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**Creating the Wholesale Market for Electricity in Japan: What Should Japan Learn from Major Markets in the United States and Europe?**

by

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**01-005 WP** **July 2001**

**A Joint Center of the Department of Economics, Laboratory for Energy and the Environment, and Sloan School of Management**

# Creating the Wholesale Market for Electricity in Japan: What Should Japan Learn from Major Markets in the United States and Europe?

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June 2001

***Abstract***

The movement of deregulation in Japan's electric power industry started in 1995 with the revision of the Electric Utility Industry Law. During these past over five years, levels of various discussions have been made in Japan, but remarkable changes of market structure have not appeared except for so far little utilized provision allowing large industrial customers to be supplied by suppliers other than 10 incumbent Electric Power Companies (EPCOs). The big problem confronting deregulation in Japan is the potential market power of these vertically integrated, regionally franchised utilities. This paper proposes the first step to deregulate Japan's electric power industry at the wholesale level in Japan and of policy lessons from four major deregulated markets: California, PJM, England and Wales, and Norway.

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## 1. Introduction

Retail competitive bidding for the direct electricity supply to the office building of the Ministry of International Trade and Industry (MITI, now the Ministry of Economy, Trade, and Industry, or METI) took place on August 10, 2000—the first time competitive bidding was used at the retail level in the history of the Japanese electric utility industry. Although the revised Electric Utility Industry Law was enacted to implement direct access to large industrial customers on the 21st of March, 2000, it was not until almost five months later that this first contract under the new system came under agreement. Three companies—Tokyo Electric Power Co. (TEPCO), Tohoku Electric Power Co. (ToEPCO), and Diamond Power Corporation—offered bids. Diamond Power Corporation, an affiliate of Mitsubishi Corporation, was awarded the contract for approximately $245,400 for 14,650 MWh ($50,600 per month of demand charge, and 11.7 cents per kilowatt-hour of electricity charge).[2] That price was reported to be 4% lower than the previous contracted price with TEPCO. The tone of newspaper articles after the bidding seemed in general to welcome this result.

However, as many analysts have pointed out, many controversial issues remain in this case. In fact, Itochu Corporation and Tokyo Gas Company had to forego bidding in the above instance because of the high transmission access charge and strict safety regulations on assets' specifications. And the mere 4% price reduction achieved may be said to have been far from both customer's and the regulators' expectations for direct access.

Generally speaking, the price of electricity cannot be reduced satisfactorily simply by opening third parties' direct access to the transmission network, for several main reasons: 1) the market is completely monopolized by EPCOs within the franchise area, 2) the number of market players is fundamentally very small, 3) transmission access is restricted in terms of preserving the transmission network's reliability, especially. More importantly, Japan technically has no electric power "market," as yet. Rather, vertically integrated utilities manage (or completely control, in most cases) the overall electricity supply. I believe that the first step to accelerate deregulation properly and to promote competition in Japan's electric utility industry is to find a way to create substantial, well-functioning energy markets, which will involve mitigating the formidable market power exercised by vertically integrated utilities.

[2] METI (2000). Calculated as $1 =120yen

In terms of market structure, competition in the electric power sector may be of two sorts: wholesale competition and retail wheeling competition.[3] In most cases around the world, restructuring at the wholesale level to open direct access to the transmission network has been the first step in deregulation, followed by retail wheeling restructuring. I therefore concentrate on the wholesale level in my discussions of deregulation here, as a logical entry point to the debate for Japan. Throughout this report, therefore, “market” should be assumed to mean “wholesale market,” except as noted otherwise.

This report consists of two sections. The first briefly describes and analyzes four major deregulated markets in the United States and Europe: California, the Pennsylvania–New Jersey–Maryland Interconnection (PJM), the United Kingdom, and Norway.[4] These analyses of actual deregulated markets can offer clues to the Japanese electric utility industry, which has just begun to deregulate, about how best to do so, through careful consideration of the successes and errors of those who have gone before. Although deregulation was implemented much earlier in both Europe and the United States than in Japan, the regulatory authorities in those countries are still struggling to come up with the optimal scheme for implementation. Japan can learn much from their successess and mistakes.

The second section of this report turns to Japan’s situation, starting with a summary of the existing electric power market, proceeding to an examination of what may be the best possible course for Japan’s deregulation to take, and concluding with a proposal of one possible way to create a competitive market in Japan, including concrete steps.

[3] Brennan *et al.* (1996), p.40.
[4] In this report, from this point forward, “the UK electric utility industry” and “the UK market” refer primarily to the industry in England and Wales.

## 2. Deregulation Policy Lessons from Major Electric Power Markets in the United States and Europe

Countries' primary goal in deregulating their electric power industries is to lower the price of electricity by maximizing use of the market function. Regulatory authorities and new market entrants expect deregulation to optimize the electricity market structure, functionalizing the market on the basis of free-trade market principles. Regulators also hope to mitigate the centralized market power of incumbent utilities to promote competition. Many countries that have decided to reform their electric power markets are struggling to install a new scheme to set up competitive, effective, and vital electric power markets by trial and error through various arrangements and adjustments between theory and practice, implementing corrections as deemed to be necessary.

Especially at the wholesale level, various electric power trading structures have appeared since the tsunami of deregulation and liberalization surged over countries' electric power sector in the late 20$^{th}$ Century. Those market models are, in most countries, formed by a combination of the concepts *power pool*, *bilateral contracts* over the short & long terms, *power exchange* ("PX," or spot trading), and *power derivatives* (primarily financial transactions).

It would be difficult for a paper such as this to address all the issues facing countries that are even yet seeking solutions, yet several important points can be made about deregulation. This chapter introduces four fairly typical market models operating in the United States and Europe, where the most aggressive structural changes are now occurring. For each market, endemic characteristics and problems encountered are outlined to suggest what may have happened and how countries have dealt with the challenges introduced by competition. The various markets have their own unique cultural and economic backgrounds and problems, so no clear solutions for other countries embarking on deregulating their electric power sector may seem to be indicated. I believe, however, that analyzing the more mature markets' various issues offers understanding, providing countries such as Japan that are contemplating a move toward deregulation a better view of what might be expected from such a change.

## 1.1. California

### 1.1.a. Legislative Background[5]

The first legislation to open the door to wholesale market deregulation of the electric power sector in the United States was the Public Utility Regulatory Policies Act (PURPA) of 1978. The act is well known for creating a new category of power supplier, the *qualifying facility* (QF), promoting the supply of power from non-utilities, especially through cogeneration and renewable energy sources. After PURPA took effect, host utilities were required to purchase power supplies from qualifying facilities at avoidable cost and to integrate them into their incumbent systems.

But the regulations that substantially opened the market and expanded competition at the wholesale level were Orders 888 and 889, issued by the Federal Energy Regulatory Commission (FERC) on April 24th, 1996. These regulations put into effect the Energy Policy Act (EPACT) of 1992, which accelerated the deregulation that had been launched by PURPA.[6] Order 888 required transmission owners to provide third parties access to their transmission network at cost-based maximum prices and under nondiscriminatory terms and conditions,[7] through their own Open Access Transmission Tariff (OATT). To support implementation of Order 888, Order 889 was issued simultaneously, requiring all investor-owned utilities (IOUs) to participate in the Open Access Same-Time Information System (OASIS), an Internet-based database system.

On the basis of FERC Order 888, California enthusiastically and aggressively moved to restructure its electric utility industry. After several years of study under the direction of the California Public Utility Commission (CPUC), Assembly Bill 1890 (AB 1890) was enacted in California on September 23rd, 1996.[8] To implement competition in an electricity market system within the state, AB 1890 established a four-year transition period, then launched retail competition, allowing customers to shop for electric power in an open market as of March 31st, 1998. Since then, independent power producers (IPPs), out-of-state utilities, and others have competed as energy service providers (ESPs).

AB 1890 also allowed stranded costs to be recovered through competition transition charges (CTC) by adding to the Public Utilities Code a Section 368, which requires utilities to propose cost-recovery plans to the

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[5] This description is based on Department of Energy, Energy Information Administration (DOE/EIA) (2000a) and Joskow (2000), pp.79–91.
[6] Brennan *et al* (1996), p.31.
[7] Joskow (2000), p.28.
[8] The following detailed description of AB 1890 is based on the California Energy Commission (1998), pp.10–13.

Public Utilities Commission (PUC) and directs the PUC to authorize such plans if certain criteria are met. At the same time, AB 1890 ordered the retail rates of regulated IOUs for industrial, large commercial, and agricultural customers to be frozen at the 1996 level. As for small commercial and residential customers, rates were reduced by 10 percent, where they were to remain until March 31, 2002, at the latest.

Through AB 1890 also, California's three largest IOUs were required to divest their fossil-fuel generation assets to mitigate their market power. As a result, a large number of generation plants were sold, with a capacity of 20,187 MW. [9]

### 1.1.b. Market Structure[10]

While the California electricity market was still regulated, it was monopolized by the three largest IOUs: Pacific Gas and Electric Co. (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric Co. (SDG&E), which are vertically integrated and regionally franchised. The primary goal for CPUC when issuing AB 1890 to achieve full competition in the market was to mitigate the monopolistic market power of the three largest IOUs, vertically or horizontally, providing new market players equal opportunities to capture customers for their electricity supplies. Now, California's IOUs (PG&E, SCE, SDG&E) are local utility distribution companies (UDCs). The UDCs continue to provide regulated distribution service, but no longer control their transmission systems.

#### ***Power exchange***[11]

To achieve its intended goal, described above, CPUC adopted a new market system that borrows heavily from the United Kingdom's "pool model." Under this system, the wholesale market in California consisted mainly of spot electricity trading through the California Power Exchange Market (CalPX) and a bilateral contracting market that was managed by scheduling coordinators (SCs). To encourage spot trading as well as bilateral contracts-based trading, a single-state-based PX market called the Western Electric Power Exchange (WEPEX) was formed. Unlike the United Kingdom's pool model, the state of California detached functions of this generation spot market system from the California ISO (Ca-ISO) grid operation, and WEPEX handled the wholesale power spot market on a day-ahead basis only. Although new entrants were allowed bilateral contracts,

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[9] This capacity figure was taken from <http://www.energy.ca.gov/electricity/divestiture.html>.

[10] The following description is based on Philipson and Willis (1998), the Ca-ISO web site, and the California Power Exchange web site.

[11] The CalPX ceased to exist in December 2000. This section describes how it operated prior to that time.

the three largest UDCs were mandated by AB 1890 to both sell all their non-fossil-fuel generated power and to make all their power purchases through the newly created Power Exchange (PX) during a four-year transition period ending March 31, 2002.[12]

CalPX managed two exchange-based "spot" markets. As of fall 1999, approximately 70 entities from the United States and Canada were certified to trade through CalPX. In the Day-Ahead Market, participants bid supply and demand for the next day's 24 hours. The Day-ahead Market started at 6 a.m. the day ahead of trading day, and closed at 1 p.m. the day ahead of trading day, when the ISO issued the final day-ahead schedule. The second CalPX market was the Day-of Market (originally introduced as the Hour-ahead Market). This market permitted participants to conduct energy transactions nearer to the delivery hour, when generation and energy use conditions may require changes in trading positions. The Day-of Market included 24 auctions conducted in three batches during the course of a day—at 6 a.m., noon, and 4 p.m.[13]

***Independent system operator***

At the same time CalPX was established, the California Independent System Operator (Ca-ISO), a fully independent, non-profit entity, was established to better ensure a reliable transmission network and mitigate any vertical market power exerted by the IOUs. Unencumbered by asset ownership, the ISO assumed from the transmission owners oversight of the power grid's operations and responsibility for the transmission network's reliability, and offered all potential market players equal access to the power grid. Under ISO, three types of supplemental open-competition markets help to maintain reliability of the grid:  a Real-Time Imbalance Market, an Ancillary Service Market[14], and a Congestion Management Market the last of which allocates physical power transmission to the various users to mitigate congestion.[15]

The ISO establishes protocols to certify parties as SCs, which are responsible for submitting schedules to the ISO for all buyers and sellers. Each market participant using the grid is required to designate a scheduling coordinator; prior to December 2000, the PX was the designated scheduling coordinator for the UDCs.

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[12] To deal with the energy crisis, in December 2000, FERC ordered remedies for California wholesale power markets, which eliminated the mandatory requirement that UDCs transact all the electricity through the CalPX.

[13] The California Power Exchange White Paper, "The Basics: How the CalPX Works," December 1996, is also available at the web site of CalPX, <http://www.calpx.com/news/publications/index.htm>.

[14] There are four types of competitive, auction-based markets: regulation, spinning reserves, non-spinning reserves, and replacement reserves.

[15] To facilitate this allocation, the Cal ISO accepts "adjustment bids" a day ahead and an hour ahead of when electricity is consumed. In the case that market participants do not make sufficient bids, congestion charge would be levied as long as the situation of the scheduled heavy use over the transmission capacity continues.

One distinguishing feature of California's electric power market is that the system operator is completely separate from the PX market function. This system differs from that in other market areas such as Pennsylvania–New Jersey–Maryland Interconnection (PJM), as it was reached through political compromise and regulatory necessity rather than through agreements among market participants and regulatory authorities.[16] A simplification of California's market structure is shown in Figure 1.

***Transmission pricing methodology***

The Ca-ISO has adopted a "postage stamp" approach, with twenty-four adjustable congestion zones, as its pricing method to manage congestion. In an unconstrained situation, all congestion zones have the same rate without zonal charges. During congested periods, established prices within each zone supersede CalPX's unconstrained market clearing price (UMCP), which is based on the aggregated energy supply and demand curves' point of intersection for each hour.

[16] Economic Insight, Inc. (2000).

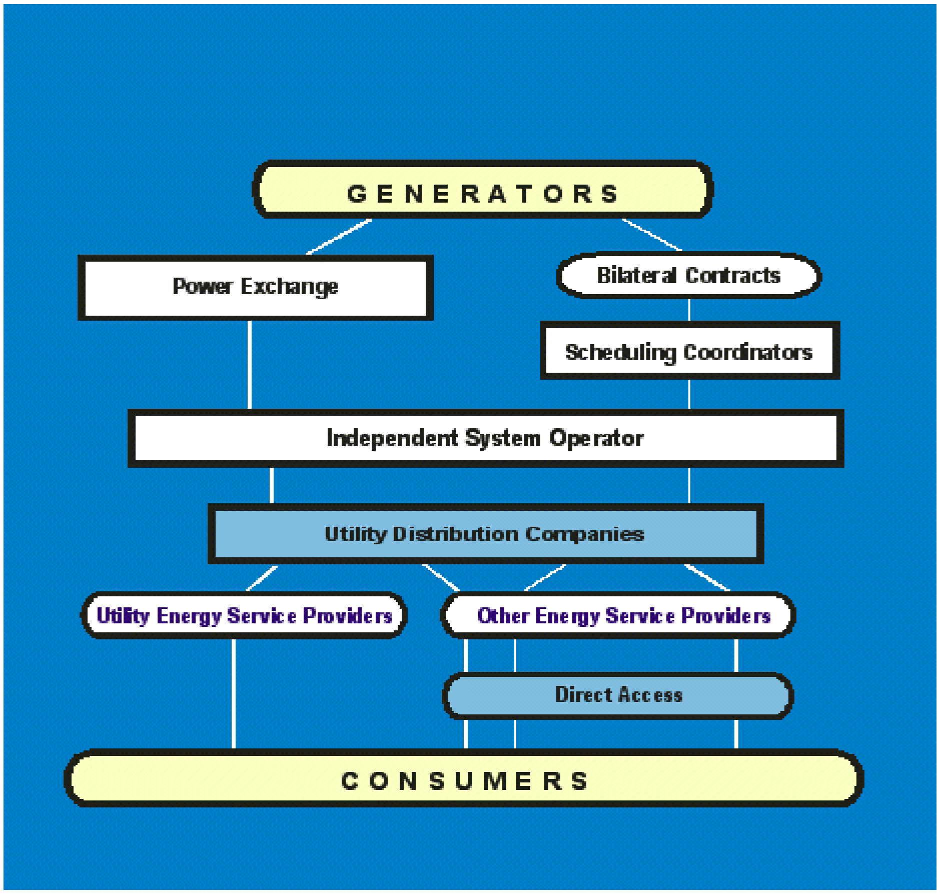


**Figure 1. California's competitive electricity market structure**

*Source: http://www.eia.doe.gov/cneaf/electricity/epav1/fig12.html*

### 1.1.c. California's Energy Crisis: The Demise of Deregulation?

Turmoil in the California electricity market began in May 2000. During the summer, a series of misfortunes, including a heat wave, sharp economic growth, gas price spikes, and a water shortage struck California simultaneously in the "Perfect Storm," and the wholesale price of electricity has remained abnormally high. Northern California has suffered periods of rolling blackouts because of serious energy shortages. California's UDCs have also struggled against sizable gaps between retail rates frozen at low prices and high wholesale prices; an especially serious case precipitated the bankruptcy of one UDC in April 2001.

Since many other papers offer explanations of what has been happening in the California market, I do not detail the facts here. However, for countries that have recently introduced the California system of deregulation or that are on the verge of doing so, the reason why the California system collapsed should be seriously considered as a case study, not simply unwelcome news. Is the California system clearly doomed to fail? Does this case portend the demise of deregulation? If not, what should we learn from the crisis?

As already mentioned, California's energy crisis may have been precipitated by the confluence of several very inopportune circumstances; alternatively, the crisis may have been inevitable because of a fatal flaw in the market system. California's energy crisis has, in fact, been linked to three fundamental causes: 1) deficient generating capacity, 2) a market system that does not permit enough forward market trading to manage the risks of supply and demand, and 3) insufficient customer response to high prices.[17] Among these factors, California's energy-deficient market, generating only 75% of the total capacity of electricity consumed, is especially crucial: In the words of Wilson (2001), "in real world electricity market, when supplies are tight, conditions are often not competitive, and bids and prices are typically very high."[18] In other words, given adequate supply, a market becomes competitive to some degree, no matter what sort of system is employed.

Besides the insufficiency of California's energy generation, inconsistent price regulation must be considered another failure of the California system. Since wholesale prices are regulated with price caps while retail rates remained frozen, price signals weren't sent properly to customers, severely limiting the function of the market mechanism. To make matters worse, the UDCs whose retail rates were frozen suffered an intolerable rate gap with wholesale prices, to the point of insolvency. Some electric power suppliers chose not to supply power to these unfortunate UDCs for fear of non-payment, essentially pouring oil on the flames of California's energy deficit.

As a consequence, California's case is not proof that an electric utility industry cannot adjust to deregulation policy. Rather, this crisis has had endemic causes. Deregulation can succeed only in a properly functioning market, one in which market signals are correctly reflected to both suppliers and consumers, the electricity supply is sufficient to meet demand, and the system can be expected to operate reliably.

[17] DOE/EIA (2000a).
[18] Wilson (2001).

### 1.2. Pennsylvania–New Jersey–Maryland Interconnection L.L.C.(PJM)

### 1.2.a. Brief History of PJM and Pennsylvania Legislation[19]

PJM was formed by three companies in 1927 as the world's first power pool. It has evolved over seven decades on a "tight" power pool model, functioning as one control area[20]. In July 1993, the PJM Interconnection Association was established under the administration of the PECO Energy Company (PECO). In July 1996, soon after FERC Order 888 was issued, a majority of the member companies (called the "Supporting Companies"[21] of the Association) filed interconnection agreements and a transmission tariff with FERC to restructure PJM, establishing a new competitive wholesale electricity market. The agreement specified that the Association would function as the ISO.

In April 1997, the PJM Interconnection Association became a limited-liability company, offering membership to all participants in the wholesale electricity industry and at the same time implementing Open Access Transmission Tariff (OATT) to begin operating the first bid-based electricity market in the United States. On November 25th, 1997, a restructuring plan of PJM as revised in July 1997, describing PJM as an ISO and manager of OATT, was approved by FERC.[22] Becoming operational in January 1998, PJM-ISO became the first full-service and fully functioning ISO in the United States. In May 1999, it implemented the Fixed Transmission Rights (FTR) Auction.

Like California and Massachusetts, Pennsylvania, with the largest number of customers in the PJM operating area, "falls into the camp of relatively high-priced States that have been somewhat aggressive in restructuring".[23] In December 1996, Pennsylvania enacted HB 1509, called the "Electricity Generation Customer Choice and Competition Act." The Act froze rates as of January 1997 and phased-in retail customer choice, such that 33% of customers could choose their electricity supplier by January 1998, another 33% could do so by January 1999, and the remaining 34% could do so by January 2000. All customers in Pennsylvania can now choose their generators and expect to realize savings of more than 10% of what they paid in the past.

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[19] The following description is based on PJM Annual Report (1997, 1998, and 1999), PJM training materials, DOE/EIA (2000a), pp.88-89, Mansur (2001), and Williams (1997).
[20] For the definition of "tight" and "loose" power pool, see <http://www.ncouncil.org/pubs/pool.html>
[21] Supporting Companies comprise the following: Atlantic City Electric Company (Atlantic City Electric), Baltimore Gas and Electric Company (BG&E), Delmarva Power & Light Company (Delmarva), Pennsylvania Power & Light Company (PP&L), Potomac Electric Power Company (PEPCO), Public Service Electric and Gas Company (PSE&G), and GPU, Inc. (GPU, which consists of Jersey Central Power & Light Company (JCP&L), Metropolitan Edison Company (Met Ed), and Pennsylvania Electric Company (Penelec)).
[22] PJM-OATT was most recently amended and approved by FERC on March 1st, 2000.
[23] DOE/EIA (2000a), p.88.

This retail-level restructuring took place first in Pennsylvania, then in Delaware, New Jersey, and Maryland, consecutively.

In terms of stranded-cost recovery, the PUC is authorized to determine the level of stranded costs that each utility is permitted to recover. The PUC set a maximum period of nine –years for CTC collection, also permitting PUC approval of an alternative time frame, in contrast to the four-year period set in California.

### 1.2.b. Market Overview

PJM is the oldest and largest centrally dispatched "tight" power pool in the United States, and the third largest in the world, with a pooled generating capacity of over 57,000 megawatts transmitted over an 8,000-mile extra high voltage (EHV) transmission network. Geographically, it supplies electricity to Pennsylvania, Maryland, New Jersey, Virginia, Delaware, and the District of Columbia, and handles approximately 8% of the country's electric power, via a centralized market. It is unique in that only one control area (containing six-state jurisdictions) falls in a region served by the North American Electric Reliability Council (NERC).

PJM adopted a sort of Poolco system, with functions of both ISO and PX combined, unlike Ca-ISO, because "the pool infrastructure to operate a competitive energy market already exists here and the separation proposed would be inherently less efficient and reliable".[24] PJM comprises four markets: a capacity credits market (CCM), an energy market, a financial transmission entitlements market, and an ancillary services market.

#### *Capacity credits market (CCM)*[25]

Capacity obligations play a critical role in both maintaining reliability and contributing to the PJM energy market's effective, competitive functioning. Capacity obligations require load-serving entities (LSE)[26] to purchase sufficient capacity resources to cover their peak load plus a reserve margin to better ensure system reliability. Retail restructuring allowed new market entrants to compete against incumbent utilities if the new entrants can offer sufficient capacity to meet loads gained through the competitive process.[27] Incumbent utilities must sell capacity that is no longer need if any of their loads are lost to new competitors. The PJM

[24] Williams (1997).
[25] The following description is based on Bowring and Gramlich (2000) and Stoft (2000).
[26] An LSE is any utility that sells power at retail to loads within the PJM control area.
[27] According to Bowring and Gramlich (2000), capacity resources may be obtained in three ways: by building or purchasing generation assets, through the bilateral market, and through the PJM CCM.

CCM balances capacity supply and demand not met by the bilateral market or self-supply.

***Energy market***

PJM adopts various flexible options for physical energy transactions, supported by a variety of financial contracts separate from the physical market. PJM energy markets combine a bilateral contracting market, physical spot market, and financial energy contracting market. In PJM markets, most electricity is supplied by vertically integrated utilities as self-supplied energy (about 55%) and through bilateral trading (30%). LSEs meet only 10 to 15 percent of demand in the spot markets[28], while CPUC in California, in contrast, requires all UDCs' electricity purchases to be made through the PX market.

PJM also differs from California's market by permitting forward transactions to any of its market players. Such transactions occur through the New York Mercantile Exchange. And to enhance the robust, competitive market in the PJM control area, two settlement markets are provided: a Day-ahead Market, based on scheduled hourly quantities and day-ahead hourly prices, and a Real-time Energy Market that is based on actual hourly quantity deviations from the day-ahead scheduled hourly quantities and real-time prices.

***Financial transmission entitlements market***

PJM introduced an auction-based Financial Transmission Rights (FTRs) market on May 1st, 1999. To protect "firm" transmission customers from increased costs due to transmission congestion, PJM established the FTR, a financial contract entitling the holder to a stream of revenues based on the hourly energy price differences across the path of transmission.

***Ancillary services market***

In the PJM area, only a frequency regulation market has been implemented as an ancillary service since June 1st, 2000. Unlike the case in California, market interactions for ancillary services have not yet been determined for the PJM area. PJM is responsible for such other services as real-time imbalance settlement and voltage control.

### 1.2.c. Pricing Methodology in the PJM Control Area

Locational marginal pricing (LMP), also known as locationally based marginal pricing (LBMP), is the

[28] Market Monitoring Unit (2000).

pricing method adopted by PJM. LMP determines the marginal cost of supplying the next increment of electricity demand at a specific location (node) on the electric power network, taking into account both generation marginal cost and the transmission system's physical aspects. Thus, the PJM energy market can include thousands of different locational prices at a given time. PJM LMP is calculated by the following formula:

- LMP = marginal cost (MC) + transmission congestion cost (TCC)[29]

Under unconstrained conditions, the price of energy in bilateral contracts can be determined by simply charging a flat transmission fee on the generation charge. In the spot market, the LMP equals the bid price of the highest increment of generation that is requested for operation.[30]

### 1.2.d. Is PJM the Most Successful Electricity Market?

The biggest state within the PJM control area, Pennsylvania, was ranked No.1 in the nation for the success of electricity deregulation on 7th February 2001. More than a little credit is due to its well-functioning PJM grid operator. Because of PJM, the market has worked well and phase-in to customer choice has been implemented successfully.

PJM is now considered to be one of the best competitive electricity markets in the world. The Herfindahl-Hirschman Index (HHI) of only 1,124 suggests that a good, homogeneous market containing several firms of similar size is unlikely to exhibit market power[31]; remarkably, the six largest utilities in PJM account for only ten to twenty percent of the market's capacity. Furthermore, as represented by Pennsylvania PUC, PJM is confident that its area will not suffer from a severe energy crisis analogous to that in California because PJM holds much more electricity capacity than is consumed, states in the PJM control area were not required to divest their generation assets, and participating utilities are not prohibited from committing to long-term contracts. This very positive situation enabled PUC Chairman John M. Quain to say, "Before electric choice, Pennsylvania electric rates were 15 percent above the national average, and now our rates are 4.4 percent below the national average. And state government is saving taxpayers money, too, by shopping for power."

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29 Strictly speaking, the cost of marginal loss (COML) must be added to (MC + TCC), but this is not currently implemented.
30 Vactor (2000).
31 Mansur (2001).

However, a few points must be kept in mind. According to Market Monitoring Units (MMU) (2000), LMP increased between 1997 and 1999. Tables 1, 2, and 3 show that LMP did increase slightly. After careful analysis, MMU concluded that scarcity could be responsible for some of this price increase, but market power also played a part; the relative proportions of these two factors are unclear.[32] Regarding market power, Dalton (1997) observed that frequent auctions for a homogeneous product under similar demand and supply conditions tend to facilitate collusion. The present case shows that price spikes caused by either scarcity or market power may occur even in PJM markets. The MMU data also suggests that some firms may have exercised market power to raise the price of electricity.

Generally eastern markets, especially PJM, are said to be successful. PJM, however, may only "have had better luck than California with regard to demand growth, fuel mix, and capacity availability. …all of these regions now face a potentially tight supply situation during the peak summer season this year."[33] Awarding PJM a blue ribbon at this point may thus be premature. In fact, PJM still experiences problems with market power and price spikes on its spot market. I think that taking a little more time to gather data is warranted to determine whether PJM markets are truly successful.

**Table 1. Average Daily LMP Summary Statistics ($/MWh)**

*Source: MMU (2000)*

| | Summer 1997 (MCP)* | Summer 1998 (LMP) | Summer 1999 (LMP) |
|---|---|---|---|
| Average LMP | 23.08 | 29.65 | 53.69 |
| Median LMP | 17.25 | 20.40 | 22.78 |
| Standard deviation | 17.89 | 58.99 | 140.33 |

* MCP = market clearing price

**Table 2. April-March, 1998-1999 and 1999-2000 LMPs ($/MWh)**

*Source: MMU (2000)*

| | 1998–1999 | 1999–2000 | % Increase |
|---|---|---|---|
| Average LMP | 22.04 | 29.53 | 33.99 |
| Median LMP | 16.93 | 18.37 | 8.49 |

32 MMU (2000), p.18.
33 Joskow (2001).

| | | | |
|---|---|---|---|
| Standard deviation | 31.38 | 72.64 | 131.52 |

**Table 3. April–March, 1998–1999 and 1999–2000 Fuel Cost Adjusted LMPs ($/MWh)**

*Source: MMU (2000)*

| | 1998–1999 | 1999–2000 | % Increase |
|---|---|---|---|
| Average LMP | 22.04 | 28.64 | 29.95 |
| Median LMP | 16.93 | 17.37 | 2.57 |
| Standard deviation | 31.38 | 74.30 | 136.79 |

### 1.3. United Kingdom: England and Wales

### 1.3.a. From an Era of Nationalization to Privatization[34]

Restructuring of the electric power sector in the United Kingdom (UK) is explained in the context of the UK's overall privatization of national enterprises. Privatization was carried out during Prime Minister Margaret Thatcher's conservative administrations, as part of the economic policy to introduce competition to the electricity market and simultaneously minimize the role of government in the national economy.

The regulatory reform itself as well as the process of nationalizing, privatizing, and then introducing major reforms to the electric utility industry in the UK—especially in England and Wales, in this case—offer quite an interesting model for deregulation. Not only was the UK the first country to privatize its electricity industry, but it has also become one of the most aggressive and ambitious countries in the world, in terms of restructuring. In fact, several countries in Latin America and Australia have followed the UK's example.

In 1882, the UK's electric utility industry commenced operations under the Electricity Lighting Act. In 1889, through an expansion of the 1882 Act, the first legislative framework was constructed for an electricity supply business intended for customers in a specific region. The UK government passed the resultant Electricity Act in 1926, establishing the central government's authority in electricity matters through a Central Electricity Board (CEB). The Act required the CEB to build and operate a national transmission grid to coordinate a nationwide transmission network and establish a set of common technological standards.

In 1947, a national electric power utility was founded to integrate the electric utility industries in England, Wales, and South Scotland under the Labor administration, and the British Electricity Authority assumed responsibility for generation and transmission. Distribution was controlled and managed by 12 semi-autonomous regional distribution boards (area boards) in England and Wales, two vertically integrated companies in Scotland, and one vertically integrated company in Northern Ireland. To expand the role of central government in electricity, the Electricity Act of 1957 was enacted, establishing the Central Electricity Generating Board (CEGB). The act created a firm foundation for government initiatives in the electric utility industry that lasted over thirty years.

The Electricity Act of 1983 opened the central electricity grid to IPPs, and became the first step to privatizing and restructuring the electric utility industry in the UK, functioning similarly to PURPA (1978) in

[34] The descriptions in Sections a and b are based on Philipson and Willis (1998), pp.319–324, Thomas (1997), Newburry and Green (1996), Bergman et al. (1999), pp.89–115, Yajima (1998), pp.50–63, JEPIC (1991, 1993, and 1998), EIA (1997), and Electricity Association (2001).

the United States. The act obliged CEGB to open the transmission network to private generators and purchase electricity from self-generators, but proved unsuccessful in opening the market.

Six years after the Act of 1983, the Electricity Act of 1989 was enacted, implementing full-scale privatization. By this Act, CEGB was split into four companies: the National Grid Company (NGC), PowerGen, National Power, and Nuclear Electric; the 12 area boards also became regional electricity companies (RECs). Among these new companies, transmission facilities and functional operation of the grid were transferred to NGC; generation assets were transferred to the other three firms. The Office of Energy Regulation (OFFER) was organized as the UK electricity industry regulator in April 1990, to perform functions analogous to FERC and states' PUCs in the United States.

On January 1st, 1999, the roles of OFFER and the Office of Gas Supply merged in the formation of the Office of Gas and Electric Markets (Ofgem). Under the new authority, the New Electricity Trading Arrangements (NETA) were adopted, fundamentally changing the wholesale trading of electricity in England and Wales to promote competition so that lower prices might prevail. The NETA went live on 27th March 2001.

### 1.3.b. Power Pool Model after the Electricity Act of 1989

The creation of a "power pool" system was the most significant institutional change made in the UK. The UK's form of restructuring differs fundamentally from that observed in the United States in terms of "privatization." The focus in California or in PJM is on the efficient separation of the generation and transmission functions or of the transmission and distribution functions; assets are vertically owned by private entities, in most cases. In contrast, the UK government (under the Thatcher administration) was able to draw up a blueprint for a new structure on a clean slate through its process of privatization. The administration decided

**Table 4. Components in the UK's Electric Utility Industry**

*Source: Thomas (1997) p.42*

to completely separate ownership of generation, transmission, and distribution, and to form a "pool

| | Before privatization | After privatization |
|---|---|---|
| Generation | CEGB, imports | National Power<br>PowerGen<br>Nuclear Electric<br>IPPs |
| Dispatching | CEGB | The Pool |

| Transmission | CEGB | NGC |
|---|---|---|
| Distribution and supply | 12 area boards | 12 RECs<br>Licensed generators*<br>Other licensed suppliers* |

* Licensed generators and other licensed suppliers are allowed only for non-franchised supply.

system," operated by the nationwide, privately owned transmission company, NGC.

Under the Act of 1989, as a competitive market was being created at the wholesale level, generating assets of CEGB were transferred to three established generators: National Power, PowerGen, and Nuclear Electric. Forty conventional generating plants with a combined capacity of 30 GW were transferred to National Power, and another 23 stations with 20 GW of capacity were transferred to PowerGen. Twelve nuclear power stations were transferred to Nuclear Electric, and the high-tension grid plus 2 GW of pumped storage generation plants were transferred to NGC. These four companies became public limited companies on 31st March 1990 as the first step for wholesale trading to become feasible in the UK.

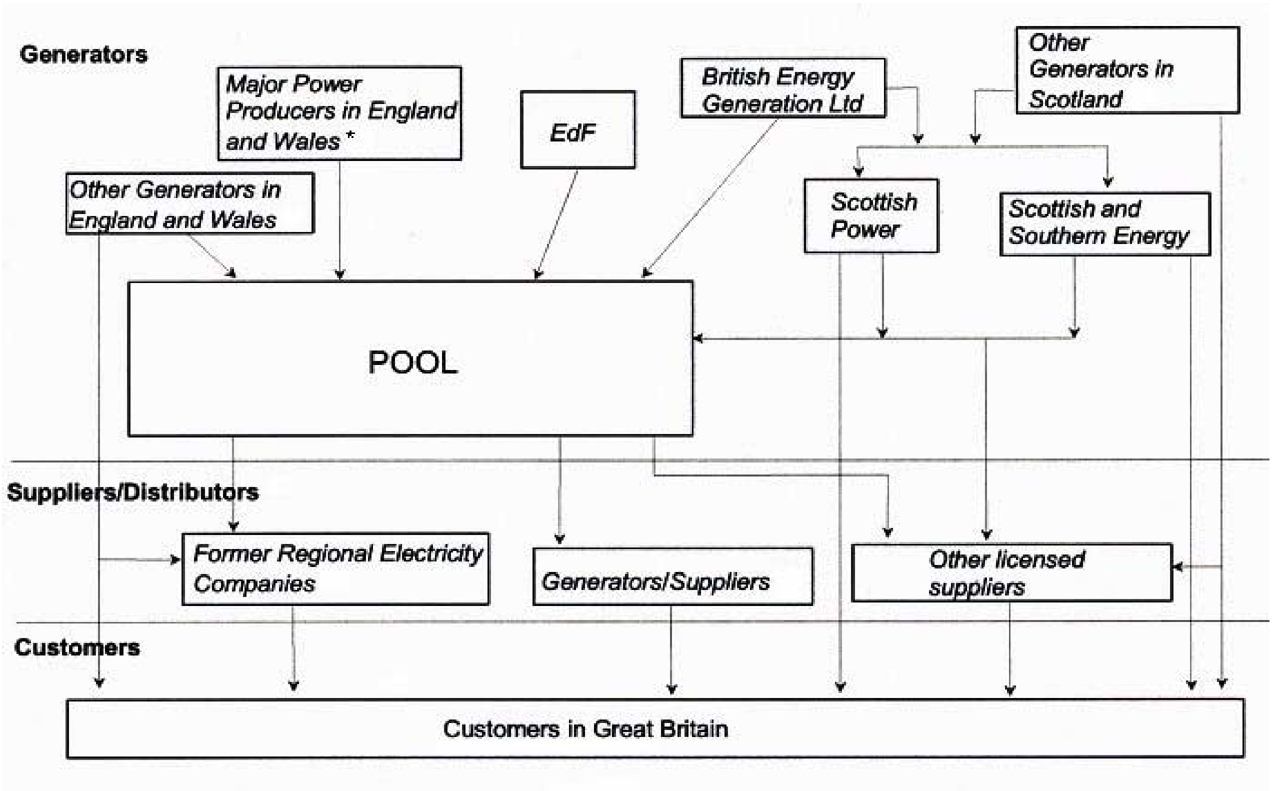
The Act of 1989 requires every electric power supplier to obtain a license to provide service. Generation licenses were given to National Power and PowerGen. Nuclear Electric holds a license that is more specific in terms of safety, and IPPs obtain individual licenses. Licenses were also provided for transmission companies and NGC; public electricity supply (PES) licenses were made available for RECs, and second-tier (private electricity service) licenses were made available to other suppliers within authorized PES areas.[35]

One remarkable point should be made, about the UK market's "mandatory pool" system run by the NGC: the so-called "Poolco system." All generators whose capacity exceeds 100 megawatts are required to submit their generation units for dispatch by the NGC, but there is no demand-side bidding. Following the demand forecast calculated by Poolco operators from load forecasts made by the RECs, generators bid competitively on a day-ahead, non-discriminatory auction basis. Bidding is managed by NGC's GOAL program, which sets the price as the market-clearing price (MCP)—the cost per kilowatt-hour of the final bid taken.

[35] Bergman *et al.* (1999), p.103.

Great Britain's electricity market structure under the pool system is shown schematically in Figure 2.

### 1.3.c. Pricing Mechanism in the Pool




* Major power producers at the end of 1999 were: AES Electric Ltd., Anglian Power Generation, Barking Power Ltd., BNFL Magnox, Coolkeeragh Power Ltd, Corby Power Ltd, Derwent Co-generation Ltd, Edison, Mission Energy Ltd, Fellside Heat and Power Ltd, Fibrogen Ltd, Fibropower Ltd, Fibrothetford Ltd, Fife Power Ltd, Humber Power Ltd, Lakeland Power Ltd, Medway Power Ltd., Midlands Power (UK) Ltd, National Power plc, NIGEN, Nuclear Electric, Peterborough Power Ltd, PowerGen plc, Premier Power Ltd, Regional Power Generators Ltd, Rocksavage Power Company Ltd, Sita Tyre Recycling Ltd, Scottish Power plc, Scottish and Southern Energy plc, Seabank Power Ltd, SELCHP Ltd, South Western Electricity, Sutton Bridge Power Ltd, Teesside Power Ltd, and TXU Europe Power Ltd.

**Figure 2. Structure of the electricity industry in the UK (including Scotland)**
*Source: Digest of UK Energy Statistics, Chapter 5, online, http://www.dti.gov.uk/EPA/05.pdf*

The MCP, in other words, might be considered to be the electric industry's marginal cost, or system marginal price (SMP), as given by the bid amount for a marginal unit in an unconstrained schedule. On the basis of the SMP, the Pool purchase price (PPP) at which the Pool buys power from generators is determined. The actual PPP is calculated with some consideration for the value of lost load (VOLL) and the loss of load probability (LOLP) in addition to SMP,[36] to take into account financial incentives for preserving peak load

[36] The VOLL attempts to measure the system cost of not producing enough electricity to meet peak load. The LOLP simply

capacity in the event that actual consumption exceeds demand forecasts. Generally speaking, the price paid to generators, or pool input price (PIP), can be calculated as SMP + {VOLL × LOLP − max(SMP, bid price)}. In contrast, the price paid by purchasers, or pool output price (POP), is equivalent to PIP plus incremental charges to cover ancillary services, demand forecasting error, transmission congestion, and marginal plant adjustments.

In the UK Pool system, "electricity prices in England and Wales electricity pool have proven to be very volatile and subject to manipulation."[37] Thus, to hedge the risk of price volatility, a contract for differences (CfD) method has developed. This market allows bilateral or multilateral contracts negotiated between generators and customers to settle the differences between contracted prices and actual prices of the time of trade, bypassing the pool market. Currently, most transactions are handled through this CfD method, solely through financial contracts. Therefore, the pool has "somewhat questionable value as an efficient price-setting mechanism."[38]

For retail pricing, the UK government rejected ratemaking on the basis of rate of return, adopting instead a sort of price cap regulation method, calculating the price cap as the retail price index minus expected future productivity gains, X: RPI − X.

### 1.3.d. Implementation of the New Electricity Trading Arrangement (NETA)[39]

From its inception, the UK's Poolco market system has exhibited some problems. For example, price cap regulation's employment of RPI − X as the transmission price control, as mentioned above, has stimulated much controversy, such as regarding which figure should be adopted for the X factor, or whether RPI is a suitable index for regulation. Joskow (2001) has identified two more problems: 1) wholesale prices have been excessive, associated with market power being exerted by the two largest generating companies created at the time of privatization, and 2) too few benefits have reached customers in the form of lower prices. Also, the single market allows no market-to-market basis competition.

To make the market more functional and competitive so that it reflects benefits properly to customers in a

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measures the probability that supply will be insufficient to meet demand at a particular point in time.
[37] DOE/EIA (1997).
[38] Brower (1997).
[39] The following description is based on Ofgen (2000) and Sweeting (2000).

transparent manner, avoiding market power, NETA went live on March 27, 2001. Under NETA, suppliers, purchasers, and probably marketers, too, can transact voluntarily, primarily through forwards and futures contracts in the absence of regulation except for the Balancing Settlement Code (BSC), which governs NETA's basic function as an imbalance settlement and Balancing Mechanism (BM). All generators, transmission companies, distribution companies, and other electricity service providers must sign up with the BSC to be BSC Parties licensed to offer service at each level. BSC is managed by a separate company, ELEXON.

***NETA Functions I: Imbalance Settlement***

Imbalance settlement is the procedure for pricing and settling surpluses and deficits between the contractual volume of generation (or demand) and the physical or metered volume of generation (or demand). It is not the process for pricing and settling bulk purchases and sales of electricity. Under NETA, all metered data is available on a half-hourly basis, so Imbalance Settlement also functions half-hourly. That is, imbalance volumes and prices are calculated every half hour, and settled daily.

The Imbalance Settlement comprises several basic concepts. *Gate Closure* is the time limit that occurs 3 1/2 hours prior to the start of every half hour of actual operation. *A Balancing Mechanism unit* (BM unit) is a basic operating unit participating in BM whose capacity exceeds 50MW. The *system operator* (SO) is that entity which is responsible for transmission operation.[40] *Initial Physical Notification* (IPN) and *Final Physical Notification* (FPN) are information to be communicated from BM units to the SO about the volume of operation proposed and the demand expected. In addition to IPN and FPN, BSC parties must submit contracted volumes to a *Central Settlement* (CS) through a single agent. This contract-based information notification system is termed *Energy Contract Volume Notification* (ECVN). The agent that submits such information to the central settlement on behalf of trading parties is the *Energy Contract Volume Notification Agent* (ECVNA), and the Central Settlement that accepts ECVN is the *Energy Contract Volume Aggregation Agent* (ECVAA).

Imbalance settlement proceeds as follows. By 11:00 a.m. the day before the half-hour of concern, BM units are required to submit IPN, providing the anticipated supply and demand volumes to the SO. Simultaneously, ECVN must be submitted to the ECVAA through the ECVNA. To ensure that the SO has

[40] According to Ofgen (2000), the system operator undertakes four activities that pertain to its responsibilities under the Balancing and Settlement Code: 1) accepting balancing mechanism actions to offset energy imbalances, 2) accepting balancing mechanism actions to accommodate transmission system requirements and limitations, and to facilitate the provision of ancillary services, 3) providing Balancing Mechanism data to the Balancing Mechanism Reporting System and Settlements, 4) installing metering to appropriate standards at the boundary between the transmission system concerned and an external transmission system.

locationally specific information identifying the total proposed volumes of operation and demand, as well as the proposed levels of generation and demand during a particular half hour, FPN is submitted with minute-by-minute profiles by Gate Closure. An Imbalance Settlement price is reached by comparing ECVN to the actual load or demand.

After Gate Closure, adjustment bids and offers are implemented to balance differences between FPN and any changes that are determined afterward. This procedure serves as the Balancing Mechanism (BM) to increase network reliability, as described below.

***NETA Functions II: Balancing Mechanism (BM)***

The Balancing Mechanism (BM) operates in a "pay-as-bid" (PAB) manner to adjust the levels of production by individual generators and of consumption, or demand. Even after FPN, generators or suppliers may wish to reduce or increase the volume level from that which was communicated to the SO. In this case, they can submit offers and bids to BM; offers indicate a willingness to increase the level of operation or reduce the demand, and bids indicate a willingness to reduce the level of generation or increase the level of demand. The SO may accept particular offers and bids placed by BM units in order to balance the national and local levels of generation and demand.

Balancing Mechanism units that cannot deliver the aggregated level of offers or bids will be subject to a non-delivery charge.

***Imbalance Charges***

Two types of imbalances are considered: information imbalances and energy imbalances.

An information imbalance is the difference between electricity usage as metered at the point of use and FPNs that are modified by offers and bids. An information imbalance charge is set to give BM units incentive to accurately meet the sum total of FPNs, offers, and bids; the charge is calculated based on the number of MWh of deficits or surpluses from modified FPNs during each half-hour period.

Energy imbalance is the net difference between all metered quantities of electricity and the volumes that had been contracted. Energy imbalance prices, which settle energy imbalance surpluses or deficits, may be one of two types: the *system buy price* (SBP) is charged for deficits so that BSC parties must pay; the *system sell price* (SSP) is charged for surpluses, so that BSC parties are paid.

### 1.3.e. UK Market Evaluation

The UK market model has attracted international attention, being the first dramatic attempt to restructure an electric utility industry. The pool system has generated tremendous interest and expectations, and many countries have adopted the model. Pool-based markets have spurred the installation of combined-cycle gas turbines (CCGT) by market entrants, and such technological improvements have contributed to reduced generation costs and better competition in the market. In some ways, the UK model has achieved the results desired from competition: "despite persistent market power problems, wholesale electricity prices have declined as the competitive wholesale market has matured over the last decade."[41]

However, one of the most serious factors obstructing fair competition in the pool system has been the existence of market power, exerted by National Power and Power Gen. The UK government has allowed these two utilities to hold a substantial number of critical generation assets, thereby enabling price-setting. Even though this problem has been identified in some papers, it has not been resolved, even after installation of the new trading arrangement, NETA. Especially in the pool, "the complexities of price formation gave the generators more market power than a normal commodity market."[42] Consequently, whether the NETA succeeds or not ultimately depends on whether an open marketplace can be set up that does not suffer from any sort of "market power."

## 1.4. Norwegian Market[43]

### 1.4.a. Electric Utility Industry Structures in Norway and Other Scandinavian Countries

The Scandinavian countries have formed quite well-functioning, effective electricity markets. With their abundant water resources, they have been able to deploy hundreds of low-cost hydropower plants to supply a great portion of their annual power demand. For these countries, especially Norway, hydropower resources are much more than either the power source at peak times or ancillary supplies. In Norway, hydropower plants account for almost 99 percent of the power generated.

Scandinavian markets in general (not just the Norwegian market) exhibit a unique character in ways beyond those stated above. These countries have formed highly cooperative markets, like those observed in

[41] Joskow (2000), p.106.
[42] Newbery (1999)
[43] The following description is based on Hjalmarsson (1996), Midttum (1997), Philipson and Willis (1998), Bergman et al. (1999), pp.117–146, JEPIC (1991, 1993, and 1998), the Nord Pool web site <http://el-ex.fi/eng99/thisis/thisis.html>, and the Norwegian Water Resources and Energy Directorate (NVE) (2000a, 2000b).

NORDEL, which was organized by the five countries of Sweden, Denmark, Norway, Finland and Iceland[44]. Since an undersea connection line joined Sweden and Denmark in 1915, the international transmission network has expanded widely over these five countries. It is also remarkable that government initiatives for deregulation have been very low-key, unlike in the UK and California, where regulatory authorities became strongly committed to deregulation. Most importantly, Scandinavian markets, especially that managed by NordPool, are quite liquid and flexible, although bilateral contracts can take the credit for much of this good result.

### 1.4.b. Norway's Major Electricity Reform in 1991

Norway's electric utility industry, before the Energy Act in 1991, consisted of many small municipal utilities and government- owned grid companies; many utilities held vertically integrated systems.

On 1st January 1991, the Energy Act was passed to introduce competition into the industry. The Act had three main objectives: 1) increase the industry's economic efficiency, 2) increase security of the nation's energy supply, and 3) equalize electricity prices nationwide. The Act required public utilities to be vertically unbundled without transferring their ownership to the private sector, and provided third parties open access to the transmission and distribution network ("third-party access," TPA).

As of 1992, Statkraft, the largest publicly owned utility, became a state-owned generating company; its former responsibility for grid operation and maintenance was assumed by a new vested "state limited liability" company, Statnett. Statnett now owns 70% of the Norwegian transmission grid, and also serves as system operator (SO). A natural monopoly remains in the network, but a foundation for complete competition has been laid in the generating and retail wheeling sectors.

### 1.4.c. Market Structure

The biggest issue in restructuring the Nordic electricity wholesale market may have been the creation of a pool market, Nord Pool ASA. Nord Pool ASA—The Nordic Power Exchange—is the world's only multinational exchange for trading electric power. Established in 1993, Nord Pool is owned by the two national grid companies, Statnett SF in Norway (50%) and Affärsverket Svenska Kraftnät in Sweden (50%).[45]

The Norwegian power pool was first established in 1971 as the result of five regional power pools

[44] Among NORDEL countries, Iceland solely forms one independent market.

[45] Nord Pool web site, <http://www.el-ex.fi/organisation/index.html>.

merging. During the initial period of deregulation under the Energy Act of 1991, transactions at the wholesale level were conducted mostly on a bilateral trading basis.[46] As deregulation proceeded, however, percolating through the whole industry after Statnett Marked was founded to operate the power exchange, Nord Pool was established as a multinational power exchange, a joint venture by the national grid companies of Norway and Sweden.

The Norwegian wholesale market structure contains some rather remarkable characteristics. First, transactions in the power exchange market are generally conducted in a fully voluntary manner by both suppliers and purchasers. Second, they have transmission congestion only occasionally, due to strong network fundamentals. Third, the market is wide open to neighboring countries, making transactions very liquid.

Nord Pool has five main markets: Elspot, Elbas, Eltermin, Eloption, and Elclearing. Because of these markets' circumstances, Nord Pool seems to be functioning quite well among European markets. Nord Pool independently operates the power exchange market, organizing both physical products—the power delivered physically under day-ahead or hourly-basis contracts—and financial products—the power trades in terms of risk management and hedging. Nord Pool also provides a clearing service, organizing the supplemental markets of physical and financial trading that control real-time balancing.

Operating in conjunction with the five markets operated by Nord Pool is an imbalance settlement market, the Regulating Power Market, managed by Statnett, the Norwegian grid operator. The various markets are briefly outlined below.

***Elspot Market***

The Elspot Market is Nord Pool's physical, day-ahead spot market, which operates on an hourly basis. To allow competitive bidding while avoiding a shortage of grid capacity, the market is usually divided into several areas geographically. Bids for purchases and sales must be met in each market zone. The market clearing price, in units of NOK/MWh, is calculated in each zone for each hour of the day ahead. The market's administration by zone in some ways resembles California's congestion-pricing mechanism.

***Elbas Market***

The Elbas Market is an hour-ahead market for hourly-based transactions conducted up to two hours prior

[46] About 70% of electricity sales are made through bilateral contracts.

to actual delivery. This market is operated by the Finnish Power Exchange, FLEX, and is based on an electronic trading system. Elbas has two market zones, in Finland and Sweden; Norway does not currently participate in this market.

***Eltermin Market***

Market participants can hedge their transaction's price risks up to three years ahead of delivery through the Eltermin Market. Eltermin provides financial (both forward and future) contracts; forward contracts are settled at the end of the contract period, while future contracts are settled daily. The Eltermin Market allows two types of physical contracts: one for base-load power, and the other for peak load.

***Eloption Market***

Nord Pool also provides option trading for power in financial markets. The Eloption Market derived from the Eltermin Market in 1999, and electric Power options traded at Eloption market include European-style options, with Futures Market forward contracts as underlying instruments, and Asian-style options, for which settlement depends on the Spot Market system price.

***Elclearing Market***

The Nordic Electricity Clearing (NEC) Market offers clearing services for contracts made in either the Elspot or the Eltermin Market, to reduce financial counterparts' risks. For clearing, Nord Pool serves as a broker in contracts to meet the buys and sells of trading contracts obtained from the Elspot and Eltermin markets, to clear the trading counterparts' contracts.

***Regulating Power Market***

The Regulating Power Market is operated by Statnett to cover unpredictable imbalances between actual generation and consumption demand at the time of use.

### 1.4.d. Transmission Pricing

In Norway, a demand-distance pricing method was adopted before restructuring went into effect. However, the old transmission pricing method was replaced by a "point-of-connection" system in most parts of the network (that is, a sort of “postage stamp” system based on nodal pricing). Under the postage stamp system, transmission owners must define connection points at which power trading takes place; tariffs charged at each connecting point are determined individually, reflecting only those costs that may be associated with an individual’s use of the network. Customers can therefore see and compare a particular node’s tariff, facilitating their choice of electric power companies with which to shop.

To set a tariff, four pieces of information are considered:  the energy charge (the cost of incremental network load), capacity charge (revenue collected in excess of that generated under normal operating conditions, through congestion management), connection charge (the estimated cost to maintain network reliability), and power charge (the cost of connected generation capacity net of load, or maximum load net of embedded generation).

## 1.5. Conclusions

While deregulation and liberalization have become worldwide trends for the 21st Century, the way to approaching them reflects the wide diversity of countries' circumstances, both politically and economically. For some countries, privatization of national electric power companies must be the top priority; for others, dissolution of generation assets, especially for privately owned and vertically integrated utilities, could be the major concern. Whenever governments have tried to deregulate their nations' electric power markets, whether in the United States, Europe, or elsewhere around the world, certain discussions have seemed inevitable, relating, for example, to functional unbundling (or "separation"), transmission pricing methodology, and market power.

Market power issues tend to be the toughest challenge facing electric power markets. Electric power markets have historically developed as people have come to accept the phenomenon of natural monopolies, and as centralized, vertically integrated electric utilities have arisen. The first step in creating a competitive electricity market should be to mitigate the market power exercised by specific electricity suppliers (which, in most cases, are incumbent utilities) by installing a new scheme for electric power transactions. From another angle, once deregulation is implemented to reduce electricity prices, companies usually work to maximize their own profits. In other words, deregulation simply gives companies incentive to profit through competition, and price reductions may result from such profit-maximizing behavior in competitive situations. As seen even in the four electricity markets that are considered in this paper, companies are strongly motivated by competition to exercise market power to survive in their markets. Therefore, new market mechanisms should be instituted with a watchful eye toward the possibility that market power may at some point be exercised.

The markets described in this chapter are all unique and, in some ways, well developed in terms of deregulation. However, no one would be able to offer with certainty a set of universally satisfactory solutions for the proposition of deregulating a given country's electric utility industry. Within each nation's own unique circumstances, regulatory authorities and market participants are now struggling to succeed in a competitive environment. To learn from their experience, careful analysis and evaluation are essential.

**Table 5. Comparison of Selected Restructured Systems**

| | Cal-ISO | PJM | England and Wales | Nord Pool |
|---|---|---|---|---|

| | | | Pool | NETA | |
|---|---|---|---|---|---|
| Regulatory authority | PUC and FERC | PUC and FERC | OFFER | Ofgen | NVE |
| System operation (SO) type | ISO and PX | a sort of Poolco | Poolco (NGC) | Poolco (NGC) | Poolco (Nord Pool) |
| SO organization | Nonprofit | Nonprofit | For-profit Private | For-profit Private | For-profit Public |
| Functional unbundling | Yes | Yes | Separation | Separation | Separation |
| Generation divestiture | Required | Not required, but strongly encouraged | Not required | Not required | Not required |
| Wholesale market | PX spot market & bilateral | PJM spot, bilateral, and financial energy markets | Mandatory pool | Negotiated spot market with balancing settlement | Spot, financial, imbalance, & bilateral markets |
| Buyers bidding | Yes | Yes | No | Yes | Yes |
| Operation of Centralized Power Market | Separate from ISO | Combined with ISO | Combined with ISO | Separated from ISO | Separated from ISO |
| Transmission pricing method | Postage stamp | LBMP | Zonal | Zonal | Postage stamp + LBMP |
| Congestion management | Zonal | LMBP | Contracts | Contracts | Zonal |

## 2. The Wholesale Electricity Market in Japan

For a long time, electricity supply by vertically integrated utilities having an exclusive franchise to different areas and the country has been commonly believed to be the most appropriate and effective system in Japan. Utilities have operated to achieve "economies of scale" in the franchised areas, and pricing regulation has been employed to offset the adverse effects of monopolistic and exclusive business practices. This "common-sense regulation" encouraged the establishment of gigantic firms called EPCOs. Under regulation, EPCOs have achieved their mission to provide high-quality, universal service, simultaneously supporting national energy security policy. So far, the highly regulated Japanese market system has worked quite well in some respects, suiting the orderly, tractable disposition of the Japanese people well.

However, as the Japanese economy has been increasingly buffeted by recent swirls of globalization, responding to global market competition has become unavoidable. Such regulated industries as oil, rail transportation, and telecommunication have had to restructure to rectify their high-cost structures, liquidating human resources and reducing disparities between domestic and foreign prices of commodities to compete internationally. No exception, the electric utility industry, too, is being exposed to world trends in restructuring. As a result, the Electric Utility Industry Law was revised in 1995, as described in Section 3.2..

As mentioned earlier, the purpose of the present report is to examine the appropriate goal of Japan's deregulation, especially at the wholesale level. Chapters 1 and 2 introduced the world's major market examples to bring specific controversial issues facing each market into sharp relief. Chapters 3, 4 and 5 offer some conclusions regarding Japan's wholesale deregulation, based on the earlier chapters' analysis. Japan might be considered to have a great advantage and opportunity in commencing its deregulation process at a time when much can be learned from so many forerunners' successes and errors.

This chapter is organized into two parts: the first two sections explain Japan's current market structure and legal situation, and the final two sections analyze the market. Following a discussion of the current Japanese market's primary issues, the chapter concludes by answering the question of whether Japan really needs to deregulate its energy sector.

### 3.1. Overview of the Current Japanese Market Structure

Japan's electric utility industry today comprises ten vertically integrated utilities (the electric power companies, or EPCOs), three wholesale utilities, and other wholesale electric suppliers, including independent power producers (IPPs).[47] The country is divided into ten regions (one being Okinawa Island), each of which provides one EPCO with a mandatory franchise for its electricity supplies (Figure 3). All transmission and distribution lines are owned by EPCOs, except for some transmission lines that are owned by the Electric Power Development Company, Ltd. (EPDC); thus, EPCOs are obligated to deliver all electricity generated to retail customers, no matter who generated it(Figure 2).

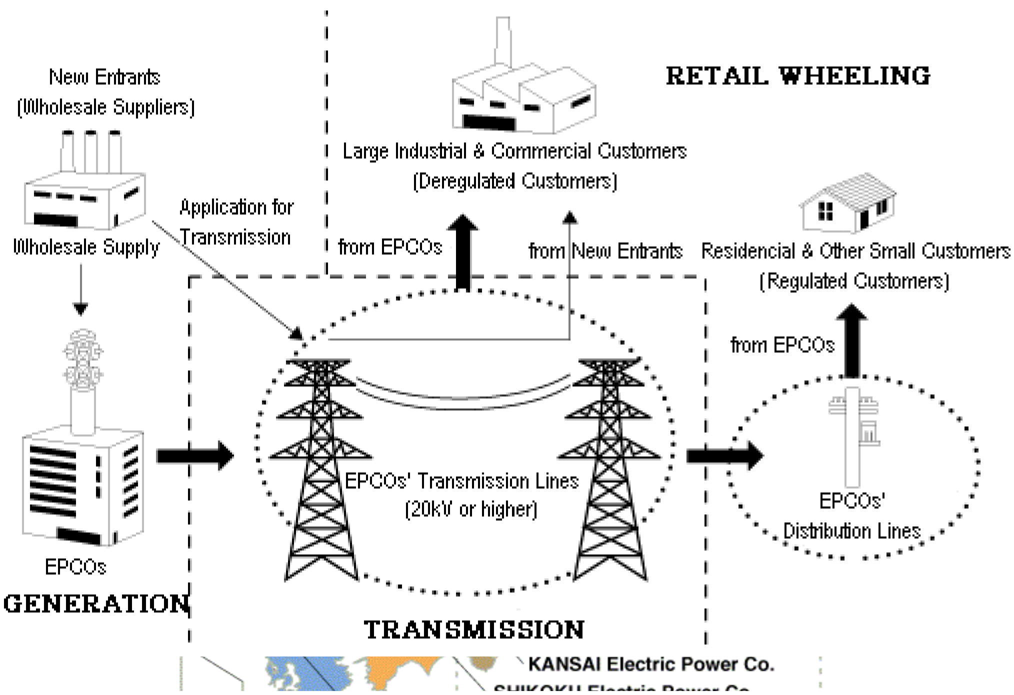


**Figure 4. Conceptual Map of Electricity Flow in Japan**
*Source: The Federation of Electric Power Companies Japan web site,*
*http://www.fepc.or.jp/ryoukin/index.html (Japanese only, translated by author)*

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*Source: The Federation of Electric Power Companies Japan web site,*
*http://www.fepc.or.jp/erj/chap02.html*

Since the 1995 revision of the Electric Utility Industry Law (hereafter, "the Law"), the number of IPPs in Japan has soared, and certain companies (e.g., in the steel and oil industries) that hold self-generating assets

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[47] According to the Electric Utility Industry Law, "wholesale utilities" are defined as regulated suppliers with 2,000Gw or more total assets' capacity. They are Electric Power Development Corporation (EPDC), Japan Atomic Power Company (JAPC), and Joh-etsu Cooperated Power Company. Other non-regulated wholesale suppliers are called "wholesale electric suppliers", including 19 joint-ventured thermal power companies, 34 municipal hydropower plants, and other independent power producers (IPPs).

have made wholesale contracts with EPCOs through competitive bidding. For four years, from 1995 through 1998, IPPs were awarded a total of 6,660 GW of wholesale supplies.[48] After the 1999 revision of the Law, in which direct access to large industrial customers[49] by non-EPCO generators was allowed, certain numbers of generators appeared as new market participants. Nine generators are now licensed for large industrial supply. Most of the total electricity supply, however—approximately 75%—still depends on the ten EPCOs, or "general electric utilities"; 13% of the remainder is covered by self-generators, 6% by wholesale utilities, and the final 6% by wholesale electric suppliers.[50]

### 3.2. Recent Regulatory Circumstances[51]

In 1995, substantial deregulation of the electric power sector began in Japan. The Electric Utility Industry Law was fundamentally revised for the first time in thirty years, since its issuance in 1964, to implement deregulation, creating a competitive market in the electric utility industry that would respond to the pressures for electricity price reductions that were being exerted by public opinion domestically in response to cheaper prices overseas. This revision was notable in three respects. First, licensing regulation on wholesale electric suppliers was removed to create a wholesale market, in principle, and widen the range of suppliers. A competitive bidding system was implemented for the first time, targeting newly installed, mid- and small-scale thermal power plants. EPCOs at first determined the amount of electricity that could be purchased from IPPs, then invited the IPPs to bid for the supply and finally signed long-term contracts with those suppliers who offered the lowest price per kilowatt-hour. Second, partial direct access to large industrial customers by the new category of supplier, "special electric utilities,"[52] was institutionalized. Third, the pricing system was switched from a cost-of-service ratemaking method to yardstick ratemaking, establishing incentives for EPCOs to reduce costs, and encouraging increased business efficiency.

While this legislative movement was proceeding, in July 1997, the Electric Utility Industry Council (EUIC), a consultative committee of the Ministry of International Trade and Industry, MITI (now the Ministry

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[48] Web site of The Federation of Electric Power Companies Japan, http://www.fepc.or.jp/ryoukin/kaisei.html.
[49] Large industrial customers defined as the customers receive electricity by more than 20,000V with more than 2,000kW of the maximum usage.
[50] Handbook of Japan's Electric Power Industry (1998)
[51] Description based on Agency of Natural Resources and Energy (1999) and Navarro (1996)
[52] Only generators with self-generation assets, who supply electricity to specific consumers under specific conditions (nearby location, financially related, no adverse effect on the general electric utilities business, etc.) are allowed direct access. These generators are called as special electric utilities.

of Economics, Trade and Industry, or METI), was organized under management of the Agency of Natural Resources and Energy, MITI's internal agency. The EUIC's goal was to achieve internationally competitive electricity prices by the end of the year 2001. Full public discussion facilitated by EUIC commenced in September 1997, and consensus was reached that all newly installed thermal power plants should be contracted only through a competitive bidding system by the end of the year.

The most critical topic discussed has been how to deregulate while preserving the public welfare in terms of energy security, universal service, supply reliability, and environmental responsibility. Regarding this question, the EUIC reached two fundamental conclusions determining the direction of Japan's deregulation. First, the deregulation might best be described as "partial liberalization". Second, deregulation should be achieved by simultaneously implementing both competition and public welfare through a process that melds with Japanese culture and method.

In January 1999, an interim report was published by EUIC, stating five major points that later appeared as revisions to the Law that were enacted in May 1999: 1) liberalize the process of retail wheeling to large industrial customers, 2) establish clear and reliable transmission access rules, 3) pass on the benefits gained from competition by reducing the retail prices charged to non-regulated small customers, 4) establish and adjust, as necessary, market-based transaction rules under an Antitrust Law, 5) evaluate the whole system in three years. As a step toward complete deregulation, not only the wholesale market but also a large industrial retail market were opened on March 21st, 2000. After the progress of deregulation is observed for three years, the whole system will be evaluated and revised in terms of the degree of deregulation and its anticipated goals.

## 3.3. Market Analysis[53]

### 3.3.a. High Degree of Market Concentration

A simple analysis of the ten EPCOs' market concentration in Japan's electric power market, using HHI in terms of market share, shows an HHI of 1360 on the generation capacity basis[54], which can be considered reasonably competitive. This index figure is not aberrant, taking into consideration one fact that the U.S. Department of Justice or Federal Trade Agency has adopted in principle: that an HHI exceeding 1,800 is

[53] Market share, generation capacity, and any other data is from Agency of Natural Resources and Energy (1999)
[54] This number came from author's calculation with data of Handbook of Electric Power Industry, 1998. Okinawa Electric Power Company is not considered into the HHI calculation because the company region is solely isolated as one island without transactions with any other regions.

thought to characterize industries with reduced rivalry.

This picture would change drastically, however, were the concept of a monopolistic franchise taken into consideration. For a long time, the Japanese electric utility industry has developed under the principle of "one supplier in one region." Given this monopolistic franchise to EPCOs, the degree of market concentration regionally has become quite high. In fact, in 1998, 80% of the electricity supplied to the Kanto Region (the area franchised to the Tokyo Electric Power Company, or TEPCO) was from TEPCO's own generating assets. The HHI rises to 8,200 (or 6500, if self-generators are considered) if the index is calculated in this franchised market only. The same can be said in all EPCO-franchised areas. This means that, in the franchise areas, powerful market concentration by the franchised EPCOs is clearly observed.

### 3.3.b. Obstacles to Introducing New Market Players

For a market to function competitively, a certain number of players is needed. The 1999 revisions to the Electric Utility Industry Law granted non-EPCO generators direct access to large industrial customers. However, since retail wheeling was partially liberalized on March 21st 2000, only nine specific-scale suppliers have applied to METI, representing a total output of approximately 1,020 GW. These suppliers are Diamond Power (affiliated with Mitsubishi Co.), Marubeni Co., Asashi Glass Co., e-Rex (a weather derivatives and power marketing company), Nippon Steel Co., ENNET Co. (NTT), Summit Energy Co. (Sumitomo Co.), Daio Paper Co., and SANIX Inc.

In Japan, three main obstacles to new entrants' participation in the market are observed. First, a fundamental problem is that the overall demand for self-generation capacity surpluses is very small. As of March 1999, self-generators' capacity totalled only 27,897 GW, and they contributed 137,138×10*6 kWh annually to the market. Simply calculated, their load factor was about 56%. In theory, self-generators could provide more than 40% of their total possible load to retail customers; the actual load, however, would be much smaller because of restrictions placed on the system to better ensure its reliability as well as the EPCOs' success in meeting their mandated obligations to serve their communities. As long as the EPCOs' total generation capacity remains 191,526 GW, the amount of self-generation in the market is far from adequate to stimulate any real competition.

Second, the transmission assets are completely owned and managed by the ten EPCOs. In terms of maintaining transmission network reliability, safety regulations give an electric utility exclusive rights and obligations for constructing and maintaining transmission assets, and also for transmission price-setting. Such regulations consequently protect (or rather, strengthen) the monopolistic franchise system, enabling EPCOs to exert tremendous vertical and horizontal market power. In contrast, new entrants must plan their electric power supply business to accommodate a much shorter payout time than that enjoyed by the EPCOs, which is guaranteed by the cost of service-based ratemaking, and to assume a higher risk of price volatility as a result of deregulation. The "pancaking" transmission-pricing method also erects a barrier to market entrants, which must bid their electricity price over several franchise areas served by EPCOs. This transmission issue will be detailed in Section 3.3.c, below.

Third, no electricity markets are open to all market participants in the sense that transactions are voluntary, nondiscriminatory, and transparent. In many European countries, and in some areas of the United States, organized, open markets in electricity are not only permitted but also strongly encouraged. The electricity supply in Japan, by contrast, is basically transacted as self-supply or on a bilateral basis with very few market players, so the market is very illiquid. In other words, newcomers who establish assets for power generation must cover their investments solely through actual transactions, via bilateral contracts. Although competitive bidding has been partially implemented since 1995, this system doesn't create a continuous open market in electricity. "This sort of power purchase agreement (PPA) between EPCOs and IPPs can be characterized as a part of 'outsourcing' of generation supplies without creating the wholesale market."[55]

A review of the situation above would suggest that it is quite important to remove the obstacles facing new entrants, and in other ways, too, give them more incentive to participate in the electricity market.

### 3.3.c. Transmission Network: Opportunities for Improvement

A uniquely characterized transmission network system and pricing methodology are critical issues for Japan's electric power industry. Unlike the U.S. transmission network, which is structured geographically, with hubs and spokes connecting all points on the network grid, the Japanese network is like a belt extending down a long, narrow strip of land, connecting independent service regions from north to south. Each EPCO's franchise region is strongly independent, and adjacent regions are connected by one AC interregional connection line and one supplemental DC connection line.

Congestion is observed in some areas of Japan (for example, in Seburi-Kansen, in northwestern Kyusyu

[55] Nishimura (2000) p.69

Island), but is probably not problematic currently. The most notable challenges may concern the weakness of the interregional connections between adjacent EPCOs' franchise regions. Since networking inside each franchise is tremendously strong and independent, as mentioned above, and the annual power exchanged over interregional connection lines is very small (6 – 7% of the total power generated), transmission capacity on the interconnection lines is currently adequate. The weak connections could become a serious problem, however, if many new generation plants are constructed by IPPs to more vigorously import and export energy between regions (e.g., Enron plans to construct a new, 120 MW gas thermal power plant in Aomori Prefecture to supply the Tokyo region).

Transmission access charges (TACs) in Japan are based on each region's basic two-part tariff, which consists of an electricity charge and a capacity charge. The TAC is set in every region by the EPCOs, following general contractual agreements for the electricity supply. In addition to TACs, charges are applied as necessary for any energy imbalance, reserve capacity, emergency backup, double-circuit supply, and transmission loss, since these services are automatically supported by EPCOs. The average charge per kilowatt-hour by the Tokyo Electric Power Company is roughly 3.3 yen[56] (2.8 cents, calculated as $1 = 120yen), but the actual TAC charge depends on physical path flows, geographical area, and the amount of power transmitted. Additionally, once generators begin to supply electricity from one EPCO's franchise area to another's area across the point connecting them, a transferring charge is added. As an example, suppose a supplier in the Hokkaido area has a contract with a consumer in the Kanto area, and a transferring charge is required at each connecting point (in this case, charged at both the Hokkaido–Tohoku connecting point and the Tohoku–Kanto connecting point). Such "pancaking" pricing would dampen market newcomers' motivation to compete with the EPCOs.

### 3.4. Does Japan Need Deregulation Yet?

Although the electric utility industry in Japan is now being pressured by the public to fundamentally restructure, we now know, from the preceding overview of other electricity markets around the world, that Japan's electric utility industry is a much different system than those being employed by analogous industries in the United States and Europe. Given this situation, does Japan really need to deregulate yet?

At least two points of view inform us on this issue. First, some expect and want competition in the electric power market to better reflect market signals for electricity pricing than has been the case. Japan's 30-

[56] From an EPDC internal source, March, 2000

yr-old vertically-integrated, franchised system has kept prices unnecessarily high. The conventional system's inefficiency was proved, ironically, by the fact that most EPCOs reduced their costs 10 to 20% soon after deregulation commenced. Quite naturally, customers and regulatory authorities believe prices could be reduced further if the market mechanism continues to provide strong incentives for increased business efficiency. Thus, although powerful voices still assert that competition is not suitable for Japanese business culture, it cannot be denied that such assertions represent only regulated monopolists' business ethics, uninformed by observation and analysis. In my view, it is necessary for Japan to at least prepare for competition that includes many market players, to optimize the market, regardless of whether competition is ultimately chosen to be partial or complete.

Second, from a business viewpoint, some individuals may see competition as a great opportunity to build new business in the electric power market. In fact, technology advancements, as typified by the high-efficiency combined-cycle gas turbine (CCGT), has facilitated self-generators' and other firms' participation in the market. Environmentalists' political pressures have helped to advance technology development in such areas of renewable energy as wind power and waste-to-power.

Nishimura (2000) explains in detail that the deregulation methods chosen by the United States and European countries are not always directly transferrable to the Japanese electric utility industry, especially in terms of the type of transmission network (reviewed in Section 3.3.c of the present report).[57] According to Nishimura, therefore, perfect competition of the type American economists usually advocate, with complete vertical separation, could never be optimal in Japan. While recognizing the need for deregulation, Nishimura considers invention of a Japanese-specific market system to be essential.

In conclusion, the Japanese electricity market should be deregulated, following the world trend, and right now is the time to pursue efficiencies this way. To do so, I think a new methodology is needed for the Japanese electric utility industry to reap the full benefits of deregulation. Japanese customers tend to place greater importance on the quality of power service (e.g., no blackouts, a reliable system) than on the price of electricity, differing dramatically from values in the U.S., where competition is employed primarily to maximize social benefits through thoroughly efficient business practices. Thus, Japan must seek a more "idealistic" system that better suits the Japanese culture, to simultaneously achieve both market efficiency and market reliability.

One last important point: deregulation of Japan's electricity power market not only benefits customers by

[57] Nishimura (2000) pp.97-110

reducing retail prices; it also offers market participants opportunities to develop new business. Seeking ways to deregulate Japan’s electricity market will also increase the possible ways to benefit firms, I believe.

## 3. Proposals for Deregulating Japan's Wholesale Electricity Market

A survey of electricity markets around the world in which new schemes have been installed, when considered in light of Japan's situation, offers helpful perspectives on how to proceed with deregulation in Japan. I myself strongly believe that the Japanese electric utility industry needs increasingly aggressive restructuring. Restructuring would not only benefit the national economy, but also strengthen companies within the industry, offering them greater promise of business success. Even the simple observation made in Section 3.3 proves that numerous hurdles must be cleared for a viable market to form, but such a market must be possible.

The remainder of this report focuses on one way I consider to be particularly practical and feasible for creating an open and liquid electric power market in Japan. Perhaps more importantly, it suggests the very first step to put deregulation into operation. To conclude this discussion, therefore, I offer the following five proposals to facilitate Japan's deregulation. While these proposals may be rather rough and intuitive, admittedly, I believe they provide a good foundation upon which a more rigorous examination might be built.

***Proposal 1:***
***Create Markets on the Basis of "Pool" Concept***

**Japan Needs "Markets"**

As mentioned in Section 3.3.b, the Japanese electric power industry is structured as a franchised monopoly for only a few market players. Strictly speaking, as I have emphasized throughout this report, the Japanese system doesn't have an open "market": most electricity is currently self-supplied, although a small number of bilateral contracts are negotiated by IPPs. For example, at the wholesale level, the amount of electricity purchased through competitive bidding has always been determined by EPCOs (some EPCOs may not offer bids at all because they are not obliged to do so), and all electricity is actually purchased only by the EPCOs. The current system technically employs outsourcing of supplies rather than any bona fide market mechanism. Therefore, any consideration of deregulating Japan's electricity market in the short run will first require the creation of real markets in which any players can participate to supply energy.

Standardized markets in which both the amount and price of electricity are determined by suppliers' and consumers' bids would open wide the door for potential suppliers to enter Japan's electric power markets, and also promote fair competition among the players.

**Why a "Pool"?**

For the first step in creating a nationwide, standardized market in Japan, I think the pool model would be most feasible in terms of implementation. One advantage of this model is its simplicity, which would be appreciated by regulators. A pool may also help broaden the opportunities for potential suppliers to compete with incumbent utilities. As evidenced by PJM and Nord Pool, the "pool" concept encourages entry of new participants into a market by generally opening access to the power transmission system.

It would be ludicrous for a nation to install an entirely new model of voluntary trading without any experience in this activity, as the case happens to be in Japan. Historically speaking, no utilities in Japan have ever functioned in a truly competitive situation, governed solely by a market-centered philosophy, so rapid restructuring to introduce perfect competition to Japan's electricity market would only create political and economic disruptions. At this point, I think a phase-in period would be judicious, and the "pool" offers a particularly convenient model for such a transition period, since a number of countries' experiences are showcased by actual installations of this model around the world.

Simplicity is not my only reason for proposing the pool model. Since electricity prices are determined by the point of intersection between supply and demand in the pool, this model automatically eliminates the EPCOs' traditional rate-of-return methods for pricing electricity generated at their plants. The new pricing method would provide an equal footing for newcomers entering the market environment to compete with the incumbent EPCOs. Needless to say, cross-subsidization among the EPCOs' generation plants could be avoided by transparent marginal price-setting. Moreover, the pool system would encourage competition among EPCOs that have been accustomed to conducting business cooperatively, rather than in competition with one another. An HHI comparison of national and regional levels, as presented in Section 3.3.a, also suggests that a single national market would create the most competition, by far, as the next section will explain in detail.

***Proposal 2:***

***Promote Competition among EPCOs in the Nation-wide Single Market with Congestion Management by Zonal Concept***

**Mitigating Market Power Through a National Market**

When Japan's electricity markets are discussed, the focus is generally on the EPCOs' regional franchises. To consider setting up a competitive environment regionally would seem to be unrealistic, however, judging from the available HHI calculations; in the TEPCO region, for example, the HHI calculation is about 8200, revealing tremendously high market concentration (see Section 3.3.a). Judging from this HHI calculation at the regional level, clearly some mitigation of the potential market power is necessary. At this point, PJM and Nord Pool offer one scenario, showcasing markets that are functioning well, with many players and market shares in a proper ratio.[58] For example, in Norway, the market share of the largest publicly owned generator is only 25%; in contrast, EPCOs exhibit monopolistic power in their respective franchise regions. The huge (almost 80%) share of the national market that is currently enjoyed by EPCOs may present a serious obstacle for newcomers to surmount.

To mitigate the currently high market concentration, some of the EPCOs' generation assets might be divested, as one solution. Encouraging the EPCOs to sell their stranded generation assets by leveraging their stranded assets recovery, a regulatory authority could lower the regional market concentration ratio enough that new entrants might be able to acquire incumbent generation plants from the EPCOs. Although CPUC used this method to make adjustments to the California electricity market, I don't think this methodology can be transplanted to the Japanese electricity market, due to Japan's economic and cultural background. Most significantly, Japanese companies tend to strongly resist any transfer of ownership of their assets. Transfer of ownership seldom occurs, and many Japanese firms (especially in traditional industries) tend to avoid mergers and acquisitions of assets. Thus, it is not difficult to expect that divestiture proposals would be strongly opposed. In addition, METI may not have the authority to require EPCOs to divest themselves of assets.

An alternative method for mitigating market power would be to create a single national market in Japan to promote competition among the EPCOs. In contrast to the very high HHI calculated for the regional level in

[58] Bergman *et al.* (1999) reported HHI of the united market of Sweden-Norway-Finland shows 1300 to 800.

Japan, the HHI at the national level is 1360, a reasonable value for competition to occur. Although companies in the electric utility industry have formed alliances to cooperate closely, the market would become much more competitive if competition among EPCOs were implemented. To promote competition, undoubtedly a single national electricity market in Japan would be required; as mentioned in Proposal #1, above, such a market should be established under the pool model.

Japan is a long, narrow island country stretching from north to south, and each EPCO's franchise region lies adjacent to one or two other EPCOs' franchise regions, in a single line that essentially forms a belt, or perhaps a bead necklace, the beads of which are joined by connection lines that extend through the various regions. For a long time, this configuration has determined the "pancaking" pricing format for transmission that has been under each EPCO's individual control. However, establishing a single market in Japan should also be possible, because practical electricity dispatch can be controlled through modifications of the economic dispatch that is optimized by the ISO.

**The Zonal Concept in a Constrained Case**

The pool system being advocated here must be installed on the basis of "zones". Since the Japanese electric utility industry has developed under a franchise system monopolized by EPCOs, the franchise regions shown in Figure 1 operate highly independently, without frequent transactions across regions except for economic dispatch, which is usually conducted via mutual agreements between EPCOs for the sake of convenience. Physically, the weakness of the transmission network in Japan—that is to say, the "bottleneck" most likely to put constraints on the system—exists in the connection lines between franchise regions.

In addition, Japan has adopted two different electrical transmission frequencies for its western and eastern regions: 50Hz and 60Hz,[59] between the Kanto region and the Chubu region. For economic dispatches between east and west, the frequency difference is handled by converters at the border between Kanto and Chubu.

Zone-based markets would cope well with such challenges as congestion and this frequency difference. In a zone-based pool, market-clearing prices are settled in each zone and may differ by zone when congestion occurs, though there may be only one clearing price in an unconstrained situation. Norwegian markets present a

[59] Frequency difference between east and west are dealt with the connection lines with frequency conversion system going through Shin Shinano and Sakuma.

strikingly similar case.

When the zonal concept is employed to solve congestion problems, incentives for transmission owners to expand connection lines must be taken into account. Many economists provide financial transmission rights (FTR) transactions as the methodology to create those incentives, but I am not certain whether this method would work in Japanese markets.

***Proposal 3:***
***Create an Independent Entity to Operate the Transmission Grid***

**Functional Unbundling (Not Separation)**

The current highly concentrated Japanese electricity market structure dominated by EPCOs tends to block newcomers' market participation, and also creates pricing problems. Therefore, our first consideration before introducing competition to the system should be how to mitigate the EPCOs' market power, and to what extent. In this regard, I believe that the dissolution of vertical market concentration must be the first step in Japanese electricity deregulation. To dissolve vertical market concentration after implementing deregulation (though only temporarily), I propose an adjustment of the nationwide ISO system for transmission. What is being proposed here is not "vertical separation," but "functional unbundling" as seen in the United States, in both California and PJM. This distinction must be made for three main reasons.

First, separation of power transmission from power generation, at least, under the open access rule is essential for mitigating market power as long as the EPCOs own a huge portion of the electricity-generation capacity. In the case of California, policy makers' judgment in this regard is apparently called into question frequently: "if the utilities continue to maintain control over the electric transmission system, competition could be stifled by limiting competitive access to the transmission and distribution systems—the only means of delivering electricity to customers."[60] The critical point here is not the physical separation of power transmission from power generation, but rather the transfer of "dispatch and re-dispatch rights" from transmission owners to entities responsible for operations. This point is tremendously important.

Second, there is no clear reason to order a separation of the EPCOs' ownership of generation and

[60] California Public Utility Commission, Frequently Asked Question

transmission functions as long as EPCOs are all privately owned utilities. Anti-Trust Law offers the only way by which property rights might be ordered to be separated; in the U.S. case, however, it has been observed that "the anti trust laws provide no mechanism for market power."[61] Fundamentally, Japan's Anti-Trust Law restrains only unfair transactions and illegal blockades of new market participants' entry into the market. Therefore, although some may say that ownership transfers are possible by leveraging Anti-Trust Law, it is quite difficult to claim that the business of electric utilities is illegitimate. Without any exercise of public authority, the transmission and generation functions will be impossible to separate completely—and so far, no motivation to separate these functions has been apparent. Therefore, the ISO concept is being considered very seriously as a means by which to separate operational functions from EPCOs without conflicting with property rights.

Third, the U.S. ISOs' experiences show that some ISOs developed through modest cooperation between transmission owners. For example, the PJM ISO has enjoyed a 70-year history of cooperation between owners since its first entity was established in 1927. The Japanese EPCOs have cooperated rather closely to supporting the nationwide transmission of electricity for a long time, so the creation of a united entity to transmit power is feasible; the power system's organization must be completely independent of EPCOs, however.

**Third Party Access (TPA) to the Transmission Network**

Open access to the transmission network has been the most popular method used to promote competition under deregulation. Generally speaking, "deregulation creates competition usually through mandated open access."[62] In the United States, FERC issued Order 888 requiring TPA to open access to the transmission network in a transparent, nondiscriminatory manner; transmission owners and operators then filed the Open Access Transmission Tariff (OATT). The Norwegian and many other European markets also opened their access, dissolving the incumbent utilities' vertical integration.

Traditionally, EPCOs have accepted TPA once various conditions, such as ancillary services and technical matters, have been met through special Access & Supply Agreements. These conditions are usually reflected in TACs, including an ancillary service charge that is set by EPCOs individually. Newcomers to the electricity market thus face a high hurdle because the charges associated with tight technical conditions and ancillary services tend to be very high. However, under the ISO system, transmission owners only benefit from

[61] Werden (2000)
[62] Philipson and Willis (1998) p.203

TACs, which are usually set on a rate-of-return basis; other charges and technical conditions must be determined by the ISO via the sole open rules that are standardized across the nation. Details on this point are described under the next proposal.

***Proposal 4:***
***Adjusting the "Postage Stamp" Pricing Method for Transmission Charges***

**Transmission as a "Fee Business"**

TACs, transmission loss charges (TLCs), and other charges associated with transmission assets are calculated by each EPCO. Since each EPCO sets these charges independently, the charges are added whenever electricity is dispatched across the EPCOs' franchise regional lines (see Section 3.3.b). Without a doubt, this "pancaking" problem blocks newcomers' participation in the electricity market.

The "postage stamp" pricing method, which charges the same transmission price regardless of the electricity's source or destination, offers a good solution to this problem. The postage stamp concept has been adjusted to suit many EU countries in which deregulation has been implemented; at the same time, this method seems to increase the number of entrants to the electricity market. The transmission business thus becomes a "fee-only business" for transmission owners: the investment to construct the transmission network is collected only through an access charge that is calculated on a rate-of-return basis.

**Fairness to Transmission Owners**

To discuss this concept, transmission owners' major complaints must be reviewed. Because construction costs to maintain and expand the transmission network differ by region, some transmission assets cannot cover the investment. For example, transmission costs including maintenance in the Hokkaido region are relatively higher than in other regions. Also, EPCOs that own a larger ratio of newly constructed transmission lines tends to obtain lower margins than do other EPCOs that own fully depreciated transmission lines.

To deal with this problem, during transition periods the EPCOs need both opportunities to recoup their invested money and incentives to keep their network well maintained. On the basis of a uniform TAC (by rate – of –return), the ISO should accept the incremental costs associated with such worthwhile functions as local maintenance and network expansions, adding these as $C_1$, $C_2$, $C_3$,…$C_n$ to the uniform TAC to calculate the total

TAC. The ISO is responsible for properly allocating to transmission owners the total transmission charge (TTC) collected.

**Ancillary Service Charge**

An ancillary service charge is basically calculated and allocated by the ISO. Whether or not ancillary services are obtained through the open market, the charge must be considered separately from transmission charges associated with construction investment.

> ***Proposal 5:***
> ***Create Several Supplemental Markets under the Pool System:***
>
> - ***Bilateral plus long- or short-term contracts markets***
> - ***Spot energy market***
> - ***Real-time imbalance settlement market***
> - ***Ancillary service market***

**The Pool Itself Is Not a Self-contained Method**

As noted in Nishimura (2000), markets in which an "auction type" pool system exists as the sole wholesale market have quite low probabilities of succeeding.[63] The UK's deregulation started with this pool system, but switched to another market method when regulators recognized that the market comprised one single pool that could not avoid market power completely. This case of the UK may perhaps support Nishimura's assertion.

To install a pool system properly, supplemental markets must be installed at the same time to support the pool-based transactions. The pool market should not be the only one, nor should there be restrictions that obstruct voluntary transactions in each market. How best to establish and develop supplemental markets remain a controversial question, but analyses in California and the old system in the UK show that the pool model works poorly in the absence of supplemental markets.

At the time supplemental markets are installed, a "phase-in" period is necessary to determine, for example, what bilateral contracts and power exchange should be introduced first; financial markets can then

[63] Nishimura (2000) pp. 44-62

follow after the pool and supplemental markets have operated successfully for a couple of years. One reason for this phase-in is that market players need to become accustomed to trading through voluntary negotiation, since Japan's electric power industry doesn't have experience transacting business in open markets. Another reason is that some transactions (especially those conducted through financial or ancillary service markets) are highly technological and sometimes complicated, so implementation needs to be postponed until all players become skilled and mature, to avoid the exercise of market power by a few players.

**Market Types**

As evidenced by the Scandinavian market and PJM, several markets should be taken into consideration as supporting the pool market. Here I provide four types: bilateral contracts, real-time imbalance settlement (spot), financial and ancillary services markets.

Bilateral Contracts Markets

Bilateral contracts may constitute the majority of transactions even after installation of a pool. If vertically integrated utilities exist, their contracts should include self-supply. In PJM, almost 90% of electricity trading is based on bilateral contracts, which surely contribute to a stable, reliable system. Also, in the Norwegian market, most electricity is traded outside Nord Pool, based on bilateral contracts. In contrast, the California market has been seriously damaged partly because CPUC banned bilateral transactions by UDCs. Even in the UK, transactions by CfD contract bypassed the pool by more than 80%, as stated in Section 2.3.c. These facts prove that bilateral contracts can play important roles in the electric power market. Even though a competitive market mechanism may be installed on the basis of the pool model, bilateral contracts can become primary transactions in terms of their total transaction volume.

The role of bilateral contracts is generally to hedge the price volatility of day-ahead or hour-ahead spot trading. Moreover, long-term bilateral contracts (for five or more years) help to cover the risk of initial investments to establish new power plants. Newcomers to the electric power market usually suffer large initial investments to acquire or construct power sources under pressures of unrecoverable risks without long-term contracts. Bilateral contracts are one efficient contractual method for increasing newcomers' incentives to enter the electricity market.

Spot Energy Market

As with other primary commodities, the spot market for electricity through a power exchange plays an important role in the competitive market. In electricity, "many analysts envision that the Poolco would operate something of a central market."[64] Thus, the present proposal's market should be organized and controlled by the ISO.

Spot markets facilitate a wide-range of large-scale transactions. They encourage bulk power transactions for the time of use on a second-by-second basis, and some power marketers may appear as the bulk power markets mature. Also, a certain volume of spot trading surely influences contract prices for all the physical markets, making them more liquid and vital.[65] Spot markets in electricity consist of hour-ahead, day-ahead, and real-time imbalance settlement trading.

Financial Markets

Price volatility will be observed after a certain volume of spot-based trading is reached. The tighter a supply situation becomes, the more volatile spot prices could become. This price uncertainty is usually considered a crucial risk, especially threatening suppliers' livelihoods.

As methods to hedge the price risk, financial markets of futures, options, and transmission financial rights should develop, as seen in Nord Pool. If the combination of spot markets and bilateral contracts markets works, electricity trading will be vital, so active transactions between market participants can be expected.

However, we must keep in mind that financial markets can be installed only after a certain number of market participants appears. Consider Nord Pool, for example: the Eltermin market became successful because hundreds of generators were in competition, originally. In the United States, the New York Mercantile Exchange (NYMEX) provides wholesale futures contracts at six locations, but is generally considered to be unsuccessful due to the fact that "the volume of electricity trade in the futures markets relative to overall electricity sales has remained low."[66] The NYMEX's lack of success is not only " because this market is relatively new and deregulation is present in only about half the States,"[67] but also because the markets are controlled by only a few players, who serve as "market makers."[68]

[64] Brennan *et al.* (1996) p.50
[65] According to Cambridge Energy Research Association presentation, experientially, contract prices link to spot prices if the share of spot trading excess 15 to 20 percent of total volume of physical trading. (provided at seminar titled "Energy &Commodity Risk Management" at Oslo, Aug.29 – 30, 2000)
[66] DOE/EIA (2000b)
[67] DOE/EIA (*Ibid.*)
[68] By interview from NYMEX

Ancillary Services Markets

Although both PJM and Nord Pool have implemented regulation markets, I am not sure that their providing ancillary services by bid-based transactions is, in fact, efficient. In California, three types of ancillary services—spinning reserve, non-spinning reserve, and frequency regulation—are made available in the Ancillary Services Auction, but installation of competitive bidding for ancillary services may produce price spikes, creating a tight supply situation. In such a situation, some generators move toward bidding in the ancillary services markets rather than in the physical trading markets because the price of ancillary services can spike so high (because of insufficient capacity margins) that generators in the ancillary services markets can make money without actually generating any power. In this case, the physical supply continually tightens as the price of service in the ancillary services markets remains high.

Therefore, for a transition period, ISO should manage ancillary services and also secure the authority needed to control plants' generation.

## 4. Conclusion

Although this paper does not cover all the issues that arise regarding deregulation (including such important issues as nuclear power and fuel procurement to ensure energy security ), it does offer an idea of the fundamental structure that would seem to be required to introduce competition into the Japanese electric utility industry. This paper is intended not to provide an idealistic goal for deregulation but only to recommend a first step for the process. In other words, the concepts based on the pool model that are proposed here are not meant to dictate the final form of the Japanese electricity market; that final form must evolve as competition increases.

The most crucial issue for implementing deregulation relates to market power, as evidenced by the fact that so many economists and newspaper columnists in the world have chosen to analyze this particular issue. Market power is such a concern because companies are usually motivated to maximize their profits in a freely-competitive world. The price reductions resulting from competition's implementation are nothing more than the result of companies' profit-maximizing behavior. The basic concepts of ISO and open access stem from the question of how to mitigate the market power that may conceivably be exercised at some point by incumbent utilities.

In Japan, the same thing might be said. The question, "How might we best introduce competition to reduce the price of electricity?" is essentially being posed by the Japanese public right now, in other terms, i.e.: "How might Japan best mitigate the EPCOs' potential market power to remove obstacles from the paths of other market participants?" As mentioned repeatedly throughout the present report, creating a functional market that will mitigate the EPCOs' potential market power is the greatest concern facing Japan's deregulation.

Basically, Japan must do two things to deregulate its electricity industry: (1) increase the number of market participants by creating a single standardized, nationwide market that is characterized by open (i.e., nondiscriminatory and transparent) access to the transmission network, and (2) reduce the EPCOs' market shares by unbundling their generation, transmission, and distribution functions. Pricing methodology and the creation of financial markets only support these two basic concepts, both of which underlie the five proposals offered in Chapter 4 of this report.

The simplicity of whatever system is chosen to implement deregulation in Japan is an important consideration . Along with the two concepts described above, simplicity was the principal reason I chose the pool system as a particularly suitable model for Japan to employ.

Additionally, it should be noted that during times like this, when deregulation is being considered, the crucial roles of the regulatory authority and public opinion in determining whether to move toward deregulation or not are often overlooked (since market structures and functions are usually the main centers of attention). In the United States, FERC is strongly motivated to implement nationwide deregulation, and even in the UK, Ofgen is now showing strong inclinations toward installing and settling a new trading arrangement. Moreover, it is advantageous for a government to progress on a system that public opinion supports for deregulation. Looking back on Japan, METI’s role as regulatory authority is significant regardless of which system is ultimately implemented.

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## Acknowledgment

I have been in CEEPR for two years, July 1999 – June 2001, as the 6th visiting researcher sent from Electric Power Development Co (EPDC). Two years might seem a long period, but it was, in fact, a very short for me to digest so much beyond description. I learned also that “time flies.”

Although my research did not always go smoothly and I was greatly helped by the executive director of CEEPR, Dr. A. Denny Ellerman, who met with me whenever I needed, and gave suggestive ideas to keep my research on the right way. Here I would like to express my deepest thanks for his warm-hearted support. Without this support, I could not have completed my research.

Mr. Natsuki Tsukada is one of my colleagues at EPDC and a visiting researcher with the Joint Program, during the same period of mine. I thank him for the many discussions about deregulation that greatly helped much to put my ideas in order.

Judith V. Stitt. She carefully edited my entire report, kindly offering detailed suggestions sentence by sentence for how to communicate the material more clearly. It was my great pleasure to learn from her how better to express concepts in English.

Then, I also thank EPDC’s people such as Mr. Wataru Okuyama, Manager of Administration Office, International Activities Department, Mr. Atsushi Yoshida, Manager of Washington Office, and Mr. Takenori Iwasaki, Business Development Department.

The last but not least, I would like to show my great thanks to my wife. Far from Japan, she was perfectly understanding of my work although I may not have been able to spend enough time at home, and she also supported my life here in Boston sincerely.