CHAPTER 1

ELECTRICITY REGULATION AND DEREGULATION

1.1. THE ELECTRICITY INDUSTRY: RESTRUCTURING AND DEREGULATION

During the 1990s, a deep transformation in the electricity industry took place in many countries. This sector is moving from a monopoly structure to a more competitive one, as are the transportation and telecommunications sectors. For example, in Latin America, Chile was a pioneer in the early 1980s with the development of a competitive system for electricity generation based on marginal prices. In 1992, Argentina privatized an inefficient government-owned electricity sector, splitting it into generation, transmission, and distribution companies, and introduced a competitive generation market (see Chapter 9). These experiences were repeated in other countries in the region, such as Bolivia, Peru, Colombia, Guatemala, El Salvador, Panama, and, to a limited extent, Brazil and Mexico.

In Europe, Scotland and Northern Ireland followed the experience of England and Wales (Littlechild and Beesley, 1989). The Scandinavian countries, following Norway, have gradually created a Nordic wholesale electricity market (see Chapter 7). In the European Union in 1996, the European Parliament and Council issued the Internal Electricity Market Directive 96/92/EC that set goals for a gradual opening of national electricity markets and rules for transmission access in the 15 member states (European Parliament and Council, 1996; Schwarz, Staschus, Knop, and Zettler, 2000). Spain in 1998 and Netherlands in 1999 created fully competitive generation markets (see Chapter 8). The rest of the members are adapting to the new regulations. For an international comparison of transmission grid access, see Grønli, Gómez, and Marnay (1999). For other international comparisons, see Gilbert and Kahn (1996).

In New Zealand, Australia, and some provinces of Canada (Alberta and Ontario), deregulation of the electricity industry is being introduced as a way of increasing efficiency and reducing prices. This is also true in some states of the United States (US); restructuring legislation has already been enacted in half the states, with California and Pennsylvania–New Jersey–Maryland (PJM) in the lead. See Stoft (2002). However, the California electricity crisis of 2000 and 2001 has slowed the move toward electricity deregulation in the United States (see Chapter 6).

Under restructuring and deregulation, vertically integrated utilities, in which producers generate, transmit, and distribute electricity, have been legally or func-

tionally unbundled. Competition has been introduced in the wholesale generation and retailing of electricity. Wholesale electricity markets are organized with several generation companies that compete to sell their electricity in a centralized pool and/or through bilateral contracts with buyers. Retail competition, in which customers can choose among different sellers or buy directly from the wholesale market, has also been implemented. This was done instantaneously for all customers (as in Norway), or progressively, under a multiyear program, according to different customer sizes (as in England and Wales, Australia, Argentina, etc.).

Transmission and distribution are still considered natural monopolies (see Chapter 2 for the economics of monopolies and natural monopolies) that require regulation (see Chapter 4 on the regulation of natural monopolies). To achieve effective competition, regulation is still needed to ensure open, nondiscriminatory access to the transmission grid for all market participants.

1.2. FROM MONOPOLIES TO MARKETS

Restructuring and deregulation involve a transformation in the structure and organization of electricity companies. Traditionally, a single utility, vertically integrated, was the only electricity provider in its service territory and had the obligation to supply electricity to all customers in its territory. This provider could be

- Owned by a national, regional, or local government
- Owned by a cooperative of consumers
- Owned privately

Because of the monopoly (single seller) status of the provider, the regulator periodically sets the tariff to earn a fair rate of return on investments and to recover operational expenses; see Chapter 3 on determining the rate of return and Chapter 4 on rate-of-return regulation. Under this regulated framework, firms maximize profit subject to many regulatory constraints. But because utilities have been allowed to pass costs on to customers through regulated tariffs, there has been little incentive to reduce costs or to make investments with due consideration of risk.

Under perfect competition, in theory, the interaction of many buyers and sellers yields a market price that is equal to the cost of producing the last unit sold. This is the *economically efficient* solution. The role of deregulation is to structure a competitive market with enough generators to eliminate ***market power*** (i.e., the ability of a firm or a group of firms to set prices "a small but significant and non-transitory amount" above production cost; see DOJ/FTC, 1992). (See the Glossary for the definitions of words and phrases in ***bold italic*** type.)

With deregulation, electric utilities must split regulated from deregulated activities and compete with new firms originating from other energy businesses or retail services (see Chapter 5). The economic decision-making mechanism, under competition, responds to a decentralized process whereby each participant maximizes

profit equal to the difference between total revenue and total cost. However, under competition, the recovery of investment in new plant is not guaranteed. So, risk management becomes a crucial part of the electricity business.

1.3. WHY RESTRUCTURING AND DEREGULATION NOW?

There are many forces driving electricity restructuring around the world. These forces are

1. New generation technologies, such as combined-cycle gas turbines (CCGT), have reduced the optimal size of an electricity generator.
2. The competitive global economy requires input cost reduction; electricity is a primary input for many industries.
3. The State, as owner and manager of traditional infrastructure industries, cannot respond as quickly as private owners to economic and technological change, prompting privatization.
4. Information technologies and communication systems make possible the exchange of huge volumes of information needed to manage electricity markets.

CCGT manufacturers have been racing to achieve (1) technical efficiencies close to 60%, (2) short power plant construction periods (less than 2 years), and (3) low investment costs (around U.S.$500/kW). These technical developments (along with low natural gas prices and new natural gas transportation networks) have made this technology the dominant choice for new investment in competitive generation markets.

Even before the opening of generation to competition, CCGT technology was being built by independent power producers selling electricity to traditional utilities under different types of regulated agreements. The efficient size of these power units is currently between 150 and 300 MW. This is much smaller than efficient scales for traditional fossil or nuclear power stations.

Global competition promoted by international firms is emphasizing international price comparisons and, consequently, inducing nations to reduce electricity costs to be globally competitive. Restructuring and deregulation processes are carried out by governments through the introduction of electricity markets to increase efficiency and reduce prices. Markets also promote participation of external agents and neighboring countries with lower production costs as a way to achieve lower prices.

After World War II, in many countries, for strategic reasons, the electricity industry was gathered in a single, nationalized company. This situation was common in Europe and Latin America. But public ownership has been in crisis during the last decade for various reasons. For instance, in Latin American countries that had high rates of electricity demand growth, the State, with a significant external debt, was unable to carry out the needed generation investments. This situation, plus the

recommendations of international financial institutions, such as the World Bank and the Inter-American Development Bank, led governments to initiate privatization and restructuring.

Also, the internationalization of fuel markets called into question national subsidies to specific primary energy sources. For instance, in several countries in Europe, the State has been subsidizing the coal industry. Low international coal prices (and the usual environmental problems associated with burning low-quality domestic coal) prompted governments to progressively abandon this type of intervention. Similarly, the nuclear power industry was developed with a high level of State support. However, political opposition has undercut this support, postponing or stopping new investment in nuclear plants.

Finally, information technologies and communication systems are making possible day-ahead and on-line electricity markets with multiple agents and multiple types of transactions. Further, metering, billing, quality control, and load management options based on new information technologies and communication systems are being offered under restructuring and deregulation. Also, retail competition and customer choice based on these technologies encourages entry of new electricity service providers with new commercial relationships, offering attractive prices, high quality, and other integrated services.

1.4. REGULATION IS STILL REQUIRED

Although regulators' objectives differ across countries and sectors, their primary objective is to protect the short-run and long-run interests of consumers by promoting economic efficiency. The most direct way to achieve efficiency is to encourage or mimic competition. However, economic regulation must be used where competition is not feasible, for example, in sectors that have natural monopoly characteristics or in situations where externalities have not been internalized.

Traditionally, the electricity industry has been dominated by monopolies. Under restructuring, only high-voltage transmission, distribution, and system operation exhibit natural monopoly characteristics. Achieving economic efficiency in natural monopoly industries requires regulation. In these industries, the largest firms can charge the lowest prices, driving rivals from the market. Once there is no competition, the surviving firm can charge monopoly prices, reducing quantity and social welfare (see Chapter 2). There are several solutions to this problem, including

1. Government ownership of the industry, with a mandate to provide adequate output at reasonable prices
2. Private ownership with government regulation to ensure adequate output and a reasonable return on private investment

The economic theory of regulation (see overview in Joskow and Noll, 1981) attempts to predict which institutional arrangement is preferable as a function of the comparative social costs and benefits of

- Private monopoly without regulation
- Government monopoly
- Private monopoly with regulation

Each solution involves costs, including (1) the social cost of the monopolist using its market power, (2) the cost of maintaining a regulatory agency, and (3) the costs imposed on the monopolist by the regulator. Besides the administrative costs associated with regulation, another potential cost arises from misguided regulatory interventions that can create social welfare losses. Therefore, the regulator must carefully consider the costs and benefits of each regulatory requirement on the regulatory agency and the regulated utility (see Chapter 4).

The role of regulation is to encourage enough investment to meet customer demand and to compensate investors with a reasonable rate of return. There are several ways of accomplishing regulatory goals in the electric power industry. Two basic regulatory forms are (1) *Rate-of-Return* (ROR), also known as *Cost-of-Service* (COS), regulation, which requires the regulator to actively monitor the electric utility; and (2) *Performance-Based Ratemaking* (PBR), which requires much less regulator intervention. Under ROR or COS regulation the regulator determines

1. Appropriate expenses
2. The value of invested capital
3. The allowed rate of return on invested capital

This process requires a costly exchange of information between the regulator and the electric utility. PBR involves mechanisms that attempt to reduce the cost of regulation by allowing utilities to keep profits resulting from efficient operation.

As an electricity industry is restructured, the role of the regulator becomes one of setting market guidelines to yield competitive conditions in which prices and quantities are similar to what they might be under perfect competition (see Chapter 5).

Establishing competitive electricity markets requires a reduction in the market power that could be exerted by the formerly integrated utilities. In some cases, the regulator has obliged these utilities to divest their generation assets. Economic efficiency gains from deregulation can disappear if there is no real competition at the wholesale level.

On the other hand, usually, retail competition is initially dominated by the utilities that formerly distributed electricity to customers. They can also create their own retail or service provider companies as deregulated firms. The role of the regulator in this area is crucial to ensure fair competition. Regulated distribution companies, as former vertically integrated utilities, will provide preferential treatment to their own spin-off retailers rather than to new entrants. The regulator should establish clear rules to avoid this discriminatory behavior, while actively promoting the entrance of new participants.

Where regulation is maintained or introduced after privatization, regulators should adopt open, transparent, and objective decision-making procedures (i.e., ob-

servable data sources, replicable methods, open debate, and reasoned decisions). This is because regulatory decisions are always a part of an ongoing regulatory regime. Electricity companies will continue to be regulated where capital-intensive investments can lead to monopoly conditions. In the current environment, these conditions clearly apply to investments in transmission and distribution.

In a regulatory regime that sets revenue for an industry characterized by assets with long lives, the credibility of regulatory commitments is extremely important. Before investors will commit funds to such investments, they must be convinced that the regulator will allow future revenues that provide reasonable assurance of cost recovery. For example, preventing the recovery of *stranded costs* or *assets* (see Chapter 5) associated with past investments would allow the regulator to make an immediate price reduction, but also reduces the necessary credibility that future investments might be recovered. Therefore, the regulator must consider both consumers' short-run interests in low-price, high-quality service and their long-term interests in continued maintenance and investment in the electric power sector.

1.5. WHAT LESSONS CAN BE LEARNED FROM INTERNATIONAL EXPERIENCES?

The economics of natural monopolies, markets, and regulation are not enough to understand the complexities of real regulatory reforms. There are many issues of practical implementation that should be analyzed through case studies to obtain a clearer understanding of electricity restructuring. For that purpose, we have selected four restructuring experiences to describe in detail in this book. These experiences correspond to the cases of California, Norway, Spain, and Argentina. This complexity is portrayed in Table 1.1, which compares the institutional, regulatory, organizational, and technical issues of the four case studies.

We begin with California because of the problems during its transition from regulation to deregulation. In the late 1990s, California tried to ensure compatibility between *bilateral trading* and a *centralized pool.* In addition, California addressed the issue of the stranded costs of the former investor-owned regulated utilities. To recover these stranded costs, electricity tariffs were frozen at a regulated tariff 10% below 1996 levels and a *competition transition charge* was added to them. Consequently, when the stranded costs were recovered and regulated tariffs disappeared, customers faced the high prices of the wholesale market. See Chapter 6 on this and other issues associated with the California "electricity crisis."

Norway's original restructuring design was one of a wholesale, competitive market based on bilateral trading. However, it was extended to incorporate international trading with other Scandinavian countries and retail access with the opening of the market to small customers. These are characteristics that justify the inclusion of this case. Further, markets for peak power, including demand-side bidding, are under development in Scandinavia (see Chapter 7).

Electricity restructuring in Spain is similar to California's wholesale market design and stranded cost recovery. However, the starting point before deregulation in

Table 1.1. Electricity Restructuring Reforms in California, Norway, Spain, and Argentina

	California	Norway	Spain	Argentina
Conditions driving restructuring	• State's electricity higher than national average • Federal regulation: EPAct (1992), FERC orders (1996) • Inefficient centralized regulation	• Promote efficiency in investments and reduction of regional price differences • Avoid cross-subsidization among customer groups • Create cost reduction incentives	• Electricity prices higher than prices in neighboring countries • European Directive (1996) • Eliminate subsidies to the coal industry	• Power shortages due to lack of investment and generation unavailability • Highly inefficient public owned sector • Need for new investment
Restructuring law	AB 1890 (1996)	Energy Law (1990)	Electricity Law (1997)	Electricity Law (1992)
Structural changes	• Functional separation of Generation, Transmission, and Distribution (G, T, D) • Recovery of stranded costs • Generation divestiture	• Accounting separation of regulated and competitive functions • The transmission grid was separated as a new company • No privatization of publicly owned sector	• Legal separation of regulated and competitive functions • Recovery of Endesa • Privatization of stranded costs (main publicly owned generator)	• Vertical (G, T, D) and horizontal disintegration • Privatization of federal and provincial companies

(continues)

Table 1.1. Electricity Restructuring Reforms in California, Norway, Spain, and Argentina *(continued)*

	California	Norway	Spain	Argentina
Regulatory and market institutions	• FERC and CPUC (federal and state regulators) • ISO (system operator)	• NVE (regulator) • Statnett (grid owner and system operator) • Nord Pool (market operator)	• MIE and CNSE (regulators) • REE (system operator and transmission grid owner) • OMEL (market operator)	• Secretary of Energy and ENRE (regulators) • CAMMESA (system and market operator)
Wholesale market	• Centralized and physical bilateral trades • Several transmission owners	• Centralized and physical bilateral trades • Trading in the Nordic Pool	• Centralized and physical bilateral trades	• Mandatory pool with financial bilateral contracts
Retail competition and customer choice	• All customers (1998) • Metering and billing competition	• All customers (1991)	• Gradual implementation in a 5-year period • All customers in 2003	• Large users (1992), and small customers in the future

Spain was different from California's. For several years, a single independent company in Spain was operating as transmission owner and operator. This facilitated the introduction of a wholesale market. In addition, the previous regulatory framework in Spain set a national benchmark for efficiency whereby utilities were regulated in competition by comparison (see Chapter 8).

Finally, Argentina is an example of a privatization resulting in a competitive wholesale electricity market with new generation investment during the last decade. Regulatory reforms in Argentina and Chile have influenced all other reforms in Latin America (see Chapter 9).

Other experiences are also relevant, such as those of England and Wales, Australia, and the PJM (Pennsylvania–New Jersey–Maryland) in the United States. We do not include case studies of these experiences. They are left as exercises for our readers and we encourage them to submit cases to our web site www.iit.upco.es/witt/Electricity_Economics. Also, because international experiences become outdated with the fluid state of deregulation and restructuring, at the end of the book we list World Wide Web sites where it is possible to find more up-to-date documentation.

Many organizational, institutional, and regulatory issues must be solved with deregulation. (For discussions of specific issues, see Ilic, Galiana, and Fink, 1998.) Although the ultimate objective is to achieve a technically reliable and financially viable competitive electricity supply industry, each government has adopted different approaches to restructuring. In the remainder of this chapter, we review the motivations that led to restructuring and the solutions adopted to address transitional issues. This discussion serves as an introduction to the case studies in Chapters 6–9.

1.5.1. Starting Points and Motivations for Deregulation

A combination of factors promotes the political will to deregulate. Nationally owned systems have been segregated into different companies and then privatized under a new regulatory competitive framework. This is the case for the experiences in Argentina, Chile, and England and Wales, where the ideology of the government was clearly oriented toward a general liberalization program in the country. In Argentina, in addition, the situation of a chronic lack of investment, high growth in demand, and frequent power outages, encouraged the adoption of dramatic changes.

Electricity prices higher than those in neighboring countries or regions have also pushed deregulation. In high-price areas, customers and governments influenced by a general wave of deregulation have advocated restructuring. For example, Spain was encouraged by European Directive 96/92/EC that called for the introduction of competition. In both Spain and California, the electricity industry was primarily private before restructuring. Therefore, privatization was not an issue.

However, another issue arises when private, regulated utilities have expected *required revenues* that are greater than what they would be in a competitive market. This difference is known as ***stranded cost.*** A recovery procedure for stranded cost can be designed by the regulator and used during a transition period. Also, where investor-owned utilities are required to divest their generation assets to mitigate possi-

ble market power problems, the difference between the book value of these generating assets and the price received for them in the market is known as ***stranded assets***. We will refer to both stranded costs and stranded assets as "stranded cost."

Another objective pursued by deregulation is to avoid cross-subsidies among different customer classes by designing more transparent tariffs. Electricity is bought in the market at posted prices, whereas regulated costs (e.g., for transmission services) are charged under a separate system through access tariffs. Additionally, under deregulation, subsidies to domestic primary fuels, such as coal, and to nuclear power, progressively disappear, as in Spain and in England and Wales.

1.5.2. Structural Changes and System Operation

The introduction of electricity competition requires the separation of competitive from still-regulated functions. In most restructuring experiences, the transmission grid has been separated, in ownership and in operation, from generation companies by creating a regulated transmission owner and operator. This is the case in England and Wales, Argentina (with separation between system operator and transmission owner), Norway, and Spain.

However, the situation is more complicated in California and other US states in which utilities have retained ownership of some generation assets and parts of their transmission grid. Here, new entities have been created to control the operation of the interconnected transmission grid. This is an attempt to prevent a utility from manipulating its grid to the disadvantage of competing generators.

Another key regulatory issue concerning system operation is how to maintain reliable operation under the unbundled structure. Regulated, vertically integrated utilities cooperated voluntarily to operate a reliable system by coordinating their resources with neighboring utilities, knowing that regulated tariffs would cover bundled costs. Under deregulation, the *system operator* is responsible for system reliability. It buys different *ancillary services* from generators and users to maintain a reliable system. However, legal responsibilities of system operators (particularly those that do not own transmission assets) must be clearly defined by new regulations.

On the other hand, transmission grids were not designed to transmit power flows from electricity markets. To do so requires updating transmission planning procedures and defining transmission investment responsibilities between system operators and transmission owners. This is especially true in those cases in which these functions have been separated, as in Argentina and throughout the US. Further, systems with transmission congestion problems use locational prices as a mechanism of sending market participants the right economic signal for using congested paths. In that sense, market participants can promote grid investments according to the economic value they perceive. Chile, Argentina, and PJM have *nodal prices,* whereas Norway and California have *zonal prices.* See Chapter 5 for more on nodal and zonal prices.

Therefore, under deregulation, transmission and distribution, also known as "wires businesses," continue to be regulated. *Performance-Based Ratemaking*

(PBR) regulation is being introduced through price or revenue caps that limit company revenues during a regulatory period of several years (see Chapter 4). England and Wales were the first to experience price caps as a formula to remunerate regulated activities performed by distribution companies. Argentina, California, Norway, and Spain also use PBR formulas for the same purpose. In addition, associated with the concern that cost reductions can lead to quality degradation, mechanisms to control service quality are also being used.

1.5.3. Design of Wholesale Markets and Market Institutions

A major objective of electricity deregulation is to achieve a workably competitive wholesale market. See Stoft (2002, Part 3). At first, wholesale markets were designed for economic dispatch of generating units in a centralized pool, managed by the system operator. Participation in the pool was mandatory for all generators. This was the case in Argentina, Chile, and England and Wales. (For an international comparison of power pool operations, see Barker, Tenenbaum, and Wolf, 1997.) Generators declared costs, or submitted bids, to the system operator who (using economic dispatch algorithms) obtained the generation schedule and hourly marginal prices (in England and Wales for each half hour). There was no demand-side bidding. Also, in Chile and in Argentina long-term marginal prices (3 to 6 months), instead of hourly prices, were passed through to regulated final customers. Unregulated customers could buy electricity with financial contracts.

In Norway, however, the wholesale market design was based on bilateral bidding with both generation and demand bids. A market for *futures contracts* (up to 3 years in advance) was also instituted. Market operations were coordinated by a separate entity distinct from the system operator, specifically created for this purpose—the market operator. Later, as in California and Spain, market operations were separated from system operations. Energy transactions can be made in a centralized pool or directly, outside the pool, through bilateral contracts.

Wholesale electricity markets have high price volatility due to daily and seasonal variations in supply and demand. This raises two important issues under deregulation: demand responsiveness to price variations and new investment in generation resources.

Under regulation, electricity demand was considered inelastic and new capacity was built to cover projected demand to minimize investment plus operating costs. Under deregulation, it is assumed that competitive prices will encourage new generation. In some cases (e.g., in Argentina, Chile, England and Wales, and Spain) besides energy revenues obtained from selling electricity, generators are paid a supplemental capacity payment to encourage generation investment. In other cases (e.g., Australia, California, New Zealand, and Norway), this supplemental payment is not used.

This is a controversial issue. In Argentina, generation investment has been successful, even when wholesale prices are depressed, because of capacity payments. On the other hand, California has experienced high price volatility and high average wholesale prices due to high fuel prices and delays in generation investment. In

Scandinavia, markets for peak power (capacity markets) are under development. Elsewhere, there are proposals to address the issue of long-term electricity supply. For example, by using market mechanisms, consumers and generators can arrange long-term contracts so consumers can cover their expected needs and generators can stabilize incomes to recover fixed investment costs.

1.5.4. Retail Competition and Customer Choice

The aim of deregulation is to provide market-based electricity prices to customers with reliable service at efficient prices. Wholesale competition is enhanced, on the supply side, by participation of several generation firms, and, on the demand side, by allowing customers to buy directly or indirectly from generators through customer choice and retail competition.

The introduction of customer choice differs from country to country. In Norway, all customers were ***qualified*** to choose their supplier when the competitive wholesale markets started. In most other cases [e.g., Argentina, Australia, the European Union, and the United Kingdom (UK)] there has been a progressive implementation of conditions defining qualified customers, starting with the largest customers under a multiyear phase-in transition program. (Note: although we realize that UK refers to the United Kingdom of Great Britain and Northern Ireland, occasionally, this book refers to England and Wales as the UK.)

A good indicator of competition and market maturity is the number of effectively *nonregulated* customers and total energy consumed outside regulated tariffs. For example, in California all customers were qualified in 1998, but two years later most of them continued under regulated tariffs, frozen at 10% below 1996 rates (not including charges to cover stranded costs). Later, during the electricity crisis in California of 2000 and 2001, retail choice was suspended. In Spain, on the other hand, the regulator adopted specific measures, such as the reduction of access tariffs, to promote the exit of regulated customers. At the end of 1999, of the more than 10,000 qualified customers about 80% were nonregulated customers, but the corresponding consumed energy was a small portion (2%) of the total consumption in Spain.

1.6. CONCLUSIONS

Restructuring and deregulation of the electricity industry is a movement with the aim of achieving lower prices to customers through cost savings. However, the brief history of this process shows that there is still much to be learned. Despite this, there is a consensus (1) to introduce competition into wholesale and retail markets by deregulating generation and opening retail and (2) continuing to regulate network activities.

But the experience also shows that those governments that started deregulation are continually revising their regulations. Argentina, California, England and Wales, and Spain, are still carrying out important revisions. The regulatory solu-

tions adopted and the design of a transitional period to implement the new organizational structures are strongly influenced by the starting point of the industry and the political and institutional constraints in each country. To understand this continuous revision, this book explains the economic and regulatory principles behind electricity restructuring and focuses on some of the most representative experiences to illustrate its complexities.