PRIVATIZATION AND DEREGULATION OF THE ELECTRIC POWER SECTOR - FUNDAMENTALS

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ABSTRACT

The structure of electric utility industry around the globe has been rapidly changing. It is worthwhile to look at the fundatementals of electricity service in order to gain insight into the restructuring of the electric power industry.

I. INTRODUCTION

Electricity markets were traditionally served by "vertically integrated" utilities. The utilities were responsible for all key components, namely generation, transmission and distribution, of delivering power to the customers. In this traditional model, electricity markets were considered to be a natural monopoly. During the last two decades, this traditional model has been challenged both in the developed and developing countries [1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14].

In the new model, the transmission operator is decoupled from generation and distribution segments in order not to give any unfair advantages to companies competing in them, since scales of economies favour a "regulated" single transmission operator, instead of, building multiple (parallel) high voltage networks [1].

In the case of generation, there are no physical constraints to having more than single provider. In the United States, where investor owned utilities has already delivered majority of the electricity, several states started what is called the deregulation process, during which competitive market rules are being brought into the generation component [2, 4, 7]. In other developed and developing countries where the vertically integrated utilities were owned by the state, the generation sector has been privatized [6, 8, 9, 10, 11, 12, 13]. The main drivers for this process have been raising investment for either aging or under-built electricity infrastructure, respectively; the goal of providing the right investment messages to the market; and the goal of providing electricity at its competitive market value.

The case of distribution is a bit more complex. Within a , the electrical power flows to the end-user through a highly connected transmission network. The supply at the aggregated distribution delivery points acts as if it is coming from a pool. As a result, as long as open and fair access is given to the transmission network for competitive generation providers, there are no physical constraints in having multiple and competitive service providers, i.e., load serving providers (LSPs) at the distribution points. Note that scales of economies does not favour building multiple (parallel) low voltage networks, either [1].

In the case of developed countries, multiple LSPs are generally allowed. In this case, deregulation and/or privatization bring in more competition and efficiency to the market place. In the case of developing countries, the recipe to competitive electrical power markets generally calls for regulated and single LSPs within properly defined regions. Privatization, in this case, brings in the much needed investment and efficiency. Generalized overviews of these models are shown in Figures 1 and 2.

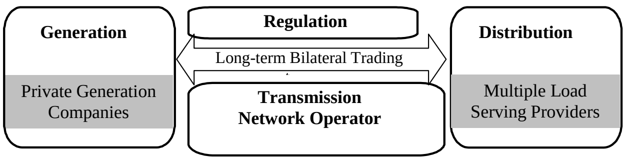

Figure 1. Competitive electricity market model in developed countries

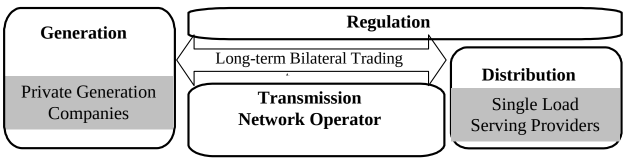

Figure 2. Competitive electricity market model in developed countries

In any case, the process of restructuring the electric power industry is very complex and difficult, and by no means follows a single, well-defined route. Even within the United States, different states have applied different market rules to the three key components of electrical power markets, leaving the rules at the interfaces and connection points vague and difficult to manage [7]. As a result, the restructuring, deregulation and privatization of electric power industry have recently become one of the most controversial topics of our times.

There are several papers that track the evolution of restructuring of the electric power sector around the globe, as well, as that cover the specifics of the actually implemented markets [4, 5, 6, 8, 9]. This paper concentrates on the fundamentals of electric power markets, and tries to highlight the economic side of the complexity that has made the restructuring of this important sector difficult.

In Section II, certain unique characteristics of electrical power are discussed. In particular, how these characteristics make it difficult to introduce competitive market structure in electric power markets is covered in detail. In Section III, the economic fundamentals as they may apply to the electric power markets are introduced. In general, the fundatementals of electricity service are covered in order to gain insight into the restructuring of the electric power industry.

II. ELECTRICAL POWER AS A COMMODITY

Electricity has some key attributes that make it different from any other commodity [1, 2, 15]. In a typical power system, little or no electric storage capacity exists. The supply for electricity has to instantaneously match with the demand.

The transportation of electricity is usually over long transmission lines that form a greater network. The network may extend to international or inter-regional grids. Due to its physical nature, it is almost never possible to plan and trace the actual path of the generation (supply) that matched the demand (load).

The electric grid does not physically allow identification of a single transmission line with a single physical energy delivery. Instead, it appears like a vast “pool” - electric energy is produced and put into the pool, and taken out by consumers.

Many transmission systems have bottlenecks or “congestion” when various lines in the grid are at risk of being overloaded by the patterns of production and demand that exist. The only way to control transmission flows on individual lines is to adjust the production (and possibly demand) at the grid substations so that the physical behavior of the grid produces the desired outcome. Congestion can be modelled at different levels of complexity. This brings in challenges in market implementations. In developed countries, there are transmission markets with derivative products. However, the infrastructure for such markets requires significant investment. Therefore, these are not usually implemented at the beginning of the restructuring process in the developing countries.

The energy consumer cannot predict with 100% accuracy how much energy will be utilized a day or an hour ahead. The quantity actually delivered and consumed may be, in fact almost always is, different from the quantity contracted for. Thus, electricity has to provide not only for basic energy contracts on a forecasted basis (i.e., a day or an hour ahead which can be “scheduled” for delivery and production and transportation planned accordingly), but also has to provide for instantaneous or balancing energy which is required to make up the differences between forecasts and demand.

All generators in an interconnected power system must run in synchronism with one another. In most industrialized countries the integrity of the power system depends upon keeping the frequency of supply (either 50 or 60Hz) very close to nominal. Frequency deviation is a near-instantaneous measure of the difference between supply and demand. This requires maintaining the frequency by momentary variation of generation plants output up and down. As a result of these real-time operation requirements, a certain market design and implementation may introduce several derivative energy products. The instantaneous balancing creates additional complexity. This complexity creates several other services that must be provided by the grid operator. One important such service is “reserves” or the ncillary services (A/S) [1, 2, 3]. Reserves are used to maintain quality of supply over the networks. They are needed to provide for the event of a local plant outage and required to come online within a certain time frame after the outage occurs. They come in several variations ranging from instantly available, called spinning reserve, to capacity reserve which may be called on over a longer time frame.

Due to the physical nature of electricity, electric transmission lines consume what they are essentially built to carry, electrical energy. These are referred to as losses and the amount of the losses depend upon several factors, such as the transmission and distribution line equipment characteristics, and operating pattern of production and demand. Losses may be significant - in the range of 5-10% of the delivered energy. It is typically higher in developing countries. The fact that energy effectively flows into a giant pool and then flows out to the end users produces a new problem of ensuring that fairness prevails in settlement of payments for its production and use.

III. ECONOMIC FUNDAMENTALS

The key to a price is a market, which exists when a willing buyer and a willing seller meet at a mutually agreed price. Price is one element of the interface between buyer and seller. For the supplier, price could be thought of the value given by the purchaser. The purchaser, on the other hand, could see the price as the supplier's cost.

The traditional electricity market model used both in the developed and developing countries utilized a unique cost-based pricing system [1, 16, 17]. This cost-based pricing system was around for so long, it seemed the only natural way to price electricity. Regulatory utility commissions in the case of the US, and the state agencies at other countries defined the services provided by a utility and regulated/decided on the price of electric power. Traditionally, pricing of utility services has just been based on costs instead of a competitive marketplace. Cost-based pricing developed as a natural extension of cost accounting.

Under the traditional utility pricing, the utilities in fact have provided considerably more than kWh of energy and kW of capacity to the customers [16, 17]. Among such services, one important one is the reliability. The reliability of the service is usually forgotten since it has become an integral part of the electricity commodity. Others include wheeling and transmission services for other utilities, dispatching, coordination of bulk transactions, investment in transmission and distribution networks, emission controls, tree-trimming, maintenance, and other functions that need to be performed for delivery.

The cost-based pricing aims at fair and stable cost recovery for these services. Ideally, prices are designed to recover all of the utility's operating costs and costs associated with its investment in generation, transmission and distribution facilities. This includes cost of interest on bonds which were sold to finance the capital investments, and return to the shareholders to compensate them for the use of their money, where applicable.

However, the traditional cost-based pricing has several short-comings and competitive market advocates complain about its serious weaknesses [18]. As an example, it is prone to cross subsidies between different classes of customers in the case of investor-owned utilities like the ones in the United States. Since there is not a best way of allocating cost among different customer classes, "captive" customers may end up paying for plant power capacity that provides a high level of reliability, a service cut for industrial customers.

In the case of state-owned utilities, it may promote inefficiency. The main reason for this is that cost-based pricing is generally below marginal costs. Marginal costs can be shown to optimize customer/utility decision-making under certain assumptions. Marginal cost is the cost of producing one more unit of a product. Consider the following simple example. Assuming that the complete cost of delivering the next kWh of electricity is 4 cents for a particular utility:

i. A customer for whom the electricity is worth 5 cents will forego the use of energy, thus the 5 cents benefit from it if the electricity is priced at 6 cents/kWh (above its marginal cost)

ii. A customer for whom the electricity is worth 3 cents will use too much energy, thus wasting it if the electricity is priced at 2 cents/kWh (below its marginal cost).

It can be shown that under certain conditions, the profit-maximizing price is the marginal cost. The society loses as a whole if goods are priced other than at their marginal costs. In general, it is argued that the cost-based pricing is a poor substitute for the competitive market-based pricing. However, restructuring the electric power industry to eliminate the inefficiencies may introduce different kinds of inefficiencies if the restructuring model is not carefully chosen and tediously implemented [1, 15, 18]. In fact, the new inefficiencies may turn out to be costlier than the ones that were eliminated by the transition.

The main difficulty in marginal pricing is how to define it properly. Usually, a distinction is made between short-run and long-run marginal costs. In the case of electricity, the short-run costs are associated with operating the existing system. Long-run costs include costs of additional plants or system parts. In practice, the competitive market-based pricing refers to short-run marginal cost. Although still not clear, the short-run marginal costs associated with the network component have been found to be too low to recover the existing capital investment. Only if the network is often constrained, and if opportunity costs are particularly high, will the capital costs be recovered. As a result, the discussion on the "correct" definition of short-run marginal cost for electric power has opened up another thorny issue: transmission pricing.

Another problem with short-run marginal costs is that they may be very volatile. No one will want to make decisions in a market where the prices fluctuate wildly. The dramatic price increases in the Midwest of United States in the spring of 1998 are examples of how it is difficult to introduce truly competitive market structure to electric power industry [17]. In this instance, the price "spike" was an extraordinarily high, but rather narrow and short-lived increase in wholesale spot market prices. In the aftermath, pricing caps were introduced by the grid operators or state and federal regulators. However, these are distortions and externalities to the market.

The theory says that marginal cost pricing can improve efficiency so as long as the market does not include any biased, subsidies or outside intrusions, i.e., externalities. The principle of second best says that partial optimization may be useless: there is no guarantee that using marginal costs as the basis for pricing is better than any other approach in a system with distortions. However, it seems like the restructuring of the electric power markets is a foregone decision as more and more countries opt for it. The challenge in future will lie in defining the best market rules and implementing them.

V. CONCLUSION

The electric power sector is going through a transition period where the rules of delivering power are changing constantly. Since the privatization of the electricity industry started in the United Kingdom in the late 1980's, the "vertically integrated" utility service and cost-based pricing models have been questioned, challenged, modified and totally abandoned in many countries.

The process of restructuring the electric power industry does not follow a single, well-defined route. Different market rules have been applied to the three key components of electrical power markets, leaving the rules at the interfaces and connection points vague and difficult to apply and manage. As a result, the restructuring, deregulation and privatization of electric power industry have recently become one of the most controversial topics of our times. It currently seems certain that the restructuring of the traditional electric power markets to competitive ones. Yet, the ultimate question if the end-user will profit from these changes in the form of cheaper electricity still remains an unknown.

This paper concentrated on the fundamentals of electric power markets, and tried to highlight the economic side of the complexity that has made the restructuring of this important sector so difficult.

REFERENCES

1. W. Hogan, "Reshaping the Electricity Industry," John F. Kennedy School of Government, Harvard University, November 1994.
2. W. Hogan, "Coordination for Competition in an Electricity Market," John F. Kennedy School of Government, Harvard University, March 1995.
3. W. Hogan, "Independent System Operator: Pricing and Flexibility in a Competitive Electricity Market," John F. Kennedy School of Government, Harvard University, February 1998.
4. "The Changing Structure of the Electric Power Industry: Selected Issues, 1998," Energy Information Administration, U.S. Department of Energy, 1998.
5. Ç. Çelik, "Electricity Market Models Around the Globe," The Eight International Middle East Power Systems Conference MEPCON 2001, University of Helwan, Cairo, EGYPT, December 29-31, 2001.
6. J. Moen, "Electric Utility Regulation, Structure and Competition: Experiences from the Norwegian Electric Supply Industry," NVE-Norwegian Water Resources and Energy Administration, Oslo, April 1994.
7. Ç. Çelik, "The Recent Developments on the Regional Transmission Organizations in the U.S.A.," 2nd Balkan Power Conference, June 19-21, 2002.
8. Ç. Çelik, "Electric Power Market Models in Europe," IPEC 2003, The Sixth Power Engineering Conference, Singapure,27-29 November,2003.
9. RP. Lalor and H. García, "Reshaping Power Markets—Lessons from Chile and Argentina," World Bank Note No. 85, June 1996.
10. A. Estache and M. Rodriguez-Pardina, "Regulatory Lessons from Argentina's Power Concessions," World Bank Note No. 92, June 1996.
11. M.A. Abdala and A. Chambouleyron, "Transmission Investment in Competitive Power Systems: Decentralizing decisions in Argentina," World Bank Note No. 192, June 1999.
12. D. T. O'Leary, J.-P. Charpentier, and D. Minogue, "Promoting Regional Power Trade - The Southern African Power Pool," World Bank Note No. 145, June 1998.
13. Ç. Çelik, "Electric Power Market Models in Developing Countries," ELECO 2003, Bursa, 3-7 December, 2003.
14. Ç. Çelik, "Recent Developments in Electric Power Market Restructuring in Turkey," 5th Balkan Conference, Sofia, Bulgaria, September 14-16,2006.
15. F.C. Schweppe, R.D. Tabors and R.E. Bohn, "Electricity Spot Pricing," Kluwer Academic Press, 1988.
16. Electricity Prices in a Competitive Environment: Marginal Cost Pricing of Generation Services and Financial Status of Electric Utilities. A Preliminary Analysis through 2015," Energy Information Administration, U.S. Department of Energy, 1997.
17. Electricity Prices in a Competitive Environment: Marginal Cost Pricing of Generation Services and Financial Status of Electric Utilities. A Preliminary Analysis through 2015," Energy Information Administration, U.S. Department of Energy, 1997.
18. H.M. Merrill, "Have I ever Got a Deal for You… Economic Principles in Pricing of Services," IEEE PES Summer Meeting, 1991.