17.72	18.12	17.41	16.26	17.68	16.83	18.04	17.91	20.07	17.76	

(Source) Denki Jigyou Binran FY2001 (Hand Book of Electric Power Industry)

Table 5 : Electricity Tariffs - at the end of March, 2001 -

The Kansai Electric Power Co.

Contact Category	Charge		effect on Feb. 1, 1998 Rate (Yen)	effect on Oct. 1, 2000 Rate (Yen)		
Residential Service	(B)	Minimum charge for first 15 kWh per contract		301.00	295.00	
		Energy Charge	per kWh for next 105 kWh (1 st block)	18.48	18.05	
			per kWh for next 160 kWh (2 nd block)	24.48	23.91	
	per kWh for any additional kWh exceeding 280 kWh (3 rd block)		26.79	26.16		
	(C)	Basic charge per month : per 1 kVA		360.00	360.00	
		Energy Charge	per kWh for first 120 kWh (1 st block)	15.98	15.44	
per kWh for next 160 kWh (2 nd block)			19.60	18.94		
per kWh for any additional kWh exceeding 280 kWh (3 rd block)	21.61		20.89			
Commercial Power Service	For the service supplied at 6 kV		Basic charge per kW of contract power	1,660.00	1,660.00	
			Energy charge per kWh	Summer (*1)	14.15	13.32
				Other season (*2)	12.86	12.11
Small Industrial Power	Low tension power service	Contract Power < 50 kW	Basic charge per kW of contract power	980.00	980.00	
			Energy charge per kWh	Summer (*1)	11.57	11.39
				Other season (*2)	10.52	10.35
	High tension Power service	(A)contract power: 50-500 kW	Basic charge per kW of contract power	1,260.00	1,260.00	
			Energy charge per kWh	Summer (*1)	11.07	10.96
				Other season (*2)	10.06	9.96
Large Industrial Power	(B)contract power: 500- 2,000kW	Basic charge per kW of contract power	1,780.00	1,780.00		
		Energy charge per kWh	Summer (*1)	10.23	10.12	
			Other season (*2)	9.30	9.20	

(Source) Denki Jigyou Binran FY2001 (Hand Book of Electric Power Industry)

- The Consumption Tax is not included in the rates above.
- A delayed payment charge of 3 % of the total bill shall be added to any bill which is not paid on or before the due date.
- The due date shall be 21 days from the date of meter reading.

(Notes) *1 Summer : July 1 to September 30

*2 Other seasons : October 1 to June 30

Table 6 : Electric Power Demands

	Electric Power Sales (TWh)											
	FY1991	FY1992	FY1993	FY1994	FY1995	FY1996	FY1997	FY1998	FY1999	FY1994-99 (annual growth rate)	FY2000	
General Suppliers (10 E.P.Cos.)												
Lighting Residential A & B	148.6	153.6	157.3	172.1	178.5	179.9	182.2	188.6	193.4			197.3
Residential C	29.6	30.9	31.8	33.9	35.6	36.5	37.4	38.3	39.3			40.0
Others	7.1	7.6	8.6	9.5	10.6	11.8	12.8	14.0	15.5			17.3
Sub-total	185.3	192.1	197.7	215.5	224.7	228.2	232.4	240.9	248.2	2.87%		254.6
Power Commercial Power	123.9	129.0	134.1	147.7	152.8	159.7	166.9	175.0	179.7			157.9
Large Industrial Customers - small-	101.1	99.9	99.1	107.7	108.0	109.5	110.8	111.4	113.5			115.8
Large Industrial Customers - large-	252.2	247.5	242.4	252.4	254.7	260.2	265.3	256.1	259.3			74.8
Others	16.8	17.2	17.2	16.8	16.8	17.0	16.1	15.5	15.8			15.0
Sub-total	493.9	493.6	492.9	524.6	532.3	546.4	559.1	558.0	568.7	1.63%		363.5
Total	679.2	685.7	690.6	740.1	757.0	774.6	791.5	799.0	816.9	1.99%		
Qualified Customers *												219.8
Direct sales by wholesale suppliers	19.4	19.1	18.6	18.9	19.6	19.7	19.8	19.4	19.8			
Supplied by special suppliers	-	-	-	-	-	-	-	0.0				
Self-consumption by auto-producers	91.3	93.0	95.5	99.8	105.0	109.2	115.2	116.3	120.6			
Total	110.7	112.1	114.4	118.7	124.6	128.9	135.0	135.7	140.5	3.43%		120.2
Grand Total	789.9	797.8	804.7	858.8	881.6	903.5	926.5	934.7	957.4	2.45%		978.3

(Source) Denki Jigyou Binran FY2001 (Hand Book of Electric Power Industry)

(note) * New category since in March 2000. Almost all power sales come from "Large Industrial Customers - large-".

Table 7 : Electric Power Consumption by Large Industrial Customers *

(Unit: million kWh)

Items		Purchase from				Consumption by		Total				
		10 E.P.Cos.		Wholesalers		Self-Generation						
		FY1990	FY1999	FY1990	FY1999	FY1990	FY1999	FY1990	%	FY1999	%	
Classification of industries												
Mining & Manufacturing Industries												
Mining	Sub-total	1,493	1,296	40	0	1,025	625	2,558	0.7	1,922	0.5	
Manufacturing	Food	11,281	14,984	52	0	1,140	2,191	12,473	3.5	17,175	4.3	
	Textile	6,839	4,108	0	0	713	882	7,552	2.1	4,990	1.3	
	Paper & Pulp	11,877	10,345	4	0	19,952	23,897	31,833	9.0	34,243	8.5	
	Chemical	27,341	25,737	1,090	1,480	26,722	35,299	55,153	15.6	62,516	15.7	
	Oil & Coal Products	2,348	1,405	38	0	4,002	8,078	6,388	1.8	9,483	2.4	
	Rubber Products	2,699	3,462	769	0	111	464	3,579	1.0	3,927	1.0	
	Ceramics & Earth Products	14,899	11,711	65	0	4,678	6,944	19,642	5.5	18,655	4.7	
	Iron & Steel	33,665	34,674	25,258	19,746	19,587	23,376	78,510	22.2	77,796	19.6	
	Non-ferrous Metal	12,251	13,708	347	448	2,319	2,457	14,917	4.2	16,613	4.2	
	Machinery & Equipment	57,309	67,238	60	74	1,135	4,480	58,504	16.5	71,792	18.1	
	Miscellaneous	22,118	26,233	20	6	626	2,085	22,764	6.4	28,324	7.1	
		Sub-total	210,903	213,605	19,427	19,756	80,985	110,152	311,315	87.9	343,513	86.5
		Total	202,406	214,901	29,456	19,755	82,010	110,778	313,872	88.6	345,434	87.0
Others	Railway	16,366	18,152	0	0	3,568	3,713	19,934	5.6	21,865	5.5	
	Others	18,639	26,677	385	0	1,398	3,028	20,422	5.8	29,705	7.5	
	Total	35,004	44,829	385	0	4,967	6,741	40,356	11.4	51,570	13.0	
Grand Total		247,410	259,730	19,841	19,755	86,977	117,518	354,228	100.0	397,004	100.0	
<Reference> supplied by 10 E.P.Cos.	Residential	177,419	248,234									
	Commercial	116,339	179,693									
	Industrial	365,175	388,993									
	Total	658,933	816,920									

(Source) Denki Jigyō Binran FY2000 (Hand Book of Electric Power Industry)

(Note) * Large Industrial Customers : contract demand is 500 kW or more. Sub-total of "Mining" to "Machinery & Equipment" includes "Others".

Table 10 : Composition of Generating Capacity (electric utilities)

(Unit: MW ; as of the end of fiscal year)

FY	1975	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hydro	23,670	33,060	31,480	33,240	34,420	38,380	40,370	41,190	42,970	43,020	43,820	44,330	44,780	44,860
Conventional	16,600	18,710	19,310	19,400	19,530	19,560	19,600	19,710	19,780	19,830	19,910	20,020	20,080	20,150
Pumped-storage	7,070	14,360	17,010	18,210	18,520	18,940	20,860	22,280	23,180	23,180	23,910	24,310	24,710	24,710
Thermal	65,250	92,600	104,320	105,850	109,040	111,310	114,940	118,160	122,360	127,430	132,500	134,860	139,430	139,700
Coal	4,870	9,940	12,230	13,430	14,480	15,780	18,030	20,140	20,280	21,910	24,610	24,880	29,220	30,500
Geothermal	20	180	240	240	260	290	370	490	520	520	520	520	520	520
LNG(incl.N.Gas)	4,700	28,690	38,390	39,100	40,910	41,900	42,800	44,310	49,140	52,480	55,190	56,770	57,220	58,800
Oil *	53,110	49,280	49,620	49,230	49,340	49,490	49,950	49,530	48,750	48,490	48,150	48,600	48,390	48,390
LPG and other	2,550	4,510	3,850	3,850	4,060	3,890	3,790	3,690	3,690	4,040	4,040	4,100	4,100	4,100
Nuclear	6,600	24,520	31,480	33,240	34,420	38,380	40,370	41,190	42,550	44,920	44,920	44,920	44,920	45,740
Total	95,520	150,190	172,120	176,690	181,510	188,190	195,770	201,340	207,880	215,360	221,240	224,100	229,130	23,030

(source) Current Situations of Electric Power Industry 2000 (Denkijigyou no Genjou)

* Oil in FY 1975 includes "other gases"

Table 11 : Composition of Electric Energy Generated (electric utilities)

(Unit: billion kWh)

FY	1975	1985	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Hydro	78.5	80.7	88.1	96.9	83.4	98.7	70.4	85.4	83.8	94.5	96.2	89.3	90.4	87.8
Conventional	76.1	73.9	78.8	85.4	73.6	85.3	59.2	72.6	71.3	80.0	82.0	76.9	77.9	75.3
Pumped-storage	2.5	6.7	9.3	11.5	9.8	13.4	11.2	12.7	12.6	14.5	14.2	12.3	12.5	12.5
Thermal	284.0	344.4	448.1	453.7	466.6	434.1	495.7	478.2	485.7	479.8	471.5	509.7	524.9	513.5
Coal	15.3	57.2	71.9	78.5	87.1	95.7	106.5	117.2	123.7	134.5	134.8	152.9	173.2	189.4
Geothermal	0.1	1.3	1.5	1.5	1.7	1.6	2.0	3.1	3.6	3.7	3.5	3.4	3.3	3.3
LNG(incl.N.Gas)	20.4	126.7	163.9	176.2	176.0	175.2	187.6	191.8	203.7	214.6	222.1	240.5	247.9	247.5
Oil	240.6	144.8	195.1	181.7	185.9	147.4	185.8	151.0	139.1	112.6	97.1	98.5	86.8	59.4
LPG & Other	7.7	14.4	15.7	15.6	15.9	14.0	13.8	15.1	15.7	14.3	14.0	14.3	15.9	16.9
Nuclear	25.1	159.0	201.4	212.3	223.1	249.1	269.0	291.1	302.1	319.1	332.2	316.5	321.9	319.8
Total	387.6	584.0	737.6	763.0	773.8	782.8	835.9	855.7	872.9	895.0	901.8	917.6	939.6	924.0

(source) Current Situations of Electric Power Industry 2000 (Denkijigyou no Genjou)

* Oil in FY 1975 includes "other gases"