



CIFE CENTER FOR INTEGRATED FACILITY ENGINEERING

**International Comparisons of Electricity
Restructuring:
Considerations for Japan**

By

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International Comparisons of Electricity Restructuring: Considerations for Japan¹

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1 Our Understanding of the Japanese Electricity Sector

The structure of Japan's electricity sector, as modified by legislation in 1995 and 1999, will be reviewed in 2003. At that time, it is likely that further decisions will be made regarding the restructuring of Japan's electricity sector. The objectives of this study are to provide insight into the alternative ways that the sector might be restructured and the experience of other countries that have already undertaken restructuring. It is hoped that learning from the experiences of others can help Japan find its own best way to provide low-cost, reliable and environmentally acceptable electricity to all its end-users.

Japan is undertaking electricity sector reform to reduce electricity rates for end-users, which – as of 1999 – were the highest of all OECD countries. The means proposed for doing this is to make electricity markets more competitive. This effort began in 1995 with an amendment to the Electric Utility Industry Law that allowed independent power producers (IPPs) to build generating plants and sell electricity to Japan's ten integrated electric utilities. An amendment in 1999 permits an end-user with demand exceeding 2 mW at levels of 20 kV or higher to choose its own electricity supplier, including IPPs. Moreover, electric utilities can sell power to one another. Another amendment requires that all new thermal generating capacity be subject to competitive bidding and allows integrated utilities to submit bids outside their own service areas.

Regulation of the electricity sector is the responsibility of the Ministry of Economy, Trade and Industry (METI). METI is responsible for developing, implementing and enforcing rules regarding transmission rates and transmission access for service provided by electric utilities to IPPs and other utilities and for rules regarding environmental and safety standards. It is also, together with the Japan Fair Trade Commission, responsible for competition policy and dispute settlement. To date, transmission and distribution remain regulated monopolies.

2 Electricity Sector Restructuring

2.1 Why Restructuring?

In OECD countries, the principal motive for restructuring has been to increase economic efficiency and reduce electricity costs to end-users. For example, California and Pennsylvania in 1996 had the tenth and eleventh most expensive prices of the fifty states in the U.S. Economic theory suggests that the best way to increase efficiency and lower costs is through making markets competitive, and this has been an increasingly popular policy over the past ten years. There is, however, another path: to reform regulation so that the results of regulation closely mimic the results of competition.

Our study has focused on comparing several countries' efforts to make electricity markets competitive. It may be worthwhile in the future to explore innovative regulatory schemes and assess how well they have worked in increasing efficiency and lowering prices.

For many years, it was believed that – because of economies of scale -- the electricity sector could only be organized as a vertically integrated monopoly that combined

generation, transmission and distribution. However, economic analysis and improved technology demonstrated that generation was not a natural monopoly. Moreover, in principle, retail sales could be separated from physical distribution (a natural monopoly) and be a competitive industry. These findings led to the possibility of competition in the electricity sector.

It is generally believed that it is not possible for the electricity sector to become competitive while maintaining its vertically integrated structure. Thus, most proposals for electricity sector reform require de-integration (unbundling) of vertically integrated utilities. Experience from different countries, as well as basic reasoning, shows that there are many ways to achieve de-integration and competition. In addition, there are some de-integration proposals that do not lead to completely competitive markets, but they might make costs more transparent and make possible regulation that would mimic competitive results.

At a minimum, restructuring always involves some form of separation between transmission and generation functions. Several characteristics of transmission make electricity complicated:

- Loop-flows allow power to move in many directions rather than just from the seller to the buyer. This characteristic creates spillover effects between firms that are difficult for any one firm to capture.
- Transmission investment requires large upfront costs and land acquisition that cannot be easily duplicated by another firm. These conditions prevent competition from other firms and provide the incumbent firm with market power if unregulated. Competition cannot happen in this industry unless transmission is separated from the other functions.

Countries have experienced many different restructuring approaches that appear to work. They can range from small to large changes:

- A single buyer (power pool) buys and sells power for re-sale. However, in some cases, large end-users may choose other suppliers like independent power producers (IPP) if they have access to the transmission system.
- Customers and suppliers can trade in bilateral contracts (England and Wales' New Electricity Trading Arrangement, Nord Pool). The system operator must dispatch power from any seller to any buyer that is feasible and that does not jeopardize the system's reliability.
- Markets for auxiliary services exist in conjunction with single-buyer and bilateral markets to insure system reliability. Auxiliary services include additional reserves that can provide power quickly to help relieve power surges and other short-term changes in loads and generation. (California, Texas, Australia, New Zealand)
- Private exchanges exist for forward trading of electricity itself and/or for standardized financial instruments that reduce the risk of spot market transactions (Norway, PJM and England and Wales).

The following discussion presents several options for de-integration, ranging from least change from the existing vertically integrated structure to the most change. Each of these options includes all previous options unless otherwise stated.

2.2 Options for De-integration

2.2.1 IPPs Sell to Integrated Utilities

The amendments to Japan's Electric Utility Industry Law discussed above allowed independent power producers (IPPs) to build generating plants and sell electricity to its ten integrated electric utilities and for some end-users to choose their own electricity suppliers, including IPPs. This is the basic structure of the Japanese electricity sector today and of most states in the United States. Since 1978, U.S. utilities were mandated to buy electricity from IPPs that either used conventional fuel efficiently (e.g. cogenerators) or used renewable energy (e.g. hydro and wind). Since 1992, all IPPs in the U.S. were allowed to sell to utilities under mutually agreed terms.

This option does not change the basic structure of the vertically-integrated utility industry. However, IPPs provide some competition in wholesale markets, and the ability of large end-users to bypass the home utility and purchase power from other utilities introduces a potentially important element of retail competition. The following table shows the advantages and disadvantages of these arrangements from the point of view of those who wish to make the electricity sector more efficient and to have lower prices.

Advantages and Disadvantages of "IPPs Sell to Integrated Utilities"

Advantages	Disadvantages	Requirements
Introduces efficiency of some competition in generation	Does not go far enough	Non-discriminatory access to transmission
Maintains stability and predictability of the utility system.	Utilities remain in control, can discourage IPPs	Efficient transmission pricing

2.2.2 Accounting Separation within the Utility

A further step in de-integration is internal accounting separation of generation, transmission and distribution, without changing the basic structure of the utility. Accounting separation makes costs more transparent and perhaps makes utilities easier to regulate. Germany is one example where accounting separation within each utility has taken place, and it is generally permitted in the European Union. In our further research, we will seek examples of such an option. For such an option to be effective in increasing efficiency and reducing costs, it must be joined by innovative regulation. The prospective advantages and disadvantages are shown in the following table.

It should be noted that in the European Union, there is a strong opinion that internal accounting separation is not sufficient for the establishment of a competitive market, particularly with respect to transmission. (Commission of the European Communities, 2001, p. 70)

Advantages and Disadvantages of Internal Accounting Separation

Advantages	Disadvantages	Requirements
Introduces transparency of costs to permit easier regulation	Does not provide incentives for efficiency and cost reduction that are as effective as competition	Changes in utilities' basic accounting structures.
Permits more focused, incentive-based regulation	Maintains power of traditional utilities	Introduction of incentive-based regulation.
Maintains stability and predictability of the utility system.	Since all stages are still part of the same company, there is an incentive to favor other parts of the company over competitors.	Strict assignment of costs to various functions and clear boundaries between them.
	Accounting units can still manipulate costs for regulatory advantage	
	Need to regulate three stages of electricity costs instead of one implies higher regulatory costs	

2.2.3 Functional Separation within a Holding Company Structure

Introducing full competition in the generation and/or retail stages is likely to require that the generation, transmission and distribution functions of a vertically integrated utility be de-integrated into separate companies. However, the separated companies can still be owned by a single holding company. Thus, they are functionally separated, and each is responsible for its own financial performance.

The holding company structure is common in the U.S. wherever electricity reform has taken place. For example, PG&E, which used to be northern California's integrated electric and gas utility, is now a holding company that owns separate generation, transmission and distribution companies and is planning to sell its distribution business to be a separate company altogether. Similar structures exist for other utilities in California and Pennsylvania.

The major reason to do this would be if there is some combination of bidding rather than negotiated contracts at the wholesale level, several distribution companies competitively bidding for power, and de-integration of retail sales from distribution. A major difference between separation of companies and accounting separation within one company is that the separate companies cannot transfer assets among themselves as easily as entities of the same company that are separated only by accounting rules. The following table shows the advantages, disadvantages and requirements for introducing full competition with the vertically-integrated utilities being transformed into holding companies and subsidiaries.

Advantages and Disadvantages of Functional Separation in a Holding Company

Advantages	Disadvantages	Requirements
Encourages efficiency and price reduction through competition.	Does not provide incentives for efficiency and cost reduction that are as effective as competition	Break-up of traditional integrated company.
Introduces transparency of costs to permit easier regulation	Maintains much of the power of traditional utilities	Competitive markets for generation and/or retail sales
Removes much of the incentive to favor other stages owned by holding company since each company is responsible for its own profit and loss.	Accounting units can still manipulate costs for regulatory advantage	Non-discriminatory access to the transmission and distribution system by competitors and efficient transmission pricing.
Permits more focused incentive regulation	Difficult to protect against exercise of market power by generators	An independent intermediary between generation and distribution to prevent favoritism to other members of the corporate family
Maintains stability and predictability of the utility system.	Market rules and enforcement must be sophisticated	
May be more difficult to manipulate costs than in the "accounting separation" model	Electricity markets may be unstable and unpredictable	

Functional separation in Chile, England and Wales, and California -- where spot wholesale markets were established -- proved to be volatile and possibly subject to manipulation. A major on-going effort in electricity sector reform is addressed at solving these problems and is discussed below.

Another problem that arose in the functional separation of the privately-owned systems in California and Pennsylvania is that of "stranded assets." This problem occurs when utilities made good-faith investments in assets that would not be viable in a newly competitive market. Prominent examples in U.S. experience are nuclear power plants and contracts for the purchase of renewable or environmentally friendly energy that were mandated by law and regulation. Since the power from these sources is not competitive in a deregulated market, investors would not recover their investments. It is possible that similar problems could arise for Japanese utilities if generation is deregulated.

In California and Pennsylvania, the decision was made that the utilities should be allowed to recover their investments in stranded assets through "competition transition charges" made to end-users. However, the way these charges were assessed caused serious distortions in the pricing and competitiveness of retail markets. If Japanese

utilities face stranded assets problems, great care must be taken to find solutions that do not cause other problems.

2.2.4 Horizontal Divestiture – Generation Only

In addition to allowing competitors to enter electricity markets, some governments or regulators have required or strongly suggested that integrated utilities divest themselves of some or all of their generating assets. California is the only place that we know where this has been a requirement, although it was strongly suggested (under threat of stronger action) in England and Wales. In Argentina and Australia, the state-owned integrated utility was sold off to many buyers. In Argentina, the law requires that no one firm own more than ten percent of Argentina’s total generating capacity.

The table below shows the advantages, disadvantages and requirements associated with divestiture of generation only.

Advantages and Disadvantages of Divesting Generation

Advantages	Disadvantages	Requirements
Increases competition and helps avoid exercise of market power by generators	Does not eliminate market power, which depends on market arrangements as well as the number of competitors	Sales of utilities’ generating capacity to independent power producers and/or allowing only IPPs to build more capacity.

2.2.5 Divestiture of Complete Functions

It is conceivable that a vertically-owned utility, such as those of Japan, could be required to completely divest itself of generation, transmission or distribution, or all of these functions. PG&E divested itself of its distribution function voluntarily for business reasons. However, there is no apparent reason for a utility to be required to divest itself of all functions unless it is state-owned and policy requires privatization, as in Argentina, Australia, and England and Wales. The table below shows the advantages, disadvantages and requirements for complete divestment of some but not all functions.

Advantages and Disadvantages of Complete Divestiture of One or More Functions

Advantages	Disadvantages	Requirement
Avoids exercise of vertical monopoly powers, self-dealing	There are more efficient ways to reduce market power and threats of self-dealing	Sale of all utility assets in function or another.
	Disruption of management and employees	

2.3 Transmission Access and Pricing

To accomplish economic efficiency objectives, it is important that a restructured industry provides open access to its transmission system. Open access means that the operator cannot prevent an electricity customer or another supplier from exchanging power along its system.

- Most countries implement open access by de-integrating transmission operation (at a minimum) and sometimes separating ownership of transmission from generation, distribution and retail supply, as described above.
- Some countries, such as Germany, allow the integrated utilities to own and operate the wires with the requirement that they negotiate open or “third-party” access. Such arrangements, however, may lead to discriminatory and strategic pricing by the transmission system operator and may require additional regulatory oversight and legal review to ensure open, competitive markets.

An effective transmission pricing system will meet the following objectives:

- Recovery of investment costs
- Provide incentives for new investment
- Provide incentives for efficient operation, especially managing congestion
- Avoid discrimination
- Promote simplicity and transparency

The first two objectives are addressed by establishing average price levels for the entire system. The second is addressed by differentiating relative prices by location. Establishing average prices of transmission services can be done in several different ways:

- The price can be based upon the historical cost of the undepreciated capital used to build the system (Germany).
- The price can be limited so that change is not allowed to exceed inflation minus assumed productivity improvements (Norway, England and Wales, and Australia). This approach is one type of “performance based regulation” or PBR.
- Another type of PBR sets the price on the basis of a yardstick or benchmark, in which the costs of other firms are used to set the yardstick price. This approach is used in Argentina and Chile.

2.3.1 Embedded-Cost Pricing

Embedded cost methods focus on cost recovery for transmission system investment and operation. They offer few incentives for efficiency.

“Postage-Stamp” Pricing

“Postage-stamp pricing is a simple charge for transmission per kWh or for peak kW: it treats generation and consumption as being at a single point and ignores costs of transmission due to line losses and congestion

England and Wales use a postage stamp system in which transmission tariffs are set every five years and then allowed to increase at a rate equal to the growth rate of the Retail Price Index (RPI) minus some rate of anticipated technological change (X), where X is a measure of the performance improvement the regulator wants the ISO to achieve over the next five years. At a first glance, this RPI-X pricing seems to be straightforward. However, in practice this is not the case as the value of X depends on expectations and on the regulator being able to get accurate information from the transmission system

owner. The major advantage of RPI-X pricing is that it gives transmission system owners an incentive to increase efficiency (reduce costs) faster than X until the next review, when a new benchmark is established.

Postage stamp pricing does not take into account different costs of different voltage levels at which power is delivered. Also, it does not solve the problem of providing correct incentives for consumers to expand or curtail consumption or for generators to locate generating capacity optimally. It only provides incentives to the system operator for efficient exploitation of the grid.

Germany and Japan use postage stamp systems in which the prices are based on the historical cost of transmission investment and current operating costs, but not including allowances for line loss or congestion. If reform of the Japanese electricity market requires competition to come from existing utilities' generation, then the relatively small capacity of inter-regional transmission lines may create a significant amount of congestion, and a simple postage-stamp system for all of Japan may be inefficient.

Multi-Part Tariffs

In order to get somewhat closer to charging according to capacity voltage levels as well as peak demand and energy, multi-part tariffs charge separately for connect charges that vary by voltage, peak demand charges, and perhaps energy and reactive power charges. However, they do not account for line losses and congestion costs.

2.3.2 Differentiating Transmission Prices by Location

Pricing transmission services by location is very important for relieving congestion and recovering the costs of transmission losses.

Postage-stamp Pricing, as discussed above, this approach allows a customer or supplier access to an area's transmission system at the same uniform cost regardless of where power is injected or used (Germany and England and Wales). However, if there is congestion, the system operator may need to deviate from least-cost generation to select sub-optimal generation whose location will relieve congestion. Postage-stamp pricing is relatively simple, but it can cause real-time dispatch to be badly inferior to what it would be if line losses and congestion are significant and were priced appropriately.

Nodal Pricing refers to the practice of charging a different price for each point (or node) where power is used or injected (PJM, New Zealand). If congestion arises along the system, the prices at different nodes will change. Higher price differentials will reduce congestion along certain lines, while lower price differentials will increase the use of other lines. Firm transmission rights can reduce the risks of sudden changes in nodal prices for companies participating in restructured electricity markets.

The complexity and restrictive characteristics of nodal pricing are rationalized on the grounds of short-term economic efficiency. However, like all bidding systems, it is vulnerable to the exercise of locational market power. Moreover, since nodal pricing requires centralized dispatch, it gives enormous power to the system operator for favoritism or other sub-optimal behavior. Thus, if nodal pricing is implemented, it is important that the system operator does not have any conflict of interest and that it has strong, independent regulation and supervision. All things considered, although there are many problems with nodal pricing, it may still be an improvement over postage-stamp pricing – especially if congestion or line loss is important.

Zonal pricing separates a country's or large region's transmission into zones. It is an attempt to have location-based pricing that is less complex than nodal pricing by setting prices on the basis of area (zones) rather than points (nodes). This is used in Australia and California. It implicitly assumes that zones do not have any serious congestion problems within their borders. Congestion across zones can be relieved by charging different zonal prices. In practice, it is more complex than it appears. If the zones are few (and therefore large) congestion can arise within the zones and must be handled separately. If the zones are many, the pricing system becomes more like a nodal system. PJM began with a zonal system and then abandoned it in favor of a nodal system.

Balancing Markets: In Nord Pool, separate balancing markets are used to manage and price congestion. Sweden and Finland use "countertrade" principles in which the system operator pays for power that would be competitively generated in an area but is constrained by transmission congestion. It also pays the additional amount for electricity that would normally not be competitive but needs to be brought on line to relieve congestion. The system operator recovers the revenue through system-wide transmission charges.

In Norway, prices are lowered in surplus areas and raised in deficit areas until congestion is relieved. Whatever costs that the system operator incurs are recovered in a market settlement process among all market participants.

The "Pancaking" Issue²

In countries such as the United States where integrated utilities often use postage-stamp pricing, power flows across several utilities had to pay for the "postage stamps" of each of the utilities their paths. If there are several utilities between the generator and the buyer, the "pancaked" charges may make transmission costs so high that they discourage inter-regional competition. This practice has now been forbidden in the U.S. for transmission within regional (multi-state) transmission areas.

Thus, while there may be incremental costs of inter-regional transmission due to congestion and line loss, each region adding the full costs of intra-regional transmission is not an efficient way to deal with this problem and significantly overstates costs.

² A "pancake" is a type of flat bread found in many English-speaking countries. They are usually served in stacks. Thus, "pancaking" means that transmission charges are added to one another, as in a stack of pancakes.

Advantages and Disadvantages of Transmission Pricing Approaches

Pricing Approach	Advantages	Disadvantages	Requirement
Nodal	Eliminates congestion by reducing demand or increasing supply at points where prices are high.	Participants may have difficulty in following and understanding multiple prices in many locations.	System must allow a different price at each point that power is inserted and extracted. Participants need financial instruments (e.g., firm transmission rights) that will protect them from changes in nodal prices.
Zonal	May reduce some congestion with fewer prices than the nodal system.	Congestion can develop within a zone, requiring constant and confusing changes in how zones are defined.	Zones must be defined to eliminate congestion within a zone.
Postage-Stamp	One fee is charged in a simple and transparent fashion.	Approach does nothing to relieve congestion and tends to protect incumbent generators from competition with new entrants.	Mechanisms for allocating fees across multiple system operators are needed. Otherwise their fees will be added on top of each other.

2.4 Power Exchange and System Operations

A power pool is a centralized mechanism that schedules supply and demand to be efficient and reliable. Thus, power pools undertake centralized system operations. Power exchanges are markets that determine the prices and quantities of electricity that are to be sold under unconstrained conditions and provide schedules to the system operator. Power pools may also have the function of running an auction to determine least-cost dispatch of units, subject to reliability constraints. Thus, pools may also be power exchanges, but power exchanges are not pools.

California is an example in which the exchange was separate from system operations. In most systems that have centralized dispatch, such as England and Wales before 2001 and PJM Interconnect, the two functions are integrated. Thus, the term “power pool” is often used in a way that includes the power exchange as well as the systems operation function. Also, power exchanges may be either auction markets, as in the California Power Exchange, the England and Wales Power Pool, or the Australian National Electricity Market; or they may be a clearinghouse for buying and selling contracts, as in Nord Pool’s Eltermin.

There are several models for the ownership, operation and regulation of electricity system operations. With the exception of Germany, however, all of the countries that we have investigated have separated ownership of generation from operation of the transmission system. In California and PJM, the former integrated utilities own the transmission lines; but the transmission system operator is an independent, non-profit entity that reports to a board in which the utilities do not have dominant influence. Also, the transmission system operators in the U.S. are regulated by the federal government. This appears to be a workable model, inasmuch as the independent system operators (California ISO and PJM Interconnect) have not been subject to serious criticisms of unfairness.

Argentina and England and Wales privatized their transmission systems into separate companies. By law, generators can neither own an interest in the transmission system nor participate in its operation. In England and Wales, the owner of the grid is also the operator and is regulated by the government. In Argentina, a separate non-profit company was established to operate the grid. It is owned and managed by the government and organizations that represent market participants. Victoria, Australia, has a similar arrangement. However, the grid owners in these cases do not operate the power exchange.

2.5 *Electricity Trading Arrangements*

One of the most important aspects of electricity restructuring if there are de-integrated functions is how to buy and sell power at the wholesale level. Many of the problems of de-integrated systems to date have been concerned with the economic efficiency of wholesale markets and their vulnerability to manipulation. In this section, we describe in general terms some of the alternative arrangements of wholesale markets.

Do we want to explain uniform-price auctions and bilateral trading in this parag? There is no dominant system, and there is till a great deal of controversy over whether it is best to use uniform-price auctions or bilateral trading. Only the England and Wales system has used both as its dominant means of organization, starting with uniform-price auctions and switching to bilateral, pay-as-bid trading in March 2001. Australia uses a mandatory auction market like the former England and Wales Power Pool. Nord Pool uses a bilateral market for longer-term transactions and an auction market for day-ahead transactions.

The International Energy Agency (2001, pp. 85, 86, 92, and 93) has summarized the arguments concerning bilateral trading and auctions as follows:

- For bilateral trading and against auctions:
 - Demand is represented explicitly in the market. In principle, this should permit more demand responsiveness and therefore increase efficiency in the market through better market information.
 - Offers and bids are firm. Thus, participants that can best manage risks are responsible for doing so and face the costs and consequences for failing to meet commitments.
 - Bids and offers are simple and transparent.

- Against bilateral trading and for auctions:

- Bilateral trading is incompatible with optimization through centralized dispatch. However, in principle bilateral trading may still be economically efficient. Experience in Nord Pool and in England and Wales under NETA suggest that this may be the case.
- Lack of transparency of prices to end-users. However, the England and Wales and California auction markets did not turn out to be very transparent either.
- Potential collusion between generators and retailers. This concern was one reason California chose an auction market for its major utility distribution companies, but it does not seem to have been a problem elsewhere.

2.5.1 Auctions

Power exchanges are centralized markets and are organized to provide an efficient market place for electricity, especially on short notice. This is necessary to achieve optimal, differentiated generation and flexible load.

Power exchanges typically have auctions as one of the means of matching supply and demand and setting prices for electricity. Several auctions (day-ahead, hour-ahead) auctions are run by each power exchange, and they are run frequently – say every half-hour. In a typical auction, sellers submit bids in the form a supply schedule (how much they are willing to supply at various prices), and buyers submit bids in the form of a demand schedule (how much they are willing to buy at various prices).

Block-forward auctions allow bids for blocks of electricity to be delivered at a set price at some time in the future. Imbalances between scheduled and actual supply and demand that inevitably arise are handled following some predetermined procedures, which may be market-based or not. The price actually paid by the bidder can be determined in basically two ways:

1. pay-as-bid (PAB), in which each transaction is settled at the price that was bid
2. uniform-price, in which the price that is received by all accepted bidders is the bid that was received by the last bidder whose bid was accepted. In theory, this is the marginal cost of supply in the system (system marginal price or SMP)

The system operator constructs aggregate supply and demand schedules many times per day. In a uniform-price system, all producers whose bids are below the SMP earn that price times the quantity sold. Under PAB-pricing, producers earn their own bids times their bid quantities, as long as they are below the SMP at supply-demand equilibrium.

2.5.2 Bilateral Agreements

On most markets bi-lateral agreements besides the spot market transactions dominate electricity trading. Bilateral transactions are decentralized in that they take place between multiple buyers and sellers rather than through a single buyer, such as a power exchange. These agreements are typically contracts for a certain amount of power to be delivered at a particular date in the future at a particular price. Unlike a block-forward auction, such contracts are struck by bilateral negotiation. Such agreements are

coordinated by system operators, and auctions are used for balancing transactions. The spot market prices may serve as guidelines for price determination for short-term bilateral contracts, while longer-term contracts involve expectations about future prices.

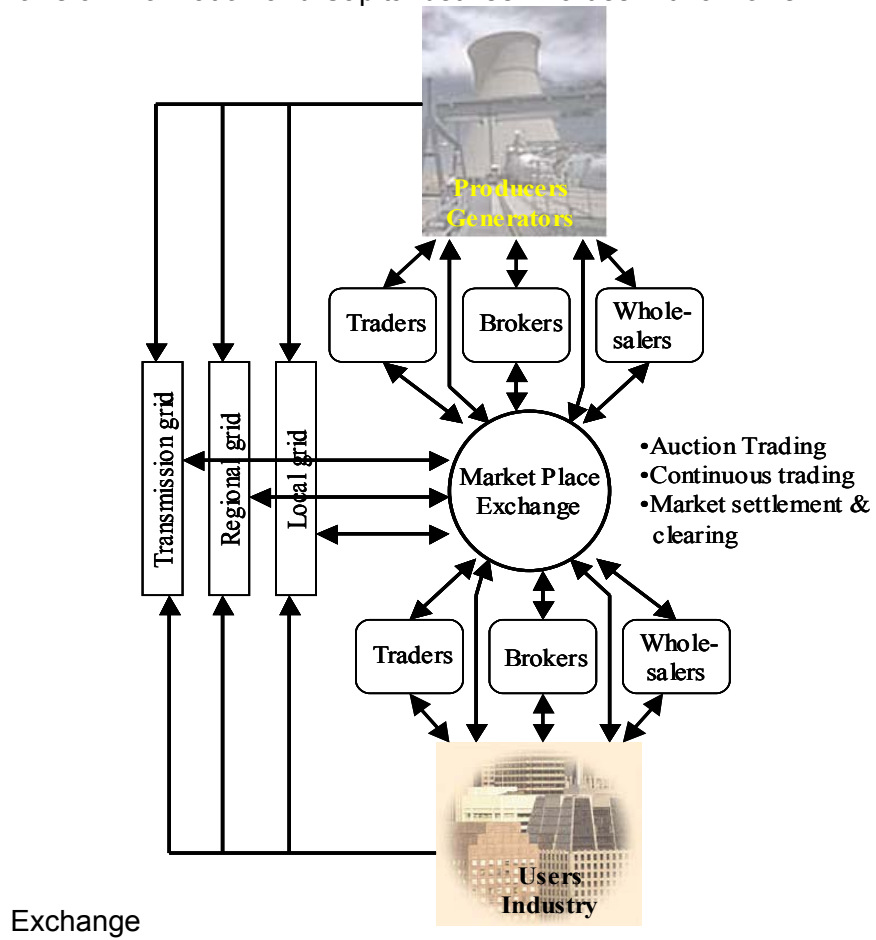
2.5.3 Market Participants

In a power exchange, no single generator is responsible for the supply of a specific customer, as in power systems with vertical integration or bilateral contracts. A power exchange market has many participants with different roles. Some are considered as part of the infrastructure (exchange operators, systems operators, grid owners, and the regulator) and have to cooperate in order to insure a reliable supply of electricity. The basic organization of a power exchange is shown in Figure 1.

A power exchange creates an economically efficient market for wholesale electricity because of the following characteristics:

- Anonymous trading in a central market
- Coordination of a market for financial products, such as forward, futures, and option contracts.
- Use of the spot market's price mechanisms to alleviate grid congestion (capacity bottlenecks) through optimal use of available capacity.
- Speedy trading without negotiations
- Neutral and reliable power-contract counterparty to market participants.
- Open information about prices and traded volumes

Figure 1
Flows of Information and Capital between Parties with a Power



2.5.4 Comparison between Different Existing Power Exchanges

A summary of how trading is organized on some existing electricity markets is provided in Table 1.

Table 1
Organisation of Electricity Pools in the OECD Area

Market	Participation	Demand side Bidding	Simple bids*	Pricing**	Capacity Mechanisms	Integrated Dispatch***
England and Wales before NETA	Mandatory	No	No	Ex ante	Yes	No
Nordpool	Voluntary	Yes	Yes	Ex ante	No	No
Australian NEM	Mandatory	Yes	Yes	Ex post	No	Partially integrated
New Zealand Electricity Market	Voluntary	Yes	Yes	Ex post	No	Yes
Spanish Electricity Market	Voluntary	Yes	No	Ex ante	Yes	No
California PX (US)	Voluntary	Yes	Yes	Ex ante	No	No
PJM ISO (US)	Voluntary	No	No	Ex post	Yes	Yes

* Simple means that bids are price-quantity pairs; not simple means that prices may have additional terms

** Ex ante means that prices are calculated for scheduled supply and demand; Ex post means that prices are calculated for actual supply and demand

***Integrated dispatch means that system optimises joint use of generation and grid resources; otherwise there is unconstrained dispatch that ignores possible transmission constraints.

Note: Participation in the California PX was mandated by the California regulator for the three big utilities (75% of the market) until 2002, but it collapsed before participation became voluntary.

Table 1 shows that pricing and scheduling mechanisms vary widely. Bidding, e.g., can be iterative or one-shot and may allow for demand side bidding or not. Bids can be firm or non-firm and can be simple, containing just a price per kWh, or may include several terms. There can be price ceilings or other constraints on bidding behavior; and transactions can be settled in a number of ways. It has been found that electricity spot markets with mandatory participation tend to have more volatile prices than systems with voluntary participation.³

2.5.5 Derivatives Markets (Financial Hedging)

Spot markets are volatile, and volatility implies risk. Thus, there is a great variety of financial instruments that may be used for transactions on power exchanges. These are continuously traded since the market must be flexible and participants should be able to change their positions frequently in relation to the ever-changing market conditions.

³ Wolak, F.A., 1997. "Electricity Market Structure and Pricing - an International Comparison". Paper presented to Energy Modeling Forum 15, 11-12 September 1997, Stanford University.

2.5.6 Some Existing and Recent Power Markets

England and Wales

England and Wales was first to introduce a “deregulated” exchange. The Pool (which has now been replaced by the New Electricity Trading Arrangements or NETA) was established in 1990 to serve twelve regional distribution companies and now a fully competitive retail market. Its trading arrangements were based on a centrally organized spot market that set prices for electricity throughout the following day, by way of an auction market that matched supply offers and an estimate of demand. Thus, it was a day-ahead auction market. The principles were simple; the Pool was (OGEM, August 2001) :

- A set of rules defining how electricity was to be traded;
- The actual system through which generators had to offer wholesale electricity, and from which those who wanted to buy wholesale electricity had to buy;
- The mechanism by which wholesale electricity prices were set, for each half hour, and plant was dispatched; and
- The settlement system, by which generators were paid and suppliers were charged

Dissatisfaction with the Pool’s performance in reducing electricity prices led to NETA, in place since March, 2001.

NETA is based on bilateral trading between generators, suppliers, traders and end-users. NETA operates as far as possible like other commodity markets, while at the same time making provision for the electricity system to be kept in physical balance at all times to maintain security and quality of supplies. It includes contracts for electricity to delivered several years ahead; short term spot markets, which allow participants to “fine tune” their contract positions in a simple and accessible way; a balancing mechanism for last-minute requirements for supply to equal demand; and a settlement process for charging participants

The Nordic Countries - Nord Pool

The Nordic Market (Sweden, Norway, Finland and Denmark) is today a unified and largely deregulated market. Nord Pool is a voluntary electricity wholesale exchange that operates the following marketplaces and market services:

- A spot market for physical contracts (day-ahead, unit prices)
- A financial derivatives market – future, forward, and option contracts
- Clearing services for financial electricity contracts

Market participants include direct participants (power generators, distributors and large end-users), traders acting on behalf of actual or potential participants, and market makers for financial derivatives.

California Electricity Market

The California Power Exchange (PX), before its collapse, conducted daily auctions to allow trading of electricity in the day-ahead and hour-ahead markets. It was in principle a voluntary pool. However, the major Californian utilities were mandated to sell and buy only through the PX for the first four years of operation (i.e., until mid 2002).

The PX accepted demand and generation simple bids (price, quantity) from its participants, determined the Market Clearing Price (MCP) at which energy is bought and sold (a uniform price), and submitted balanced demand and supply schedules for successful bidders to the TSO. It also submitted bids for ancillary services, real time balancing and congestion management. The auxiliary services and real-time balancing markets are alternatives to a capacity market.

The trading procedures in the day-ahead and hour-ahead markets were as follows. For each hour of the 24-hour scheduling day, the PX constructed aggregate supply/demand curves. Their intersection determined the MCP. The TSO determined, based on all unit specific supply bids and location specific demand bids, whether there was congestion. If there was congestion, the TSO used adjustment bids to submit an adjusted schedule to the PX. These adjusted schedules and TSO determined usage charges become the foundation for zonal MCPs and the final schedule submitted to the TSO.

A major element of California's electricity problems was that hedging by the major utility distribution companies was forbidden. To our knowledge, this was the only power exchange that has had such a requirement. (IPPs, however, could hedge their risk by selling power under contract to traders, who then sold it on the PX.) Also, California was unique in that it separated the power exchange and the TSO into separate entities.

PJM Interconnection Electricity Market

PJM is both a voluntary power exchange and a TSO. It operates a day-ahead market in which generators submit offers that may include a number of price terms. However, only one price bid per day can be submitted. Dispatch is determined on the basis of these offers. PJM sets nodal prices for energy. These prices are computed for the actual dispatch and, when transmission constraints are binding, prices are differentiated by location.

PJM also operates a capacity market. This approach is also followed by other US system operators such as Nepoch (New England) and the New York system operator, but not in California. The capacity market results in capacity payments to generators, just as in the England and Wales pool, but they are determined by the market instead of administratively. All distribution/retail companies are required to purchase installed capacity reserves in addition to energy.

Germany

Germany's electricity market is the only one in the European Union that has no independent regulator. Instead, it has a system of self-regulation through various existing energy laws and -- most importantly -- the so-called Associations.' These gentlemen's agreements govern the use of the grid but have no legal status. The agreements include mainly the industrial end-users and the grid owners/operators, but not households

The European Energy Exchange (EEX) uses day-ahead trading with standardized products on the EEX Spot Market, which can be accessed on the Internet. There is also a futures market that permits market participants to hedge risks. Thus, EEX is keeping the entry hurdles for potential market participants intentionally low. New participants can be connected to the systems faster and more cost-effectively. Some characteristics of the German market development from 2000 are as follows⁴:

- Market Development (from 2000 to 2002)
 - Overall trading volumes are expected to increase more than twofold from 218 TWh in 2000 to 552 TWh in 2002
 - Volumes in physical trading are expected to increase from 188 TWh to 271 TWh, while volumes in financial trading are expected to increase from 30 TWh to 281 TWh
 - Wholesale trading will shift from a primarily physical to a balanced physical and financial trading market
 - Exchange markets supplement OTC markets in both physical and financial trading
 - OTC markets remain the dominant market places for physical transactions
 - Roughly 20% of physical transactions will be conducted on power exchange spot markets
 - Exchange future markets are estimated to gain a 50% market share in financial trading
- Transactions and Contracts in the OTC markets
 - On average, each company conducts 900 spot transactions á €50 and 100 forward transactions á €700 each month
 - Deal completion of a spot transaction takes between 43 seconds and 5:27 minutes; of a physical forward transaction between 8.58 hours and 178.91 hours
 - “Forwards” represent the most frequently traded contracts in the physical forward market, “Day Ahead Peak” contracts in the spot market and “swaps” in the financial forward market
 - 68.75% of the respondents did not trade derivatives with a cash settlement at all
- Electronic Trading
 - 62.5% of the respondents use electronic OTC trading platforms
 - Electronic trading platforms are almost always used for information search (in 63.11% of all transactions)
 - Anonymity is not considered an important advantage of electronic trading platforms
 - Most respondents could imagine using an automated negotiation and price discovery by means of electronic trading systems

France

French law is unclear with regard to electricity trading. A restrictive interpretation does not allow for such trading (purchase for resale), except for duly authorized producers and their subsidiaries, who must obtain special permits. Furthermore, such trading is limited to 20% of a producer's capacity. A liberal interpretation does not expressly prohibit or regulate electricity trading. Only the producers authorized to produce electricity in France would be limited in their trading activities.

⁴ <http://www.electricitytrading.org/extras/strecker-weinhardt-ebusiness-in-the-deregulated-german-wholesale-electricity-market.pdf>

Since September 2001, the regulatory authority (CRE) determined that trading activities may be carried out freely in France, in particular by foreign suppliers. It also approved that an electricity spot market be set up. "Powernext" is backed by the French government and is a daily spot market organized on the basis of standardized hourly-based contracts that allow day-ahead exchange of electricity. Both French and foreign operators (generators, traders, brokers, eligible end-users) are allowed to participate in the market, which covers 30% of the total market. The opening of Powernext has led to an average price reduction to end-users of about 15%⁵.

3. Outstanding Issues Facing Japan's Electricity Sector

While the current Japanese system of private vertically integrated utilities charges high prices for electricity, it has the advantage of being highly reliable and predictable. Also, it provides universal service. These strengths must be kept clearly in mind so that they are retained in any restructuring scheme. Thus, the goal of electricity restructuring in Japan may be stated as minimization of prices to end-users subject to the constraints of high reliability and universal service. Other important considerations are environmental quality and energy security.

In the restructuring of Japan's electricity sector, a number of issues must be resolved. These will be presented briefly to establish a framework for subsequent discussion.

3.1 Issues for the Entire Electricity Sector

3.1.1 Complete Liberalization in Five Years

Electricity reform is often referred to as "liberalization" or "deregulation." Its objective is to come as close as possible to the working of perfectly competitive markets in terms of efficiency and consumer welfare. However, because of inherent monopoly characteristics of transmission and distribution it is never possible to completely liberalize electricity markets: some type of government control must be present and may even be more complicated than under vertically integrated, franchised monopoly utilities. What can be liberalized is generation and retail sales, and transmission and distribution must also be restructured to accommodate new issues that arise from liberalization of generation and retail sales.

Allowing five years for complete liberalization, in our opinion, is feasible. Other successful states/countries have taken longer, such as Pennsylvania, England and Wales, and Victoria, Australia. California, however, with an electricity sector much like the integrated utilities of Japan, tried to completely restructure its electricity sector in two years and had serious problems. Had it moved more slowly, some problems might have been identified and solved before they became serious.

It has been clear for many years in many places that generation can be competitive and that most of the gains of electricity restructuring come from increased efficiency in generation. The countries that have restructured successfully started by developing the institutions and rules necessary to liberalize the wholesale market. Liberalizing the retail market came much later, if at all. England and Wales and Victoria, Australia reached

⁵ Andersen Legal, 2002

complete liberalization of retail sales only in 2002, eight to ten years after liberalization began. Argentina maintains a regulated retail market with franchised monopoly distributors.

Moreover, the gains in consumer welfare from liberalizing retail sales may be small and no greater than would be the case under effective regulation. In Argentina, regulation of sales to small customers has been effective so far, while generation is competitive. Thus, it appears that liberalization of retail sales can follow liberalization of the wholesale market. Following the experience of others, it can be phased in: the largest customers first, the smallest customers last.

An important question for Japan is how it is to achieve competition in generation. At present, each region is dominated by a single utility, and the utilities seem to have adequate generating capacity to serve current and future load for some time. There are few independent power producers. Thus, if the EPCOs retain their own generating assets, significant competition can come only from other EPCOs. However, this requires a substantial capacity in transmission lines between the EPCOs. At present, this capacity is small relative to what would be necessary for a competitive generation market.

3.1.2 De-integration of Utilities

There is a controversy over whether it is possible to have the benefits of competition in liberalized markets if there is no functional separation of different stages of utility activity: generation, transmission, distribution and retailing. Where utilities have been owned by government – as in England and Wales, Australia, Argentina – they have typically been completely de-integrated in ownership as well as function. However, in the United States – whose basic structure is similar to Japan's – utilities have de-integrated functionally but have retained many of their generation, transmission and distribution assets. In Germany, however, utilities have become somewhat competitive while maintaining only accounting separation. The various options for de-integration are discussed in general on pp. 4-7 of our earlier paper (June 2002).

Germany is unusual in that it has maintained its vertically integrated utility structure, is unregulated (but is subject to anti-monopoly laws), and competitive in principle. Germany's six major utilities use a system of self-regulation through various existing energy laws and -- most importantly -- a grid code. It is an example of the accounting separation approach.

The three industry associations that have agreed the grid code represent mainly the industrial customers and the grid owners/operators, but not households or other diverse interests, especially newcomers to this market. (Ku, 2001) The code is a private, voluntary, non-legal framework agreement for the use of the grid. Competition among the utilities is made possible by a highly interconnected grid between the utilities' former monopoly franchise areas.

The lack of an independent regulator empowered to act before the event, and the essentially secretive nature of negotiated third party access, has made it relatively easy for vertically integrated incumbent utilities to defend their businesses from serious challenge. The grid code has done little to improve transparency of information, and new

suppliers have frequently had to file 'abuse of dominant position' complaints with the Federal Cartel Office.

In 1998, a law was enacted that immediately opened Germany to retail competition. However, there has been very little switching of retail suppliers by domestic customers. This appears to be due to a combination of factors: domestic customers are basically satisfied and – in the absence of electric heating and cooling – not too concerned about their electricity bill, it takes four to five months to process the paperwork to switch suppliers, and households are not represented in the deregulation process. (Ku, 2001)

In general, there appears to be little strong opposition to the accounting separation model within Germany, except for potential new entrants, who have difficulty gaining access to transmission. However, in the European Union, there is a strong opinion that internal accounting separation is not sufficient for the establishment of a competitive market and that strong de-integration measures are desirable, particularly with respect to transmission. (Commission of the European Communities, 2001, p. 70)

De-integration of Utilities

Many observers believe that it a necessary condition for competitive electricity markets is the de-integration of vertically integrated electric utilities. One outstanding issue is to what degree it is desirable for utilities to maintain ownership of functionally de-integrated generation, transmission and distribution entities. Another is how to accomplish allow utilities to retain ownership and still maintain the advantages of competitive markets.

3.2 *Issues for Generation*

3.2.1 How to Introduce New Generating Capacity into the Market

Because land is scarce, there is a barrier to entry of new electricity capacity from IPPs. It is difficult to build new generating capacity anywhere except in established power plants or industrial sites. Even if they are able to find sites, new IPP plants must comply with national, prefectural and municipal environmental requirements, implying long planning cycles and high costs.

Another barrier to entry is that fuel supply for IPPs (mostly LNG) is largely controlled by integrated utilities, putting IPPs at a competitive disadvantage. Also, many IPPs would prefer to buy power plants rather than build, but there is nothing to encourage or compel integrated utilities to sell.

Perhaps the single most important factor in attracting new generating plants to an electricity market is strong regulations that require that all qualified generators and customers have access to the transmission system and that they pay non-discriminatory rates. In all of the markets we have examined except Germany, this is required by law and/or regulation. In Germany, many actual and potential independent generators complain that they do not have fair access to the transmission services and that the pricing of transmission services is unfair. (Ku, 2001)

Another important issue is how to induce investors to provide enough capacity to insure that reserve margins are adequate for desired levels of reliability. Some systems, such as PJM, England and Wales during the Power Pool, and Spain, provide for separate

capacity payments to insure that there will be adequate capacity. Others leave the provision for capacity to the market but require that retail suppliers always have reserve capacity, thus providing a market enough plants to provide it. The International Energy Agency has a number of criticisms of capacity payments and suggests alternative approaches to achieving adequate reserve capacity. (International Energy Agency, 2001, pp. 96, 97)

An important problem is that under deregulation, investors take greater risks than under regulation, since regulated utilities can count on recovering capital expenditures through regulation. The greater risks due to unregulated markets will tend to raise the cost of capital for new capacity. This will tend to discourage the addition of new capacity.

3.2.2 Exercise of Market Power

There is a potential for the exercise of market power as long as utilities have near-monopoly positions in traditional regions. Examples of remedies are divestiture of generating assets, which seems unlikely (Hori, 2001, p. 42) or interregional competition (a national market) among the existing ten utilities. In any case, for competition to be healthy, there must be a reasonable number of strong competitors and regulatory safeguards to assure that they do not exercise market power, either through collusion or through manipulating the market.

3.3 Transmission

3.3.1 Low Interregional Transmission Capacity.

A straightforward way to make the wholesale power market more competitive is to sell power freely from region to region. However, even though interregional transmission capacity is not a problem currently, it could become a serious problem if there is much new IPP capacity trying to sell power throughout the network. (Hori, 2001, p. 37)

3.3.2 Transmission Access and Pricing

Competitive electricity systems require fair transmission access and efficient transmission pricing. Currently, transmission access charges are based on a capacity charge and energy charge. In addition, charges are levied by the utilities for energy imbalances, reserve capacity, emergency backup and other services that are supported by the utilities. It is said that these charges are high, and their bases are not transparent. (Iida, p. 5) Moreover, if power is transmitted over several utilities' regions, each one will levy a transfer charge, and the cumulative charge may be prohibitive. (Hori, 2001, p. 37) The accumulation of charges is what we have referred to above as the "pancaking" issue.

It appears likely in Japan that competition will require a substantial increase in the flows across inter-utility connections. The best pricing system depends significantly on the amount of congestion that these flows will create. If congestion is not present, then simple postage-stamp pricing is likely to be efficient. However, if congestion is present, then nodal or zonal pricing should be considered. One way or the other, it would seem advisable to establish a nationwide system of transmission pricing that avoids the "pancaking" issue.

3.3.3 Importance of Independent Dispatch

Dispatch of generating units is currently done by the integrated utilities that own the transmission system. This situation could thwart the introduction of increased competition if potential investors are worried that the owners of the transmission system will be biased toward the dispatch of their own generating units.

3.4 Distribution and Retail Sales

Currently, there is no competition among distributors for procurement of least-cost electricity or competition for end-use customers.

3.5 Independent Regulation

As part of the elected Japanese government, there might be a concern that METI may not be independent of political influences in its regulatory activities. In other countries, this has caused serious problems, and most observers believe that regulators should be appointed in such a way as to be independent of electoral politics. In Argentina, however, the regulator is in the Ministry of Energy and has so far maintained its independence.

4 Basic Electricity-Sector Organization Alternatives

There are several basic ways to structure the electricity sector. Each of them has strengths and weaknesses that should be considered in the process of reform.

4.1 Integrated Electric Power Companies

In Japan, as in the U.S., the basic organization of the electricity industry has been that of private integrated electric utilities that operate as franchised monopolies under the supervision and control of regulators.⁶ Each electric utility owns a number of generating plants whose power is distributed over the grid through centralized dispatch to regional distribution units, who then provide electricity to end-users. This basic form of organization is shown in Figure 1. Until 1995, the electricity industry in Japan followed this simple model completely, and it is still fairly accurate as a basic description, although developments since 1995 and then 1999 have changed it somewhat.

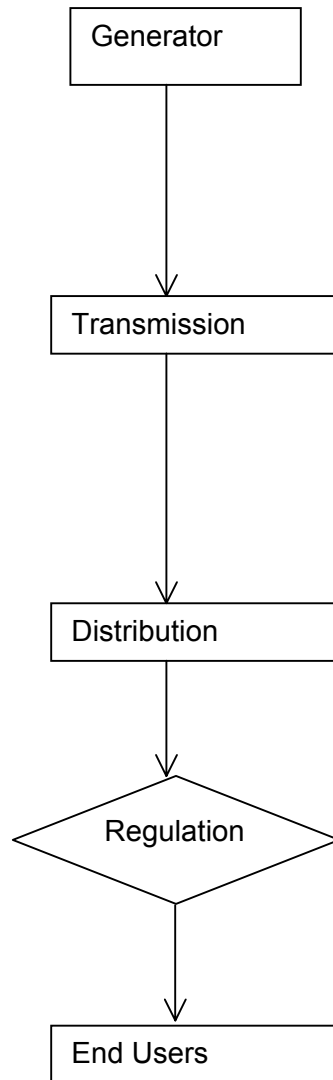
Regulators pursue the objectives of least cost, reliable electricity, subject to the constraint of financially healthy electric power companies that are willing and able to operate and maintain their systems effectively and expand their capacity to meet growing electricity demand.

The problems with this form of organization are well known. One is the lack of incentives to operate and invest efficiently under conventional regulation. The principal focus of conventional regulation is the cost of electricity delivered to end-users. Allowed tariffs are set to generate enough revenue to meet a predetermined rate of return on capital or equity. Any cost savings that might be realized are passed on to end-users

⁶ A major difference is that in Japan, regulation by a ministry of the government, whereas in the U.S. regulation is by state and federal commissions that are independent of elected officials.

rather than shareholders, thus offering the electric utility no incentive for efficient operation.⁷ Moreover, if the electric utility makes a mistake and incurs excessive costs, regulators may not allow these costs to be passed on to end-users. Thus, electric utilities tend to avoid risk, since good outcomes are passed on to end-users and bad outcomes are passed on to shareholders. Also, the structure of conventional regulation encourages capital expenditure in excess of what is needed to supply required levels of service. Regulators attempt to control such expenditure by tests such as whether they are "used and useful" or "prudent". However, these are crude, subjective tools that are difficult to apply efficiently and equitably.

Figure 2
Electricity Flow
Integrated Generation, Transmission and Distribution



⁷ More complex regulatory schemes have been introduced in some places to provide more incentives to electric utilities by allowing them to share in the returns to increased efficiency.

4.2 De-Integrated, Competitive Generation with Integrated Transmission and Distribution

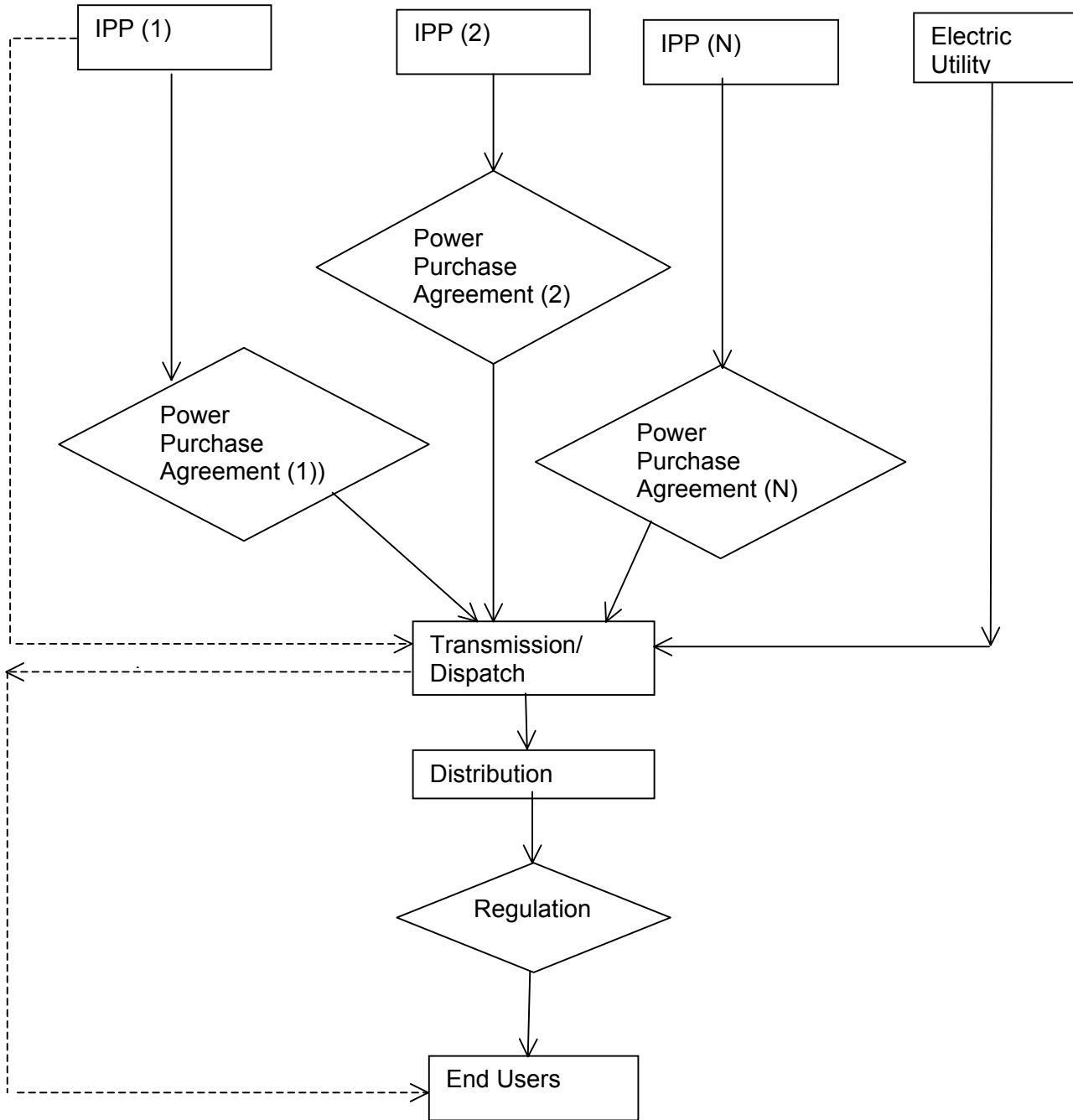
It has long been recognized that the natural monopoly attributes that were applied to integrated electric utilities did not apply to electricity generation standing alone. Beginning in the late 1970s, the U.S. began a series of statutory changes that led to the emergence of independent power producers (IPPs). IPPs are privately owned, unregulated power generators that sell their output to electric utilities, the grid or to large retail customers (such as electricity-intensive manufacturing plants). The most common organization involving IPPs has been for them to sell power to electric utilities via long-term power purchase agreements (PPAs). Given the single-buyer (monopsony) status of the electric utilities, the only sensible way for an IPP to be in such a market would be through a long-term contract. Since the 1995 revision of Japan's Electric Utility Industry Law -- as in most electric utilities of the U.S. since 1978 -- IPPs supplement the electric utility's own generation. Moreover, as mentioned above, since year 2000 Japan's large customers have been able to buy directly from IPPs, with the power wheeled over the integrated utility transmission system.

The organization of the electricity industry with IPPs and integrated transmission and distribution (the current state of the Japanese electricity sector) is shown in Figure 2. PPAs obligate the IPP to deliver a certain amount of electricity to the electric utility under a specified price formula. The electric utility is typically obliged to pay for the contracted amount of electricity whether it needs it or not. (In some cases, the purchaser pays for capacity (kW) but not necessarily for energy (kWh) that it does not need.) PPAs can be awarded on the basis of competitive tender or direct negotiation.⁸

The primary motive to move from an integrated electric utility to IPPs is the desire to increase efficiency in generation through competition. IPPs with PPA's are an important step toward more competitive electricity markets, inasmuch as the electric utility no longer has a monopoly on generation. However, they still fall short of the conditions for full short-run competition. First, even though the PPA may be competitively tendered, its terms are fixed over a long period of time -- say twenty years. Therefore, it is only by coincidence that its price would be the same as a spot market's price. If there is excess capacity, it is likely that the PPA price will be higher than the spot market price would have been, while if there is excess demand, the PPA price will be lower than the spot market price would have been. Of course, price stability may be considered a major advantage compared to the price volatility of spot markets. Unlike conventional rate of return regulation, once the PPA is in place any cost savings due to increased efficiency are kept by the IPP rather than passed on to end-users.

⁸ See Crow (2001) for an account of the development of IPPs and PPAs.

Figure 3
Electricity Flow
De-integrated Generation with Integrated Transmission and Distribution



In Japan after 1999, this basic structure was altered by the revision to the Electric Utility Industry Law to allow direct sales between IPPs and large end-users. However, electricity must still be “wheeled” over electric utility transmission lines. This development is indicated in Figure 2 by the dashed lines.

One approach to alleviate the distortions introduced by a single buyer and to enable electricity to be sold on a spot market is a power exchange. This requires the operation (but not necessarily the ownership) of the transmission system to be de-integrated from generation and for an institutional framework to be established in the transmission system so that power is sold on an auction basis on the power exchange. It is then dispatched to distributors at cost plus fees to cover the costs of operating, maintaining and perhaps expanding the transmission system.

4.3 *Merchant Power with Many Monopoly Distributors*

While IPPs competing for PPAs are an important step toward a competitive electricity industry, they have important shortcomings as discussed above. The next step toward perfect competition is to arrange markets so that they match many sellers (IPPs) with many purchasers. When there is only a single purchaser, PPAs are necessary because only by negotiating long-term agreements before building a power plant can the IPPs avoid being of the victim of the purchaser’s monopsonistic power. Thus, many buyers make it possible to eliminate PPAs and (theoretically, at least) have prices determined by short-run marginal costs on a spot market based on auctions. In practice, however, full reliance on a spot market can lead to great price volatility; so almost all places with power exchanges (e.g. England and Wales Power Pool and Pennsylvania/PJM) provide for hedging of prices through some combination of bilateral contracts and financial hedges. (These will be discussed further below.) One of the most important factors of the failure of the California market was its heavy reliance on spot-market transactions without hedging.

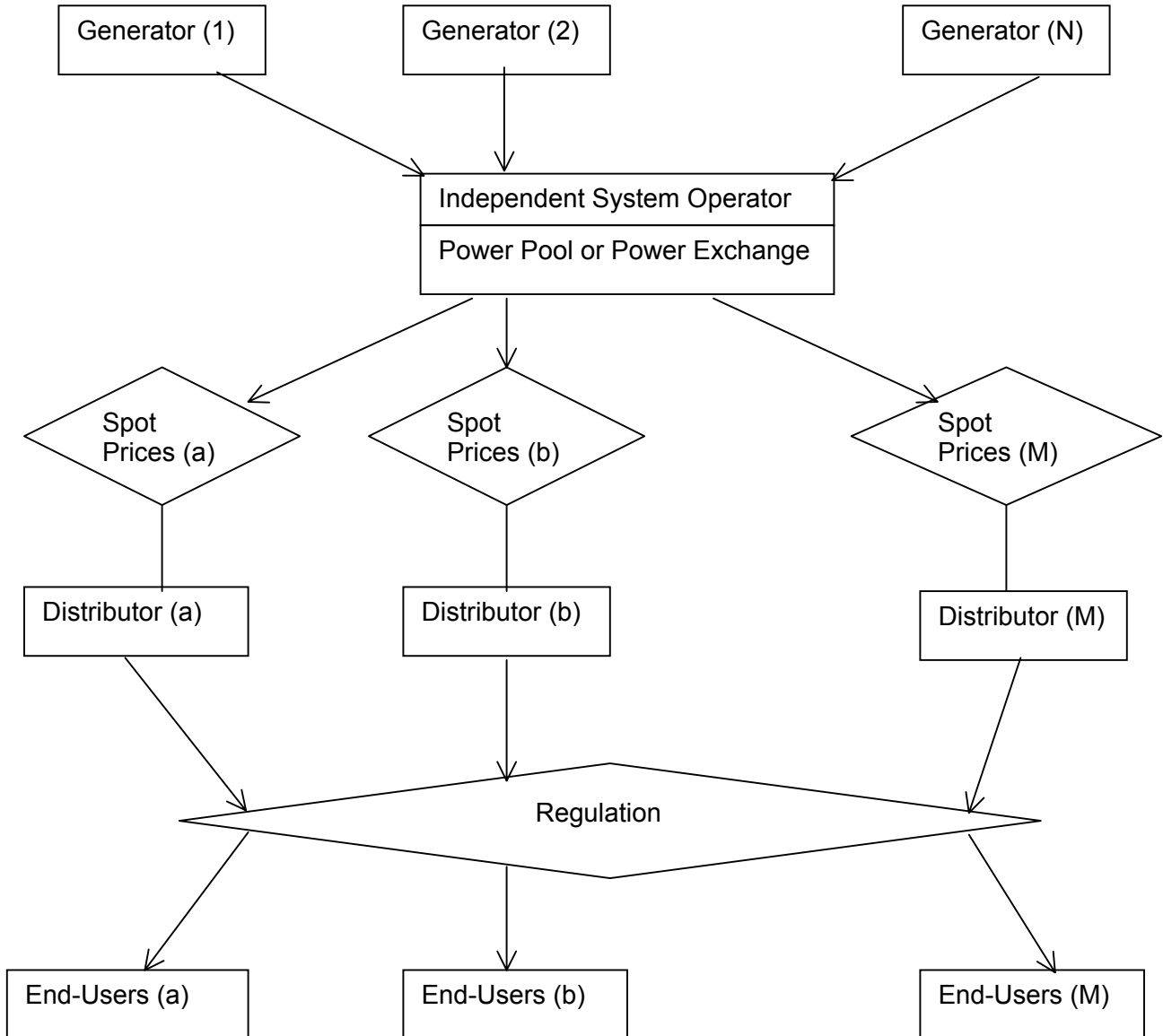
The major new ingredients in this alternative are many buyers and a power exchange to organize transactions between many buyers and many sellers. One way to accomplish this is horizontal divestiture of distribution into a number of distribution companies. This alternative is similar to the path chosen by Argentina and Nord Pool and is shown in Figure 4.⁹ In this case, the distribution companies and the generating companies may transact with one another on a spot market through the power exchange. Thus, the market is cleared on the basis of short run supply and demand. In most de-integrated electricity sectors with power exchanges, systems operation and the power exchange are undertaken by the same entity. In California, however, they were separated.

Regulatory oversight is necessary for the effective and responsible functioning of the independent system operator, the power exchange and for the distribution companies. The regulator must assure that both generators and purchasers have equal access to the transmission system. In addition, regulation is necessary to assure that charges for transmission services are reasonable. That is, they must be no more than adequate for operations, maintenance and capacity expansion and reasonable profit (if the transmission company is privately owned and/or operated). This type of regulation

⁹ In reality, Argentina and Nord Pool do not conduct all transactions through power exchanges but also use bilateral contracts, discussed below.

seems more technical and complex than that of the integrated electric utility. Regulation of integrated electric utilities is primarily financial, and mastery of technical aspects of transmission is less important, inasmuch as the incentives for effective operation of the transmission system are internalized.

Figure 4
Electricity Flow
Merchant Power, Many Monopoly Distributors



In addition, the distribution companies must still be regulated to assure that the rates charged to end-users are appropriate and that service conditions are maintained. Integrated distribution companies with monopoly franchises must also be monitored to

see that the prices they pay for electricity on the spot markets are competitive and reasonable. These regulatory tasks are similar to those of an integrated electric utility.

Thus, under de-integration, the regulatory burden may actually increase, compared to the integrated electric utility alternative. Not only must the monopoly transmission company, the independent system operator and the power exchange be regulated, but so must all of the distribution companies; and it seems reasonable that there are economies of scale in regulation. That is, it is likely to require fewer regulatory resources to regulate one large integrated electric utility than it does to regulate the transmission system and many distribution companies. Of course, more distribution companies rather than fewer are desirable to maintain conditions of competition. Thus, there appears to be a significant trade-off between competitive conditions and regulatory burden.¹⁰

One problem with merchant power alternatives is that their optimality is largely based on static equilibrium economic theory. In fact, due to long lead times between the perception that additional generating capacity is necessary and bringing such capacity on line, it is unlikely that the market will be in equilibrium very much of the time. This implies that reliance on spot markets is likely to lead to either excess capacity (prices approaching short run marginal cost) or excess demand (prices including a significant element of rent). Some of the volatility of such markets can be mitigated by futures contracts. However, this adds additional costs and complexity to the system.

4.4 Merchant Power with Power Exchange and Retail Competition

Distributors may further be de-integrated into “wires” companies and retail suppliers. The former own and operate the physical distribution system as a public utility. The latter use the wires, much as truckers use highways,

Under the previous alternative, distributors with regional monopolies purchase power on a competitive basis from IPPs. However, the distributors maintain monopolies vis-à-vis end-use consumers. The next step toward competition is to remove monopoly in distribution. To do this, the function of distribution is split into two parts: physical distribution and retail sales. Physical distribution -- moving electricity over the wires -- remains a natural monopoly but retail “electricity service providers” (ESPs) compete with one another for end-users, using the physical distribution system as a common carrier and offer competitive retail services by attempting to differentiate electricity service in various ways. This alternative is shown in Figure 5. This was the structure envisaged by California’s reforms in 1996 and by Pennsylvania’s.

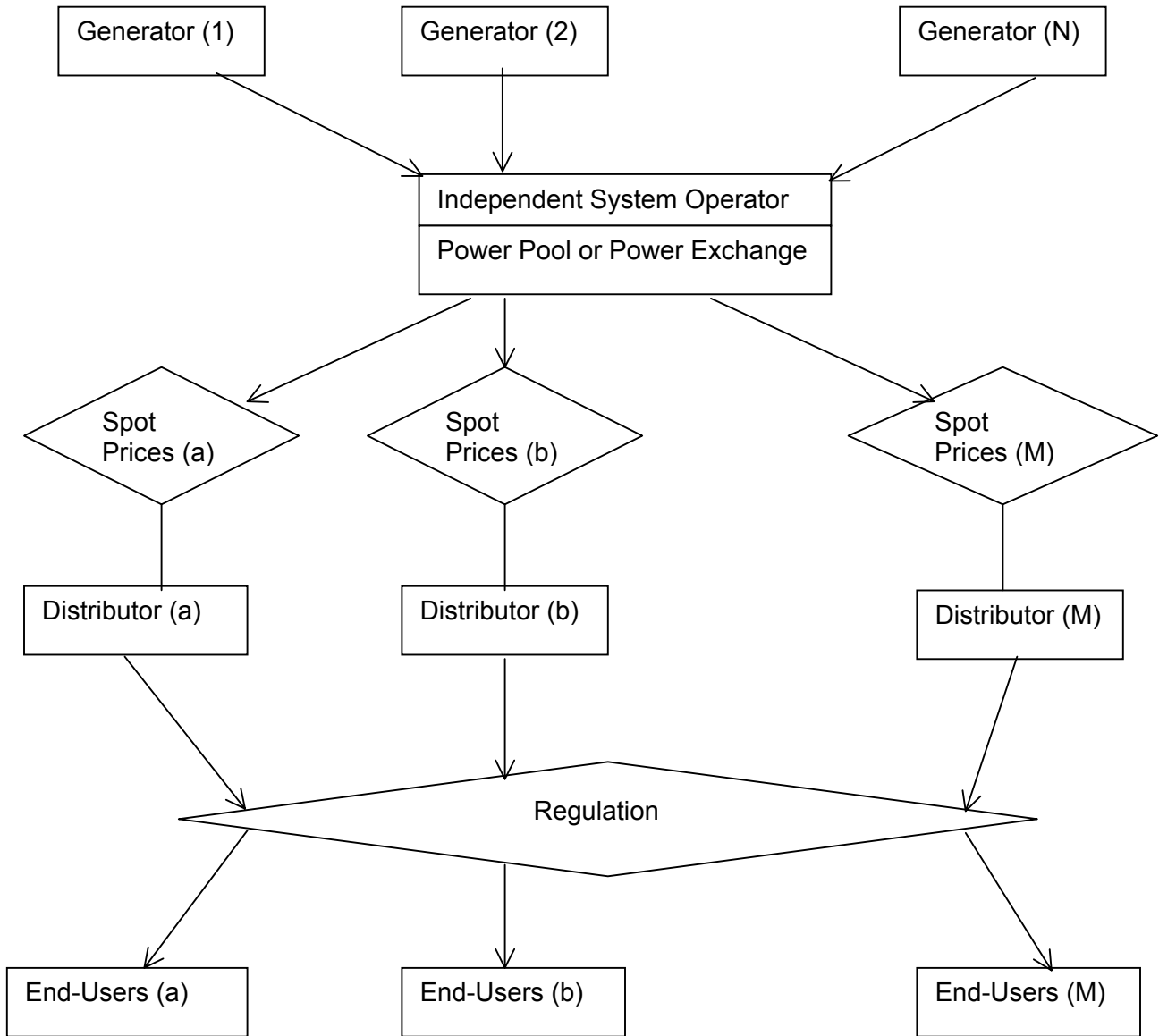
In this alternative, the ESPs compete for end-users on the basis of price and other differentiating characteristics. For example, in the Southern California Edison service territory, 10 ESPs provided 13 different services in competing for residential end-users. The principal differentiators between the services in California were rates and environmental friendliness.¹¹ For example, one service’s rates might be particularly attractive to residential consumers that typically use large amounts of electricity, while another might be attractive to consumers that use small amounts. One service might be

¹⁰ For a more complete discussion of this trade-off, see Dossani and Crow (2001).

¹¹ They did not, however (by mandate), offer risk mitigation, which in hindsight might have been the most valuable differentiator of all.

heavily reliant on "green" energy, while another might be reliant on conventional generation. A third might guarantee that its price would remain within a fixed range. Reliability might be a particularly important differentiator for some customers.¹²

Figure 5
Electricity Flow
Merchant Power, Many Monopoly Distributors – Power Exchange



In California, ESPs were required to post their rates and their differentiating qualities but were otherwise unregulated, other than supervision to insure that they deliver electricity

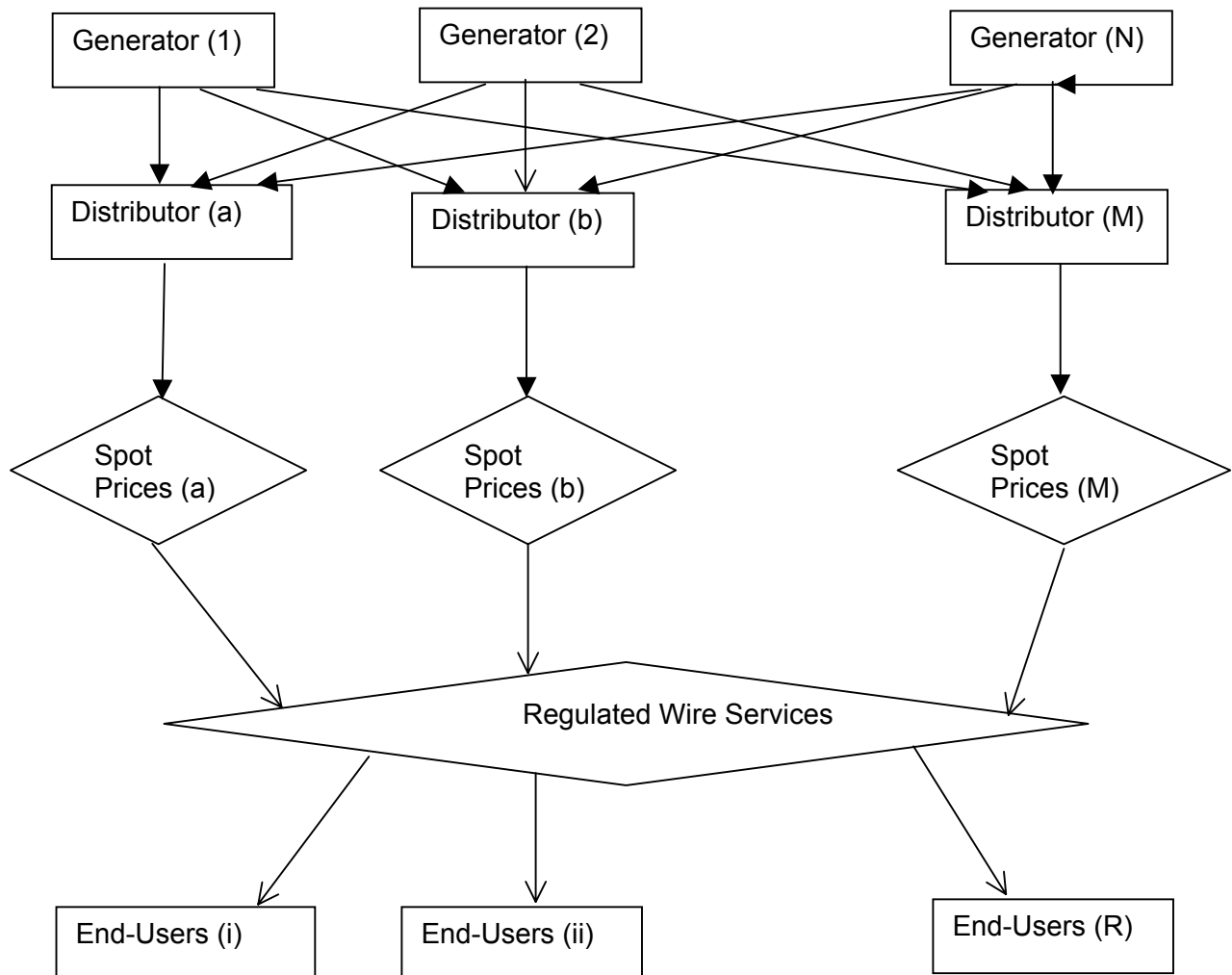
¹² For further discussion of how ESPs can expand and differentiate their offerings, see Faruqi and Seiden (2001)

to consumers at the agreed price. However, ESPs must still move electricity over the physical distribution network, which is still owned and controlled by a major electric utility. Thus, regulation is needed to assure that the rates for the service of the distribution system are reasonable and that all ESPs have access to the system. This would appear to be a much smaller regulatory burden than for cases in which there are many integrated distribution and retail supply companies.

4.5 Merchant Power with Bilateral Contracts and Retail Competition

One problem with power exchanges is that their uniform-price auction structure may leave wholesale markets vulnerable to manipulation. This appears to be the case in California and in the England and Wales Power Pool. Thus, in 2001, England and Wales moved to the New Electricity Trading Arrangement, which rely on bilateral transactions between generators and retailers, with intervening traders. The bilateral trades can be for any term. All trades are reported to the system operator, who schedules dispatch and organizes a short-term market to balance any difference of demand from supply as a result of the bilateral transactions.

Figure 6
Electricity Flow
Merchant Power, Many Monopoly Distributors – Bilateral Contracts



5. Comparison of General Restructuring in Several Countries

In this and the next four sections, we systematically examine and compare restructuring in several states/countries, based on their prominence and/or their success.¹³ California was selected because its restructuring – generally conceded to be a failure – has attracted so much attention and indicates some things that should *not* be done. Pennsylvania -- in conjunction with PJM Interconnect, which operates the grid and conducts wholesale transactions for the Middle Atlantic states from Pennsylvania to Virginia -- was selected because of its importance in the U.S. Also, together with California, it was one of the pioneers of restructuring in the U.S. Argentina was selected because it seems to have hit on a combination of restructuring elements that have been successful and stable over a relatively long period of time. The England and Wales system was selected because it is the largest system to undertake radical reform and is therefore best known.¹⁴ Victoria in particular and southeast Australia in general was selected because they began the restructuring process some time after the other states/countries and attempted to learn from them. Like California and Pennsylvania, Victoria restructured its electricity sector in a federal system that has itself undergone significant change. Germany was selected as an example of a system of integrated utilities that is trying to achieve some of the results of restructuring without functional de-integration. Nord Pool, a creation of the Scandinavian countries, is a prominent and apparently successful example of restructuring. France is a country that is trying to do the minimum amount of restructuring, particularly with respect to de-integration.

This section examines the motives for electricity sector reform in these states/countries and describes the situation before reforms took place. It also describes the control parameters for overall structural reform and the actions that were taken by the various states or countries. Tables 2 and 3 provide brief descriptions of the aspects of general restructuring, followed by more detailed discussion.

¹³ “Success” in this context is not easy to define, given that reform often has multiple objectives. However, in each of these cases, retail prices have declined from pre-reform conditions, albeit not as much in some cases as their architects expected. A recent exception is Argentina, where real prices have increased due to an element of the pricing formula (described below) that has little to do with the success or failure of restructuring. Moreover, in a revealed-preference sense, success is indicated by the absence of efforts to revert to earlier regimes.

¹⁴ Often, discussion of restructuring refers to the United Kingdom. In fact, however, Scotland and Northern Ireland maintain fairly traditional vertically integrated utility structures.

Table 2
Comparisons of Motives for Reform and Pre-Reform Structure

	Motives for Reform	Pre-Reform Situation
California	Lower electricity prices through wholesale and retail competition.	75% of electricity supplied by IOUs, the rest by munis. IOUs were under conventional RoR regulation. Surplus generating capacity and high prices.
PA/PJM	Lower electricity prices through wholesale and retail competition.	Dominated by IOUs under conventional RoR regulation. High prices.
Argentina	Provide incentives for adequate capacity, increase efficiency, reduce subsidies.	State-owned, integrated utilities. Political pricing. No incentives for efficiency. Distorted tariffs.
England and Wales	Free-market ideology, Lower electricity prices through wholesale and retail competition.	National government ownership of generation and transmission plus semi-autonomous regional distribution boards in England and Wales. Scotland and Northern Ireland had vertically-integrated companies.
Victoria/Australia	Lower electricity prices through wholesale and retail competition, reduce public expenditure and government debt.	Vertically-integrated, publicly-owned state utilities. Weak interstate grid connections.
Germany	Meet mandates of European Directive to open transmission access and increase competition	Eight large private integrated utilities controlled all industry functions.
Nord Pool	Lower electricity prices through competition but still maintain strong companies .	Powerful national integrated utilities and some city-owned utilities.
France	Meet mandates of European Directive to open transmission access and increase competition	One national integrated utility (EdF) controlled all industry functions.

5.1 *Motives for reform*

California and Pennsylvania

In 1996, the average revenue per kWh (which is used as a proxy for price) of electricity sold in California was 9.48 cents, the tenth highest rate among the 50 States and the District of Columbia. In Pennsylvania, it was 7.86 cents, the eleventh highest. (U.S. Energy Information Administration, 2001b, Chapter 8) Competition was regarded to be the best way to bring costs down.

Argentina

Prior to reform, in the 1980s, Argentina had chronic electricity shortages – due in large measure to poor maintenance of existing equipment. Also, the electricity sector was overstaffed and ran a deficit, which exacerbated a sovereign debt problem that was already serious. Moreover, electricity at the retail level was expensive and frequently stolen. (U.S. Energy Information Administration, 1997, Chapter 4) Remedy of these difficulties, plus the need to attract private investment to expand capacity, led to reforms that would encourage competition and enhance efficiency.

England and Wales

Electricity privatization in England and Wales occurred in the larger context of the privatization of much of the formerly state-owned UK industries and the reduction of the central government's role in the national economy.

According to Steven C. Littlechild, (1999), who was the Director General of Electricity Supply in the Office of Electricity Regulation, UK, 1989-1998, "The main motivations for privatizing the British electricity sector were as follows:

- o Reduce the role of government in industry. An underlying aim in privatizing the British electricity sector was to reduce the role of the government in industry.
- o Increase the role of the customer. A parallel aim was to increase the role of the customers, so that their voice should determine what happens.
- o Increase efficiency. The electricity industry was not considered particularly inefficient for a nationalized industry, but it was widely believed that nationalized industries were not as efficient as the private sector, nor as efficient as they could be.
- o Privatization. Privatization was becoming increasingly popular among those many citizens who were able to participate by buying shares, watching their shares grow in value, and believing rightly that they had a stake in the development of the economy.
- o Proceeds for treasury. The privatization programme brought in significant financial proceeds for the treasury, which could be used to reduce government borrowing, or to spend in other areas, or to reduce taxation, which was important to encourage initiative.
- o Efficient regulation of monopoly. Finally, with the development of effective ways of controlling monopolies, particularly by incentive regulation, it was now possible to consider privatizing electricity."

Victoria/Australia

The "over-capitalized investments" made by the state governments in the electricity sector (generation capacity, transmission systems, and distribution) had resulted in "high levels of reserve plant margins combined with high debt levels with minimum returns." (U.S. Energy Information Administration, 1997, Ch.3) This situation was particularly true of Victoria and New South Wales. Financial restraints and debt placed pressures on the federal and state governments to reduce expenditures and increase efficiency while still providing service for the public. In particular, in the case of Victoria, much of the debt was electricity related; and privatization offered a means of relieving the debt burden.

Thus, the objective of reform in Australia was to "deliver more efficient and sustainable use of capital infrastructure and energy resources and to improve Australia's domestic and international economic performance" and to reduce debt. In addition, the state governments estimated that electricity reform would add an estimated \$5.0 billion annually to the Australian Gross Domestic Product (U.S. Energy Information Administration, 1997, Ch.3)

Germany

Directive 96/92/EC of the European Parliament and of the Council (19 December 1996) concerning common rules for the internal market in electricity called for each member country of the European Union to open transmission access and increase competition in order to facilitate the movement towards open electricity markets without barriers to electricity trade between countries. German retail prices for households and industry were the highest in Europe.

Nord Pool

All of the Nordic countries, with the exception of Iceland, have now opened their electricity markets to competition. Nord Pool, the first international market place for electric power, was opened in 1996. Motives and backgrounds for the reform varied slightly between the Nordic countries. There are, however, some key factors and principles that influenced the development of today's unified and largely deregulated Nordic power market:

- Desire to increase economic efficiency of the electricity sector through competition.
- Maintain large, dominant national companies to meet the requirements of the The EU electricity market directive, which demanded that at least 33 percent of the electricity markets of member states should be opened to competition by the year 2003. A common Nordic market reduces the dominance of these large companies within individual countries without weakening them.
- Nordic Governments' agreement on the value of a pan-Nordic competitive power market

Norway opened its electricity market to competition in 1991 in order to increase competition and provide the consumers with greater freedom of choice and, by open and increased trade in electricity, to create the conditions for efficient pricing. The 1999 energy strategy of the Norwegian Government specifies that the energy policy shall be drawn up so that it underpins an ambitious environmental policy. The generation and utilization of energy must conform to environmental demands, and the energy prices should reflect, as far as possible, the environmental costs. Increased generation should be based, to a greater extent, on renewable energy sources.

Sweden opened its electricity market to competition in 1996 as a means to achieve greater economic efficiency and provide increased freedom of choice. Finland also began to reform its electricity market in and 1996 and was concerned with both economic and thermal efficiency as motives for reforms and has emphasized renewable energy. The electricity market in Denmark was opened to competition to the same extent as in the other Nordic countries in 2002. The Danish electricity policy is focused on reducing the environmental impact from electricity generation. The Danish Government's plan of action specifies that the most important means of achieving reduced environmental impact is to develop renewable energy sources, improve energy efficiency and adapt the energy sector to a reformed energy market.

France

France has resisted far-reaching reforms in its electricity sector. It has tried to do the minimum necessary to implement the European Union's electricity directive to create competitive markets. The French market was opened in 2001 to 16GWh users and above, which meets but does not exceed the EU minimum of 30% of the market. The country planned to move a year ahead of schedule by reducing the threshold to 9 GWh customers (34% of the market) in 2002.

France has restructured to favor Electricite de France (EdF), the national electricity company that enjoys a near monopoly within France and that is owned by the government.

New entrants face a number of other barriers. Nuclear generating capacity tends to be relatively cheap, and EdF's capital costs for its nuclear plants are long-since amortized. Moreover, French generation currently enjoys considerable overcapacity. New combined-cycle, gas-fired units will not enter easily because new entrants have limited access to long-term gas. There are few independent power producers. Eligible users can change supplier no more frequently than every three years.

The rules classify the non-state owned distributors as buyers and not consumers. For the most part, these companies buy their power from EdF and resell it to their customers. As a result, they cannot search for bulk power outside the EDF system except for those sales supplied directly to eligible customers.

The country has also has been severely restricted power trading by requiring that it must be conducted by accredited producers under authorization from the ministry. Moreover, trading can not exceed 20% of a company's own annual production. In addition, all electricity suppliers must pay a per/kWh charge to cover EDF's public service obligations.

The best opportunity for new entrants exists in international electricity trade. In November 2000, the regulator CRE introduced the so-called Balancing Circle Manager (BCM), which allows importers to aggregate contracts and, more importantly, offers them better terms. Previously this had been organized through EdF at restrictive prices. Now the new entrant can negotiate balancing power with the System Operator RTE under improved terms even though they remain above costs.

Cogeneration and other plants for eligible industrial customers also offer opportunities. Serious competitors in this market include Vivendi and Suez Lyonnaise des Eaux (via energy services subsidiary Elyo). EdF has countered these CHP options with some attractive tariffs.

EdF's proposed capacity auction has been criticized for failing to open the market. It amounts to only 6 GW and restricts the market through flaws in the auction process. Under an overly complex approach, EdF may withhold capacity by imposing too high a reserve price. The auctioned "baseload" product has an unrealistically low energy price component coupled.

5.2. *Pre-Reform Structure*

California

Three traditional integrated, investor-owned utilities (IOUs) – Pacific Gas and Electric (PG&E), San Diego Gas and Electric (SDG&E), Southern California Edison (SCE) – served about 75 percent of the load in the state. Their scope is now limited to retail operations. The remainder of load is served by the Los Angeles Department of Water and Power, the Sacramento Municipal Utility District, other publicly owned utilities, cooperatives, and small investor-owned utilities.

The three major investor-owned utilities had high generation costs, largely because of investments in nuclear power in the cases of SCE and PG&E. Also, however, mandated contracts for renewables under the Public Utilities Regulatory Policy Act of 1978 -- as interpreted by the California Public Utility Commission -- resulted in high prices for these sources. Rates were set under conventional rate-of-return (RoR) regulation.

California has strong transmission interties to other states in the north and east, but the western states (comprising the Western States Coordinating Council) have weak interties to the regions to the east.

Pennsylvania/PJM

Much of Pennsylvania's reform was in the context of wholesale generation and transmission reform for the PJM region, comprised of Delaware, New Jersey, Maryland, Pennsylvania, Washington, DC and Virginia. Prior to reform, PJM Interconnect, which operates the current power pool, was a regional dispatch center, focusing on reliability and least-cost dispatch. However, unlike its current pool structure, it did not participate in making a market for power. Most of the utilities that used PJM prior to 1997 were integrated entities that produced their own power, contracted with each other, or contracted with independent power producers (IPPs).

In addition, Pennsylvania undertook to reform its retail sector by introducing competition at the retail level. Prior to reform, Pennsylvania was characterized by integrated investor-owned utilities, conventional rate-of-return regulation, and high retail prices.

Argentina

In 1991, just prior to the beginning of privatization, Argentina's electricity industry included four federal utilities, one Argentina-Paraguay agency (controlling a large hydroelectric plant owned jointly by the two countries), one Argentina-Uruguay agency (also controlling a large hydroelectric plant owned jointly by the two countries), provincial utilities, and several electricity cooperatives. One of the four federal utilities generated and distributed electricity to the greater Buenos Aires and La Plata area, one served the balance of the country's needs for power generation and transmission, one operated the hydroelectric power generators of southern Argentina, and one operated nuclear power generation plants. At the time of privatization, the non-nuclear utilities accounted for about 80 percent of the approximately 15,000-megawatt generation capacity of the system.

Argentina's electricity industry suffered from recurring power outages, substantial and regular unavailability of power generators, and weak finances. Moreover, it was constantly threatened with the possibility of blackouts, a threat that worsened during periods of relatively little rainfall because of heavy reliance on hydroelectric capacity

(about 34 percent of total generation). Electricity was also expensive and often stolen by end users, either through illegal hook-ups or by failure to pay bills. (U.S. Energy Information Administration, 1997, Chapter 4)

United Kingdom

The Electricity Act of 1957 established the nationally-owned Central Electricity Generating Board (CEGB) whose responsibilities included control over the operation of electricity generation and transmission facilities and all related investment decisions. There were twelve semi-autonomous regional distribution boards in England and Wales, two vertically-integrated companies in Scotland, and one vertically-integrated company in Northern Ireland. Some observers, at least, found the former system to be “inflexible, bureaucratic, secretive and largely out of political control.” (Newberry and Green, 1996, p. 58)

Price regulation employed an inexact and controversial measure of long-run marginal cost in order to construct a wholesale price charged to the distribution companies by the CEGB. Often governmental electricity policy directives were guided by some overriding macroeconomic or industry policy objective, such as controlling inflation or sustaining the coal industry. (U.S. Energy Information Administration, 1997, Ch. 2)

Victoria/Australia

Prior to the reforms of recent years, the supply of electricity in Australia was provided by vertically-integrated utilities owned by individual states and territories. As in the U.S., the electricity industry had never operated on a national or even on a regional basis. Interstate grid connections were weak, and electricity trade had been limited between a few interconnected states. At the state level, Victoria has pursued the most aggressive electricity reform measures in Australia, within the context of reform in all five of the states of southeast Australia, while other states pursued reform more slowly. (U.S. Energy Information Administration, 1997, Ch. 3) Most, however, are now approaching the depth and breadth of Victoria’s reforms.

In reforming the electricity sector, there are three basic control parameters that cut across its vertical structure: the form of restructuring (de-integration and privatization/divestiture), the form of regulation, and the sequence of actions to be taken with respect to structure and regulation. These parameters and a summary of the actions undertaken by the states/countries are shown in Table 2.

Germany

Prior to 1998, large private integrated utilities dominated generation, transmission, distribution and retail supply. Mergers have reduced the number of integrated firms to six, but the basic market structure remains the same.

Historically, concession and demarcation arrangements encouraged utilities to operate like cartels in their service areas. Concession agreements with municipal governments allowed utilities to serve an area without fear of a third party gaining access or without competition from the government itself. In return, governments earned substantial concession fees to apply to public transit and other services. Demarcation agreements between electricity suppliers ensured that the utilities would not compete against each other in their respective service areas.

The policy discussion has focused on how to implement competition without forcing the private companies to divest their assets and financially unbundle the industry.

Nord Pool

Historically, the energy markets in the Nordic countries have largely consisted of regional and local monopolies. Thus, energy investments have mainly been influenced by notions that are derived from a planned economy. Electricity was considered to be a public utility, a common good, and the suppliers were given certain privileges in return for keeping the supply at a certain level. Thus the market was long protected from competition. Due to economy of scale electricity companies were considered to be natural monopolies. There were a few large companies, one in each country owned by the state, that were completely vertically integrated.

France

France has one public utility (EDF) rather than several private ones. There has been no interest in unbundling or selling the parts of this public firm or in facilitating entry by new participants. No rivals can buy into this government company. Obtaining a supply license in France requires a company to contribute to the country's public service costs. It must also implement the same labor benefits enjoyed by EDF staff, which is currently estimated to be about 15% higher than its rivals.

Table 3
General Control Parameters to Implement Reform

	De-Integration and Privatization/ Divestiture	Regulatory Reform	Sequence of Reform
California	IOUs were forced to sell generation, give up dispatch control to the CAISO, buy power only through the PX, and compete in retail markets. IOUs retained operational control of distribution only.	CPUC retained oversight of IOU distribution, including the terms and conditions of power purchases from the wholesale market. Also, it influences the CAISO, despite federal jurisdiction over transmission.	De-integration in one step, Only twelve months to implement an extremely complex structure and infrastructure.
PA/PJM	Pennsylvania IOUs were allowed, but not required, to sell facilities. It was required that they unbundle services. They were required to compete in retail markets.	PPUC retained oversight over transmission and distribution. T&D charges passed through to retail customers.	Retail choice implemented over three years.
Argentina	State-owned utilities de-integrated in a single step. Gradual privatization of generation and distribution. Transmission privatized.	Autonomous, independent, five-member regulatory body within the Ministry of Energy, but the Minister retains some regulatory functions.	Simultaneous de-integration into state-owned companies and establishment of a strong regulator. Followed by privatization of generation, transmission and distribution.
England and Wales	State-owned utility became three generation companies, a power pool, and distribution/retail companies. Later privatized by auction.	Establishment of a one-person, independent regulator. Price regulation for transmission and distribution. Competition for generation and retailing, but regulator has influence over pricing.	First de-integration and establishment of regulator. Then privatization. Deregulation of retail markets was in three stages, covering 1990-1998.
Victoria/ Australia	Establishment of "National Electricity Market" at wholesale level. Victoria de-integrated generation, transmission, distribution and retail supply.	National regulator replaces state regulators for wholesale power supply. States regulate retail markets. Regulation to be driven by efficiency concerns.	Victoria first de-integrated the state-owned system and set up a regulator. "National" power pool was established. Victoria then privatized the sector on an auction basis over several years.
Germany	Accounting unbundling was implemented but private firms did not have to divest their assets.	Eliminated laws that protected monopoly franchises. Responsibility for competition placed with	All end users allowed to choose their suppliers immediately. The private transmission

		antitrust competition authorities. No new electricity regulator.	agreements have been revised several times.
Nord Pool	Does not de-integrate existing large companies , but strip them of their control of the network	An independent system operator (monopoly) introduced with responsibility for the operation of the system and regulated by the state.	All end users allowed to select supplier. Implemented in steps, first for large users and later for individual households. Began 1996 and complete 2002 (Denmark last)
France	Neither de-integration nor privatization was advocated. Competition with EdF is discouraged.	No major changes in electricity regulation.	Restructuring began in 2001 with only 30% of end users allowed to choose suppliers (the European minimum).

5.3. *De-integration and Privatization/Divestiture*

The United States

In the United States, the federal government has jurisdiction over transmission, inasmuch as transmission networks typically cross state lines. States are responsible for distribution and retail sales. The federal government and states share jurisdiction over generation. States claim jurisdiction over the basic organization of the electricity sector within their borders.

De-integration of generation in the United States began with the Public Utility Regulatory Policy Act of 1978 (PURPA). This legislation mandated IOUs to buy power from “qualified facilities” (QFs) if the energy source used in generation met certain environmental and conservation standards and if it was less than a given IOU’s (investor-owned utility’s) “avoided cost.” PURPA also exempted owners of QFs from the Public Utility Holding Company Act (PUHCA), which imposed onerous conditions on ownership of non-utility generators. The state public utility commissions (PUCs) were permitted to define avoided cost as they deemed appropriate.

PURPA was sufficiently successful in producing reliable, competitively-priced energy that the Energy Policy Act of 1992 (EPA) opened the generation market further to permit non-utility generators to enter the wholesale market on a market, rather than cost-of-service basis. This was aided by an interpretation of the Federal Power Act that permitted market-based as well as cost-of-service pricing to fall under the “just and reasonable” mandate of the Act. In addition, EPA mandated that owners of transmission provide access to the grid for non-utility generators on a non-discriminatory basis. Federal Energy Regulatory Commission (FERC) Orders 888 and 889 laid out the specific legal framework for wholesale competition in 1996. A third major provision was that all non-utility generators would be exempt from the ownership provisions of PUHCA.

California

California’s IOUs were forced to divest themselves of most generating assets, others (primarily hydro and nuclear) being retained by entities that are operationally independent of the transmission, distribution and retail functions. The nuclear power plants and the long-term contracts signed as a result of PURPA cost the utilities much

more than they could hope to recover in a competitive regime. Therefore, a special provision was made in AB 1890 for a retail Competition Transition Charge to be applied to each kWh consumed in order to help the utilities recover costs that they had undertaken in good faith under cost-of-service regulation.

The utilities were also forced to give up control of the transmission system to the Independent System Operator (CAISO), although they maintained ownership. Thus, they became utility distribution companies (UDCs), retaining ownership of distribution facilities that they operate as regulated common carriers. It was originally contemplated that the UDCs would compete with other entrants for retail business. However, the competition has collapsed; and the UDCs effectively have reverted to being regulated monopoly providers.

Pennsylvania

Pennsylvania's Electricity Generation Customer Choice and Competition Act became law on December 3, 1996. It basically separates the generation of electricity from the services of transmitting and distributing it. Electric utilities are permitted to divest themselves of facilities or to reorganize their corporate structures, but de-integration of services is required. The law also permitted and encouraged new entrants into a competitive retail market

Argentina

Argentina's restructuring began in 1992 with the creation of a national regulatory body. It then restructured the federal electricity companies, and the electricity industry in general, into separate state-owned generation, transmission and distribution companies. These companies were then privatized. Privatization thus followed the creation of an effective regulatory structure.

Generation and distribution companies are competitive, for-profit entities. However, by law, no company is allowed to control more than ten percent of all generation capacity or have cross-holdings with transmission companies. Transmission is owned and operated by private, regulated companies. Another (non-profit) company runs the pool, is responsible for scheduling and dispatch, and conducts settlement of transactions. .

United Kingdom

The Electricity Act of 1989 de-integrated the electricity industry along functional lines. Guiding the government's restructuring was the idea that electricity generation and retail sales could be made into private, competitive industries, while transmission and distribution needed to be treated as natural monopolies for the indefinite future. Thus, it privatized generation, formed a non-profit power pool, and organized distribution (and initially retail sales) into private regional companies.

Victoria/Australia

Victoria de-integrated and then privatized its electricity sector beginning in 1994. It started by separating its generation, transmission and distribution assets into single companies (the latter being combined with the distribution assets of Municipal Electricity Authorities). It then further de-integrated into five generation companies, two transmission companies (an owner and an operator) and five monopoly distribution companies. These, in turn, were privatized.

The formation of the National Electricity Code provides a framework for de-integration and provides a mechanism for interstate wholesale power transactions. As a result, several other states of southeast Australia have also undergone considerable restructuring to remove vertical integration.

Not all states, however, have undergone privatization (in the sense of asset sales). Even so, private entry into all segments of the sector is now allowed. However, for those states that have not privatized, Sam Lovick pointed out that “continued state ownership of most of the assets creates a conflict of interest problem, since the state governments are also the ‘owners’ of the key market operating companies, control regulation, and control selection of boards of key institutions. On top of which, states still rely on utility revenues to support state budgets.” (private communication)

Germany

In responding to the 1996 EU directive to restructure, Germany enacted a law in 1998 that abolished the long-standing exception for electricity and natural gas in German competition law. Also, German utilities unbundled their generation, transmission and distribution activities for accounting purposes. However, they retained their integration within the same company, and no utility had to divest its assets.

While genuine competition has been sluggish, the rate of corporate activity has been like a sector facing out-and-out retail warfare. Over 400 mergers, cooperative agreements or takeovers have occurred since the April 1998 electricity law took effect. The big four (Veber, Viag, RWE, VEW) have become the dominant duo (E.ON, RWE), with the next two biggest (EnBW, HEW/Bewag/Veag) morphing into shop fronts for EdF and Vattenfall respectively, two of Europe's most powerful state-owned companies.

Stake sales among the municipal Stadtwerke utilities, meanwhile, have let in a few genuine new entrants (such as TXU Europe's participation in SW Kiel, or Essent's in SW Bremen) However, the ownership trend is towards consolidation, with the most powerful strengthening their regional positions.

Much has been made of the perceived decline in wholesale power prices since liberalization. It is true that generating overcapacity in Germany has put a lot of pressure on plant exposed to the open market. Quite how big a segment of the market is 'open', and therefore tethered to this price, is not clear. Only a small part of the market is visible, and exchange-traded power, over-the-counter and forward rates discovered by pricing services as well as large industrial rate indexes have shown some big drops, down in mid-2000 to cash cost levels of 5-6 pfennigs/kWh. But as the EEX and LPX exchanges will testify, under 7% of German production is traded openly on the exchanges. The great majority of electricity is still sold via bilateral agreements at twice the 5-6pf/kWh level. Incumbents may have exaggerated the financial stress facing the generation sector in order to discourage new entrants.

Nord Pool

The energy act, 1991, in Norway, mandated separation of grid transmission activities from competitive activities – generation and retail supply -- at least in accounting. Norway's national power company was split in 1992 into the nation-wide grid company,

Statnett, and a generating company, Statkraft. Responsibility for monitoring and operation of the power grid and its cross-border links was assigned to Statnett.

The first step of the market reform in Sweden was taken in 1991, with the decision to separate transmission from generation. Svenska Kraftnät was established to manage the main transmission network. The networks were gradually opened to new participants, and legislation providing for competition became effective in 1995.

Operational separation of transmission - separating system operation from the ownership of transmission assets -- was done in Norway and Finland. In Sweden the transmission ownership was fragmented among several parties, and an independent systems operator of the net was introduced.

In Sweden, municipalities have intensified the privatization of their electricity trading, and the small private electricity trading companies have been acquired by larger companies. In some cases municipal companies have merged to form larger entities. New Swedish-owned as well as foreign –owned players who have neither electricity generation nor network operations have entered the electricity trading market in order to utilize the new competitive situation. However, the main trend is towards increased market concentration.

The large, dominating companies in the Nordic region, such as Vattenfall (Sweden), Statkraft (Norway) and Fortum (Finland), have been buying holdings in recent years and thus increased the market concentration. Moreover, the biggest players have taken market shares in other European countries. The possibility to do so was one of the main reasons for not de-integrating the large companies when the reform was introduced. The EU electricity market directive demands that at least 33% of the electricity markets of member states should be opened to competition by the year 2003. This should be on the principle that the biggest electricity users should gain access to the market first.

France

Electricite de France maintained its separate functions and the government expressed no interest in selling this public company. Competitors are discouraged by such requirements that any new electricity supplier must provide the same level of substantial benefits that EdF currently provides.

5.4. Regulatory reform

The United States

The basic regulatory structure in the United States has stayed intact. Only the privately owned elements of the electricity sector are regulated. Publicly-owned generating authorities (such as the Tennessee Valley Authority and the Bonneville Power Authority), municipal utilities (such as the Los Angeles Department of Water and Power and the Sacramento Municipal Utility District), and rural electric cooperatives are not subject to regulation at either the state or federal level.

In principle, FERC is responsible for regulating all private wholesale rates and for enforcing access to the transmission system.¹⁵ It has a legislative mandate under the Federal Power Act to ensure that wholesale prices are “just and reasonable.” From the summer of 2000 through the spring of 2001 in California, when spot market prices soared in the face of generation and transmission capacity shortages, serious questions arose about whether and how generators exercised market power and the extent to which FERC could or should exercise regulatory control. These questions remain unresolved.

California

The CPUC implemented several crucial policies that have affected California’s electricity markets. One was to require that the IOUs separate the generation that they own from their distribution businesses. A second was to order the IOUs to divest themselves of most of their thermal generating assets. A third was to first forbid the IOUs to participate in forward markets and later to permit such participation, but only under onerous conditions.

Pennsylvania

The major changes in Pennsylvania have been through legislation. Regulatory responsibilities have remained intact, and the Pennsylvania PUC has not made landmark decisions.

Argentina

Restructuring began with the creation of a national regulatory body (ENRE), organized as a five-member commission. The law that provides the regulatory framework of the electricity sector was approved by the congress in 1992. ENRE’s functions are the following;

- Enforce regulatory framework, contracts and public service obligations.
- Issue rules and regulations on safety, technical procedures and norms, measurement, billing, meters, access and quality of service.
- Prevent anti-competitive, monopolistic and discriminatory behavior.
- Define the basis for tariffs set in contracts.
- Publish general principles to be respected by the distributors and transmission companies to ensure free access to their service.
- Determine the basis and criteria for the assignments of concessions.
- Organize and implement the bidding, adjudication and signature of contracts.
- Monitor the respect of property rights, environment and public safety.
- Take to court relevant issues.
- Regulate procedures to impose sanctions.
- Publish information and advice for all actors in the system.
- Issue an annual report and recommend actions where needed.
- Collect information from transmission companies.

ENRE is politically independent, notwithstanding that it is organizationally under the Secretary of Energy. Its functions and obligations derive from law and not executive

¹⁵ In fact, politically powerful states that do not depend heavily on the interstate transmission of private power -- New York, California and Texas -- retain a fair degree of independence in the name of “comity” between the federal and state governments.

power, and its members cannot be easily removed. Also, its funding is independent of government budgeting, inasmuch as the participants in the electricity market fund it. ENRE publishes its budget, which is subject to objection by any participant. If no objections are raised, the budget is passed as a part of the national budget. Once approved, each participant pays in proportion to its share in gross production.

However, ENRE can propose new policies unilaterally only when issuing or renewing licenses. It must respond, however, to proposals for change (e.g., to alter price-setting formulas or tariff structures) emanating from consumers as well as generators and distributors.

England and Wales

In England and Wales, the goal was to deregulate generation and retail sales. For transmission and distribution, a new form of regulation (based on a price cap) was introduced--along with a new regulatory authority, the Office of Energy Regulation (OFFER), later merged with the Office of Gas Supply to create the Office of Gas and Electricity Markets (OFGEM).

However, OFFER/OFGEM has not kept a completely hands-off policy with regard to regulation of generation. In February 1994, it responded to concerns that the only two generators at that time exercised undue influence in electricity supply. Thus, it threatened to refer this concern to the Monopoly and Mergers Commission. As a result, it was able to negotiate a cap on pool prices that was implemented for the 1994/1996 fiscal year period. Also, it proposed partial divestiture of the dominant companies' generating assets. The actions were implemented simultaneously, in agreement with the generators.

In addition, there has been continued regulation of retail electricity prices (discussed below) and service standards for "captive customers" (those who are compelled to receive their service from the twelve Regional Electricity Companies (RECs)). Although services provided by the electricity industry in England and Wales were generally considered reliable prior to reform, higher-quality service standards were mandated by OFFER during the initial privatization phase. These standards were later tightened in 1993 and 1994. The RECs are required to offer various special services to the elderly and disabled. Service standards also were set for bill payment, meter reading, and responses to complaints.

The Director General of OFGEM is the sole regulator, unlike the commission structure favored in the United States. A one-person regulatory structure may make the UK electricity policy decision-making process more arbitrary than that of the United States, in that it has "tended to personalize both the OFFER (OFGEM) and the decision-making process, possibly causing the UK regulatory regime somewhat of a credibility problem." (U.S. Energy Information Administration, 1997, Ch. 2) However, a single regulator rather than a commission provides some inherent advantages with respect to speed and flexibility. The Electricity Act of 2000 created the Gas and Electricity Markets Authority to oversee the work of OFGEM. (Department of Trade and Industry, 2001) It is headed by a commission of eleven. This structure, although it adds a layer of management and administration, has the apparent advantage of retaining the flexibility of OFGEM while protecting market participants from "personalization" of OFGEM decisions.

Victoria/Australia

Regulation in Australia, like the United States, is shared by federal and state governments. State regulators regulate distribution and some aspects of retail supply. Federal regulators have jurisdiction over transmission and the National Electricity Market.

The National Electricity Code sets out the objectives of the market, contains the market rules, and specifies the rights and responsibilities of two national regulatory bodies, the National Electricity Market Management Company (NEMMCO) and the National Electricity Code Administrator Limited (NECA). It was first published on November 19, 1998.

NECA was established by the participating jurisdictions in the national electricity market: the states of New South Wales, Queensland, South Australia and Victoria; and the Australian Capital Territory. It supervises, administers and enforces the Code and is governed by an independent board.

The Electricity Group of the Australian Competition and Consumer Commission (ACCC) regulates transmission system revenue and assesses applications for changes in the NECA or the National Electricity Market Access Code. (Australian Competition and Consumer Commission)

There are four groups that participate in the wholesale power generation market: participants, NEMMCO itself, transmission and distribution service providers, and regional system operators. Participants include contestable customers, generators, marketers, and brokers. They are required to become participant members of NECA and are subject to all Code rules. Initially, only contestable customers (defined as those with an annual electricity peak demand of at least 10 megawatts) were eligible to participate in the market. However, as the market has matured, all customers have become contestable and – through representatives – have the option to participate. All generators with a net export in excess of 30 megawatts are required to participate in the wholesale power generation market. Smaller generators can also participate on a voluntary basis.

In Victoria, the Office of the Regulator General (ORG) was created to promote competition in the generation and marketing sectors; to maintain an efficient and economic system; and to protect the rights of customers. In fact, since the formation of the NEM, the role of the ORG has primarily been to regulate distribution. Other states have similar regulatory bodies, whose scope varies according to the degree to which the retail market is competitive (less competition, more regulation).

Germany

The lack of an independent regulator empowered to act before the event, and the essentially secretive nature of negotiated third party access, has made it relatively easy for vertically integrated incumbent utilities to defend their businesses from serious challenge. The sector's own grid code agreement has done little to improve transparency of information, and new suppliers have frequently had to file 'abuse of dominant position' complaints with the Federal Cartel Office (FCO).

The FCO, which acts as a tacit energy regulator in Germany, is gradually challenging the worst regional grid over-chargers, and Germany is under pressure from Europe's

independent power regulators (gathered under the Florence Forum banner) to drop its cross border fee charged on all declared imports and exports. Nevertheless, there is little political support for the appointment of an independent regulator. Even a number of large industrial users are against the idea.

To encourage a more open market, there is no longer a long-standing exception for electricity and natural gas in German competition law. Moreover, the new law voided demarcation agreements between power companies as well as contracts that provided utilities with an exclusive local concession for retail sales. A further amendment to the competition law prevented companies from refusing access to electricity or natural gas networks without justification.

As a result, firms must negotiate third-party access agreements with other suppliers and end-user representatives but they are not regulated by any new government entity. Antitrust competition authorities have the sole responsibility for ensuring competitive practices. Since these powers require the use or threat of legal actions, however, they tend to be quite cumbersome in responding to market power abuses.

France

France has passed several laws to allow entry by new firms. However, since a public company still controls key industry functions and does not answer to a regulator, there have been no new major policy reforms.

5.5 Sequence of Reform

United States

Wholesale market regulation in the U.S. is under federal jurisdiction. The first steps in reforming the wholesale market were PURPA and EPAct, as described in Section 3.3.

California

In California's restructuring of the electricity system, only twelve months were allowed for complete de-integration, including IOU divestiture of generating assets, setting up the Power Exchange and other wholesale entities, setting up the CAISO, and setting up retail competition. These far-reaching moves implied establishment and implementation of sophisticated market rules and complex hardware, software and communications systems, with no transition period to test how the systems would work and whether there were loopholes. This was done independently of market participants and their experience. (Besant-Jones and Tenenbaum, p. 39)

Pennsylvania/PJM

Pennsylvania took three years to phase in full retail competition. In addition, it had a pilot program that enabled distribution companies to work out problems before full implementation. Moreover, PJM itself had many years of experience in transmission system operations.

Argentina

Restructuring began in 1992 with the Electricity Law, which stipulated the creation of a national regulatory body, ENRE. Argentina first restructured the federal electricity companies, and the electricity industry in general, into separate generation, transmission and distribution companies and then privatized them. Privatization of generation began

in 1992 and was largely completed by 1995. Privatization of the six transmission companies began in 1993 and was largely completed in two years. Privatization of distribution began in 1992 and was largely completed by 1997. (Gomez, 2001)

United Kingdom

One of the first acts of electricity reform by the Thatcher government was passage of the Electricity Act of 1983. Similar to PURPA and EAct, it was designed to encourage the growth of independent power producers by providing open access to the national grid. Prior to 1983, entry to the electricity sector was prohibited. The Act required the Central Electricity Generation Board to purchase electricity from private producers at avoided costs, that is, at a price equal to the costs the Board would have incurred to produce the same quantity of electricity itself.

In the Electricity Act of 1989, one of the most important elements of privatization was the restructuring of the industry prior to its sale. Initially, the former Central Electricity Generating Board was restructured into two fossil power producers, National Power and PowerGen; one nuclear power producer; and a transmission company. National Power was the larger of the two fossil generation companies and accounted for 46 percent of electricity supplied in England and Wales in the 1990/1991 fiscal year. PowerGen accounted for 28 percent of generation output.

All of the generating companies were initially under government ownership then privatized. Shares in National Power and PowerGen were sold to the public in March of 1991. Most of the nuclear generating company was also privatized as British Energy Company in 1996, with the government retaining ownership in older plants that were not commercially attractive.

Ownership of the national grid was initially transferred to the RECs upon their privatization. However, in December 1995, they divested their shares in the national grid, at which time it became a separate publicly-traded company, the National Grid Company.

The twelve RECs underwent a separation between the wires (distribution) side of the business (which was to be continually regulated) and the retail sales function (which was to be gradually deregulated). The RECs were also the first segment auctioned off to the public by the UK government. These were sold in December of 1990. Large users of electricity were allowed to choose their suppliers, as opposed to being required to purchase electricity from their REC. The RECs were allowed to retain their franchise for small industrial and commercial companies until 1994 and for the remaining franchised end users (primarily residential) until 1998.

Victoria/Australia

Seven years of discussion and planning took place before the first step in restructuring Australia's electricity sector. This was the creation of a "national" power pool, consisting of Victoria, New South Wales, South Australia, and the Australian Capital Territory. Other states are being integrated as transmission links are completed.

Victoria first separated generation, transmission and distribution into three state-owned segments in 1994. Privatization of the five distribution companies took place in 1995. Privatization of generation took place between 1992 and 1997. The transmission company was also sold in 1997.

The National Electricity Code was first published in November 1998, about the same time as the “national” market for wholesale supply and purchase of electricity. It sets out the objectives and rules of the national electricity market, and the rights and responsibilities of market participants, the market manager, and the regulator. The objectives of the National Electricity Market are that:

- it should be competitive;
- customers should be able to choose which supplier (including generators and retailers) they will trade with;
- any person wishing to do so should be able to gain access to the interconnected transmission and distribution network;
- a person wishing to enter the market should not be treated more favorably or less favorably than if that person were already participating in the market;
- a participating energy source or technology should not be treated more favorably or less favorably than another energy source or technology;
- the provisions regulating trading of electricity in the market should not treat intrastate trading more favorably or less favorably than interstate trading of electricity.

Retail customers were freed to choose their own suppliers between 1996 and 2000 -- large users first and residential customers last.

Germany

Germany immediately opened up its entire end-use market to competition. Integrated utilities were required to provide open access to transmission by providing negotiated third-party access. With considerable excess capacity at the time of restructuring, these provisions resulted in some dramatic declines in end-use electricity prices early in the process, although prices have begun to rise again.

Nord Pool

Reform was introduced gradually in the Nord Pool region, but the main structural change, the creation of an independent systems operator and the immediate access to the transmission net, was introduced in 1996. Wholesale trading and the opportunity to choose a retail supplier were introduced gradually. Opening the retail market was completed in 2002 with the ability of the smallest retail customers (households) to choose suppliers almost instantaneously.

France

Trailing Germany and other European countries by several years, France chose to open up only 30% of its market, the minimum required by the European directive. Since that time, there has been very little additional effort to introduce competition.

5.6. Lessons Applicable for General Restructuring

De-Integration

De-integration of generation, transmission and distribution/retailing has been a basic, common theme of restructuring in all of the countries studied except for Germany and France. In general, de-integration seems to have worked well in other places. In fact,

too little de-integration (as in the case of Germany) has resulted in an industry where integrated utilities price strategically and distort electricity trade.

Regulatory Reform

Except for France and Germany, all of the countries examined here have regulators who have a high degree of independence. This is especially important for the operation and pricing of transmission and distribution services. The German experience has demonstrated the need for some industry-specific regulatory reform. Antitrust competition law by itself will not ensure sufficient competition.

Sequence of Reform

Even allowing for the time necessary for privatization in Argentina, England and Wales, and Australia, all of the entities investigated here took significantly longer than California in implementing restructuring. This enabled them to discover and remedy mistakes before they became serious. In moving forward, Japan might consider a flexible approach that allows policymakers the opportunity to adjust their policies as new problems arise. A flexible approach may include many different procedures including adopting one step at a time to make sure that each element of the restructured industry is working before introducing the complications of the next one.

At the same time, some aspects of regulatory reform can happen more quickly than others. Germany's immediate opening of its market to 100% of end users was implemented with little loss in efficiency. Together with considerable excess generation capacity, it had significant effects on industry prices early in the reform process.

6. Comparison of Generation Restructuring

In this section, the control parameters for restructuring generation are examined. The responses of the various entities are set forth, and lessons are derived.

Table 4
Comparison of Control Parameters for Generation Restructuring

	Ownership	Conditions of Supply and Pricing	Capacity Expansion
California	IOUs forced to divest ownership to IPPs. Some ownership retained by utility holding companies.	Sales to Power Exchange and CAISO only on a bid-based spot market. Structure permitted exercise of market power. Ancillary services market provides ability to provide reserve capacity.	Competitive, non-discriminatory entry. Significant barriers to entry w/r siting permits and regulatory uncertainty.
PJM	Utilities retained ownership of their generation.	PPUC set a high cap on wholesale prices. Transactions on power exchange or bilateral contracts. Long-term purchase contracts were allowed.	Competitive, non-discriminatory entry.
Argentina	IPPs, except for some state-owned hydro and nuclear. By law, no single generator can serve more than 10% of the market.	One-year contracts, hourly bid energy market with price caps, and seasonal contracts. Capacity payments to available and scheduled units. Prices are largely cost-based.	Concessions controlled by Secretary of Energy, apparently non-discriminatory.
England and Wales	Initially three private companies after reform, too few for effective competition. Opened up since.	Reliance on a uniform-price auction market, with hedging allowed, has been replaced by bilateral contracts of varying terms and a pay-as-bid spot market.	Competitive, non-discriminatory entry.
Victoria/Australia	Initially five private generation companies in Victoria	All generators who export more than 30 mW must participate in the wholesale market. Long-term, short-term and spot-market contracts.	Competitive, non-discriminatory entry.
Germany	No change in ownership as a result of reform.	Mostly physical markets, although financial markets are growing.	Competitive, non-discriminatory entry, although utilities own transmission lines.
Nord Pool	No change in ownership as a result of the reform	Spot market and an adjustment market for physical trading. Also a futures market for trading in different financial	Competitive, non-discriminatory entry.

		instruments.	
France	One large public company.	Restructuring has not changed supply and pricing conditions.	EdF essentially controls investments.

6.1. Ownership.

California

IOUs were forced to sell most of their thermal capacity to IPPs. Hydro and nuclear were spun off by the Utility Distribution Companies (UDCs)' parent companies into new generation companies, separate from the parents to prevent self-dealing. These sell to the wholesale market on the same terms as other generators.

Pennsylvania/PJM

There was no requirement for utilities to sell generation they already owned. IPPs can enter freely.

Argentina

The Argentine regulators have established restrictions to prevent reintegration of the electricity industry. There is complete separation of ownership of transmission from either generation or distribution. Also, no single owner can provide more than ten percent of national generation capacity.

England and Wales

Originally, generation was split into three companies, as described above. Since privatization, the nuclear utility has doubled its output with essentially the same facilities, and new generators have come into the market as a result of some divestiture by the original two fossil utilities and from greenfield IPPs. The divestiture, in which OFFER negotiated an agreement whereby National Power and PowerGen divested about 15 percent of their combined capacity, was prompted by a rising trend in electricity pool prices in 1993 and 1994. (Communication with Richard Green) Its objective was to reduce market concentration.

Since privatization, the distribution companies have been allowed to acquire generation assets with the restriction that no single REC's generation accounts for more than 15 percent of its peak demand (kW). (As Richard Green pointed out, however, an REC's generation may account for significantly more (and conceivably less) than 15 percent of its kWh sales.) This action was taken in order to introduce more competition in generation. Most of the RECs' investment in generation has been through joint ventures in new IPPs.

Victoria/Australia

Victoria created five generation companies – more than the three of England and Wales, but fewer than in California. Thus, the Victorian market is still concentrated by California market standards, especially since interties to other states are still weak. However, incentives to misuse market power have been mitigated by an extensive system of vesting contracts, in the form of contracts for differences, between generators and retailers. These last up to five years. Unlike California, where they were prohibited by the CPUC, vesting contracts are encouraged in Victoria. Competition will be enhanced further by future interstate transmission ties and new entrants into generation.

Unlike the United Kingdom (where electricity assets were sold at prices set by the national government), Victoria auctioned its four state-owned generation companies. Moreover, they were sold intact to other companies or consortia of companies. No restrictions were placed on foreign investors.

Germany

Although reduced from eight to five companies, integrated utilities own most of the generation assets. Other industry groups, e.g., railroads and coal companies, and municipal utilities sometimes produce power too.

Nord Pool

Generation is dominated by the large state-owned firms. There are also many independent power producers, as well as some generation owned by municipalities. There have been many mergers and acquisitions since reform started, making the whole sector more concentrated. The reform has thus made the economy-of-scale factor more important. Many of the mergers and acquisitions have taken place across international borders.

France

EdF owns virtually all generation assets, including the country's significant investment in nuclear capacity.

6.2. *Conditions of Supply and Pricing*

California

Beginning in April 1998, the Power Exchange operated day-ahead and hour-ahead auctions, conducted on an hourly basis. All transactions with UDCs were mandated to take place on the Power Exchange, including generation (hydro and nuclear) still owned by UDCs' parent companies. Others could participate on a voluntary basis. In addition to the spot market for energy, there is an "ancillary services" market in which the CAISO purchases reserve capacity.

The Power Exchange was organized as a uniform-price auction. That is, the most expensive (last) bid accepted set the price for the entire market. The logic of this structure is that it would mimic the marginal cost structure of the entire system, with price being determined by the price of the "marginal" bidder, who presumably would bid when the price was bid up to the bidder's marginal cost.

However, it is widely held that the reliance of California's UDCs on the spot market led to situations in which the market could be manipulated by generators in such a way as to violate FERC's "just and reasonable" standard for wholesale rates. Moreover, Besant-Jones and Tenenbaum (p. 32) have suggested that in addition to contributing to price volatility, the lack of forward markets may also have suppressed price signals that would have indicated a need for new generation investment.¹⁶

¹⁶ Problems with uniform-price structure of the auction were exacerbated by rapidly escalating natural gas prices and expensive nitrogen-oxide emissions permits. This combination caused a severe "rotation" of the supply curve because the highest-marginal-cost plants were also those which had the least thermal efficiency and the highest levels of pollution per kWh. See

Also, generators could bid each of their generating units separately rather than being required to bid all as a single entity. This enabled multi-plant generators to withhold small units in hope that they could set a high price for all, with relatively little risk that the bulk of their generation would not be dispatched. (Taylor and Van Doren, 2001, p. 13)

One of the most controversial aspects of California's restructuring efforts was the CPUC refusal and then reluctant approval of forward contracts between generators and the UDCs, including so-called vesting contracts between IPPs and the UDCs that formerly owned the power plants. In other restructuring contexts, such as Australia, vesting is often for five years or more.

Even after forward contracts were allowed by the CPUC, the UDCs were still subject to a "prudence" review. If the result of this review was that spot prices turned out to be below the forward prices, the CPUC could force the UDCs to absorb the difference. Thus, the UDCs were placed in a no-win situation and had little incentive to engage in forward transactions, even when they were allowed. (Besant-Jones and Tenenbaum, 2001, p. 38)

High spot market prices combined with frozen retail prices (see Section 8.3) led to PG&E to declare bankruptcy and to SCE being on the brink. Thus, some generators refused to sell to the Power Exchange for fear that they would not be paid (since the Power Exchange funds were limited to their sales revenues). The result was that in early 2001 the Power Exchange collapsed, and CAISO took over all short-term transactions. Also, the state government entered the market as a single buyer under long-term contracts.

CAISO manages the ancillary services, real-time imbalance, and congestion markets. Moreover, it is obliged to buy power on an emergency basis if demand threatens to exceed the supply contracted on the day-ahead markets. CAISO real-time transactions are settled every five minutes on the basis of bids 45 minutes ahead of time. While price caps were placed on the spot market in the Power Exchange, the CAISO is obliged to buy emergency power regardless of price in order to avoid outages. During California's electricity crisis, this apparently led some generators to withhold power from the normal day-ahead market on the chance that they could sell it at a higher price on the emergency market.

Transactions on the CAISO are monitored by the Market Surveillance Committee. It is required by FERC and investigates issues related to the structure and rules of the wholesale market and the potential exercise of market power. It reports and advises enforcement agencies on its findings but has no enforcement power of its own.

Pennsylvania/PJM

Pennsylvania's utilities were not required to divest their power plants and were permitted to enter into long-term contracts with generating companies. Some 80% of the power supplied over PJM's grid is either generated by the utilities or provided through long-term contracts. In addition, market participants can purchase power either through the pool or through bilateral contracts with financial hedging through "contracts-for-differences"

Borenstein (2001, pp. 9) An open question is why natural gas prices got so high. Exercise of market power has been put forth as one possibility.

(CfD) provisions.¹⁷ Also, there is a market for capacity as well as a market for energy, with the prices set by bidding.

PJM integrates pricing for transmission congestion into generation pricing through nodal pricing, essentially setting higher prices where transmission is congested. In effect, this permits generators to receive higher prices for generating electricity where demand threatens to exceed transmission capacity. Because they can earn higher profits by supplying power to such congested zones, generators have an incentive to add generation capacity in these areas.

Retail suppliers are required to contract for a certain amount of installed capacity (based on annual peak load) to allow for contingencies. If they fall below their capacity requirements, they must pay a fine to PJM. The proceeds of these fines are distributed among the generators. There is a market in which installed capacity can be traded by those who have excess capacity and those who need to acquire capacity.

An independent Market Monitoring Unit operates like California's Market Surveillance Committee, reporting and advising relevant agencies on issues related to the functioning of the PJM wholesale market

Argentina

Argentine generators can sell electricity either through the spot market or through contract. There is no provision for financial hedging. (Gomez, 2001) The buyers in the spot and/or contract market are distribution companies and large end-users (over 30 kW demand). Also, generators (who must occasionally buy power to meet contractual obligations or who can supply power in excess of their contractual obligations) participate in the spot market for their own account. The coordination of hourly demand and supply is done through seasonal and spot market prices. CAMMESA -- a nonprofit, independent operating agency jointly owned by the government and an organization of generators, transmitters, distributors and large users -- administers the wholesale market.

There are three types of prices, contractual prices, seasonal prices and spot market prices. Contractual prices are negotiated between generators and distribution companies and large users. The length of these contracts is typically a year, and they are unregulated. Although they call for a specified amount of power to be bought and delivered at a specified price, they are not actually physical contracts in that actual dispatch is conducted on a merit order basis by CAMMESA, regardless of contracts. Thus, the generator may be obligated to buy electricity from the pool at the spot price to be able to meet contractual obligations if it is not dispatched or to sell electricity to the pool beyond its contractual obligations if it is dispatched.

¹⁷ In CfD markets, generators and electricity purchasers can hedge prices by committing to a contract with an agreed-upon price, (the strike price). Contracts for differences are purely financial contracts and may take many different forms. For example, the strike price may be set at an average of expected daily pool prices. If the strike price turns out to be higher than the daily average pool price, then the purchaser pays the generator for the difference. Conversely, if the strike price turns out to be lower than the daily average pool price, the electricity generator reimburses the purchaser for the difference.

The seasonal prices are paid by distribution companies that purchase power in excess of their contracted levels. CAMMESA sets these prices using information based on demand forecasts, availability of reactive power, weekly load curves, availability restrictions, equipment information from transmission companies, etc. To a large extent, seasonal price determination is influenced by Argentina's dependence on hydroelectric power. Spot prices are determined hourly in CAMMESA by the interaction of buyers and sellers.

Sellers in the spot market include generators, distributors who have contracted to purchase more electricity than they can use, large users of electricity, and foreign producers of electricity. The buyers consist of distributors, large users, generation companies and foreign buyers.

In Argentina, as in the rest of Latin America and unlike the other countries/states discussed here, spot prices are determined on the basis of costs rather than bids. This is an important distinction. In order to set the spot market price, CAMMESA dispatches the generators in the order of increasing cost until demand is satisfied, with the last (most expensive) thermal plant dispatched setting the price, up to a price cap that is determined by CAMMESA. Prices paid by buyers include "nodal factors" that incorporate transmission loss and congestion. (Gomez, 2001) Wholesale prices also include the costs of reserve capacity, although (according to Gomez (2001)) this is being reconsidered in the light of Argentina's excess generating capacity. In addition, there are capacity payments for thermal plants' ability to meet unexpected electricity demand during hypothetical dry hydro years and for other conditions, including maintenance of cold reserves and ancillary services. (Gomez, 2001)

England and Wales

Prior to March 2001, England and Wales prices were set through a power pool similar to the California Power Exchange in that a merit order dispatch schedule was created whereby the generation units with the cheapest bid prices were selected first until supply was adequate to meet demand. The pool purchase price for all suppliers became the price bid by the last generation facility needed to accommodate the last unit of demand. The price actually paid to generators also included a financial incentive for maintaining some additional (peak load) generation capacity in the event that demand exceeded forecasts. (Because similar features are still used in other systems, the mechanism used in England and Wales for capacity payments is described more fully in Appendix A.)

An important feature of the England-Wales power pool was that, in order to mitigate price volatility, it permitted and encouraged a contract-for-differences hedging market. This allowed for bilateral contracts to be negotiated between generators and RECs and large end-users. According to communication with Richard Green, contracts-for-differences accounted for almost 90 percent of all generation since privatization and carried terms of one to fifteen years.

In practice, electricity prices in the England and Wales electricity pool proved to be volatile and subject to possible manipulation. Allegations were made that, due to their dominant position in the pool, National Power and PowerGen were able to manipulate pool prices by strategic bidding. The fact that both companies were once the same company suggests that each possesses an intimate understanding of the other's cost structure. (U.S. Energy Information Administration, 1997, Chapter 2) Thus, without

overt collusion, each had information about the other that would be relevant to withholding bids until the most advantageous price could be reached -- without a serious risk of failing to sell power at a lower, but still profitable, price. Moreover, the uniform price structure used in California and in the England and Wales power pool prior to NETA may facilitate covert collusion and strategic behavior.¹⁸ (Currie, 2000)

Littlechild (1999) outlined the problem as follows: "The consequence of all this competition is that the share of the two largest companies has halved -- a significant and very encouraging change in market structure. However, unfortunately, it is still the case that this has not been enough to create effective competition to bring prices down to where they ought to be." In addition, "I would say that however many companies you have in a market, if that number is fixed, it is always possible for them to agree to keep prices up. You always need the ability of new companies to come in from outside to compete prices down."

Dissatisfaction with the power pool led to a reconsideration of how electricity markets should be organized, beginning in 1997 (about the time that California was adopting a similar structure). In March 2001, the pool was replaced by the New Electricity Trading Arrangements (NETA), which are based on bilateral, pay-as-bid trading between generators, suppliers, traders, and customers. That is, each transaction stands on its own rather than having the marginal transaction set the price for the entire market. NETA envisages that private power exchanges (but not auctions) will be set up to enable the transactions. (Currie, 2000)

The International Energy Agency (2001) finds that NETA is built upon the following key principles:

- Demand is represented explicitly in the market. In principle, this should permit more demand responsiveness and therefore increase efficiency in the market through better market information.
- Offers and bids are firm. Thus, participants that can best manage risks are responsible for doing so and face the costs and consequences for failing to meet commitments.
- Bids and offers are simple and transparent.

The system includes futures markets, a balancing mechanism to enable the National Grid Company to balance the system, and a settlement process. Long-term contracts provide the foundation for generators and end-users to make long-term plans. Short-term forward trading allows purchasers to make changes in contract coverage one or two days before actual trading begins, providing flexibility to purchase more electricity at less expensive prices or sell contracted power in excess of the purchaser's needs. Spot trading balances supply and demand in real time and sets the price of electricity at that specific time. Thus, the England and Wales electricity market now looks much more like

¹⁸ Not everyone is convinced that pay-as-bid auctions are superior to uniform-price auctions. Wolak (2001a) suspects that they are at least as likely to be manipulated as uniform-price auctions. Thus, it is critical that in moving forward reformers determine the operational as well as theoretical advantages and disadvantages of the two types of bidding systems by learning as much as possible from the experience of England and Wales.

those of Argentina, PJM and Australia than in the past. As observed by one of the architects of NETA, it “moves the electricity market much closer to that of a normal market; and ... puts in place a governance structure that allows for relatively easy adjustment and change.” (Currie, 2000)

Victoria/Australia

In Australia, electricity traded in the National Electricity Market is on a spot basis through a uniform-price auction. However, participants are free to hedge their transactions with contracts for differences of any term. The effect is that participants achieve risk mitigation similar to that of contracts of varying lengths. All wholesale electricity trading is accounted for through the pool.

The Code realized that in order to give the correct market signals in the spot market, it is important for the spot price to be allowed to approach realistically high values. The Code also recognizes that in an immature market, such as Australia, allowing the spot price to operate at a level where supply and demand are balanced may result in an extremely high price that would expose inexperienced participants to unnecessarily high financial risks. Therefore, the Code makes provisions for a temporary Value of Lost Load price cap, set to strike a balance between the highest price that purchasers would pay rather than curtail consumption and a price high enough to ensure that generators would not be discouraged from investing in plants with high operating costs. This cap is set at a very high rate and is thus a last defense against a breakdown of the spot market. However, the real risk mitigation is from the ubiquity of hedging contracts. (Communication with Sam Lovick)

Wholesale generation prices are integrated with pricing of congestion in the transmission system. That is, generation costs include the costs of deviations from optimal dispatch due to transmission constraints. Regional spot prices are calculated every five minutes, and generators are paid according to these regional spot prices, calculated after the fact rather than when the bids are made. Thus, there is no need for a separate balancing market to remedy short-run disequilibrium conditions.

Germany

Germany’s wholesale market consists of bilateral agreements between generators and large customers and a power exchange. Germany had two power exchanges: the Leipzig Power Exchange (LPX) and the European Energy Exchange (EEX) in Frankfurt. They have recently merged into a single exchange, the European Energy Exchange in Leipzig. The LPX was set up on the Nord Pool model, initially emphasizing a day-ahead auction market. The old EEX initially emphasized futures markets. However, as the LPX developed a futures market and the EEX developed a spot market, they decided to merge. The new European Energy Exchange has a day-ahead and a financial futures market. Both buyers and sellers conduct transactions with the Exchange rather than directly. Anonymity of trades is a basic principle of the market. (European Energy Exchange, current-a, Section 3.4 and European Energy Exchange, current-b, Section 3.3) Of course, for bilateral agreements, terms can be kept confidential.

Spot markets for physical flows dominate the activity of the EEX, although financial futures markets are growing in importance. The functioning of this market has been controversial. For example, an association of energy users filed a complaint with the Federal Cartel Office over price spikes in December 2001, which it alleges to have been due to manipulation by electricity producers. (Platts, 8/08/02)

Moreover, laws favor certain types of generation by imposing priority dispatching and administered, above-market prices for lignite, cogeneration, and renewable energy. Thus, less than 50% of generation is competitive. (Ku, 2001)

Nord Pool

The Nordic wholesale market has a large number of market participants, which promotes competition. The power exchange provides the market with a transparent spot price and price forecasts via forwards and futures, within a time horizon of up to four years. The power exchange is not mandatory and competes with bilateral markets (70% of the total annual Nordic power generation) for trading financially settled and physical-delivery power contracts. More information about Nord Pool is available at www.nordpool.com.

A balancing or regulation market operates in each Nord Pool member country to manage transmission bottlenecks and imbalances resulting both from trade in the pool and from bilateral trade. Nord Pool arrangements are the blueprint for other more recently organized markets including markets in California, Germany, England and Wales (NETA) and others.

The joint Nordic power exchange Nord Pool consists of a spot market and an adjustment market for physical trading. It also consists of a futures market for trading in different financial instruments, which the players can utilize to hedge prices and spread risks.

On Nord Pool's spot market, Norwegian, Swedish, Finnish and Danish players trade in hourly contracts for the 24 hours of the coming day. Each morning, the players submit their bids for purchasing or selling a certain volume of electricity for each hour of the following day (midnight to midnight). Once the spot market has closed for bids, at 12.00 each day, a uniform-price auction is held. Purchasing and selling curves are constructed and the point at which supply equals demand point where determines the system price and the energy being traded. The system price applies to all purchases and sales unless the market area has to be split into smaller markets because of network constraints (see below). By 14.00 each day, the power exchange is able to inform the players about the price and their assigned trading during the coming twenty-four hour period. The generating companies that trade on the spot market can plan their production in more detail. These production plans are submitted to (?) each country's ISO in Sweden as a basis for planning the operation of the electricity system.

The ISO's responsibility includes planning and coordinating the national balance between the production and consumption of electricity, as well across borders exchanges. A balancing service has been established that must maintain the country's electricity balance in decentralized way via balance regulation, and distribute the costs of maintaining the balance between players on the market via balance settlement.

The largest producers have signed agreement (balance obligation agreement) to plan, on an hourly basis, for the production and purchasing of power to correspond to the expected consumption and sale. Differences in the balance are settled financially afterwards.

France

Pricing and supply conditions have not changed much in France since restructuring.

6.3. *Capacity Expansion*

California

IPPs are the primary source of privately owned capacity additions that sell into the California market. Unlike the integrated utilities they replace, however, they have no mandate to serve. All decisions about capacity additions are made on strictly commercial grounds. Capacity expansion by publicly owned utilities, such as the Los Angeles Department of Water and Power and the Sacramento Municipal Utility District are undertaken according to their own assessment of their constituents' needs and commercial opportunities to sell power in excess of their own needs.

Environmental permits due to California regulations imply that power plants take about twice as long to site as in the rest of the U.S. (Besant-Jones and Tenenbaum, 2001, p. 22) Local and environmental intervenors have been able to block and delay new capacity through litigation and ballot measures. Moreover, there has been little coordination between electricity and environmental regulators to accommodate each other's objectives and mandates.

In addition to expansion of generation capacity within California, it is also possible to expand capacity available to California in other states of the Western Systems Coordinating Council (WSCC). By the same token, capacity built in California is available to the rest of the WSCC.

Pennsylvania/PJM

Like California, the de-integration of the electricity sector implies that investment in generation capacity be done strictly on the basis of commercial motives in a competitive market. Moreover, the establishment of PJM Interconnect as the power pool implies that the generation market is the entire PJM region. Thus, capacity built in the rest of the PJM region is available to Pennsylvania, and vice versa. Moreover, transmission interties also connect PJM with other regions.

Argentina

Capacity expansion is undertaken as a commercial activity by IPPs. One constraint on capacity expansion is that no single firm can control more than ten percent of the generation market. This constraint could, in principle, inhibit investment to the point that it is sub-optimal. So far, there are no signs that this might occur.

England and Wales

There is a great deal of freedom for new generators to enter the England and Wales market. (Richard Green surmises that about 10 GW have already done so, as of 2001.) Moreover, it is possible to expand capacity through purchases over interties with France and Scotland, although this expansion is limited.

Australia

New generators are free to enter and sell to any part of the Australian market. However, sales between states are still constrained by weak transmission interties.

Germany

Integrated utilities may blunt the competitive forces for determining new generation capacity expansions. On the other hand, these firms may have the advantage of

coordinating their generation and transmission investments rather than doing generation assets on a merchant basis.

Nord Pool

Any new player is free to enter the market with new generating capacity. Capacity can also be expanded abroad.

France

One government-owned utility determines new investments in generation capacity with very limited influence from competitive forces.

6.4 *Lessons Applicable to Restructuring Generation*

Ownership

There do not appear to be any clear lessons from comparison of policies with respect to ownership of generation. All entities except Germany and France have de-integrated ownership of generation from the transmission and distribution functions. The fact that California and PJM have allowed parent companies of distributors to retain ownership of generation and transmission does not seem to have itself been a deterrent to competition, given that they do not operate the power exchanges and must compete on the wholesale market. Moreover, in Nord Pool it was an explicit policy that dominant state-owned generators remain strong. Nord Pool itself resolved the conflict between competition and strong generating companies by creating the conditions for trans-border competition. This might be a useful model for Japanese utilities maintaining their generation intact *if* inter-utility transmission capacity is adequate for meaningful inter-regional competition.

Market concentration was a problem in early restructuring efforts in Chile and in England and Wales. Argentina, by watching Chile, realized that exercise of market power is possible if there are too few generators and placed a restriction on the percentage of total generation that can be owned by a single entity.¹⁹ A similar restriction might be necessary for effective competition in Japan in the absence of a national grid that can support effective competition among large generators. One way for existing utilities to maintain the aggregate size of their current generation assets would be to sell generating capacity to each other so that each utility would have competition from other utilities within its traditional service area.

Conditions of Supply and Pricing

Some of the most important lessons are in the realm of how wholesale markets are structured. California's uniform-price auction system has apparently been subject to manipulation for the achievement of something other than the mimic of a "price-equals-marginal-cost" solution envisioned by its architects. This was also found to be the case in England and Wales. (Currie, 2000)

¹⁹ However, while restrictions on the market share of generators might foster competition in general, it will not necessarily prevent the exercise of market power altogether. Borenstein (2001, p. 11) observes that in California, "The unregulated generation owners that have been accused of exercising market power own between 6% and 8% of the production capacity in the ISO control area."

In addition, the attempts to force a “competitive” (price = short run marginal cost) market have come at the expense of a free market. In a free market, say for financial instruments, there is provision for risk mitigation through hedging and contracts of various durations. California has been unique among the states/countries examined in not permitting *any* meaningful risk mitigation in its electricity sector.

Moreover, even England and Wales – the originators of reliance on spot markets, albeit hedged – have replaced the pool with NETA, in which participants can make whatever bilateral transactions they want on the basis of a pay-as-bid price. As California moves forward, it will already have an overhang of long-term contracts. Thus, it might be reasonable to consider moving toward a pay-as-bid market that focuses initially on shorter term transactions, perhaps like the England and Wales’ NETA. This structure would allow participants to make their own decisions regarding which terms and conditions would be most appropriate. This would include short-term, intermediate and long-term contracts, as well as extremely short-term balancing transactions. However, there is no consensus as to whether pay-as-bid is superior in practice to uniform-price as a basis for conduction auctions. Among the systems studied, only England and Wales has tried both and have opted recently for pay-as-bid. Those responsible for restructuring should develop a thorough understanding of the practical as well as theoretical considerations behind England and Wales’ shift and take note of the arguments of detractors as well as supporters.

Also, it should be considered – as a practical rather than theoretical matter – whether bidding is superior to cost-determination (Argentine style) as a way to make spot markets. In principle, the results should be the same. In practice, however, lie the details; and the devil is in the details. There is significant evidence that uniform-price auctions have been subject to exercise of market power in California and in England and Wales. The jury is out regarding pay-as-bid auctions in that there is little experience. However, Argentina has had a cost-based spot market in place for about ten years and shows no inclination to change it. There may be a lesson here.

Capacity Expansion

The principal difference regarding the expansion of generating capacity is between California and the other states/countries with respect to the impact of environmental considerations on timely development and construction. It would seem reasonable to expect that siting and development processes in California could be streamlined and speeded up somewhat without undue violence to the environment and to community concerns. Also, if environmental advocates fear that faster approval might compromise the process, a mutually acceptable trade-off might be to adopt higher standards to compensate for whatever losses might result from speedier decisions.²⁰

In particular, with respect to California, there could be better articulation of goals and needs and better coordination between the responsible state power and environmental agencies. Besant-Jones and Tenenbaum (p. 8) identify what is required: “The economic regulator for the power sector and the environmental regulator need to work together. Each is in a position to undermine the work of the other. The ultimate success of both regulators requires a change in their mindsets.”

²⁰ We are grateful to Gregory Rosston for this observation.

7. Comparison of Transmission Restructuring

This section examines transmission, the interface between generation and distribution. The transmission system is complex in that it incorporates wholesale market-making and how electricity is dispatched over the network, as well as the physical facilities for moving electricity.

Table 5
Comparisons of Control Parameters for Transmission Ownership and Operation

	Ownership/ control	Access	Operation	Capacity Expansion	Transmission Pricing
California	UDCs own transmission facilities, receive a fee regulated by FERC. Cumbersome stakeholder governing board for CAISO has been replaced.	Open access, to sellers and distributors. Congestion pricing.	CAISO was to operate the transmission system, but not the Power Exchange. Later, CAISO operated the spot market by default	CAISO leads a coordinated planning process.	“Adjustable postage stamp” – same charges in each zone, except when there is congestion.
PJM	Ten IOUs own transmission facilities, receive a fee regulated by FERC. PJM governed by eight-member independent board.	Open access to sellers and distributors, uniform transmission tariffs.	PJM operates as an ISO. It operates the system and manages the exchange market.	PJM administers transmission planning for the region.	Separate price for each injection and end-user point (or node).
Argentina	Private ownership of facilities. Operation of system and market by stakeholder-owned corporation.	All distributors and qualified wholesale end-users have equal access to the grid.	CAMMESA operates the system and the market. Dispatch based on costs.	Expansion can take place by private contract or public auction. Conditions are complicated.	
England and Wales	Private ownership and operation, under regulation.	All distributors and qualified wholesale end-users have equal access to the grid.	Dispatch and market-making functions are combined in the National Grid Company.	National Grid Company plans and executes expansion.	Simple postage-stamp pricing.
Victoria/ Australia	State-owned, then privatized in 1997. Regulated	All distributors and qualified wholesale end-users have equal access to the grid.	The Power Exchange is responsible for pool operations and dispatch.	NEMMCO identifies opportunities. Private sector initiative under regulation provides actual expansion.	
Germany	Integrated utilities	Private agree-	Agreements	Utilities decide	Postage-stamp

	own transmission and negotiate third party access and rates without government interference.	ments determine rates and how capacity is allocated. New entrants complain about barriers to access	determine operation procedures.	with oversight by municipal and other government regulatory bodies.	pricing along each utility's transmission system.
Nord Pool	National grids owned by state-owned companies. Regional and local grid owned by private firms or municipalities	Open access to all market participants	The main grid is operated by an independent system operator. Regional and local networks are operated by private parties or municipalities	Grid owners are responsible for planning of expansion	Point-of-connection tariffs (nodal tariffs, with a "zonal" character). Cost to users has fallen by 5% since reform
France	Owned by a single government-owned company (EdF).	EdF decides access.	EdF controls operations.	EdF decides to expand with approval by other agencies for siting.	Regulated price based upon investment costs.

7.1 Ownership/Control

California

The three major IOUs own the transmission system, although the State of California has offered to buy it. They receive fees for transmission services that are regulated by FERC.

Grid operations are controlled by CAISO, which is a non-profit, public benefit corporation. Although FERC requires governance of CAISO to be independent of the stakeholders in the system, the CAISO and Power Exchange boards were originally built on stakeholder interests. CAISO was governed by a 24 member stakeholder board. It has been said that it "resembled a mini-legislature and was susceptible to roadblocks." (Besant-Jones and Tenenbaum, 2001, p. 14) There was a similar condition in the Power Exchange, where one or another party could veto any changes in market rules, including forward trading on the part of UDCs. (Besant-Jones and Tenenbaum, 2001, p. 34). FERC ordered the CAISO Board to be disbanded and replaced by a smaller, non-stakeholder board.²¹

Pennsylvania/PJM

Ten IOUs own transmission facilities, receiving fees regulated by FERC. PJM Interconnect is governed by an eight-member independent Board of Managers. The PJM Members Committee advises the Board. Owners of transmission facilities have less than 50% of voting control of the Members Committee.

Argentina

The transmission network has a national high voltage transmission system (500 kv) and six regional systems (220 kv). TRANSENER, which has been privatized, owns the

²¹ Given that the state government has been a major player in the wholesale market since the spring of 2001, it is not clear that the Board is independent under current circumstances.

national high voltage system and one of the regional systems. The majority of the regional transmission companies have been privatized. All of these companies operate under concessions of fixed duration and are closely regulated by ENRE. By law, ownership and operation of transmission systems is separate from ownership and operation of generation.

CAMMESA is responsible for dispatch. It is a non-profit organization whose owners are the government (represented by the Energy Secretary) and organizations representing generators, transmission companies, distributors, and large end-users. Each has 20 percent of the equity of the company, but the Secretary of Energy appoints its chairman and vice chairman and has some veto powers.

England and Wales

Ownership of the national grid was initially transferred to the regional electricity companies (RECs) upon their privatization. However, in order to preserve its independence, the ownership was through a holding company structure. In December 1995, the RECs divested their shares in the national grid, at which time it became a separate publicly-traded company, the National Grid Company plc (NGC). It is governed by a board of directors, of whom four members are executives of NGC and six are independent.

NGC is the operator of the grid, responsible for its efficient operation and reliability within the guidelines of the NETA.

Victoria/Australia

PowerNet Victoria, a private company, owns Victoria's high voltage transmission grid network and is responsible for its maintenance. Until the establishment of NEMMCO in late 1998, the Victorian Power Exchange was responsible for pool operations and system dispatch in Victoria. NEMMCO now has these responsibilities for the five states/territories that are in the "national" electricity market. NEMMCO is a self-funding company owned by the participant states and the federal government.

Germany

The country imposes functional and accounting unbundling of transmission but does not require separate operation or divestiture of wires from the rest of the utilities. Integrated utilities own transmission and negotiate third party access and rates without government interference. However, these firms and large end users are encouraged to make negotiated third party access work because they realize that an electricity regulatory board may appear if the private agreements fail to open transmission access and keep prices competitive.

Nord Pool

The national grid is owned by a state-owned company. Regional and local grids are owned by private companies or municipalities. As natural monopolies, their performance is monitored by appropriate regulatory bodies, which also specify grid owner responsibilities. These include:

- Build, operate, and maintain the grid within its defined area.
- Connect end-users to the grid.
- Collect metered hourly consumption for all end-users or estimate hourly results based on a "load profile."

- Submit hourly values to TSOs and power generators in the grid owner's area.
- Purchase energy equal to the grid's energy losses.

France

EdF owns transmission lines and operates the transmission wires business.

7.2. Access

California and PJM

In 1992, Congress passed the Energy Policy Act, which set the stage for all wholesale participants to have access to transmission lines owned by IOUs. Under EPAct and its enabling regulations, all new generating capacity has non-discriminatory access to the transmission network. In 1996, FERC issued Order 888 requiring all vertically integrated IOUs to file an open access transmission tariff that would provide universal access to the transmission grid to all qualified users.

With the implementation of the PJM Open Access Transmission Tariff on April 1, 1997, PJM Interconnection began operating the first regional bid-based energy market in the U.S.

Argentina, England and Wales, and Australia

All of these have open access to the transmission system for all generators and wholesale customers.

Germany

The dichotomy between Germany's official 100% market opening and the reality of restrictive third party grid access charges and minimal customer switching has made the country's power market uniquely frustrating for new entrants. Private agreements between electric utilities and other suppliers and large end users determine transmission rates and how capacity is allocated. However, the legal framework is insufficient for efficiently providing third party access to the grid due to: no legal provisions for details of grid contract use or for determining access fees, no regulatory authority, and no independent system operator. (Ku, 2001)

Nord Pool

There is free access of all market participants to the national, regional and local nets. Large operators or traders are encouraged to sign the balancing obligation act.

France

EdF decides access issues.

7.3. Operation

California

Participants submit output and demand schedules through forty Schedule Coordinators, who submit balanced load schedules to the CAISO on a day-ahead basis. CAISO dispatches are based on the aggregated schedules submitted. To correct imbalances, the CAISO conducts a real-time auction to buy needed energy not covered by

commitments. The CAISO is obliged to purchase power regardless of price whenever it is necessary to keep the system from failing. When demand approaches capacity to the extent that reserves are inadequate for reliable service, the CAISO declares three stages of alerts to the public to encourage reduction of consumption. At Stage 3 (1.5 percent reserve margin), the CAISO begins rotating outages by distribution system block. These are typically about 90 minutes per block until adequate reserves are restored.

Congested transmission is allocated via auction by the CAISO to the Schedule Coordinators.

Pennsylvania/PJM

PJM is both the market-maker and the operator of the system. It uses merit-order dispatch based on day-ahead offer prices and projected loads. PJM has enforced an offer cap on wholesale prices and accepts no offers that exceed the cap, except under "Emergency Conditions," in which the cap is relaxed.

A generating unit that is dedicated to serving load within PJM is designated a "Capacity Resource," and subject to PJM dispatch. If its energy is not provided when called, its value as a capacity resource is diminished in the future. Also, PJM maintains a market in capacity resources so that those who need capacity to meet obligations can buy from those with capacity in excess of their own needs. Also, distributors can buy and sell capacity resources according to their needs. The price of capacity resources varies according to market conditions.

When capacity utilization is high enough to warrant Emergency Conditions, PJM recalls for its own use any energy produced by Capacity Resources that is being sold via bilateral exports. This recalled energy is paid the market price in PJM. Also, in emergency situations, it may curtail some service under its Active Load Management program and may engage in load shedding.

Argentina

CAMMESA is responsible for scheduling and dispatch of generating units and conducting the auction for spot market transactions. Also, it coordinates payments for wholesale spot market transactions. It operates according to merit-order dispatch, based on the contractual, seasonal and spot prices, which are cost-based.

England and Wales

Dispatch is governed by the transactions under NETA, as discussed in Section 4.2 above.

Australia

The National Electricity Market Management Company (NEMMCO) is a pool to which all generators above a certain size are obliged to sell their output at prices determined by the highest bid for distribution through regulated transmission networks. However, interstate transactions in NEM currently account for only about 7% of total generation.

Germany

The same companies that own the wires also control their operations. Congestion is handled administratively by each integrated utility or by coordinated utility actions.

Nord Pool

The owners of the grids, who are also the systems operators, are to make sure that the supply and demand for electricity is balanced at all times and all places.

- Determine rules and requirements to secure supply and supply quality, within regulatory guidelines and in close cooperation with generators,
- Make sure that short-term power reserves are adequate to meet emergencies.
- Manage real-time system operations.
- Manage a real-time market to balance generation with consumption.
- Cooperate with TSOs of interconnected grids.
- Calculate and resolve imbalances for all participants in the wholesale market.
- Manage financial settlement of imbalances.

The Power exchange, Nord Pool, is owned by the national grid companies. The exchange shall:

- Provide a price reference to the power market.
- Operate a spot market and an organized market for financial products, such as forward, futures, and option contracts.
- Act as a neutral and reliable power-contract counterparty to market participants.
- Use the spot market's price mechanisms to alleviate grid congestion (capacity bottlenecks) through optimal use of available capacity.

Two methods are used to manage bottlenecks, (i.e. sectors of the network where transmission capacity is not sufficient): market splitting and counter-trade. Both principles are used simultaneously on the joint market.

France

EdF controls the operations of the wires. They recover costs but do not try to consistently use prices to relieve congestion along the lines.

7.4. Capacity Expansion

California

CAISO coordinates capacity expansion of the transmission system, with participation from regional transmission planning agencies. CAISO, FERC or other market participants may identify a need for transmission system additions or upgrades. CAISO determines where and when the investment is needed and allocates its costs to the participants according to their benefits. The grid owners are then required to make the required investments and are allowed to recover their costs. (Weiser and Pickle, 2001)

PJM

PJM prepares a Regional Transmission Expansion Plan that coordinates all of the transmission expansion plans throughout the PJM region. It has both five-year and ten-year components to incorporate immediate and intermediate-term horizons. The elements of the Plan originate with the Regional Transmission Owners (RTOs) and are limited to those plans by the RTOs that have a regional impact. The Plan is based on a formal consultation and advisory structure that takes into account the interests and plans

of all stakeholders, including those of IPPs planning to build new generating capacity. The Plan is also integrated into that of the larger MAAC regional reliability council of which PJM is a member. (PJM, 1998)

Argentina

Transmission planning is based largely on petitions by generators and purchasers of electricity. As an alternative to expansion by petition, potential users may band together by private contract and allocate among themselves the costs of the new capacity. However, the expansion can be vetoed by ENRE. (Gomez, 2001)

“Congestion rents” are collected in transmission corridors in which there are capacity constraints. These revenues comprise a fund that is used for transmission capacity expansion when potential users suggest a new line. CAMMESA estimates the cost of the new line and assigns its costs to potential users, and the capacity expansion funds are used to offset part of the cost. The line must be proven to be cost-effective for the entire system. However, potential users who do not wish to pay the assigned costs may band together to oppose the line. If it goes forward, a new transmission company is formed to own and operate the line.

A study by NERA, a consulting firm deeply involved in energy problems, has identified the following flaws in the scheme: (Gomez, 2001)

- o Generators may be unwilling to pay for economic lines and, on the other hand, have incentives to invest in lines that are not economic.
- o The availability of the fund may encourage uneconomic construction.
- o Both of the above may encourage uneconomic location decisions.

England and Wales

NGC is responsible for planning and executing transmission system additions and upgrades under the National Electricity Code.

Victoria/Australia

NEMMCO is required to provide an annual Statement of Opportunities, covering all electricity sector investment, including transmission. This assessment is based on recommendations of the Inter-Regional Planning Committee, which in turn is based on findings by the transmission network service providers. It is up to private sector initiative to act upon the transmission opportunities that are identified.

There are two types of interconnectors to enhance transmission network development. Regulated interconnectors must pass strict tests in terms of contributing to market development; they receive guaranteed rates of return. Unregulated interconnectors derive their income from the price difference between two sides of the interconnector.

The International Energy Agency (2001, p. 7) believes that interconnection between states of the NEM (which are clustered in the relatively heavily populated eastern part of the country) needs to be reinforced. There are significant price differences between NEM regions, which imply that there is not enough trade. Efficient transmission pricing is needed to encourage investment in transmission and interconnection, as well as efficient plant siting. The IEA believes that transmission pricing should be reviewed to

better reflect transmission costs, including grid congestion. One result of such a review might be that generators as well as end users should pay transmission charges. Such a review of transmission pricing was initiated in 2000. (International Energy Agency, 2001, p7)

Germany

Each utility decides whether to expand transmission lines subject to siting and other reviews by government agencies.

Nord Pool

Grid owners are responsible for expansion.

France

EdF decides whether to expand transmission lines subject to siting and other reviews by government agencies.

7.5 Transmission Pricing

California

California has a single-price (“postage-stamp”) system for each of 24 adjustable zones. When there is congestion, surcharges that vary across zones depending on congestion are imposed. This approach is sometimes referred to as “zonal” pricing. Conceptually, it lies between a fixed postage-stamp rate for the state and a fully flexible set of rates for each node along the system.

PJM

PJM uses a flexible pricing system that sets a price for each point where electricity is injected or drawn from. These points are called nodes and the approach is referred to as nodal pricing. Each price is flexible and allowed to rise or fall (and even become negative under certain conditions) as congestion along the transmission lines change. Fluctuating prices creates the possibility of substantial price risks for participants. As a result, PJM has a financial transmission rights instrument that protects “firm” transmission customers from increased prices during periods of congestion.

Argentina

Argentina has a complex transmission pricing regime. First, there is a basic transmission pricing scheme that is designed to recover operations and maintenance costs of the existing system, plus a “reasonable surplus.” (World Energy Council, Sec. 2.1.2, 2001) The basic transmission price consists of three parts. (Gomez, 2002) One is a connection charge that is paid by all members of the wholesale electricity market and remunerates transmission assets for their connection to the grid. It varies according to the voltage of the connection. The second is a capacity charge paid to recover the operations and maintenance of transmission lines. It calculated at each node according to its estimated use of system capacity. Also, there are two variable charges intended to reflect reliability and marginal losses, based on costs at interconnection nodes

In addition to the basic transmission charge, there is a congestion charge that goes into a special fund that finances new transmission construction, as discussed above. In addition, there are penalty charges that may be levied for unavailability of capacity.

England and Wales

In determining the spot price of electrical energy in the day and hour preceding delivery, England and Wales essentially ignore costs of transmission line losses and congestion and view all generation and consumption as being at a single point – so-called “postage-stamp” pricing. If there is congestion, the system operator may need to change the dispatch to relieve the constraints. It is a relatively simple system, but it can cause the real-time dispatch (at the time of delivery) to be badly inferior to appropriately pricing short-run transmission costs if the losses and congestion are significant.

Transmission tariffs are set every five years and then allowed to increase at a rate equal to the growth rate of the Retail Price Index (RPI) minus some rate of anticipated technological change (X), where X is a measure of the performance improvement the regulator wants the ISO to achieve over the next five years. At a first glance, this RPI-X pricing seems to be straightforward. However, in practice this is not the case as the value of X depends on expectations and accurate discovery of transmission system improvement by the regulator.

In general, postage stamp pricing does not solve the problem of providing correct incentives to the grid users to expand or curtail consumption or to locate generating capacity optimally. It only provides incentives to the system operator for efficient exploitation of the grid.

Australia

Australia’s current system sets average prices on the basis of a benchmark and then allows them to change according to an aggregate consumer price index minus an estimate of assumed productivity change in transmission – so-called “CPI-X” pricing. The average price is recovered by zonal prices that bear some relation to congestion and by “postage-stamp” prices related to energy and by fixed connection charges. (International Energy Agency, 2001, Table 11)

However, Australia’s transmission pricing is undergoing change because it is clear that the current system does not provide sufficient incentives for adding transmission capacity. Thus, it is moving to a “beneficiary pays” system, which seems to imply nodal pricing, payments by both generators and recipients. (National Electricity Code Administrator, 2001a) As of August 2002, the new system appears to be under discussion and not yet decided.

Germany

Germany uses a distance-related tariff, based on airline distance between generator and load. The longer the distance, the higher the voltage level that is assigned. Some critics think that the approach leads to discriminatory action and barriers to electricity trade. The tariff, split up in demand rate and energy rate, depends on this highest assigned voltage level. At each voltage level a standard distance is assumed, with a maximum of 100 km at the highest voltage level (400 kV). Beyond 100 km, a distance-related surplus is charged. Basing charges on distance rather than actual use and capacity requirements implies incentives for siting production and consumption close to one another, regardless of whether or not the transmission grid has excess capacity. Implicitly, because line losses are associated with distance, this tariff likely to be more efficient than postage-stamp pricing.

The German utilities do not try to price transmission in a way that alleviates congestion problems on a consistent basis. A power flow through a transmission line in the opposite direction of existing power flows reduces the total power flow, and alleviates congestion. However, it is charged in the same way as are the congestion-causing flows.

France

With limited restructuring of its transmission system, France essentially has transmission prices that are set by regulation on the basis of investment costs. The prices are similar to a postage-stamp approach. They do not reflect variations in congestion along different transmission lines.

Nord Pool

Norway uses “point-of-connection” pricing that is not based upon distance. In this approach, the price varies at each point according to transmission losses associated with that point, incremental costs of generation due to deviations from least-cost dispatch that are necessary to relieve congestion, and the individual customer’s use of the network. The charge includes: a charge for incremental network load, a capacity charge, a connection charge, and a “power” charge. (Mori, p. 28 and Dhawal) These charges are imposed administratively and vary by season. Price zones are defined administratively and regional prices are determined to clear these markets. This general approach for these systems appears to keep administrative costs low by simplifying transmission prices; but it may lead to some problems in real-time dispatch in systems where losses and constraints change quickly or significantly.

7.6 Lessons for Transmission Restructuring

Ownership/Control

It seems to make little difference who owns the transmission grid. The important question is who controls its operations and how. All of the systems reviewed here have private ownership. The California and PJM grids are owned by the original private utilities or their successor UDCs. In Argentina, England and Wales, and Australia, the grids are owned by separate private entities. In Nord Pool, national grids are owned by government companies. In each case, they earn fees for transmission services under regulation by a national authority. England and Wales is the only state/country examined here in which the owner and the operator are the same entity.

In California, PJM, England and Wales, and Australia, the grid operations are controlled by a board that is independent of stakeholder interests. This has only recently been true in California; and, given that the State of California is represented and the state government is a power purchaser, it may not be true even now. In Argentina, the board is composed of stakeholders, but the Energy Secretary – presumably acting in the public interest – has veto power. All of the boards (California’s only recently) are small, making them less cumbersome and more decisive. Thus, it appears that there are many feasible possibilities for Japan, including continued utility ownership but independent operation.

Transmission Access

This seems to be a non-issue. All of the systems investigated grant open access to new generators and customers. The only potential difficulty may be in the German or French system, where some participants question whether the transmission systems are as

open as the utilities claim. Japan would seem to be able to adjust quickly to the open access system necessary to promote wholesale electricity competition.

Operations

California is the only one of the systems studied that separated market-making from operations. In retrospect, this seems to have been unnecessarily cumbersome. California and the England and Wales pool operated under merit order dispatch, with the lowest-bid units dispatched first, subject to system reliability constraints, under a uniform-price auction. Now, Argentina, PJM, England and Wales under NETA, and Australia operate under a hybrid system that takes account of forward contracts as well as spot markets. Moreover, except for Argentina's spot market, these are pay-as-bid markets rather than uniform-price markets. They also provide financial clearing services for bilateral transactions as well as balancing transactions.

Capacity Expansion

Except for National Grid Company of England and Wales, which owns as well as operates the grid, the grid operators of the systems studied take a passive and coordinative role, waiting for others to propose additions to the grid and helping to facilitate agreement. It is not clear that this is the most efficient way of planning and executing transmission system expansion. In Argentina, in particular, the system seems complex and inefficient. Short of unifying the ownership and operation of the grid, California and PJM may have as efficient a system as could be expected, although it seems that California has taken a long time to construct some needed transmission links under its present system. A question that should be examined is that of incentives for construction of new transmission capacity. Given that Japan appears to have relatively little inter-regional transmission capacity for an overall system of its size, this would appear to be a critical question for developing a competitive wholesale electricity market.

Transmission Pricing

Many countries or states begin with a relatively simple approach to pricing the use of transmission lines that do not allow prices to change as congestion along various lines change. The principal approach is a postage-stamp procedure that allows electricity to flow through a region for a single and stable fee, much like mailing a letter within a country. Sometimes transmission prices are allowed to change with distance between the point of injection and the point of use. Once again, however, distance-related tariffs do not change as congestion varies.

Many countries adopt the simple tariff approach because they do not expect congestion to become a major problem. However, many regions find that electricity restructuring can change the flow of electricity rather substantially and that previously uncongested lines suddenly become more congested. For this reason, many countries ultimately adopt "adjustable" postage-stamp or zonal rates and sometimes nodal prices as they see lines become more congested. This issue will undoubtedly be important for restructuring in Japan since wholesale competition would seem to result in a great deal of congestion on inter-regional links.

8. Comparison of Distribution/Retail Restructuring

Moving power from the transmission system to the customer's meter may be regarded as two separate functions: the physical "wires" system and the retail supply system, in

which retailers use the services of the wires as a regulated common carrier. In the U.S., as of March 2002, 25 states and the District of Columbia had passed laws or regulatory orders to implement retail competition, and more are expected to follow. However, in the wake of the problems in California, eight have either cancelled or suspended their reform efforts. This section examines how retail competition has been handled in the states/countries of this study.

Table 5
Comparisons of Control Parameters for Distribution and Retail Supply

	Ownership/ control	Oversight, Regulation and Competition	Pricing
California	Open entry into competitive retail market, since collapsed. UDCs are now sole retail providers for the market formerly served by IOUs.	CPUC regulation of UDCs, based on performance. . No obligation on the part of UDCs to insure adequate wholesale power supply.	In principle, prices set by retail competition. This principle was diluted by legislated prices for UDCs. Charges recover costs of stranded assets. Wires services' prices set by incentive regulation.
Pennsylvania	Original IOUs own the system and are retail providers, as are new entrants.	Pennsylvania has full retail competition, regulation of distribution. Retailers are obliged to provide reserve capacity. They have access to forward markets.	Legislated price caps. Charges recover costs of stranded assets. Wires services' prices set by regulation.
Argentina	Moving toward full privatization of monopoly concessions.	ENRE regulates retail sales, set rates based on assessment of costs.	Cost-based price cap, adjusted every 5 to 8 years.
England and Wales	Open entry into competitive retail market.	OFFER has regulatory responsibility to see that competition is healthy.	"RPI-X" price regulation.
Victoria	Privatized, but maintains monopoly rights until 2001. Full competition planned for 2003.	Competition for all customers. Goal is minimum regulation except for wires functions.	"RPI-X" price regulation.
Germany	No legislated change in ownership, but franchised utilities are no longer protected.	Immediate opening of markets for all consumers but impediments to switching.	In principle, prices set by retail competition.
Nord Pool	Open entry into competitive retail market	Regulatory regimes vary between the Nordic countries. Customers free to choose supplier and change instantaneously	Prices set by retail competition.
France	No change in ownership.	30% of consumers are allowed to select supplier.	In principle, prices set by retail competition.

8.1. Ownership/Control

California

AB 1890 provided for “electricity service providers” (ESPs) to enter the retail electricity market in order to create a competitive retail market. Their services were offered over the UDC’s distribution systems, which remain regulated by the CPUC. The UDCs were the default service providers in case retail customers did not choose an alternate ESP.

Pennsylvania

The pre-existing utilities own the distribution system, and their compensation for distribution services is regulated by the Public Utility Commission. Also, however, Pennsylvania has actively encouraged retail competition, with retail service providers using the distribution network as a common carrier. The utilities are default retail service providers.

Argentina

Distribution assets formerly owned by the federal utilities were either privatized or handed over to the provinces. The provinces have since started privatizing these. Monopoly concessions are granted on the basis of competitive bidding under ninety five-year licenses from ENRE. Retail sales are not separated from distribution.

United Kingdom

There is a separation between the wires (distribution) side of the RECs' business (which was to be continually regulated) and the retail sales function of the RECs (which was to be gradually deregulated). The RECs were also the first segment sold off to the public by the UK government, as of December, 1990.

In addition to the RECs' retail sales operations, “second tier suppliers,” unaffiliated with their local REC have entered the market. These include RECs operating outside of their franchised distribution territories and electricity marketing units of National Power and PowerGen. Due to concerns relating to maintaining competition, however, the retail suppliers are required to operate separately from the generating companies and the distribution side of the RECs.

Victoria

In the first stage of its restructuring, Victoria combined the supply districts of the State Electricity Commission of Victoria with the distribution assets of Municipal Electricity Authorities into a single distribution entity. This, in turn, was split into five separate companies and privatized in 1995. Companies from the United States, and their consortia, led the way in purchasing these companies. This contrasts with England and Wales, where electricity assets were sold at prices set by the national government. Furthermore, all of the Victorian companies were sold intact, and to other companies or consortia of companies. No restrictions were placed on foreign investors.

Victoria permitted each of the five distribution companies to retain monopoly rights to supply power to customers in their respective geographic regions. At the time of sale, some customers were allowed direct access. However, in 1996 large users (the contestable customers) were freed to purchase electricity from any of the five distribution companies. As of June 30, 2000, Victoria had 22 retailers that sell electricity to contestable customers in a competitive market. By January 2003, all Australian electricity consumers are to be able to choose between electricity retailers.

Germany

Although Germany did not legislate any change in ownership at the distribution and retail level, the nation no longer protects franchise utilities with demarcation agreements. A mixture of integrated utilities and regional and municipal utilities provide distribution and retail services to end users.

Nord Pool

There is free entry to the competitive retail market. Consumers have many suppliers from which to choose, and many new suppliers have emerged since the reform. Switching one's retail supplier can be made with short notice, and there is a great deal of comparison shopping and switching done over the Internet.

France

New companies can compete with EdF for providing distribution and retail service, but any new entrants must provide the same employee benefits as EdF. This has been a barrier to offering competitive prices, so there has been relatively activity in retail competition in France.

8.2. *Oversight, Pricing, Regulation and Competition*

California

AB 1890 created the possibility of retail competition by allowing free entry for new retail sales companies. However, AB 1890 also fixed retail rates for the UDCs at the levels in effect as of June 10, 1996 and guaranteed a 10-percent rate reduction for residential and small commercial users. This sweetener was financed to some extent by tax-exempt California state bonds. It appeared to be a political *quid pro quo* for imposing the Competition Transition Charge.

Rates were to remain frozen until March 31, 2002. Thus, new entrants in the retail market were faced with competing with entrenched incumbents with artificially depressed prices. (Taylor and Van Doren, 2001) However, at the time AB 1890 was passed, it was widely believed that competition would drive wholesale rates down, so that retail competition would thrive despite the UDCs' rate reduction. In the event, however, with wholesale prices rising and UDCs' rates fixed by law, new retail suppliers were not able to survive.

The UDCs and other retail suppliers are under no obligation to maintain control of sufficient capacity to serve the loads they serve. Also, they were forbidden to mitigate risks of inadequate supply by having access to forward markets, either long or short term.

Pennsylvania

The Electricity Generation Customer Choice and Competition Act called for a phase-in of retail choice, with one-third by January 2000. All customers in Pennsylvania can now choose the generator of their electricity, but they are still required to purchase the transmission and distribution components of their electricity services from the traditional utility. Incentives were provided for participation in a pilot retail choice program. This phase-in allowed utilities and the PUC to iron out transition difficulties before full competition was launched.

In terms of numbers of customers that have switched suppliers, Pennsylvania's restructuring program has been called the most successful in the U.S. However, to some degree, retail choice has been forced. For example, as required under PECO's (a major IOU) restructuring plan, 300,000 residential customers that had not chosen a competitive supplier were randomly chosen and switched to The New Power Company, which was chosen by PECO to provide "Competitive Discount Service" from March 2001 through January 2004. Customers may opt out of the program or choose another electricity supplier without penalty. (Energy Information Administration, 2001)

Moreover, like California, Pennsylvania legislation placed a price cap on retail rates for customers served by traditional utilities. Like California, when wholesale prices rose, many customers fled the new retailers back to the traditional utilities whose retail rates were capped. (Erie Times-News, 2001)

PJM requires retail suppliers to have enough capacity to cover all current demand plus a 19 percent reserve.

Argentina

Distribution and retail sales remain integrated, and distribution companies retain a franchised monopoly. They have an unconditional obligation to supply customers, subject to penalties for failure. ENRE regulates the retail activities of distribution companies, setting rates and conditions of service. Large users may choose to be supplied either by the distribution companies or directly by generators. If they choose the latter, their rates and terms of service are determined by bilateral negotiation and are not subject to regulation.

England and Wales

OFGEM has responsibility for assuring that competition is healthy and that rates are appropriate. Rate-of-return regulation was rejected in England and Wales for several reasons. First, discovery costs were felt to be expensive, requiring a large bureaucratic structure. Further, it was felt that regulators would always suffer from a disadvantage, given that the utilities could manipulate the information they supplied to their own advantage, leaving the regulator in an inferior negotiating position. Moreover, rate-of-return regulation offered insufficient incentives for the utilities themselves to reduce costs aggressively (although this shortcoming can be mitigated by infrequent rate cases). Thus, they adopted price caps, as discussed below.

Victoria

As in the United States, regulation of distribution and retail sales is the responsibility of the state rather than the federal government. Victoria's Office of the Regulator-General is responsible for promoting competitive markets, free entry and efficiency and for ensuring that end users benefit from competition and efficiency. The overall intent is to act only when the competitive market fails.

Germany

Restructuring provided immediate open markets for all consumers. Switching to new suppliers, however, can be burdensome and can take months.

Nord Pool

The Network Authority supervises price levels, price developments and other terms for network services. If the Network Authority in its final assessment concludes that the

price level is not reasonable, this is reported in the form of a decision with an injunction to the company to adjust its price level. It is then possible for the company to appeal against this decision at a court of law.

France

There is little formal oversight or regulation. Basically, Edf regulates itself.

8.3 *Retail Pricing*

California

In principle, retail prices were to be determined by competition. However, the circumstances that led to the demise of retail competition, as described in Section 8.2, have led the CPUC to resume its traditional regulatory role.

In addition to fixing the retail cost of electricity, AB 1890 allows for stranded cost recovery in California. Utilities were to apply the difference between their actual operating costs and the legislatively-fixed price toward recovering their stranded costs (under the assumption that the costs of energy would be less than the fixed retail prices). The stranded assets in California consisted primarily of nuclear power plants and generous power purchase agreements with wind, cogeneration and other “qualifying facilities” (QFs) as defined in the U.S. Public Utility Regulatory Policy Act of 1978. The California Public Utility Commission interpreted this act generously for the QFs under Standard Offers 2 and 4, leading to a great deal of power being offered that the utilities were forced to accept at a high price under long-term power purchase agreements. Also, a “Competition Transition Charge” (CTC) on consumption is levied on retail customers to help cover the costs of stranded assets, along with another charge that finances the bonds that provided the rate reduction.

Pennsylvania

Pennsylvania, like California, has price caps for retail customers. In addition, residential and commercial customers received an additional eight percent rate reduction. Thus, like California, retail prices are decoupled from wholesale prices. Also like California, as wholesale prices have risen, retailers are being squeezed.

With regard to stranded costs, the PUC is authorized to determine the level of stranded costs that each utility is permitted to recover. Cost shifting between customers as a result of stranded cost recovery is prohibited. The costs can be recovered through a non-bypassable CTC that will be reviewed and adjusted annually for each customer who elects to receive service from an alternative generation supplier. The CTC will be collected by utilities over a maximum period of nine years, unless the PUC approves another time frame. California, by contrast, authorized a collection period of only four years.

Argentina

Like California and Pennsylvania, but unlike England and Wales and Victoria, the Argentine retail pricing regime is specified in detail by law rather than set by regulation. Thus, the regulator, ENRE, has far less discretion and is basically an administrator, whereas in the other countries/states considered here, the general rule is that the regulator is also a policy-maker and has full discretion over prices.

The prices that end-users pay are capped by ENRE. This cap is based on an assessment of costs. Inasmuch as the cap is reset every five years, the cap plus regulatory lag provides an incentive for distribution companies to cut costs. End-use price caps set by ENRE consist of an energy charge, a loss charge, connection and transmission costs, cost of capacity in the wholesale market, and a fixed distribution charge. The prices based on distribution costs are adjusted every six months on the basis of a combination of the U.S. Consumer Price Index and Producer Price Index (inasmuch as the Argentine peso is pegged to the U.S. dollar). (Gomez, 2001) The component of prices based on energy costs are adjusted every three months, according to changes in the seasonal prices.

Prices paid by customers differ by usage and other criteria. "Low demand" users pay a fixed component for distribution services and a variable energy (kWh) charge. "Medium demand" customers pay a fixed distribution charge, a variable energy charge, and a peak demand charge. "High demand" customers' tariffs depend on peak and off peak demand; on different prices for active energy according to whether consumption is in peak, shoulder, or valley times of day; and on reactive energy. (Gomez, 2001)

However, distributors may request adjustments to the initial structure. Such requests must be approved by ENRE. Rate-change requests are subject to challenge on several fronts. ENRE may call hearings on rate adjustments, for example, if it believes that a distribution company's requested rates are "unjust, unreasonable, unjustifiably discriminatory, or preferential". If ENRE inaction does not act on a request within 120 days, the licensee may institute its requested changes as if they had been approved. Thus, the distribution companies control the agenda, an attractive feature for investors. (Heller and McCubbins, 1999?)

The distribution companies' control over the initiation of policy changes indicates that the government designed the regulatory structure to ensure that private investors would continue to earn a satisfactory rate of return beyond the tenure of the government that put the reforms into place. However, it also ensures that – in principle, at least – retail prices will be closely linked to costs and that retail customers will capture some part of distributors' productivity gains. So far, the system seems to be working, as retail prices have declined.

England and Wales

Regulatory control over retail prices is the responsibility of the Director General OFGEM. England and Wales use an "RPI-X" approach to ratemaking for the "wires" sectors (transmission and distribution), in which base-year prices are escalated by the retail price index (RPI) minus an adjustment factor (X) that is generally held to represent expected productivity change. Other adjustments could be incorporated to allow for exogenous influences on price. RPI-X has also been applied to electricity retailing for residential users (although this market is scheduled for deregulation).

RPI-X regulation employs a multi-year review cycle, typically of 3 to 5 years. This provides companies with an incentive to increase efficiency faster than "X" in order to realize the benefits of their cost reduction efforts over the review cycle. Upon completion of the regulatory cycle, the regulator conducts a new review and sets new benchmarks both for the initial set of prices and for "X". The regulator is then able to pass on some of the benefits of the realized efficiency gains to consumers.

The incentive aspect of improvement over time is a well-known feature of rate-of-return regulation with long intervals between general rate cases – so-called “regulatory lag.” Also, it appears that resetting the benchmarks under RPI-X has difficulties of discovery similar to those of general rate cases under rate-of-return regulation. In fact, RPI-X has not reduced the earnings of distributors, inasmuch as they were able to reduce their costs faster than the rate of inflation. Also, companies were able to buy distribution assets at less than their replacement costs. “Price reductions *in toto*, since privatization, have been between 23% and 32% in real terms; the smallest reductions have actually been for the extra large and domestic customers,” who had more political clout than the other retail classes before privatization. (Littlechild, 1999)

In addition, industrial customers in England and Wales have had the option of real-time rates since 1991, and they have been adopted fairly widely. (Communication with Richard Green)

Victoria

Price cap regulation for distribution services is similar to that of England and Wales. Beyond that, prices are set by competition between retailers.

Germany

Competition is supposed to set retail prices. The fear of future government intervention plus excess industry capacity lowered prices immediately after restructuring. The beneficiaries of price declines have primarily been large industrial and commercial consumers. So far, prices have declined little for domestic consumers. However, there has been very little switching of retail suppliers by domestic customers. This appears to be due to a combination of factors: domestic customers are basically satisfied and – in the absence of electric heating and cooling – not too concerned about their electricity bill, it takes four to five months to process the paperwork to switch suppliers, and households are not represented in the deregulation process. (Ku, 2001)

Nord Pool

Prices are determined by competition. Prices have varied since reform and it is difficult to establish the effect of competition versus the national variation due to varying production cost. (Fifty percent of electricity is generated by hydro power plants). In principle “real-time” prices prevail unless customers enter long-term contracts with suppliers. (Most electricity is still traded in bi-lateral contracts).

France

EdF sets prices pretty much on the basis of the costs that it computes.

8.4 Lessons Applicable to Distribution and Retail Supply Restructuring

Ownership, Control, Competition and Regulation

It is still not clear whether retail supply is amenable to effective competition. California and Pennsylvania have contaminated the experiment with legislated retail prices for incumbent utilities that, in times of rising wholesale prices, make competition from new entrants unviable and threaten the financial integrity of the incumbent utilities.

One question is whether there is enough price and product differentiation to make it worthwhile for customers to shift from incumbent to alternative suppliers. Even before

escalating wholesale prices, the response to alternative suppliers in California and Pennsylvania was lukewarm. The response seems somewhat better in England and Wales and in Australia, but it is not clear that there have been major benefits in either price or quality of service compared to a regulated distribution/retail supply monopoly.

Argentina eschewed retail competition, and its retail sector seems to be working well. A question that should be asked for restructuring with respect to retail competition is, "Is it worth the trouble?"

Argentina has stuck with cost-based retail regulation, with long periods between reviews. The five years between reviews provides incentives to cut costs. The lower costs are then captured for customers, and the cycle is begun again, with continued incentives to cut costs, and continued (but lagged) capture of the cost cuts by customers. It is a system reminiscent of conventional regulation in the United States before the 1970s -- inelegant but perhaps as efficient as more sophisticated schemes.

England and Wales and Australia have adopted RPI-X regulation for distribution services. On its face, this type of regulation seems less intrusive and less subject to manipulation by distributors than Argentina's cost-based regulation -- if one knows what "X" is.

Pricing

It is clear that one of the most important mistakes in California was to decouple retail prices from wholesale prices, a mistake that is being repeated in Pennsylvania. None of the other states/countries have engaged in this practice. However, only England and Wales have initiated real-time rates for large industrial users and none have done so for small users, an innovation that offers immense potential in matching prices to costs. Japan should consider carefully the potential of real-time pricing to increase efficiency and reduce risk.

9. Implications for Japanese Electricity Restructuring

Other states and countries have had successful experiences in restructuring their electricity sectors. They have done so by greater reliance on free markets, whereas California -- in seeking the theoretical efficiency arranging markets so that price equals short-run marginal cost -- built rigidities into its system that kept it from adjusting when conditions in electricity markets took an unexpected turn. All of the other states/countries investigated in this study except Pennsylvania/PJM, Germany, and France started restructuring before California, and the structure of Argentina's electricity sector has been stable for several years. Thus, there is a record of what works.

Japan can learn much by simply observing what did not work in California. However, it is useful to know what alternatives do work in practice, so that there is guidance for the future rather than putting excessive reliance on what should work, *in principle*. First, restructuring for any given stage of electricity production and delivery -- generation, transmission or distribution/retailing -- is like jumping across a chasm. You either jump all the way across, or you do not jump at all.

California jumped half-way in wholesale markets by discouraging the UDCs from hedging their spot transactions. The failure to permit the risk-mitigation of forward

markets contributed significantly to the volatility of California's electricity markets and may well have contributed to raising average prices higher than they would have been otherwise.

California also jumped half-way across in its attempt to create competition in retail markets, while legislating fixed retail prices for the UDCs. The result was that new entrants could not compete – and UDCs could (were forced to) compete all too well, with bankruptcy and near-bankruptcy as a consequence. It is highly likely that if California had not restructured at all – that is, maintained its vertically integrated, regulated utilities – it would have been better off than it is at present. In fact, most states in the U.S. have continued to maintain this structure, except for allowing generators to compete for wholesale markets. However, it is likely that California would have been even better off than under traditional regulation if participants had been free to choose the terms of how they would compete and let the market tell them whether or not they were right.

Thus, it seems obvious that one lesson is that it is folly to decouple retail prices from wholesale prices, although Pennsylvania is only now learning this. Retail prices reflective of wholesale prices on an average monthly basis would have reduced California's demand, thereby helping to relieve capacity shortages and upward pressure on wholesale prices. Real-time pricing -- at least for large customers -- would tie retail and wholesale prices even more tightly. It seems to have been successful in England and Wales for large industrial users; and it seems to be within reach for small end-users. Argentina has moved in this direction with peak load pricing for medium-demand customers and peak demand and peak-shoulder-valley differentiation of prices for large users. However, there does not seem to be any particularly compelling reason if Japan restructures to not move to full real-time pricing.

A second lesson is that it is important to limit the incentives for possible price manipulation. Argentina, PJM and Australia have maintained uniform-price bidding on their spot markets, but their spot markets are complemented by long-term and intermediate-term markets, so that even if there is manipulation it affects only a relatively small part of the power supply. In addition, despite the theoretical attractiveness of uniform-price auctions for spot markets, pay-as-bid price-setting may be less likely to be vulnerable to generators manipulating the market by withholding capacity. England and Wales had the longest history of uniform-price auctions and finally discarded them in favor of pay-as-bid bilateral agreements.

A third lesson is that despite the attractiveness of price equaling marginal cost in static equilibrium, electricity markets are dynamic; and participants need to be able to mitigate risk by arranging to buy and sell power under long-term and intermediate time structures, as in financial and commodity markets. PJM, Argentina, England and Wales Australia and Nord Pool recognized this from the outset in the widespread use of contracts for differences; and England and Wales have now gone to bilateral physical contracts.

A fourth consideration – not really a lesson because the results are not clear – is how far does one want to push retail competition.. This goal has both theoretical and even ethical advantages of consumer sovereignty. In addition, efficient wholesale markets require some significant participation by retail customers and their choices about how much power they want at different prices and about from whom they want to purchase. These benefits need to be balanced against the transaction costs in allowing all

customers to switch. Before whole-heartedly expanding retail competition to all customers, a careful review of what end users/voters really want would seem to be in order.

Finally, the biggest lesson of all should be that “not invented here” is not an acceptable principle for developing public policy, particularly for electricity. As Japan undertakes its own restructuring efforts, the process should be given sufficient time to be done right; and this includes deliberate scrutiny of what has and has not worked elsewhere. The end results may be unique for Japan, but they should not repeat others’ mistakes.

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Appendix A

Description of Capacity Payments in the England and Wales Power Pool

Under the power pool, the price actually paid to generators also included -- in addition to the energy prices that were determined under the bidding system -- a financial incentive for maintaining some additional (peak load) generation capacity in the event that demand exceeded consumption forecasts. This capacity payment equaled the value of lost load (VOLL) times the loss of load probability (LOLP). The VOLL attempts to measure the system cost of not producing enough electricity to meet peak load. Another

way of looking at VOLL is that it attempts to measure the "extent to which generators are prepared to invest in additional capacity in excess of the actual maximum on the system." The LOLP measures the probability that supply will be insufficient to meet demand at a particular point in time.

The LOLP changes by season and day. The closer demand is to scheduled supply, the higher the LOLP and therefore the higher the capacity payment. Thus, the price paid to electricity suppliers under the pool was the system marginal price (as determined by bidding) plus $(VOLL * LOLP)$. (U.S. Energy Information Administration, 1997, Ch. 2)