REGULATORY REFORM AND ITS EFFECT IN THE JAPANESE ELECTRIC UTILITY INDUSTRY

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Introduction

Following the war, the electric utility industry in Japan was vertically integrated into nine core utilities, each devoted to a system to ensure a stable supply of high-quality electricity. Today, however, this system is undergoing gradual changes amid varying rules and deregulation that call for a more efficient system of the industry. Among the changing regulations under consideration are to liberalize entry into the electricity wholesale market, stimulate wheeling, revise rate-making system, establish direct electricity retailing in the form of specified electric utility industry, and ease safety regulations. The first drastic amendment in thirty years of the Electric Utility Industry Law is already slated.

This report is designed to consider the background and contents of deregulation of the electric utility industry currently underway. Composition of the report is as follows. Present systems of the electric utility industry and applicable regulations are reviewed (Chapter 1), followed by a discussion on why the changes are necessary(Chapter 2). Subsequently, conventional regulations are evaluated from a theoretical aspect (Chapter 3). Thus, the first three chapters deal with the background of deregulation. Then, after summarizing the contents of deregulation under consideration (Chapter 4), that extent that deregulation can produce effects on the national economy is considered (Chapter 5). The final section gives a glimpse of desirable conditions of the electric utility industry and regulation in the future.

1. Japan's Electric Utility Industry

Major electricity suppliers in Japan can be classified into electric utilities and in-house power generators. Electric utilities can further divided into general and wholesale electric utilities. There are ten general electric utilities, each taking the form of monopoly in its service area and carrying out vertical integrated operations of generation, transmission and distribution.

The Electric Utility Industry Law (1964) governs the electric utility industry. The law specifies rules of the entry/exit of the electric utility industry, supply conditions (rate-making), supply obligation, safety, etc.

While electricity demand is expected to continue to grow, general electric utilities have various problems in securing necessary supply capacity.
1.1 Systems of Electric Utility Industry
1.1.1 Electric Utilities

(1) Category of electricity suppliers

Electricity suppliers in Japan consist of (1) electric utilities designed to sell electricity generated by themselves to a third party, and (2) in-house power producers that generate electricity to be consumed by themselves. As of late March 1994, installed generating capacities amounted to 212.9 GW, including 190.4 GW owned by electric utilities and 22.5 GW by in-house power producers. Thus, electric utilities are responsible for about 90% of electricity supply in Japan (Figure 1).

Electric utilities are further divided into (1) general electric utilities and (2) wholesale electric utilities. General electric utilities, each given a specific service area of its own, are expected to supply electricity to meet general demand in their service area. On the other hand, wholesale electric utilities, without having specific service areas of their own, are designed to provide wholesale electricity to general electric utilities.

(2) General electric utilities

There are ten general electric utilities. They are Hokkaido Electric Power Co., Inc., Tohoku Electric Power Co., Inc., Tokyo Electric Power Co., Inc., Chubu Electric Power Co., Inc., Hokuriku Electric Power Co., Inc., Kansai Electric Power Co., Inc., Chugoku Electric Power Co., Inc., Shikoku Electric Power Co., Inc., Kyushu Electric Power Co., Inc., and Okinawa Electric Power Co., Inc. (Table 1). Until 1972, when Okinawa was returned by the U.S., the remaining nine had been responsible for the nationwide electricity supply as general electric utilities. This, popularly called the "nine-utility system," was established in May 1951 as a result of reorganization of the electric utility industry after World War II.

This system has survived to date. Individual electric utilities, privately owned and run, have their own service areas allocated by dividing the whole country land into ten blocks. The utilities are supplying electricity through vertically integrated operations of generation, transmission and distribution.

Tokyo Electric Power, the biggest general electric utility in Japan, is responsible for the Kanto area, with Tokyo as the core. It sold a total of 255 TWh to 24 million customers and earned sales proceeds of ¥4,558 billion (FY 1993). These figures hold around 34% of the ten-utility total in terms of both generated output and proceeds. Tokyo Electric Power is capable of generating 49.5 GW at maximum, the world's second largest after Electricite de France (EdF).

Kansai Electric Power, the second largest after Tokyo Electric Power, covers the whole of Kansai, centering on Osaka. In FY 1993, the utility sold 123.3 TWh to 11.6 million customers and earned ¥2,287 billion. These figures account for around 17% of the ten-utility total. Its generating capacity amounts to 35.0 GW, of which 28% is covered by nuclear power plants. The share of nuclear is highest among Japan's general electric utilities.
Chubu Electric Power covers the Chubu area, with Nagoya as the center. Its customers, electricity sales amount and sales proceeds are 9 million, 102.9 TWh and ¥1,898 billion, respectively, and puts the utility responsible for around 14% of the ten-utility totals.

The top three utilities alone account for 66% of the total electricity amount sold by general electric utilities (FY 1993), and their combined share has been on the rise year by year. Major reasons for the rise are various functions concentrating in urban areas, and heavier electricity demand by residential/commercial users, as opposed to instead of industrial. In addition, because their supply capacity is in sufficient, the three utilities are becoming increasingly dependent on external supply capacity outside their areas.

(2) Wholesale electric utilities

Apart from the Electric Power Development Co. (EPDC) and the Japan Atomic Power Co. (JAPC), wholesale electric utilities include twenty joint-ventured thermal power plants and thirty-four municipal electric utilities. EPDC, the largest wholesale electric utility in Japan, was founded in 1952. At the time of its establishment, electricity demand was so strong that nine electric utilities were be forced to increase their supply capacity. But, because of financial difficulties, they could hardly meet the need. Therefore, EPDC, funded 99% by the government, was inaugurated as the machinery through which massive national funds were funneled into power resources development projects.

JAPC on its part was established in 1957. Jointly funded by nine electric utilities, EPDC and industry, JAPC was expected to commercialize nuclear power generation by importing commercial-size reactors to generate electricity. Meanwhile, many of the joint-ventured thermal power plants were established during the postwar high-growth period with joint investment between steel makers, industrial users, and electric utilities. In addition, municipal electric utilities, run by municipal governments, have power plants to put local water resources to effective use. They all specialize in hydraulic power generation.

As of March 1994, general electric utilities (10) have 1,352 power plants and 163.5 GW in peak output; wholesale electric utilities have 406 plants and 26.9 GW. When combined, installed generating capacity owned by electric utilities amounts to 190.4 GW at a total of 1,758 plants. Thus, of electric utility totals, general electric utilities hold 77% in plant number, and 85% in generating capacity.

1.1.2 In-house Power Producers

(1) In-house power generation/consumption

As of March 1994, in-house generating facilities are installed at 2,185 sites and amount to 22.5 GW, responsible for around 10% of Japan’s total generating capacity. Major in-house power producers are found in the paper/pulp, chemical, steel and petroleum refining industries. Many are generating electricity as a by-product from the steam production necessary for manufacturing processes, or committing to in-house power generation in order
to reuse energy sources generating from their manufacturing processes as by-products. But, enhanced energy conservation spurred by two oil crises helped strengthen in-house generating capability as a measure of energy recovery.

In 1993 in-house power generation covered 28% of electricity needs among industrial users, and the ratio has been kept high after the second oil crisis.

(2) Specified supply projects

"Specified electricity suppliers" are non-general electric utilities which are allowed to retail electricity directly to end users within a designated area while taking the form of in-plant power producers. A MITI ordinance shows patterns of such electricity supplies to end users as follows:

(1) Electricity supply by municipal organizations to other municipal departments of their own.
(2) Electricity supply to those who have close relations through investment, etc.
(3) Reciprocal electricity supplies among those who are closely related in production processes, like inter-company supplies among those composing of an industrial complex.
(4) Electricity supply to company housing.
(5) Electricity supply by the owner of a building to meet demand within the given building.

As of late March 1994 specified supply projects numbered 1,307, under which 34.9 TWh was supplied with 5.8 GW of licensed generating capacity. These figures represent a mere 4.9% and 3.0%, respectively, to the portion covered by the electric utility industry. Also, supply capacity per project is as limited as 4.3 MW. Nonetheless, now that highly energy-efficient co-generation has been employed as their supply technology these years, these projects attract growing attention from the aspect of the national economy.

While four major sources of electricity supply are described above, the electricity supply system in recent years is also called the "composite electricity supply system." The system consists of (1) general electric utilities obliged to offer comprehensive supply services, (2) wholesale electric utilities, (3) in-house power producers, and (4) "specified supply projects." Changing regulations currently underway are unlikely to open the door of general electric utilities, but the entry of independent power producers (IPPs) into the wholesale market, expansion of specified supply projects, etc. are taken into the field of vision.

1.2 Regulations of Electric Utility Industry

1.2.1 Grounds for Regulation

The reasons why behaviors of electric utilities are restricted by regulation can be
interpreted as follows:

(1) Inherent monopolistic nature of the electric utility industry
(2) The essential and public nature peculiar to electricity as goods
(3) High risks of the project which involves huge investment
(4) National security
(5) Safety problems

These concepts have been taken over to the existing "Electric Utility Industry Law." As a result, from the aspects of effective utilization of resources and security of stable supply, (1) regulations of entry and (2) regulations of exit are provided based on the supply/demand balance principle. Also, (3) rate-making regulations (supply conditions) are provided in order to avoid the demerits of monopoly, and (4) safety regulations are specified as social regulations, among other things.

1.2.2 Electric Utility Industry Law

(1) Objectives

The Electric Utility Industry Law (1964) provides grounds for official regulations of the electric utility industry (Figure 2). It was an amended version of the Electric Utility Industry Law (1911) to help reorganize the electric utility industry after World War II, while reviving the regulatory ideas of (1) operations and (2) safety of the previous law. Objectives of the amended law are (1) protection of electricity consumers, (2) sound development of the electric utility industry, (3) security of safety, and (4) pollution abatement (Article 1).

(2) Entry-related regulations

Article 3 describes words entry-related regulations first. It provides that electric utility operations requires a license issued by the Minister for International Trade and Industry. Criteria employed by the MITI Minister in issuing the license are as follows (Article 5):

(1) The start of operations meets demand.
(2) In the case of a general electric utility, its supply capacity meets demand.
(3) If a general electric utility plans to start operations, the supply capacity should not represent double or excessive investments within its service area.
(4) The operator should have accounting/technical capabilities in carrying out the operations.
(5) The plan for operation should be firm.
(6) The operations should contribute to public interests.

In fact, general electric utilities have managed their business operations in the form of regional monopolies. But, it is not because the law specifies a franchise by a utility in an area, but because the system resulting from the "supply/demand balancing clauses" shown in (2) and (3) above, combined with the postwar reorganization of the electric utility industry.
and have made it practically hard for newcomers to become general electric utilities. However, in Article 21, the Anti-Monopoly Law cites railway, electric and gas utility services as business operations which tend toward natural monopolistic behavior, from which provisions of the Anti-Monopoly Law are made clear.

Criteria to permit the entry into the wholesale market are pursuant to (4), (5) and (6) above. After all, those who hope to enter the market are required to obtain a license issued by the MITI Minister.

In addition, "specified supply" projects exist in the service area of general electric utilities, and are engaged in retailing to limited customers. Each specified supply project is required to obtain a license from the MITI Minister, and the primary qualification is that the entry won't harm the interests of general customers supplied by general electric utilities (Article 17).

(2) Leave-related regulations

Just like the entry into markets, leaving needs an approval of the MITI Minister (Article 14). The leave can be approved on condition that there is no fear of hurting public interests.

(3) Supply obligation

In return for virtually guaranteed regional monopoly, general electric utilities are imposed a supply obligation to prevent monopolistic demerits. Namely, they "are not allowed to refuse electricity supply to meet general demand in their service area without justification (Article 18)." In addition, standards for rate calculation as well as rate levels are subject to regulations.

(4) Rate-making regulations

Electricity rating too is a matter subject to the MITI Minister's approval. Rate-making and supply conditions for general electric utilities are provided by Article 19 of the Electric Utility Industry Law, and those for wholesale electric utilities, by Article 22.

Article 19 provides that "general electric utilities shall lay down supply rules of electricity rates and other supply conditions, which need to be approved by the MITI Minister." And, there are three principles of rate-making: (1) cost-base method, (2) the principle of fair returns, and (3) the principle of fairness to customers.

On the other hand, rate-making by wholesale electric utilities, though required to recover costs, can be managed more flexibly than in the case of general electric utilities (Article 22). But, the Electric Utility Industry Law provides no rules of rating-making applicable when "any parties" other than electric utilities wholesale to general electric utilities, like a case where an in-house power producer wholesales its surplus generated output to a general electric utility.
(5) Other regulations

Beside the regulations of entry/exit and rate-making outlined above, the Electric Utility Industry Law contains side-business regulations (Article 12), broad-area operation (Article 28), accounting/financial rules (Articles 35-40), safety regulations (Articles 41-47), public utility privileges (Articles 58-65), etc.

(6) Regulatory authorities

The government office responsible for regulating the electric utility industry is the Public Utilities Dept. of the Agency of Natural Resources and Energy. Meanwhile, in drawing up important policies of the electric utility industry, key roles are played by (1) Electricity Utility Industry Council and (2) Advisory Committee for Energy, the both in the capacity of advisory bodies to the MITI Minister.

1.3 Electricity Supply and Demand
1.3.1 Electricity Demand

(1) Historical trends of electricity demand

In Japan electricity demand has been growing year by year, despite three exceptional declines in the past (Figure 3). It was during the two oil crises (1974 and 1980) and the strong yen recession in 1986 that when the demand abated.

Real GNP elasticity of electricity demand has been larger than 1, and averaged 1.26 between 1965 and 1979. Though having slowed down in the first half of the 1980s after the second oil crisis, elasticity has continued to grow at a faster rate than GNP since 1987 (staying at 1.16 in 1987-93).

Energy demand overall has slowed down since the first oil crisis, but electricity demand alone has remained relatively strong. It reflects the factors below.

In the industrial sector, (1) growing high-tech industries, like semiconductors, have offset falling electricity demand from sluggish material-producing industries; (2) advancing factory automation (FA) at individual factories, above all, automation/rationalization investments to streamline domestic production made after the yen started rising in the mid 1980s, resulted in additional electricity consumption; and (3) an increasing number of more functional air conditioners has been introduced to improve the environment of employees.

Major contributors in the residential sector are (1) the number of households kept constantly growing at 1.3%/year; (2) possession of more than two refrigerators, TVs and other electric appliances each; (3) larger/more functional electric appliances; and (4) appliances run for longer hours by those who put them on while doing other things or by midnight users.

In the commercial sector, (1) expanding commercial floor areas of office buildings, etc. which reflect the advancing inclination of the economy toward services, (2) spread of computers and air conditioners in part due to office automation, (3) extended business hours,
including 24-hour shops, and (4) greater use of lighting as decoration in such forms as lighting-up and illumination, among other things, can be cited as principal contributors to the growing electricity demand.

In 1993, residential and commercial uses held 29% and 19%, each, of the total electricity amount sold by electric utilities. When combined, they were responsible for about half of the total, up around 10 points compared to a decade ago (Figure 4).

(2) Sharply rising ratio of in-house power generation

In 1993 in-house power generation/consumption amounted to 95.5 TWh, and accounted for 11.9% of total electricity demand in that year (Figure 5). The ratio has been on the constant rise since 1983. The ratio of in-house power generation is even higher among large industrial consumers, up from 19.6% in 1982 to 26.6% in 1993.

Major industries with high in-house power generation ratios are petrochemicals at 71% (in 1993, hereinafter the same), chemical fibers 68%, paper/pulp 68%, and petroleum products 65%. These industries all have manufacturing processes which require steam in large quantities. The in-house power generation ratio among BF-based steel makers remains at 43%, because many of them have joint-ventured thermal power plants invested jointly with electric utilities. Cement makers, which had once depended on purchased electricity from electric utilities to cover almost the whole of their electricity needs, increased the in-house power generation ratio to 45% by now.

Factors behind the rising ratio are: (1) growing electricity production as a result of diminishing steam needs in manufacturing processes, (2) installed process to produce electricity from recovered exhaust heat, and (3) improved economics of in-house power generation, thanks to sluggish international energy prices and lowered primary energy prices by the strong yen.

(3) Worsening load factor

It is noted that growing residential/commercial electricity demand is paired with a worsening load factor. Air-conditioning uses, namely, space cooling and heating, which occupy a massive portion of residential/commercial demand, do not represent a constant daily or yearly load.

Above all, the surging peak power in summer during the past few years has caused electric utilities to face difficulties in securing enough supply capacity to meet the demand. Spiraling peaks can be attributed to a growing number of air conditioners in use there years, which results in increased space-cooling demand. In the background, there is a pursuit to amenity backed by rising income.

Annual-load factor, on a gradual decline throughout the 1970s and the 1980s, fell below 60% (nine-utility average) by the mid 1980s. Amid the oppressive heat in 1992, it stood at 56% (Figure 6).
It is projected by many forecasts that electricity is likely to keep growing ahead more constantly than other energy sources. Social trends, like information orientation, aging, and many working women in the society, as well as enhanced inclination toward safety, amenity and cleanliness, all point to electricity as the preferred choice. Then, without any measures taken, the load factor could further drop due to growing share of residential/commercial uses of which the load factor features sharp fluctuations.

1.3.2 Supply Structure

(1) Power resources mix

Japan's electricity supply structure has been "hydro supplemented by thermal" up to the 1950s, which reversed to "thermal supplemented by hydro" in 1962, when thermal power generation outstripped hydro. Moreover, it was oil thermal power that played a key role there. Oil thermal power met the needs of the high growth period of the 1960s when the economy and electricity demand both rapidly expanded. Namely, oil-fired thermal power plants, characterized by (1) a short lead time to construction, (2) cheapness, (3) large capacity to be built if necessary, matched the needs of the era.

In 1973 the nine electric utilities depended on oil thermal power generation as much as 67% in generating capacity, and 74% in generated output. At that time, nuclear held a scant 2%-short of generated output, and coal thermal power produced by burning indigenous coal did only 6%. Natural gas (LNG) thermal power was negligible.

But, after being hit by oil crises twice, "oil-less" moves have rapidly unfolded. With the oil crises as a turning point, the policy authorities guided electric utilities to shift to non-oil power resources; while oil thermal power concurrently became economically expensive. As a result, power resources have rapidly diversified to include nuclear, natural gas and coal, and other forms. In 1993, the weight of oil thermal power was a mere 19% in generated output (nine utilities). And, shares of nuclear, LNG and coal thermal power have expanded to 34%, 29% and 8%, respectively (Figures 7, 8). All general electric utilities except Okinawa Electric Power have nuclear power plants.

(2) Characteristics of power resources development

While electricity demand keeps growing, it is becoming harder to secure power resources to bolster supply capacity.

The security of additional electricity supply capacity is not always favorably under way, in part due to the PA (public acceptance) issue, and of nuclear power generation above all. Local residents are showing a more vehement rejection than ever against any plans to build general industrial facilities, including power plants, in their backyard.

This is reflected in the recent trend that power plants are being built in increasingly remote sites from consuming area. This requires massive transmission networks from power plants to consuming areas. Installation of these networks is actually under way, and power
plant construction involves a longer lead time (Figures 9, 10). Above all, these are true of nuclear and coal thermal power, which are large-size power resources. It is because (1) appropriate sites are absent near urban areas where consumers are present, and (2) those who live in urban areas defy any attempts to locate generating facilities in their neighborhood, among others.

Here revealed is a composition of power resources development which features consuming areas concentrating in metropolitan cities and supply sources located in sparsely-populated remote areas, and are connected with massive transmission networks. These trends of power resources development have brought about growing costs in securing an supply capacity.

In addition, electric utilities having big cities in their service areas are facing difficulties in finding sites for new power plants in their own service areas. As a result, they have no choice but to employ "board-area operation" under reciprocal cooperation in such forms as (1) power resources development overriding conventional service areas, and (2) electricity sharing with other electric utilities.

Meanwhile, a spiraling peak urges possession of generating facilities, which run as briefly as a few hours a year at longest. Due to a characteristic inherent to electricity -- it cannot be stored-- it becomes necessary to build as much capacity as required to meet a surging peak. Spiraling peaks worsen the utilization, factor of overall capacity, consequently pushing electricity rates up.

Given these rate increase pressures, measures need to be taken on both demand and supply sides. Demand-side measures under way include a campaign for electricity conservation and load management by varying rates. Apart from the broad-area operations already mentioned, supply-side measures include purchasing of surplus output from in-house power plants and elastic expansion of specified supply projects.

(3) Equipment investment and financial structure

The Japanese electric utility industry invests ¥5 trillion a year in equipment. The net worth ratio (retained profit, capital increase, etc.) has dropped from 80% in the late 1980s to 65% in the last few years. In short, the industry is as debt-prone as raising 30-40% of investment funds from corporate bonds/borrowings.

Due to such huge equipment investments, the outstanding balance of corporate bonds and long-term borrowings (outstanding fixed liabilities) has swollen to ¥25 trillion by late March 1994. Also, the net worth ratio to gross asset is 15% (total capital/liabilities + capital), much lower than the average of whole industries and/or manufacturing at 30-40%.

It attributable to (1) the industry had no choice but to make larger equipment investment than the funds on hand; (2) investment itself features a long period of conception; and (3) heavy weight is constantly held by construction in progress.

Expansion of these equipment investments also causes changes in the cost structure of
rating. In short, capital costs are on the rise in the form of growing depreciation costs, interest paid and repair costs resulting from equipment investment. In FY 1993 the share of capital costs (total of the three items aforementioned) in rating costs was 42%, the largest among all the expenses (Figure 11). Conversely, thanks to the rising yen and increasing nuclear share in recent years, the weight of fuel costs has been on the gradual decline, reaching a low 13% in FY 1993.

2. Industry's Subjects for the Present (Needs for Deregulation)

2.1 Pressures of Deregulation

Entering the 1990s, requests for deregulation of the Japanese electric utility industry have rapidly increased. The reasons can roughly be summarized in three points (Figure 12).

First, there are urgent needs for efficient electricity supply and resultant rate cuts. The move was triggered by the recession since 1991 and the rising yen’s value since 1993, which worsened the recession. For manufacturing industries, the recession at home helped intensify competition in the domestic market, and the strong yen deprived them of their price competitiveness on the international market. To restore competitiveness in markets at home and abroad, individual firms are striving for cost reduction and restructuring.

However, they have concurrently recognized that there were problems that could not be overcome through company inside efforts alone to improve their efficiency. A typical problem is big differentials between the products supplied by certain industries shipping only to domestic market and their overseas counterparts. Electricity is among them. In this way, differentials between domestic and overseas electricity rates are questioned by growing voices from industry, particularly manufacturing.

The second problem involves both supply and demand of electricity. As already mentioned, demand expansion centers on residential/commercial uses in urban areas. This type of demand features a sharply fluctuating load on not only a daily but seasonal basis. On the other hand, supply-side measures have centered, for years, on the development of large-size power resources. Unfortunately, such power resources require a longer lead time from planning to commission, and power plant sites are located more and more remote from demand. Hence, rising costs appear inevitable in the years to come.

However, technologies of electricity supply from other than big-power resources have already been commercialized. They are decentralized power sources represented by cogeneration. Effective utilization of existing in-house power generation is also under consideration. Though not large in size, these can be located near specific consuming areas and attract attention as generating forms which can contribute to effective energy use.

These two points form direct factors to prompt deregulation of the electric utility industry. Apart from them, the third reason for deregulation can be expressed as "winds of deregulation." These same winds are blowing worldwide. They are winds to call for the
reform of economic structure naturally resulting from maturity of the Japanese economy. To attain economic structural reforms, conventional industrial policies need to be changed to better match the times. The change of regulations has been increasingly requested as a viable step toward the goal. The request is not limited to the electric utility industry, but common to public utilities overall and the agricultural/distribution sectors.

Comprehensive reviews on regulation are called for from this aspect. The subsequent section deals with rating and supply/demand problems in details to confirm their real state.

### 2.2 Rate-making Issues

#### 2.2.1 Rate Levels

1. **Differentials between domestic and overseas rates**

   Japan's electricity is certainly more expensive than in major countries if compared by using exchange rates. Looking at 1993 figures with Japan taken as 100, the US was 77, Britain 65, France 59, and Germany 73 (Figure 13).

   The big differentials between domestic and overseas electricity rates are attributed to the sharply appreciated yen on the exchange rate. Indeed, if compared on local currency basis how much electricity rates were increased in 1980-93, it is found that Western countries raised rates by around 30-80%, while Japan cut its rates by about 13%. Also, if compared with price increase rates of general goods (ex. comparisons with CPI or WPI), electricity tariffs are falling in relative terms.

   A study (1995.1.26) of the Rate-Making Subcommittee of the Electric Utility Industry Council points out six reasons why Japan's electricity rates are higher. They are: (1) appreciated depreciation costs of the past equipment investment due to the rising yen; (2) rising equipment costs due to high demand growth, (3) falling annual load factor (utilization factor of capacity) due to spiraling summertime peaks, (4) inflated wages by the strong yen, (5) environmental investment and high fuel cost needed to achieve stringent environmental standards, and (6) land-related constraints.

   However, these cannot justify differentials at home and abroad to be left intact. The differentials are causing serious problems to export industries. General consumers on their part still strongly feel that electricity is more expensive (Figure 14).

   In fact, the problem of domestic and overseas electricity price differentials stems from the fact that efficiency improvement by the electric utility industry fails to catch up with the pace of yen's appreciation. Export industries manage to retain their price competitiveness even hit by the strong yen, because they have adjusted their own productivity and production factor prices to the pace of the yen's appreciation. From this standpoint, it is often argued that the problem of domestic and overseas differentials is a problem of gaps in productivity among domestic industries.

   Actually, even if the environment of the Japanese electric utility industry may be
different from that of its overseas counterparts, the industry is surely behind major manufacturing industries at home in such terms as capital cost and rate of productivity improvement.

(2) Electric utilities and in-house power generation/cogeneration

There is a problem that electricity sold by electric utilities is more expensive than that produced from in-house power generation and cogeneration. Indeed, an increasing number of in-house power plants can be attributed to the better economics of in-house power generation.

For instance, the strong yen made overseas coal and oil available for less than ever. Those who practice in-house power generation can take advantage of the strong yen in the form of falling fuel prices. As a matter of course, given differences between in-house power producers and electric utilities in sitting, costs incurring in environmental/security control, and technical elements of transmission grids, a simple cost comparison is prohibited.

However, electricity rates at the end-user level are becoming more expensive than in-house power generation due to the strong yen. This is also true of cogeneration. (Figure 14)

2.2.2 Rigidity of Rating

(1) Regulation of fair returns

There are many discontents and arguments of the electricity rating system itself. With the existing rating system, electricity rates are set by adding fair returns to the supply costs. Some criticize that the regulation of fair returns can induce inefficient production in theoretical terms. It is the so-called Averch-Johnson effect (1962).

Corroborative studies on the Japanese electric utility industry have not produced a solid conclusion in regard to the A-J effect. However, at least it is certain that the present rating system does not contain any incentives to enhance production efficiency.

(2) Market efficiency

The shortcomings of the present rating system from the standpoint of market efficiency cannot be overlooked.

Electricity consumers are manifold, ranging from residential/commercial to industrial. Rating levels applicable to individual consumers are then distributed according to consumers' characteristics by expense item. It is the called fully distributed cost (FDC) method. At a glance, this method looks fair. But from such standpoints as production factor and optimal distribution of resources, it is not necessarily fair.

Theoretically the second best rate-making system from a market efficiency aspect for the case where the cost plus returns are guaranteed, namely, after the restraint is imposed to secure a balance, is the so-called "Ramsey pricing." The greater dissociation of actual rate levels from the Ramsey price implies greater damage given to social welfare. A
collaborative study by Matsukawa et al (1993) suggests such a possibility.

On top of the employment of FDC method, all the rates set by consumer group are subject to approval of the regulatory authorities. This makes elastic rating harder for electric utilities.

(3) Growing regulatory cost

Thus, a rate-making system based on fair returns regulation and FDC, combined with meticulous approval procedures taken by regulatory authorities, has proved very much time- and labor-consuming for both the electric utilities and regulatory authorities alike. Indeed, an asymmetry of information can emerge between electric utilities and regulatory authorities. In order to balance this asymmetry, examinations by the regulatory authorities can become even more time-consuming.

Every time rates are revised, electric utilities must allocate hundreds of their employees to relevant works for a few months. The regulatory authorities, for their part, work hard for checking, and often work without sleep or rest. Naturally, details of expenses are never disclosed to the public at large.

Consequently growing regulatory costs, as well as their complexity and opaqueness, precipitates discontents of existing rating system.

(4) Rising ratio of capital costs

From the cost of rates of the electric utility industry, rising capital and repair costs can easily be noted. As already pointed out, it stems from (1) prolonged lead time of power plant construction, (2) plants located increasingly in remote sites, (3) resultant needs for giant transmission networks, and (4) deteriorating utilization factor due to falling load factor, among other things.

Under present conditions, the fuel cost favorably affected by the strong yen holds a mere 13% of the cost. The greater share held by capital-intensive and less fuel-cost-intensive power sources, like nuclear, means an ever-rising ratio of capital costs. While raising capital overseas is becoming gradually popular, an overwhelming portion of funds has been raised at home so far.

In such a situation, while the environment urges the economy to link itself with its overseas counterparts, electricity rates alone head further toward cementing rigidity.

2.3 Supply and Demand Problems

2.3.1 Problems on Demand Side

(1) Growing residential/commercial demand

Growing residential/commercial demand means sharp load fluctuations on not only daily but annual basis. Above all, growing air-conditioning use of residential/commercial demand in recent years poses a crucial problem to form peak load in summer and winter.
a result, a recent trend is that system peak load (kW) grows higher than electricity demand (kWh). This is because summertime air-conditioning load for commercial/residential uses is expanding. Taking annual average growth rates in FY 1986-92 as an example, system peak load grew 6.6%, compared with a 4.6% rise in electricity amount sold by electric utilities.

(2) Worsening load factor

Due to these tendencies, the average load factor (net: average power load/peak 3-day average) among nine utilities has deteriorated year by year to 56% in FY 1992. However, due to a combination of recession and a cold summer, the system peak load was not renewed in FY 1993 and the load factor stood at 59.2. Thus, rising residential/commercial demand and resultant worsening load factor have formed rate-increase pressures.

As demand control measures to level the load, (a) rating system-based incentives, (b) development/introduction of heat accumulators, etc. have been put in practice. In regard to industrial consumers, thanks to the introduction of different rates by time zone, interruptable contracts, supply/demand adjustable contracts, and other factors, rate-making systems designed for load adjustment have functioned effectively recently. A time-of-use rating system was also introduced in January 1988 for large industrial customers.

But, residential/commercial customers are not yet sufficiently provided for. For instance, the time-of-use rating system applicable to residential customers, tentatively introduced in November 1990 and evolving into full-scale introduction in June 1992, won a mere 100,000 contracts or so, or 0.2%-short of overall customers.

2.3.2 Problems on Supply Side

(1) Power resources development

The most serious problem on the supply side is the difficulties in power resources development which stem from PA (Public Acceptance) issue. For this reason, the lead time from planning to commissioning a newly-built power plant is prolonged. This is true not only of nuclear but of coal thermal power as well.

Moreover, new sites are located increasingly in areas remote from consuming areas; this requires installation of long-distance transmission networks.

(2) Safety regulations

Existing safety regulations too remain unchanged from those set in 1964, without reflecting (1) technical advances to date, (2) improved safety records, (3) the advent of decentralized power sources, and (4) changing consumer needs. The sense that existing regulations are outdated can never be wiped out (Figure 15). It is reported that the charges paid by Japan’s electric utilities to heavy electric machinery makers are nearly double that is paid by their overseas counterparts. The higher charges result from excessive safety regulations, which in turn push electricity costs up.
3. Evaluation of Conventional Regulations

Based on present regulatory conditions and performance of the electric utility industry as discussed so far, existing regulations need to be evaluated first.

At the least, the postwar system of the electric utility industry can highly be evaluated regarding following points. First, electric utilities have constantly supplied highly reliable, top-quality electricity. Second, they have achieved high efficiency in technical terms as demonstrated by generating efficiency. Third, they have provided models of pollution abatement.

On the other hand, however, some claim that existing regulations impede efficient electricity supply. Some of the emerging problems from the electric utility industry have already been pointed out. Therefore, this section picks out only the essential problems of regulating the electric utility industry. They are regulations of entry and rate-making, and evaluation of yardstick competition under regional monopoly.

3.1 Economy of Scale

General electric utilities are allowed to be regional monopolistic operators because their business operation is regarded as a natural monopoly. To organize the inherent monopolistic nature, subadditivity of cost is a necessary condition. "Economy of scale" which traditionally has provided the grounds for natural monopoly is included in subadditivity, and is a sufficient condition to justify inherent monopoly. Hence, the grounds for whether it is necessary or not to allow a regional monopoly for general electric utilities are verified from the standpoint of economy of scale.

3.1.1 Reviews on Past Studies

There are numbers of studies designed to verify if economy of scale exists in the case of Japanese general electric utilities (Table 2).

Their essence is outlined below. First, limiting to the generating sector, Izawa (1983) judged from data on the 1979-81 period that economy of scale existed. However, Awata et al (1987) denied its existence based on 1969-84 data. Furthermore, based on their calculation of 1966-84 data, Nakanishi/Ito (1988) argued that economy of scale was there but turned to nil later within the period of data studied. Then, Shinjo/Kitasaka (1989) in their study on 1975-85 data, concluded that there was economy of scale on the average, which, however, disappeared in the case of large-size firms.

Also, calculations were made on overall corporate management, covering transmission, distribution, and administrative sectors, in addition to the generating sector, the results are as follows. Nakanishi/Ito in their study judged there was economy of scale even at the level of overall corporate management. Conversely, Shinjo/Kitasaka doubted its existence and concluded in their study that a limited number of high-ranking firms could enjoy economy of
scale, but others of middle-standing or lower could be dominated by poor economy of scale.

Given a summary of these demonstration studies, it appears that there is no choice but to question the presence of economy of scale in the electric utility industry at both levels of generating sector and overall corporate management.

As done in these studies, an attempt is made below to verify economy of scale in the industry by using the latest (1976-93) data.

3.1.2 Model

Following former examples, the model in use employs production function of trans-log type; its twin, cost function, is used in actual estimation. Putting generated output as Q, and, of input production elements, labor as L, fuel as F, and capital as K, production function can be expressed as follows.

\[ Q = f(L, F, K) \]

Assuming that an electric utility, under rating regulation, behaves to minimize total cost while satisfying electricity demand (Q), which is exogenously determined, total cost (LTC) can be expressed as follows.

\[ \text{LTC (total cost)} = g(PL, PF, PK, Q) \]

PL: Wage rate
PF: Fuel price
PK: Capital service price

At this point, SCE, a yardstick to measure economy of scale, is expressed as follows.

\[ \text{SCE} = 1 - \left\{ \frac{\partial \ln \text{LTC}}{\partial \ln Q} \right\} \]

Where \( \text{SCE} > 0 \), there is economy of scale.

Meanwhile, total cost function of trans-log type is expressed as follows.

\[
\ln \text{LTC} = \alpha_0 + \alpha_q \ln Q \\
+ \frac{1}{2} \beta_{qq} (\ln Q)^2 \\
+ \sum_{i} \alpha_i \ln P_i \\
+ \frac{1}{2} \sum \sum \beta_{ij} \ln P_i \ln P_j \\
+ \sum \beta_{qi} \ln Q \ln P_i
\]

In order to satisfy conditions of symmetry of two-story partial differential, and of homogeneity of price, the following restraints are imposed on individual parameters.

<symmetry> \[ \beta_{ij} = \beta_{ji} \]

<homogeneity> \[ \sum \alpha_i = 1 \]

\[ \sum \beta_{ji} = \sum \beta_{ji} = \sum \sum \beta_{ij} \text{ if } = 0 \]

\[ i \\
\text{i} \\
\text{j} \\
\text{ij} \]
\[ \sum \beta \, q_i = 0 \]

\[ \text{SCE} = 1 - (\alpha \, q + \beta \, q q \, 1nQ + \sum \beta \, q_i \, 1nP_i) \]

### 3.1.3 Estimation Results

Outlined below are results of the estimation made by using the aforementioned model.

As for thermal power generation, with some exceptions for Hokkaido, Hokuriku and Shikoku, the SCE of other companies are positive, and means that economy of scale exists (Table 3). And Looking at the coefficient by years, recent figures are becoming larger than those of the past. This might be caused by the stagnant fuel prices after the mid 1980s.

However, as for nuclear power generation, most of companies' SCE are negative, without Kansai and Kyushu. Therefore, at least economy of scale in nuclear power generation is very uncertain.

In terms of overall corporate management which covers transmission, distribution and administrative sector on top of generation, the SCE of most of companies are slightly positive, with the exception of Hokkaido, Tohoku and some years of Kyushu (Table 4). Looking at the figures by time series, value is improving a little. This is also probably related to fuel prices.

In summary, we estimate that economy of scale in the electric utility industry exists in some form, with the partial exception of the nuclear power generation sector and some companies.

### 3.2 Rating Levels and Market Efficiency

While the existing rating system employs a customer-by-customer FDC method, it is feared that the method damages economic welfare. For a firm offering a number of services, like an electric utility, there is the Ramsey price as a pricing system designed to maximize economic welfare under the condition of balance restraint.

Matsukawa et al (1993) in their study divided electricity demand into residential and industrial uses, and calculated the Ramsey price by estimating price elasticity and marginal cost of electric utilities. Comparing the estimated Ramsey price and the present rating levels, they concluded that unit price for residential customers should be higher than that at present, while that for industrial customers can be much cheaper (Table 5).

### 3.3 Yardstick Competition

Have general electric utilities, for which regional monopoly is allowed, endeavored to improve their corporate management through inter-industry competition by comparing their performance with that of other utilities? This is a question which involves the issue of yardstick competition among electric utilities. The conventional regulatory system contains
no mandatory rule to deny the concept. Therefore, the question raised above is not a question designed to evaluate regulatory results of the past, but rather a question directed to electric utilities, which asks them if they have made such voluntary efforts. But, if it is confirmed that yardstick competition does function, even on a voluntary basis, it would mean for regulatory authorities that they are allowed to conduct market research as a step to introduce new regulatory instruments.

As a collaborative study on the yardstick competition in the Japanese electric utility industry, the study by Ito/Miyasone (1994) is viable. According to them, the fact that differentials among the nine utilities have gradually narrowed in cost terms (up to 1985) can be taken as an outcome of competition.

Technical improvement and quality competition have functioned more effectively. Individual utilities have uniformly attained high levels of technological introduction, which led to unmanned power plants, improved thermal efficiency, sharply lowered transmission losses, and thunder-proof/saline-proof distribution facilities. Also, a very limited outage, measured in both number and duration of blackouts “as well as stability of voltage” proves that Japan’s utilities have reached the world’s top level in quality of electricity. As far as corporate management efficiency is concerned, however, it is not certain if competition has worked or not.

These results can be thought of as the highly successful outcome of the efforts made by individual utilities, by comparing their own data with those of others in various fields.

However, it can also be argued that the successful outcome is due to the regional monopolistic system, which enabled individual utilities to invest in technology and quality without paying enough attention to cost/benefit. It is sometimes pointed out that quality of Japan’s electricity is higher than necessary. Likewise, as indicated by many experts (Vickers, J. and G. Yarrow (1988), an outcome of “possible conspiracy” can also be read from the narrowing differentials of rates, regardless of whether the parties concerned were conscious of it.

At any rate, it is a solid fact that the yardstick competition among nine utilities has functioned very well in the phase of technology and electricity quality, and that it has worked in narrowing regional differentials in the phase of rate. Nonetheless, verification has remained insufficient in regard to management efficiency.

From the standpoints above, of conventional regulatory outcome can be summarized as follows. First, the conventional system helped realize a stable electricity supply, and also contributed to the development of Japan. Second, economy of scale in the generating sector has reached its limits, and it is uncertain if economy of scale can be expected for overall corporate management. Third, the current rate system hinders market efficiency and fourth, while general electric utilities are allowed a regional monopoly and given service areas of their own, yardstick competition has functioned reasonably.
4. Deregulation Under Consideration

The contents of deregulation of the electric utility industry, currently under consideration along with amendment of the Electric Utility Industry Law, can be grouped in four categories (Figure 16). They are (1) liberalization of the entry into the electricity wholesale market, (2) activation of direct supply (3) change of rating system, and (4) revision of safety regulations.

4.1 Liberalization of Entry into Electricity Wholesale Market

(1) Opening of electricity wholesale market

So far, those who hope to participate in the market as an electricity wholesaler need to obtain a "license" issued by the MITI Minister. The deregulation under examination calls for removing the licensing system and leaving the matter to the market. It is a "bidding system" that replaces conventional "licensing." An interim report released December 1994 by a subcommittee to discuss the industry's basic problems, under the Supply and Demand Committee of the Electric Utility Industry Council, mapped out specific procedures to work out a proposed bidding system as follows.

1. Size of supply capacity subject to bidding is to be specified when power resources development plans are prepared by general electric utilities.
2. General electric utilities will prepare and publish bidding plans, which state the size subject to bidding, time to start supply, bidding conditions (avoidable cost, etc.), evaluation method, and standard agreement, and other considerations.
3. Application by bidders
4. Decision of successful bidders
5. Contract based on standard agreement

The aim of introducing this kind of bidding system is to encourage in-house power producers and cogeneration operators to participate in the electricity wholesale market. It is expected that the power resources entitled to bidding will be those which can be developed within seven years.

However, nuclear-power generation, which requires a long development period and involves great uncertainties in the future, and such large-size power resources as LNG, are not counted in that category. They remain as the power resources to be developed by general electric utilities and wholesale electric utilities power producers, with "licensing" is kept alive, as in the past. Also, the licensing system for conventional wholesale electric utilities survives intact.

(2) Free access to transmission networks

Even if barriers to new players in the electricity wholesale market are reduced by the
introduction of a bidding system, the market will not necessarily be competitive. To prevent market control by buyers, namely general electric utilities, the promotion of "wheeling" is planned as well. In other words, transmission networks owned by general electric utilities will be opened to new market players so that they can reach potential buyers in a broader area, instead of the sole one electric utility that takes charge of the area where they are located.

As for wheeling fees to be paid by the new players, applied for the present will be a corresponding fee will be applied for transfer supply (relaying) currently employed among general electric utilities. The fee is based on average transmission costs (book cost basis). It is employed on the assumption that, given that power resources of new players are smaller than those developed by electric utilities, little additional cost would be required to build up transmission facilities. Separate accounting is made if a bidder is so large as to require buildups of specific transmission facilities.

Wheeling for retailers is not counted under the wheeling issue, which is discussed in the form of opening of transmission networks.

4.2 Retailing by Non-Electric utilities
Regulatory changes under consideration widen the possibility for non-electric utilities to sell electricity directly to consumers. Conventionally "specified supply" has been treated as an exceptional form of in-house power generation. But, the drafted amendment to the Electric Utility Industry Law defines it as "specified electric utility project (SEUP)," thus positioning it as one form of electric utility.

SEUP, though in operation within a limited area, supplies electricity directly to so many and unspecified consumers that it should have high public interests. Therefore, from the standpoint of consumer protection, SEUP operators need to obtain a license similar to one currently acquired by general electric utilities. And, licensing involves "supply/demand balancing principles" similar to those applied to general electric utilities.

Also, SEUP is obliged to keep supplying to its customers within the specified area. Accordingly, the general electric utility responsible for the area where SEUP is located is exempted from the obligation to supply to the SEUP customers, though it is required to back up SEUP when necessary.

SEUP rates and supply conditions are subject, not to official approvals, but to notification alone. The grounds for the judgment are that, given SEUP customers are much more limited than those of general electric utilities, demand and cost fluctuations are likely to remain small, and the customers on their part are given, at the initial stage of contract, the right to select their supplier (a SEUP operator or a general electric utility).

4.3 Revision of Electricity Rate-Making System
The first conclusion drawn from the review on rating system-related regulations was that the total cost based method would be abided by as in the past, and that price cap system
will not be introduced.

Certainly, the Rate-Making System Committee of the Electric Utility Industry Council in its interim report (Jan. 1995) conceded merits of the price cap system, citing that (1) introduction of productivity improvement rate (X factor) could prompt efforts to improve management efficiency, (2) freedom in rate-making could be augmented, and (3) regulatory procedures could be simplified.

But, the committee concluded that the introduction of the price-cap system into the Japanese electric utility industry would be problematic, especially regarding the following points. Namely, the committee asserted that (1) the price cap system would leave fears for raising necessary equipment investment funds for the security of a stable supply, (2) there is a strong social request for a cost-based equal and fair pricing system, without leaving the matter to operators' arbitrary rate-making by type of contract, (3) due to the strong nature of regional monopoly, direct price competitions among operators should not always lead to customers' advantage, and (4) a society-wide consensus could hardly be built on the productivity improvement rate (X factor) that is not yet objectively well-grounded.

Therefore, the interim report concluded that "a future rate-making system must be designed, while (1) maintaining the basic framework of the total cost-based method with which rates are set based on actual costs, and (2) introducing a mechanism (incentive regulation) of the rate-making system which could prompt electric utilities' voluntary efforts to improve efficiency, to reflect the merits of a price-cap-like simplified rules."

(2) Introduction of incentive regulation

The second feature is to adopt yardstick competition institutionally as an incentive regulation to prompt improvement of management efficiency. The following are proposed as procedures of the adoption. (1) When revising their rates, electric utilities must disclose beforehand to what extent their management efficiency is improved, and apply new rates based on the improved-efficiency-integrated cost.

(2) The government examines and assesses the application with the method of (a) or (b) below, then encourages electric utilities' management efforts through resultant assessment. (a) To compare costs and management indicators of individual utilities. (b) Standard values set uniformly among individual utilities.

In Japan, similar incentive regulations have been in practice in the public transportation sector, including bus services.

(3) Fuel cost adjustment system/periodical assessment

Apart from the proposals in the preceding section, the Rate-Making System Committee of the Electric Utility Industry Council also proposed in its report to introduce (1) a fuel cost adjustment system and (2) a periodical assessment of rates.

The fuel cost adjustment system is designed to enable a prompt response to cost
fluctuations resulting from fluctuations in exchange rates and crude oil prices which are beyond corporate management efforts. The periodical assessment of rates is designed to assess rates, independent of rate revisions, and to learn the state of balance and outcome of ongoing corporate efforts to improve management efficiency.

(4) Rate-making system as a demand-control option

To lower electricity rates, leveling load is an important element. To this end, it is necessary to encourage efficient use among customers by broadening the range consumer of choice in the form of more diversified/elastic rate-making.

To establish rate-making which can meet the objective, the present "approval" system will be changed into a "notification" system. The latter, once in practice, enables electric utilities to offer a diverse rates menu flexibly, and helps prepare the grounds for free consumer choice on customers side. Also, in an effort to reduce summertime peak loads, it is considering, to (1) introduce a rate-making system to alleviate the burden of cost to purchase heat-accumulator-type air-conditioners, and (2) expand application of time-of-use rating.

4.4 Safety Regulations

The request to streamline safety regulations was judged unsuitable in reference to both overseas safety regulations currently enforced and present technical levels. The Subcommittee on Electricity Safety Problems of the Supply and Demand Committee, EUIC, which has discussed rationalization of safety regulations, stressed the following viewpoints in its interim report (June 1994).

(1) Importance of the principle of self-accountability and transparency of regulatory contents
(2) Even after rationalized based on technical advance, safety records, etc., safety levels be maintained/improved.
(3) Corporate activities be stimulated and benefits to the public be improved as a result of eased time and economic burdens.
(4) Voluntary safety system be upgraded as a result of higher consciousness of safety in the private sector.
(5) Rationalization be advanced in conformity with Japan's actual situation, while referring to overseas safety regulations.
(6) Safety system be constructed in a manner to meet future needs too.

Based on the examination results of the subcommittee, future safety regulations are amended in the direction below.

The most vital change in the regulations is the change in the basic stance to trim the scope of direct government involvement. In regard to electric utility facilities smaller than the prescribed size, for instance, it is proposed to (1) simplify the scope of construction plans subject to "approval" and "notification," (2) reduce the scope subject to inspection before
commercial operation, (3) leave periodical equipment inspection to operators' voluntary checks, and considerably extend an interval between checks, and (4) remove the procedure to approve welding methods beforehand to be given during welding checks. However, instead of no detailed safety regulations to be offered by the government, (5) relevant authorities will be allowed to make elastic/mobile operations of on-the-spot inspections.

Along with these, an institution will be arranged to prompt voluntary safety efforts. In specific terms, there is a move to simplify the way of involvement of licensed chief electrical engineers, depending on technical levels of electrical structures (generators, etc.) Among others things, simplification of technical standards and review on categories of electrical structures is underway.

5. Effects of Deregulation

To what extent is deregulation of the electric utility industry is expected to have effects on the national economy? In order to measure the effects in terms of domestic production value, consumer's surplus, etc., calculations were made as described below. Models in use are an inter-industry input-output table and a macroeconomic model.

5.1 Effect Estimation Method and Assumptions

Assumptions and calculation processes taken in estimating the effect are as follows (Figure 17). First, it was assumed that deregulation would help the electric utility industry improve productivity and load factor, and electricity rates would be lowered by 10% from their levels. Above all, because it is estimated that a 1% higher load factor can reduce the cost by 1%, there are high hopes for implementation of deregulation to open a road to flexible rate-making, which can promote load factor improvement.

Lower electricity rates, if realized, can reduce manufacturing costs in industries other than the electric utility industry, to bring the price of goods prices down. To what extent the price of goods of individual industries goes down can be analyzed using the inter-industry input-output table.

Effects of falling prices of goods on the national economy can be examined by dividing them into (1) price effect and (2) income effect. With price effect, a given product is priced cheaper, which results in greater demand for the product, and ultimately expands domestic production of the product. On the other hand, with income effect, falling prices of various goods increase consumers' purchasing power in real terms, thus expanding real consumption expenditure and investment.

(1) Price effect depends on price elasticity of demand for individual goods. Price elasticity of individual goods is estimated based on the input-output table. While growing domestic demand is naturally expected to expand imports, it is assumed here that the whole of incremental demand would be met by greater domestic production.
(2) Income effect means an incremental income brought about by a gap between GNP resulting when electricity prices remain unchanged, and GNP resulting when general commodity prices declines thanks to lower electricity prices. Here it is calculated in terms of the domestic production value brought about by greater income.

Estimation of income effect starts by studying effects of falling prices of individual goods on the consumer price index (CPI) and wholesale price index (WPI). Subsequently, because interest rates are also affected by commodity prices, official rates are also estimated as a reaction function to commodity prices. With the CPI, WPI and the range of official rate cuts given as exogenous variables of the macro economic model, changing levels of GNP are measured. By assigning the outcome to individual final consuming sectors in the interindustry table, an incremental portion of domestic production value can be estimated.

The effect is estimated primarily for the section of the year 2000, and by comparing the business as usual case (BAU) with a case where deregulation leads to falling electricity prices. The rate of fall in electricity prices is assumed at 10%.

5.2 Commodity prices and welfare

(1) Effect on commodity price levels

A 10% fall in electricity rates leads to a 0.67% drop in manufacturing cost of non-electric industries on simple average (Figure 18). Excluding the electric utility industry, industries (goods) expected to record massive drops are iron at 1.10 and steel products at 0.71, followed by petrochemical at 0.67% and paper/pulp at 0.57%.

When measured in terms of CPI, which is weighted by goods-by-goods expenditures of private final consumption, these suggest a 0.33% fall in CPI. They lead to a 0.30% in WPI as well.

(2) Effect on domestic production value

Due to falling prices of individual goods described above, demand for individual goods grows in proportion to price elasticity. If the whole of the incremental demand is met by domestic production, GNP in the year 2000 in the lower electricity price case would be greater by ¥2.8 trillion in terms of all-industry total than in the BAU case. This represents an increase of 0.26%. With the electric utility industry excluded as the self-sector, it is processing/assembly industries, such as electrical machinery, general machinery and transport machinery that are expected to register massive gains in absolute terms. Among others, substantial increase rates are likely for material-producing industries, such as paper/pulp, cement, steel and nonferrous metals.

(3) Welfare - Consumer's surplus

In the BAU case, the interindustry input-output table puts nationwide electricity consumption expenditures in the year 2000 at an estimated ¥20.6 trillion (in 1985 prices).
Then, assuming that price elasticity of electricity demand is -0.45, the falling electricity price would increase nationwide welfare by ¥46 billion. The figure includes an incremental surplus recorded by firms as electricity consumers. Targeting household budget alone, electricity consumption expenditures in the household budget would total ¥4.3 trillion in 2000, which means an incremental surplus of ¥9.6 billion resulting from falling electricity prices. This represents 0.3% of electricity consumption expenditures in the household budget.

Meanwhile, measured in 1990 nominal values, an increase in nationwide welfare amounts to ¥29 billion, and that in the household budget to ¥6 billion.

5.3 Effect on Income

(1) Effect on national income

A 10% fall in electricity price pushes the CPI and WPI down by 0.33% and 0.30%, respectively. Assuming that interest rate is a reaction function to commodity price levels, taking past interrelations between the two, the elasticity is estimated at around 0.5. With the falls in these three variables incorporated in the macroeconomics model, its simulation results show that GNP in 2000 could expand by 920 billion, up 0.2% over that in BAU case. (However, because falls in the three variables are incorporated from 1996 and on, the pace of expansion would be around 0.04% a year.)

Among GNP components, it is private equipment investment that grows highest, followed by private final consumption. Compared with the BAU case, they would be larger by ¥570 billion and ¥227 billion, each, in 2000.

(2) Effect on domestic production value

Substituting relevant final demand items in the input-output table for the changes by GNP component above, domestic production would outstrip the BAU case by around ¥1.6 trillion, or up 0.18%. Industries recording massive gains are electrical machinery at ¥250 billion and construction at ¥230 billion, among others. Meanwhile, those showing high growth rates are machinery-related industries represented by general machinery, and material-producing industries like cement and steel.

5.4 Price Effect and Income Effect

When combined, the price and income effects discussed above would expand domestic production in 2000 by ¥4.4 trillion, or 0.41%, over the BAU case. By industry, machinery-related industries, such as electrical and general machinery, show massive gains in their domestic production in absolute terms. In growth terms, considerable effects are produced on material-producing industries, including nonferrous metals, paper/pulp, steel products, and chemicals and cement, in addition to the machinery industries (Figure 19).
6. **Subjects of Deregulation**

   Given the deregulation under way, this section examines what are its effects, and what sorts of subjects still remain.

6.1 **Market structure**

   As a result of the latest deregulation, the electric utility industry's system is likely to change as follows.

   **First**, participation of new players in the electricity wholesale market would help improve efficiency in the generating sector. Though it is hard to forecast to what extent new players will participate in the market, some put their generating capacity commissioned from 2000 and on at 1 GW, and others at 2 GW. Even if the capacity turns out to be limited, it would be lower than the avoidable costs of electric utilities, which is very significant in the sense that it could make marginal costs in the generating sector transparent.

   In cost terms, their direct effect on overall cost reduction would be limited, because these new participants represent an extremely marginal supply capacity. But, even indirectly, their presence could stimulate cost reduction by the electric utilities.

   **Second**, the bidding system proposed by the government indicates that the system fails to put the market to best use. If new players have highly reliable supply capacity, there is no necessity to exclude specific power resources from qualified bidders. While the bidding under the latest deregulation appears to imagine power sources for peak load as bidders, it won't be unreasonable in the future to include base-load power sources among qualified bidders. From such a viewpoint, it will no longer be necessary to leave large-size power resources development, like nuclear and LNG, only to electric utilities alone. It could just leave to the market.

   An advanced shape of such an idea is an encircling bidding system. Qualified bidders could range from a general electric utility responsible for other service areas which have surplus supply capacity, a wholesale power producer, and IPP, to the electric utility which calls for the bid itself. The change under the latest deregulation fails to take such an idea into account. But, depending on new players' performance and external pressures, there can be mounting requests for further deregulation to realize such a drastic system.

   **Third**, there remains the issue of how much should be charged for the use of transmission lines by new players. With the revision made this time, it was decided to charge a fee corresponding to that set for transfer supply among electric utilities. This after all assumes that supply capacity of new players won't be so large. Once their supply capacity expands eventually, electric utilities couldn't be so generous.

   Also, in regard to charges resulting from construction of additional transmission networks, it will become necessary to put the issue into public debate, and specify it at the time of bidding.

   **Fourth**, to further improve efficiency of opening of transmission lines/wheeling system
mentioned above, relevant regulations and systems need to be changed or reviewed. The latest deregulation provides no measures to help improve efficiency of the operation of network functions of transmission lines. Therefore, even if new players are allowed to use wheeling in their wholesale electricity supply, it won’t facilitate an optimal supply/demand balance backed by transmission networks.

Any efforts to realize this should reach the use of the power pool market, as demonstrated by Britain where the transmission sector was integrated into the National Grid.

6.2 Desirable Method of Rate-making

Revised rate-making regulations enabled electric utilities to introduce elastic rate-making, which can contribute to leveling load. For consumers too, it can be highly valued for a widened possibility of choice from a diverse rating menu. Also, thanks to the introduction of incentive regulations, management efficiency can be improved more than ever. However, many subjects still remain to be pursued.

First, due to the supply cost method and FDC system being preserved intact, regulatory costs can grow. Second, there can be a distortion of resources distribution efficiency. The price-cap system, of which introduction was recently dropped, provides a viable measure to deal with these problems.

Theoretically, a cap properly set could prompt convergence to the Ramsey pricing system. Also, with a well-designed X factor of the price cap, it becomes possible to take investment into consideration from a long-range viewpoint. The price cap system can be counted as the only one rate-making system that can conform to the policy to introduce competition through deregulation.

In terms of regulatory cost-reduction, the recent changes in regulation this time could produce few favorable effects.

6.3 Problems of External Effect

Deregulation is expected to enhance efficiency by making the electricity market more competitive. To promote it further, additional changes in regulation will be required as already mentioned.

But, it should be recognized that deregulation is also accompanied by problems of external poor economy. First, there is a problem of "cream skimming". Environmental problems, and technological development are other important problems. While advancing deregulation, these problems all represent matters which require new regulations to prevent evils from arising in the form of market failure. Though not referred to in this report, it is an important subject in considering equity and fairness, as well as a stable electric utility industry's system in the long run.
Conclusion

Moves and effects of deregulation under way now in the Japanese electric utility industry have been discussed. The reasons behind the changes in the postwar electric utility industry's system, and what effects could be produced by changing regulations, were also examined.

The discussion so far can be summarized as follows. It was widening differentials between domestic and overseas electricity prices in recent years that amounted to powerful pressures to change the regulations of the electric utility industry. But, it cannot be independent of cost increase pressures on both demand and supply sides. With their utilization technologies commercialized, new decentralized power resources have become viable as new supply sources. Collaborative study results show that the grounds for electric utilities to abide by the regional monopolistic system are thinning now, and that current rate-making system also makes resources distribution inefficient.

Under such circumstances, deregulation of the electric utility industry has been under consideration in the past few years. Expected measures of deregulation are (1) liberalization of entry into the electricity wholesale market, (2) direct supply to customers (specific utility project) (3) introduction of a more elastic rate-making system and of incentive regulations, and (4) rationalization of safety regulations. With these measures, improved efficiency of electricity supply is expected.

However, problems still remain, including introduction of enhanced competition into the generating sector, efficient operation of transmission network functions, and reexamination of the introduction of the price-cap system into rate-making.

At this time, (March 1995), the yen's value is spiraling, making the already-wide differentials between domestic and overseas electricity prices ever wider. As a result, it appears inevitable that claims will become louder in demanding electricity price cuts and implementation of deregulation. While these short-run voices can certainly create political pressures, it is essential to consider what system can promote efficiency improvement of the electric utility industry from the long-range viewpoint.