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Regulatory reform of the electricity industry in Japan: What is the next step of deregulation?

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Abstract

In Japan, competitive bidding for new generating capacity (IPPs) is in progress since 1996. Retail competition was introduced for large customers (contract demand over 2 MW) after March 2000. Although the liberalization is limited in part by the fact that the retail power market has only about 30% share of total electricity demand, the eligible customers now have a choice among the nine major utilities and ten new entrants. Since November 2001, the electricity industry committee has been discussing the next step of liberalization, including the opening of the market for medium-size industrial and commercial high voltage (6 kV) customers from 2004 and 2005 on. This paper presents the experiences so far acquired and the technical issues for further deregulation. The process includes the creation of nationwide power exchange and of a neutral organization to coordinate the transmission system by 2005. The paper deals with the characteristics of the new regulatory reform of the electricity supply industry in Japan during the period of 2003–2007. We show that it is important to understand the complexity of market behavior and design the market reform carefully.

Keywords: Deregulation; Electricity; Japan

1. Introduction

The electricity industry is facing radical restructuring that aims at improving efficiency and stimulating technological innovation in industrial and developing countries. Regulatory reform of the Japanese electricity industry, which includes deregulation and re-regulation of the industry, is currently taking place following the experiences in many other countries. The transition from a vertically integrated, state-owned energy sector to a private industry that faces competition requires adjustments that cannot be accomplished overnight in Asian countries, including China, Korea and Taiwan. A long transition from regulatory regime to another is not yet concluded. In addition to this transitional problem, each region should adapt their own liberalization model, considering individual specific factors such as natural resource availability and demand characteristics.

Although the Japanese economy began to improve slowly at the beginning of 1999, the improvement never gained solid footing. By the end of 2000, the economy fell into recession again, ending a somewhat short-lived recovery. Consumer spending has been weak, and exports and plant investment decreased. Japan's GDP shrank by 1.9% in 2001, the first decline since 1998 and the largest since 1980. However, GDP grew by 1.6% in real term during fiscal year 2002, and Central Research Institute of Electric Power Industry (CRIEPI) forecasts 1.4% expansion in fiscal year (FY) 2003 and 0.8% in FY 2004.

In Japan competitive bidding of new generating capacity (IPPs) has started, beginning in 1996. By 2000 retail competition was introduced for the large customers with contract demand over 2 MW. Although the liberalization is limited in part by the fact that the retail power market accounts for only about a 30% share of total electricity demand, the eligible customers now have a choice among the nine major utilities and ten new entrants. Since November 2001, the Electricity Industry Committee, the Advisory Committee for Natural

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Resources and Energy of METI[1] has been discussing the next step of liberalization, including the possible opening of the market for medium, industrial and commercial high voltage (6 kV) customers. The panel has reviewed the experiences in the US and Europe. Japan adopted a scheme of phased liberalization.

The restructuring in the Japanese electricity industry started later than in many other countries because Japan's government and industry have stressed energy security and global warming issues, compared to improvement in the efficiency of supply. The choice of the liberalization models depends on public perception concerning the electricity supply industry. Consumers expect reliable, stable supply of electricity as their top priority, having observed power crisis elsewhere, such as in California (Ariu, 2003). In February 2003, the Electric Utility Industry Committee reported to METI, recommending a step-by-step approach for developing market-based systems in the longrun, and the Cabinet approved the future direction of regulatory reform. The law was revised in June 2003 and will become effective in December 2003.

While maintaining vertical integration, the government mandated accounting separation in electric power companies and it plans to establish an independent organization to monitor the operation of power systems and coordinate transmission planning. It also decided to open the retail market to competition, except for low voltage customers[2]. A nationwide Power Exchange will be established in 2005.

This paper presents the experiences so far acquired and the technical issues for further deregulation. We show that it is important to understand the complexity of market behavior and design the market reform carefully. The paper deals with the characteristics of the new regulatory reform of electricity supply industry in Japan (JEPIC) during the period, 2003a, b–2007.

2. Current market structure and short history of deregulation

2.1. The structure of electric power industry in Japan

Japan's electric power industry comprises five types of entities: general electric utilities, referred to as the electric power companies (the EPCos, integrated utilities), as well as wholesale electric utilities, wholesale suppliers, special electric utilities, and electric suppliers of specified scale (Fig. 1). There are ten integrated utilities: Hokkaido, Tohoku, Tokyo, Chubu, Hokuriku, Kansai, Chugoku, Shikoku, Kyushu, and Okinawa. These are investor-owned, vertically integrated companies, each of which supplies customers with electric power on a retail basis in its service area.

Wholesale electric utilities with a capacity of 2 GW or above, including Electric Power Development Company (EPDC) and Japan Atomic Power Company (JAPC), sell electric power to the integrated utilities on a wholesale basis (long-term bilateral contract).

Wholesale suppliers[3] are plant operators selected through a competitive bidding systems implemented by each integrated utility to supply that integrated utility with electric power (long-term bilateral contract).

Special electric utilities, on the other hand, are permitted to engage in retail electric power sales to meet demand at designated delivery points. These are components of industrial complexes with generators and are independent from the utility. Electric suppliers of specified scale[4] are new entrants after partial deregulation in 2000 and use the transmission lines of the EPCos to engage in retail electric power sales to certain deregulated customers (above 2 MW, 20 kV). This unique player is generator and retailer for eligible customers of specified scale.

In FY 2001, ended March 2002, the integrated utilities generated 72.3% of all the electric power production, 1076 TWh. The power source mix in FY 2001 was 52.9% of thermal power, 8.3% hydroelectric power and 38.7% of nuclear power. The combined summer peak load for the integrated utilities in FY 2001 reached 182.4 GW and the annual load factor 56.7%. The ten integrated utilities sold a total of 824 TWh of electricity in FY 2001. Two large wholesale electric utilities generated 6.9% of the total, while wholesale suppliers generated 6.5%. Self-generators, mostly owned by large industrial customers, accounted for 14.3%. Special electric utilities and suppliers of specified scale currently provide only a small fraction of total retail supply (1.4% in April 2003).

2.2. Short history of deregulation

In 1951, Japan's electric power industry was corporatized and divided into nine regional electric utilities. Regional utilities are integrated. Before the current privatization, there was one government-owned generation and transmission company with regional distribution companies. In addition to the nine general utilities, there were two major wholesale utilities and some dozens of municipal wholesale companies. Before 1995 no IPPs were allowed to enter the industry. For the next half-century, these companies applied advanced technologies and have provided a stable power to support

[1]Ministry of Economy, Trade and Industry (METI).

[2]After 2005, the regulated market share will be around 5% of LV customers (small business customers) and 31% of residential customers. The remaining 63% will be competitive.

[3]Independent Power Produce (IPP).

[4]Called PPS (Power Producer and Supplier) in Japan.

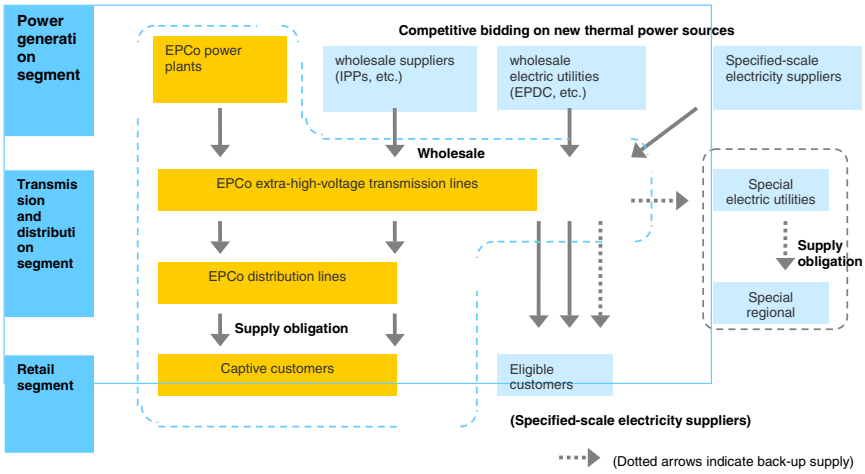

Fig. 1. Current power supply system.

Japanese society and economy. At the same time, according to government policy, the utilities purchased domestic coal, which is three times as expensive as imported coal. The coal mining industry was important, with substantial employment, and the coal mines could be shut down only gradually. This was one of the reason for the high electric price.

2.2.1. *The first reform*

The Japanese economy has suffered after the bubble economy of the early 1990s. The government tried to revitalize the economy by regulatory reforms of the major regulated industries, including the telecommunication and air line industry. High electricity prices motivated deregulation of the electricity industry in Japan. Customers, in particular industrial customers which compete internationally, claimed to bear the highest electricity prices among OECD countries during the long economic recession. Thus the goal of the first reform is to increase the efficiency of utility management, as noted by the Electric Utility Industry Council (currently the Electricity Industry Committee).

The introduction of the competitive principle led in 1995 to the first revision of the Electricity Utility Industry Law, paving the way for such reforms as the following: the introduction of a competitive bidding systems in the wholesale electric power sector; and the establishment of special electric utilities. The total amount of capacity of IPPs is around 4 GW. Additional capacity of IPPs which are under construction and to be constructed is 3.3 GW. This reform had a significant impact on utility management, in particular, on restructuring the business units for power generation and reducing prices for plants and equipment.

2.2.2. *The second reform*

The electricity supplied to the utilities as a result of the entrance of IPPs is 3–5% of total production. So the direct impact on electricity prices is apparently limited in the near term. Subscribers for the capacity produced by the IPPs exceeded the utilities' solicitations by more than three times in 1996 (the first year) and more than four times in 1997. Many businesses found the power sector an attractive area and demanded further deregulation for business opportunity. Generation costs by IPPs are 20–30% less than the avoided cost of the utility due to existing infrastructure of the new entrants, such as iron and steel company. Such opportunities increased the pressure for further cost reduction and have facilitated the process of liberalizing the retail market.

The goal of this reform is to reduce the electricity price to an internationally comparable level. Members of the Electric Utility Industry Council, an advisory panel to the Minister of International Trade and Industry (former METI), called for the liberalization of the retail market so that customers could directly access different suppliers. The utilities proposed to open their transmission lines to large customers but strongly resisted full liberalization and the formation of a power pool market like that in England at that time. Concerning the mandatory pool, there seemed to be suspicion about its functioning, as reported in Britain. The Electric Utility Industry Council decided to adopt partial liberalization and to maintain the vertical integration of the utility, given its public service obligation, such as reliability and nuclear power development.

In March 2000, the retail supply market was deregulated for customers with electric power supplied at 20 kV or above and a contracted supply of 2000 kW or above, and the transmission lines owned by the integrated utilities were also made available for use by new suppliers through a wheeling system, with the provision that the performance of this partially deregulated system would be reviewed three years after implementation. Annual consumption of the eligible customers, who can choose among various suppliers, represents about 30% of the total consumption in Japan.

In principle, free entry into the retail market and the rates new entrants charge are free from regulation, and they are under no legal supply obligation. The integrated utilities, on the other hand, are still required to fulfill the role of public utilities and, as the owners of the transmission system, to maintain stable operation and power quality. The integrated utilities have ultimate responsibility, moreover, for serving as the provider of last resort in their service area when no contract has been signed between a customer and a supplier[5].

2.2.3. Current status of competition and impacts of competition on electricity price reduction

The rates for these eligible customers, who can choose among providers of powers, are determined through negotiations between the customer and the supplier.

As of June 2003, ten companies had filed notice of entering the electric power supply market as specified - scale electric suppliers. These entrants are mainly subsidiaries of trading companies, gas companies, telecommunication company, or manufacturers with self-generating facilities. Table 1 shows the largest five PPSs (suppliers of specified scale) . The total amount of sales (kWh) in FY 2002 doubled over the previous year. The proportion of total power provided by these new suppliers is still limited since partial deregulation is in an early stage.

The share of contracted demand among eligible customers is around 1.4%. The total capacity of PPSs is 2.3 GW and will reach 4.6 GW in 2010.

This phase of deregulation contributed to an overall decline in electricity rates. In 2002, the integrated utilities reduced their rates in the regulated sector by 5.2–7.1%. They have lowered their rates through more efficient management practices and reductions in plant investment (Fig. 2) and maintenance costs in an environment of growing competition. For example, TEPCO, the largest integrated utility, reduced the average electricity price of non-residential customers by 6.1% in October 2000, and a further 8.6% in April 2002. Five PPSs acquired 97 customers in the TEPCO service area by February 2003 and the total of these bypassed demand reached approximately 330 MW. The main target of competition is the large commercial customer, in particular, government and other public facilities.

Needless to say, other integrated utilities and PPSs also reduce prices due to competition. Integrated utilities, of course, reduce prices for residential customers comparable to those for non-residential customers. In a fully competitive market, energy service providers tend to decrease prices mainly for attractive large consumers in order to retain profitable customers. Generally, residential consumers are not attractive for

[5]Either a PPS or an EPCo.

Table 1
Largest PPSs and sales in FY 2002

PPS	Sales (GWh)	Parent companies
Ennet	597	NTT-F (construction, telecom), Tokyo gas, Osaka Gas
Diamond power	536	Mitsubishi corp.
eREX	173	Nittan capital group, Ueda tanshi, Mitsui corp.
Summit energy	115	Sumitomo corp.
Nippon steel corporation	100	—

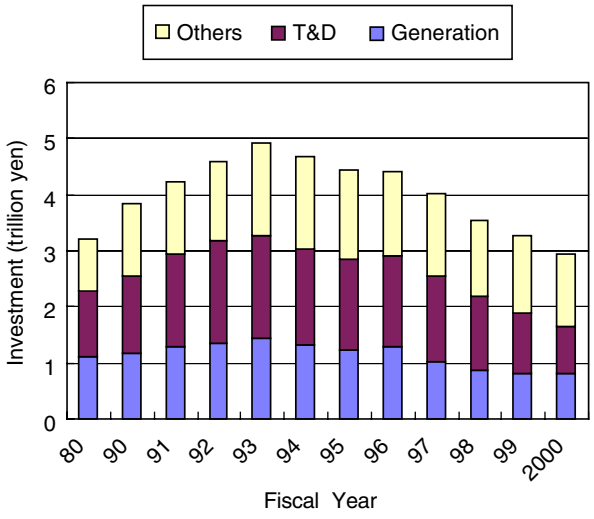

Fig. 2. Total investment of integrated utilities.

ESPs in the US and Europe where markets are fully liberalized. The ultimate objective of regulatory reform is to bring benefits to all consumers. Partial deregulation in Japan brought significant rate impacts within a few years, even though PPSs have a small portion of market share.

2.2.4. The third reform

The third stage of the deregulation focuses on the independence and transparency of the systems' operation, as well as on the additional opening of the retail market. These issues will be discussed in the following sections.

3. Policy Issues on Electricity Supply Systems

In November 2001, the Electricity Industry Committee began deliberations on further deregulation. Originally it intended to examine the performance of deregulation after 2003. However, by the end of 2002, the government's advisory committee had reviewed the performance of partial deregulation and decided to

further liberalize the industry. Discussions are being held on such issues as finding appropriate means of ensuring fair access to transmission and distribution lines and of maintaining the transparency of wheeling rates as well as of improving the market environment to promote electricity trading.

3.1. Policy goals: promotion of nuclear power in a competitive market

In June 2002, the Basic Law on Energy Policy was enacted to lay down the fundamental policy for measures concerning energy demand and supply on a longterm, comprehensive and systematic basis. As a basic policy for measures, the law prescribes that efforts should be made to ensure the security of energy supply, and achieve harmonization with the environment. Suppliers, positioned as the core of the system, are responsible for playing a central role in addressing issues such as energy security and environmental protection. General electric utilities assuming a central role in the industry are expected to make continuing efforts to promote nuclear and hydroelectric power plants since these power sources help promote energy security and are less environmentally harmful, compared with thermal power plants, especially coal-fired power plants. Considering that the promotion of large-scale power generation projects such as nuclear power plants requires collaboration with the power transmission segment, the present general electric utilities are encouraged to continue to play an important role.

The Cabinet decided that the following mechanisms would help create an environment for promoting nuclear power development even as further progress is made in retail electricity liberalization. First, the price competitiveness of nuclear power generation should be enhanced by easing the tax burden on less environmentally harmful firm (stable) power sources, including nuclear power as compared with that on fossil fuel thermal power sources. Second, fiscal measures should be planned for the development of nuclear and other power sources to achieve long-term stable operations for them. One of the critical issues is how to facilitate reprocessing and waste disposal operation of spent fuels. To promote nuclear power investment and back-end cycle operations, a government panel will be formed in late 2003. Based on the results of this panel, concrete measures including economic measures, should be proposed by the end of 2004.

3.2. Other policy issues

Maintenance of universal service is also an important issue, in particular for low demand density area such as Hokkaido and area with a lot of small islands such as in Kyushu and Okinawa. The utilities maintain the role of supplier of last resort.

Regulatory reform is needed to meet and be consistent with the need for expanding options available to customers while ensuring security of supply. Because of the physical characteristics of electricity, the integrated formulation and operation of power generation and transmission facilities are needed to achieve security of power supply, both in the short term and in the long term.

There are two regulatory approaches: structural separation of generation, transmission and distribution for more competition or the maintenance of vertically integrated utility for secure supply of services of last resort.

3.3. Wide-area coordinated operation

Japan's electric power grid comprises both 50 Hz (in Eastern Japan) and 60 Hz (in Western Japan) systems. Although the integrated utilities basically adhere to the principle of autonomous system operation, they cooperate with one another in wide-area coordinated operation to take advantage of differences in regional characteristics and demand structures, and in interchanging electric power.

These 50 and 60 Hz systems are linked to each other by two frequency converters stations (300 + 600 MW) operated by EPDC and TEPCO. In addition, Tokyo and Chubu EPCos are jointly constructing an FC station (300 MW).

The basic structure of the transmission system cannot be changed easily since it is the result of long-run optimization reflecting regional characteristics. The market should be well coordinated with these unique transmission features.

4. Prospects of Further Deregulation

In accordance with the above mentioned basic principles and peculiarities in Japan such as the physical characteristics of transmission systems, the electricity industry's institutional system will be revised as noted below.

4.1. Formulation of the Neutral Organization to supervise the rules of T&D

Regarding power systems' access, facility construction, system operation and information disclosure in the transmission and distribution sector, general electric utilities have heretofore voluntarily formulated, operated and published their own rules. It is necessary to achieve further fairness and transparency in these activities, in order to accomplish the two purposes of expanding the scope of retail liberalization and continuing to ensure security of electricity supply. In order

to build consensus among various types of electricity industry firms and to refrain from ex ante control by the government (based on the principles of responsibility sharing between the government and the private sector), one effective strategy is the following: These activities should be left in the private sector, which can take advantage of its expertise, while the government conducts ex ante checks on the decision-making organization set up to make rules in the private sector and it carries on *ex post* supervision as well.

The government panel proposed an establishment of an intermediate corporation, i.e., a neutral organization (Fig. 3) supporting T&D operation, that would make rules for the following:

- the construction of T&D facilities,
- grid access,
- systems' operation,
- information disclosure,
- conciliate and mediate disputes between power system users and the T&D owner.

The neutral organization should provide information, including the available transfer capability (ATC) of transmission lines, central dispatching liaison functions, a place for coordination regarding construction plans for regional interties (Fig. 4). It should also conduct an assessment of the electric system's reliability, develop and publish statistics, and carry out surveys and studies regarding power systems.

In order to secure neutrality, this organization should be composed of representatives of general utilities, new entrants, wholesale utilities, owners of self generation, and academia. In addition, a mechanism should be set up to prevent any stakeholders representing these members from holding overwhelmingly more powerful voting power than others. The government should check appropriately for fairness, transparency and neutrality in the decision-making process regarding the duties of the internal expert committee of the neutral organization. The neutral organization would take over the core dispatching liason functions from the Central Electric Power Council. The detailed structure of the organization should be developed by the end of 2003 and METI would authorize this organization in Spring 2004.

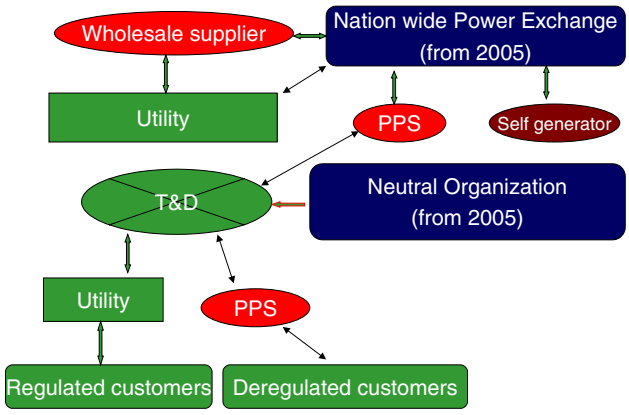

Fig. 3. New System from 2005.

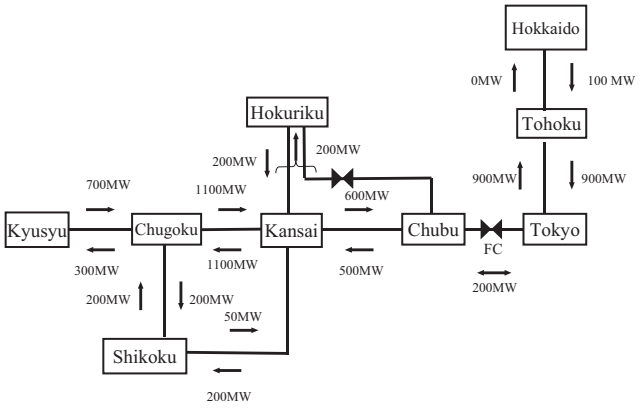

Fig. 4. Long-term ATC in Japan.
Note: 10-year long available transfer capabilities of interietility tie lines. FC: Frequency converter. *Source*: http://www.cepc.gr.jp/

In order to allow the T&D segment to fully perform its coordinating function and thereby maintain system reliability, the requirements are: insuring fairness and transparency of the T&D segment regarding the service of this function (such as individual power system operation and wheeling service, for which this segment is responsible), and gaining the trust of market participants in T&D segment. To attain this objective, three prerequisites must surely be met;

- an information firewalls between the power generation, the T&D, and retail segments,
- the prohibition of cross subsidization and
- the prohibition of discriminatory treatment.

It is suggested in the Electricity Utilities Industry Law that the general utilities should prepare and publish an accounting statement of revenues and expenditures concerning the operation of the T&D segment.

One of the unresolved questions is whether to standardize the calculation method of ATC among regions. It is difficult to reflect the diverse characteristics of regional power systems in defining reliability standards.

4.2. Creation of Nationwide Wholesale Power Exchange (PX)

In Japan, economic power interchange has been customary, primarily to achieve efficient operations of power sources among electric power companies and new entrants (PPSs). The expanded scope of retail liberalization will necessitate further measures of managing risks encountered in electric power development. Accordingly, the promotion of transactions at the power

exchange (PX) can help enhance the risk management abilities of electricity industry firms through such measures as the formation of a reference index price that is useful in assessing investment risks, and as an expansion of options of electricity sales and efficient procurement. For the Japanese situation, an appropriate approach is to open a forward market and a day-ahead spot market. A real-time market will not be created at this stage of the regulatory reform because it seems not to be cost effective.

A day-ahead market should be based on an uniform-price-single-auction system that provides a good price index. Easy entry must be insured by securing anonymity of transactions and by minimizing requirements for market participation. An appropriate approach is to minimize requirements for entry and meet participant's needs for a commodity design and other methods of transactions.

An appropriate PX which electric power companies would create and take part in its operation should be a legal entity such as an intermediate corporation. Such a corporation would provide for a form of organization to go by the rules of equality among participants. The interface between PX and the neutral organization is important.

There are huge areas of work to be done for detailed design of products (type of contracts) and trading rules in national PX. One of unresolved question is whether generators could buy power from PX. Non-utility members of the Electricity Industry Committee insist that generators sell and buy electricity in PX without constraints. General utilities are concerned with congestion on lines of interties caused by active arbitrage. A second question concerns the product line in the PX, whether a weekly ahead forward contract is posted. New entrants demand weekly contract to serve as complement to maintenance of generating facilities.

4.3. New transmission pricing scheme

During the 50 years before, ten regional electric power companies had provided power to customers in each service area basically on self-sufficiency principles. Inter-regional inter-connection lines had been constructed to meet special purposes such as reduction in reserve margin. These physical aspects do not make it easy to expand larger power transactions nationwide. It takes a long time to build new bulk transmission lines. The present inter-area wheeling service contract is a reasonable system from the viewpoint of fairness in burden-sharing. On the other hand, in order to expand options available to customers resulting from the expanded scope of retail liberalization, it is necessary to take some measures designated to promote wide-area power trade. The present inter-regional wheeling service system will be revised to apply uniform transmission system utilization charges in each service area irrespective of the transactions taking place *within* or *out of* the service areas. Such a revision will prevent charges being collected each time transaction crosses a service area[6]. At the same time, the present valuation of proximity to load center should continue to encourage the construction of power sources conducive to improvement of power flow *within* a given service area, in order to provide an incentive for the location of power sources in places of proximity to consumption centers.

One unresolved question is how to allocate the additional cost of expanding transmission capacity among transmission users required to achieve efficient operation of power systems and how to provide appropriate incentives for the siting of generation and transmission facility.

The scope of liberalization should be expanded in phases. The process should ensure the securing of system reliability, that of providing universal services, and metering and service of last resort. Expanding the scope of liberalization to cover consumers of electricity at 500 kW or more is envisaged for April 2004. These customers have a certain level of bargaining power and little practical problems such as a requirement to install meters. Their share in power sales to eligible customers will reach 40%. By April 2005, retail liberalization will be expanded to cover all high-voltage power service customers at 50 kW or more. At that time, power consumers of 50 kW or more will comprise 63% of all eligible customers. By about April 2007, an examination of expanding the scope of liberalization to low-voltage customers of less than 50 kW will begin, a group which includes residential customers.

5. Concluding remarks

The government's policy goal is to secure safe and reliable supply of electricity at competitive prices as stated in Section 3.1. Regulatory reform should be compatible with the Basic Law on Energy Policy. The amount of bypassed demand by new entrants will increase thanks to further deregulation during 2004 and 2005 (Fig. 4). As a result of competition among PPSs and integrated utilities and of low-demand growth, electricity prices are expected to decrease.

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