

ELECTRIC POWER MARKET MODELS IN DEVELOPING COUNTRIES

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ABSTRACT

Central and South America lead the developing world in restructuring of the electric power markets and sector privatization. In 1998, Brazil followed Chile and Argentina in liberalizing the state-owned power utilities. In the following years, as amount of foreign investments in the power sector of developing countries depended on the implementation of reforms, regulatory and investment policies, several developing countries such as South Korea and Thailand, embarked on privatization as well. This article focuses on restructuring of electric power sector in the developing countries, such as southern Africa, Chile, Argentina, Egypt, Thailand and India, and discusses the “Single Buyer” model.

I. INTRODUCTION

Restructuring of the electricity power sector offers significant potential benefits in terms of improved efficiency in the production of electricity and in the allocation of resources across the economy, lower prices for consumers, improved risk allocation, and stimulus to economic growth and competitiveness. However, to be able fully exploit and realize these benefits, the restructuring needs to be done properly. Electricity power sector requires complex infrastructure and it is capital-intensive. Even decisions for short-term have far-reaching and long-lived effects.

The central focus of recent restructuring has been the introduction of competition into the generation and supply through moving to a competitive market paradigm. This evolution shifts decision making from a central authority to the market. The main goals are better economic performance of the sector, lower prices and a broader array of choices to consumers. However, other important issues such as security and reliability of supply, environmental constraints and other public issues need to be considered, or even protected through some regulation. Experience up to date shows that these objectives can be met under the new competitive market conditions, but it is critical that they are considered in the design of the interim and the final market models at the beginning of the process [1,2,3,4,5,6].

Central and South America lead the developing world in restructuring of the electric power markets and sector privatization [7,8,9]. In 1998, Brazil followed Chile and Argentina in liberalizing the state-owned power utilities. In the following years, as amount of foreign investments in the power sector of developing countries depended on the implementation of reforms, regulatory and investment policies, several developing countries such as South Korea and Thailand, embarked on privatization as well.

This article focuses on restructuring of electric power sector in the developing countries and follows the first four articles of this series in an effort to monitor, analyze and summarize the restructuring efforts around the globe. As these restructuring efforts are still evolving and in some cases only starting, there is a lot to be gained in future implementations from the experience that has already accumulated [1,2,3,4].

II. SINGLE BUYER MODEL

In the developing countries where the high growth rates put a strain on the governments for the investment required for the new generating and other related large infrastructure projects in the power sector, the governments react by taking steps to increase private investment to deal with the heavy financial burden. These steps usually involve opening the industry to independent power producers, and restructuring the sector. In regions like Middle-East, southern Africa, and southeast Asia, power sector growth and restructuring usually involve more than a single country. The restructuring in neighboring countries or in a region usually takes place at different pace. As a result, the potential for international power trade and cooperation becomes another major incentive of the restructuring process.

The introduction of privately financed independent power producer (IPP) and build – operate – transfer (BOOT) projects, multiple ownership of power facilities, increased privatization, decreased central planning, possible interconnection of previously isolated systems, and increased international trade bring more competition. However, this competition come at a price of more complicated procedures. These new competitive market

and power pooling procedures are required to dispatch generation resources on a competitive basis. These procedures naturally increase the level of organizational and management complexity. Only careful definition and development of feasible operating and planning rules result in successful implementation of restructuring.

In general, the single buyer model can be viewed as a variation of the pool model that was first implemented in the United Kingdom in the late 1980's. In this model shown in Figure 1, the system operator operates the transmission network through the energy control centers. It also facilitates the financial transactions between the generation and distribution companies. As expected, the single buyer model has been implemented at developing countries with significant variations [10]. Depending on the country as explained in more detail in section 3, the distribution wires may be owned by the distribution companies or by separate organizations, or the single buyer itself.

The single buyer model was implemented in the developing countries to introduce competition between generation plants built under the build – operate – transfer (BOOT) status and the state owned power plants. There were significant capacity shortages due to high growth rates in the developing countries in the 1990s [10]. Governments in such countries lacked the necessary funds to invest in new generation plants. Private investments in the form of BOOT projects were encouraged to construct power plants to overcome the capacity shortages. These BOOTs usually sold their output through awarded exclusive rights to the vertically integrated utility, owned

and operated by the State. One of the main variations of this model from the pool model of UK is the competitive bidding and rewarding mechanism for new capacity that was immediately needed in the developing countries. Usually, a separate but state owned organization has been put in place to decide when to add new capacity and when to collect bids for new capacity construction.

Another significant variation from the pool model of UK is that the implementation is carried out in distinct multiple stages. The legislations required for restructuring take time to put in place. The government organizations are slow to respond to the implementation process. For the single buyer model to work efficiently, the generation companies, the system operator, and the capacity tendering institution need to work completely independent of each other. The tariffs need to be set by a separate regulator as well. Otherwise, the single buyer model will distort the prices and the incentives of a free market place. As a result, the overall restructuring process is usually divided into multiple stages.

In general, the main advantages for this model have been identified as providing a relatively simple and quick first step toward higher levels of competition, and a mechanism for handling stranded costs. Its main disadvantages were listed as providing no clear signals as to the value of improving the transmission network, its regulation structure being very complicated, and finally not setting up the independence of the institutions that an eventual competitive market will require.

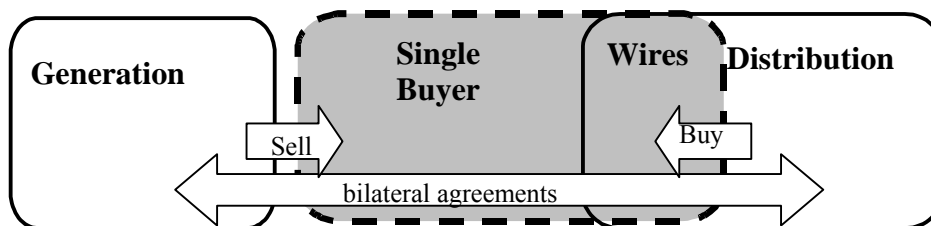


Figure 1: Single Buyer Model

III. RESTRUCTURING MODELS IN THE DEVELOPING COUNTRIES

SOUTHERN AFRICAN POWER POOL

The Southern African Power Pool (SAPP) was inaugurated in 1995 [11]. The main underlying objective of creating a regional pool was to improve efficiency within the framework of a market. SAPP encompasses about ten countries in the southern part of Africa, with South Africa being major player. So far the trade volume has averaged about 3 percent of the total production in the participating countries.

The diverse spectrum of power sources in the region, i.e., hydroelectricity in the north, and large reserves of cheap coal in South Africa, has been an major incentive to reinforce and extend the power networks between the countries. The pool agreement covers about nine million square kilometers and 200 million people [11].

There are significant differences in the generation mix. It is mainly hydro in the North. In South Africa, there is abundant cheap coal. Kariba Dam serves as the buffer in the middle. SAPP is currently based on agreements rather than any codes or laws [11]. It is organized under an executive committee, and three

subcommittees: planning subcommittee that review wheeling rates and expansion plans, operating subcommittee and the environmental subcommittee.

One of the main goals of SAPP is to set up common operating schedules based on firm and non-firm power contracts, and mutual support contracts for operating reserve, emergency energy as well as scheduled outage energy and wheeling.

The SAPP model has enabled main cooperation in the region in terms of setting up short-term contracts to match generation and load, allowing comprehensive indicative expansion plans to be made, common emergency procedures to be defined, and common operational standards for system reliability and security to be designed. In addition, it has resulted in savings by the postponement of new generation capacity, and reduction in fuel costs and more efficient use of hydro. It will be implemented in stages, and this allows participants to make incremental, but consistent steps based on self-sufficiency and autonomy.

However, participation at SAPP has been bleak. Trade volumes still average around 3% [11]. The investment in the pool infrastructure has been insufficient, and commercialization programs are lagging behind. Inter-country connections are still insufficient and the transmission network has not developed enough to fully exploit a regional pool. There is no central dispatching. Dispatching is based on long-term bilateral contracts based on the loose pool model. The utilities at most member countries are still vertically integrated. Dispute resolution procedures are extremely complex and long. Differences in the regulatory systems create possibilities for gaming or unfairness. A consistent approach to transmission access has not been defined yet. This delay has been discouraging private and foreign investment in independent power transmission projects. Finally, a common transmission pricing among the member countries has not still been implemented.

CHILE AND ARGENTINA

The market models in Chile and Argentina proved that significant efficiencies could be realized through restructuring and deregulation. There have been significant improvements in both countries and the quality of service has improved against falling prices. Despite several setbacks and problems, similar models with implementation differences have been applied elsewhere in South America.

Developing countries should pay due attention to the models implemented in Argentina and Chile, as their implementation improved performance in both countries. They were successful in bringing down both wholesale and retail prices. The models allow large

customers to purchase from any generation or distribution company, creating an incentive to lower costs, and use unregulated price as a signal for investment resulting expansion decisions being reflected by market forces. In addition, distribution sectors became more efficient.

Chile started restructuring its electricity power sector in 1982, and privatized its utilities between 1986 and 1989 [7]. Argentina introduced privatization in 1992 [8,9]. The Chile restructuring took as a part of a broader rationalization of the economy. The Argentina restructuring, on the other hand, targeted improving efficiency and attracting the much needed investment to upgrade the infrastructure.

The Argentinean and Chilean model is a variation of the single buyer model. There are five functional entities in this model, namely generation, dispatch, transmission, distribution wires and distribution supply. The dispatching is done by a central operator. However, the model supports transactions between sellers and large customers through long-term contracts. Distribution wires and supply companies are regulated.

There are some important lessons to learn from the experiences in Chile and Argentina. For example, market restructuring in these countries has not been specific enough for the different market players. In Chile, one main mistake was allowing cross-ownership. This in addition to predominance of few generation companies, lead to gaming and unfairness. Dispatch, instead of being an independent, non-profit, regulated entity, is managed by a coordinating committee of representatives from largest generators. This made manipulation of the market by the generators possible. Finally, distribution regulation has proved to be controversial and inefficient.

In Chile, bulk power transactions are made at spot prices. Transmission charges are based on replacement value of assets plus operating expenses of a generic company model. The distribution supply companies to small consumers are regulated. One of the advantages of this implementation are that it links regulated price to market price, thus, allowing small consumers share the competition effects. However, existence of only few generation companies caused an obstacle to more competitive generation. Moreover, transmission access was not fair, and transmission pricing was not defined on clear rules, resulting in several disputes.

Argentina, having learned from the experiences in Chile, did not allow cross-ownership, and set up the dispatch operator as an independent entity. Moreover, it did not permit any generator to have more than 10% of

system capacity. The generation dispatch is carried out as a least-cost centralized mechanism.

Two types of payments to generators are defined in this implementation, for energy dispatched and for capacity offered to grid. Moreover, the transmission charges are capped. One of the main advantages is that plants are selected for dispatch based on their variable costs, and get paid on the system's short-term marginal cost of production. This highly mitigated gaming. Limits on the size of generators ensure competition. However, cost recovery for generators was not allowed. Moreover, transmission pricing did not reflect incremental costs, and did not provide the right incentives for new investment for the transmission network.

EGYPT

Egypt decided to implement a single buyer model as a transition mechanism to competitive markets as well [12]. The key player in this model will be a non-profit organization that will buy electricity from generation companies and sell it to distribution companies. This organization will be regulated by an independent institution.

Several new legislations were recently put in place for restructuring. These included encouragement of privately financed independent power producer (IPP) projects. Majority of the IPP projects are envisioned to be built through the build-own-operate-transfer (BOOT) basis. The new legislations also helped establish the Electric Utility and Consumer Protection Regulatory Agency. In addition, the state owned utility and existing related companies were reorganized into three entities. These are five generation companies, seven regional distribution companies and the Egyptian Electricity Transmission Company (EETC) that will own the transmission system and operate it through the National Energy Control Center.

In this variation of the single buyer, the EETC will buy generation on a competitive contract basis, while selling to distribution companies on a regulated cost-of-service basis. In return, the distribution companies will sell to end-use customers using the tariffs setup by a forth independent institution, Regulatory Agency. The Regulatory Agency will in addition oversee all monopolistic activities in the market place, such as the services of the distribution companies.

As in the Thailand model to be discussed next, the new generation capacity will be procured through competitive tenders, privately financed and owned, and selling to the EETC on a contract basis. To encourage private and foreign investment, there are also plans to sell a certain percentage of the ownership of the distribution and generation companies. As in other

developing countries, one of the main challenges in Egypt is to develop a comprehensive framework that will enable the market organizations created to work efficiently and independently from any legislative pressures. Otherwise, the benefits of restructuring the power sector may not be realized in time, or restructuring could be derailed completely.

THAILAND

Thailand introduced a long term plan with three stages to implement a special variation of the Single Buyer model [5]. In Thailand, this model was decided to be introduced in stages. In stage one, Electricity Generating Authority of Thailand (EGAT) assumed the responsibility as the primary power purchaser until 2001. Functions within EGAT were organized into business units and operated as profit centers. Large generators were privatized. An independent regulative institution was also established. During this stage, EGAT also serves as the transmission operator. In stage two, EGAT acts as the central supplier of power with gradual introduction of wheeling from 2001 to 2003. EGAT separates network operations and power purchasing into different corporations. It also allows full generation competition and direct access for some large customers. In stage three beyond 2003, establishment of a competitive wholesale power pool with hourly pricing and introduction of retail access over time is planned.

INDIA

Restructuring of the power sector has not made much progress in India yet. In most states of the country, demand exceeds supply significantly. A premature step into competitive market would definitely result in very high electricity prices. However, there are already some steps taken by government. The Central Electricity Regulatory Commission (CERC) has been established as the regulatory agency [13].

Participation of independent power plants to level the gap between supply and demand is also encouraged through government incentives. In regard to uninstructed generation and unscheduled flows between the state electricity boards, India adopted a pricing formula, where the price for this unscheduled electricity varies with the system frequency.

With this pricing, the state purchasing the electricity compensates the state selling it at a variable price. The variable price could also be applied to electricity from independent power producers, since it is transparent across the entire network. The corresponding state board of power producing and selling IPPs acts like the intermediate settlement entity.

IV. CONCLUSIONS

The privatization of the electrical power industry in the United Kingdom was started to raise capital for the ailing British economy in the late 1980's. However, it also completely changed the way the industry was operated.

The single buyer model is relatively simple and quick to implement. It basically provides for transition mechanism through all levels of competition. It handles the process of separating the purchasing function from the grid function by establishing separate financial accounts. Finally, it provides mechanism to supply franchise customers.

However, the single buyer model has several disadvantages. First of all, this model does not provide any clear signals as to the value of improving the transmission network. Regulation is much more complicated to formulate and implement than in models with higher levels of competition. Finally, but maybe most importantly, it is prone to corruption, and imposes significant contingent liabilities on the government.

Clearly, no model is without flaws or is final. Although, the common driving inspiration is bringing electricity at its competitive market value, due to the special attributes of electricity as a commodity, and regional differences and regulatory viewpoints, the new markets have evolved into distinctively different operational structures. This trend seems to continue in the present, and a final mature model with all the flaws corrected is not available, yet. However, it is very important for the countries and regions which are moving into competitive electricity markets and restructuring their power sector only recently to understand the existing markets, to be able to compare and learn from their flaws. Otherwise, the original motivation behind restructuring may result in creating the completely opposite result.

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