

Structural Problems in the Restructuring Process of the Electric Power Sector in Developing Countries

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Abstract: The energy markets have been, or are in the process of being, restructured in many parts of the world. A variety of restructuring models is being proposed, considered, and experimented with in different countries. The electric power industry represents the largest global industry ever to move from regulation to competition. This article presents an overview of the main structural components of the emerging deregulated electric power sector. The implications of restructuring the electric power sector in developing countries in the light of the experience of industrialized countries are evaluated, with a view to identifying potential pitfalls and opportunities for developing countries. The article summarily describes the crucial differences between the electricity funding situation in industrialized and developing nations, and the dangers of indiscriminate transfer of market structures and regulatory approaches. The industrialized countries' experience has not provided an infallible general path, and each developing country must search for solutions within its own context.

Keywords: Structural problems; Funding problems; Restructuring; Electric power sector; Developing countries

Introduction

Energy is essential to life and the quantity of energy consumed per capita can be used as one indicator of a country's development level.

Population growth is one of the major forces driving the increase in energy demand. For future energy development, the two most important features of world population growth are urbanization and the concentration of future growth in developing countries.

Electricity is a very effective form of energy. It can be produced by a variety of methods, transmitted quite efficiently and safely, and used for the various areas within industrial, commercial, residential and agricultural activities. Providing sufficient, continuous, high-quality, reliable, and low-cost electricity to consumers of various characteristics in electric power systems has both direct and indirect repercussions on social, industrial, and economic life in all countries, calling for the dedication of a considerable part of national investments to the electric power field (Sohtaoglu, 1999).

The overall trends for energy and electricity consumption are markedly different between industrialized and developing countries. However, the electric power industry represents the largest global industry ever to move from the regulation to competition.

The restructuring and privatization of the energy sector, especially the electric power sub-sector, has been accelerating worldwide in recent years. The industrialized countries have led this trend. Meanwhile, a few developing countries have boldly followed suit, but many others have proceeded cautiously along the path of and privatization and restructuring the electric power sector. The original driving forces for electric power sector restructuring differed substantially among regions. Although the initial driving forces for liberalization and privatization differed between industrialized countries, there were a number of factors they had in common compared to developing countries as a group. Foremost are some basic facts of industrial maturity.

For industrialized countries, the driving forces for restructuring have been different, but that the proposed

solutions are similar. For developing countries, it would be more to the point to state that the driving forces are similar, but that the proposed solutions should be different. National solutions depend strongly upon the domestic fuel situation, levels of industrial development and income, and the state of competitiveness economy-wide. Moreover, the strengths and weaknesses of existing electric utilities and regulatory structures are widely divergent as are the bottlenecks and opportunities for a range of new technologies.

Since electric power—unlike other industrial products and commercial services—cannot be stored, it has to be produced and consumed in the necessary quantities where and when required. Planning, organization, coordination, and supervision are therefore more important and different than they are in other sectors, due to the interrelationships at various levels of the factors by which the continuity, quality, and reliability of electric power are assured.

Uncertainty levels surrounding the planning and investment decisions in electric power systems are quite high. Because development plans are in the final analysis based on forecasts of the future, uncertainty and risk—economic, legal, structural, technology and construction, political and regulatory—emerge as limiting constraints at any stage of planning and investment processes. Although uncertainty cannot be eliminated completely, risk management is possible. Hence, alternative investment and operation plans developed in the electricity sector have to incorporate a suitable trade-off between reliability and economy in order to meet general planning criteria.

Despite these facts, the specific conditions of a country and its social, cultural, political, and economic structure and its international or global contacts can be influential—even decisive—in planning and investment decisions. This is especially true in the case of developing countries (Sohtaoglu, 1999).

The resource requirements of the electric power sector in developing countries is very great. Unfortunately, these countries also have limited financial resources.

And, until the poor financial condition of the electric power sector, which affects all aspects of the sector's operations, is corrected—that is, until it becomes creditworthy—the required investments will not be undertaken at the necessary levels, nor will it be possible to operate and maintain the system at professionally acceptable levels. However, the present financial conditions in developing countries are very poor and their ability to expand and to improve the reliability and quality of the services are inadequate.

In the developing world, the electric power sector is largely publicly owned and operated. This implies that, unless there is substantial change, most of the electricity investment financing will be sought by governments. It is possible that governments will not be able to raise the necessary capital, which may lead, given more readily available private financing, to privatization or to private participation in generation. In developing countries, privately owned companies are fostered by institutional and international investors as a prerequisite to attract foreign capitals and improve performances.

Funding Requirements: As one of the most important inputs of economic and social development, energy has ranked high on the agenda of all world nations since the 1970s. The world energy sector has been marked by supply restrictions stemming from the oil crisis in the past, and by large cost increases due to environmental pressures in our day. By now the energy sector has transcended national borders and reached the status of requiring global evaluation. Decisions taken and policies implemented by international institutions and enterprises in connection with the energy sector influence all the countries of the world directly or indirectly to a varying degree.

The basic principle adopted by industrialized nations regarding sector policies has been determined as economic development with energy security and a sustainable environment. Within this scope, the basic yardsticks are identified as free and open markets, noninterventionist pricing, energy conservation, and the biodiversity and resilience of the earth. In both developed and developing countries in the latter period, the concepts of energy security, environmental protection, and energy savings, as well as "privatization" and "restructuring," have heavily entered the agenda of energy sectors. Policies related to the sector are in the process of being redefined in the direction of increasing participation of domestic and foreign private enterprises in energy investments, and of ensuring international competition. The increasing demand for electricity brings complex policy and application problems to the fore related to commerce, competition, restructuring, investment and supply security, and implemented policies—especially in developing countries—are heavily influenced by trends in the world energy sector.

Since the national investment share required by electric power assumes major proportions in underdeveloped and developing countries, the cost of instabilities in macro level policies and of untimely investments of questionable wisdom—undertaken and continued before structural problems have been resolved—is great, creating long-term, negative repercussions on the economy as a whole. Since the demand for energy—the soundest basic measure of economic, social, and technological development—increases daily at an ever-accelerating rate in all the nations of the world, trends

and changes in electric power sector must be monitored with care.

Economic growth is the main factor driving growth in energy demand. Between 1970 and 1993, world gross domestic product (GDP) rose from US\$ 12 trillion (1990 U.S. dollars) to US\$ 23 trillion. By 2015, world GDP is expected to almost double again, rising to US\$ 45 trillion. On average, demand for energy does not rise in direct proportion to increases in income (US-EIA, 1996). Population is also expected to grow substantially over the forecast period, but at less than one-half the rate of income growth. The slow growth in population relative to growth in GDP permits substantial improvements in per capita income over the projection period. Both the level and composition of energy demand are affected by gains in per capita income. In general, the more advanced an economy and the higher personal income, the greater the demand for energy-using equipment. Electricity demand is especially sensitive to growth in income. Economic development leads to increased reliance on electricity for machine drive in industrial processes and increased use for heating, cooling, lighting, cooking, and other appliances in residential and commercial activities. The geographic composition of energy demand will change substantially over the projection period. Two-thirds of all energy growth will occur in newly industrializing economies. Most of that growth will be concentrated in the developing countries of Asia, where half the world's population resides.

The macro economic situations in developing countries deteriorated. In particular, it was evident that high-priority social needs were competing for limited budgets and would severely reduce the availability of public funds to finance the mounting need for planned power sector investments. In fact, the World Bank has estimated that about US\$ 1 trillion would be needed to finance expansion programs for electric utilities in the developing countries in the 1990s, and this figure was seen as approaching US\$ 2 trillion—will be needed to finance electric utility expansion—in the first decade of this century. On the other hand, experience throughout the world has shown that the resources necessary to make the needed investments cannot be mobilized in practice without an appropriate enabling environment—in particular for the financial arrangements. Developing countries have found it difficult or impossible to find domestic and/or foreign resources on that scale. Developing countries are facing significant capacity shortfalls that are attributable in no small measure to the poor financial viability of the state electricity boards, exacerbated by inadequate tariff levels.

The forces behind electricity deregulation taking place worldwide have either been political reform, regulatory failures, high tariffs, managerial insufficiency or global economic crisis. The reasons for deregulation in South America have differed, but most have been economically or politically based. Many countries have made the changes as a result of the failure of the State to adequately manage electricity companies. In other countries, the force behind has been the lack of public resources to finance the required investment for development (the World Bank conditioning loans to the start of deregulation processes). Chile instituted its reforms as a result of political changes, that brought free-market economists into the government, which took drastic actions to reduce the control of the State over the

economy and increase the role of the private sector. In Argentina the driving force was the radical change in economic policy applied since 1989 by the new government, but the essential reasons in the electricity industry were the lack of public funds to finance new investments and the mismanagement and corruption of state owned companies. The degree of deregulation, unbundling of services, and competition is a policy choice.

International financial agencies, such as the World Bank, are also putting pressure on developing countries to provide rigorous economic justification for future power projects.

Global Perspective: Many network industries (telecommunications, electricity, natural gas, postal services, transportation, water and sewage services, etc.) are confronted with significant logistic and behavioral problems in their transition towards a more competitive environment and structure (Zaccour, 1998). As a global phenomenon, restructuring of the electric utility industry has been driven by a variety of motives, and has taken a variety of paths. The trend started in the 1980s in the U.K. and some Latin American countries, and has gained momentum in the 1990s. The main motivation and driving forces for restructuring of the electric power sector in different countries are not necessarily the same. In some countries, such as the U.K. and the Latin American countries, privatization has offered a means of attracting funds from the private sector to relieve the burden of heavy public subsidies. In the countries formerly under centralized control (central and eastern Europe), the process follows the general trend away from centralized public control and towards a market economy, also providing a vehicle to attract needed foreign capital. In the United States and several other countries where the electric power industry has for the most part been owned by the private sector, the trend is toward increased competition and decreased regulation (Ilic *et al.*, 1998).

Although energy has been a high priority on national and international agenda for over two decades, energy issues continue to confront policy makers and planners in all countries. Studies have indicated that continuation of the present patterns of energy consumption are unsustainable in the long term and will have serious environmental consequences.

The link between energy growth and economic growth is relatively weak in industrialized economies. The relatively higher energy growth in developing countries is a result not only of rapid economic and population expansion but also of changing lifestyles. Many areas of the world are now gaining access to electricity for the first time. Those that have electricity are expanding the range of appliances they use.

Electricity consumption in the developing world has been growing at a rapid rate, driven by economic growth, expansion of energy-intensive industries, rural to urban migration, and high energy intensities in end-use equipment. Unfortunately, the financial position of domestic electric utilities has not been able to keep pace with this increase, and has actually declined over the same period. The outstanding debt of electric utilities amounts to about one-fifth of the total accumulated debt of developing countries. Revenues, on the other hand, have failed to keep pace because of a combination of aging equipment, poor operation and maintenance

procedures, power theft, inadequate billing procedures, and lack of personal and corporate incentives.

As a result, the electricity generation sector in developing countries and economies in transition is confronted by extremely high demand, primarily unmet, with considerable adverse economic and environmental implications at the local, regional and global levels. Successful resolution of the problems resulting from this mismatch in electricity supply and demand requires new planning, forecasting, and management tools, not only to help electric utilities to optimize their own activities, but also to promote new, more creative arrangements with neighboring utilities, the investor community, electricity consumers, and national policy-makers.

Competitive Industry Structure: The electric utility industry everywhere in the world has been closely regulated by a combination of local and national government agencies.

Traditionally, the electric power sectors of developing countries were structured as vertically integrated public monopolies.

A number of nations own and operate their electric utility on a national basis, either as a governmental department or as a single, government-owned company, which, while legally separate, has a symbiotic relationship with the government and is closely constrained by its policies. State-owned utilities most often operate their electric power system within the dictates of national policy (Philipson and Willis, 1999).

In many developing countries, the national utility is very much involved in economic policy decisions, its purpose being both to provide available power to stimulate industrial growth, and to support public infrastructure development. In other countries, the national utility provides more than just electric services.

Electricity markets are being radically transformed throughout the world. Starting with the restructuring of Chile's electricity sector in 1982, several countries, including Argentina, Australia, Bolivia, Columbia, New Zealand, Norway, Peru, and the UK, have undertaken reforms introducing commercial incentives into the generation, transmission, distribution, and retailing of electricity (Zaccour, 1998).

Governments in various parts of the world, including those in developing countries, have been, or are in the process of reforming their power sectors in order to strengthen their performance. The goals are to improve the extent to which the sector covers its costs, the efficiency with which it produces electricity and delivers it to consumers, and the efficiency with which the consumers themselves use the power. Experience in different parts of the world has demonstrated that large performance improvements in the production, delivery, and consumption of the electricity are difficult or impossible to achieve without reform.

In many of the countries where electric power utility deregulation first occurred (Chile, Argentina, England), the government was also privatizing the industry. Privatization means the government sells its state-owned electric utility business to private investors. The push for privatization, and the accompanying political perspective, nearly always led to favoring deregulation. Deregulation does not have to be a part of privatization efforts.

Privatization in Argentina was a key element in the stabilization policy adopted after the hyperinflation of 1989 and 1990. It had both economic and political goals;

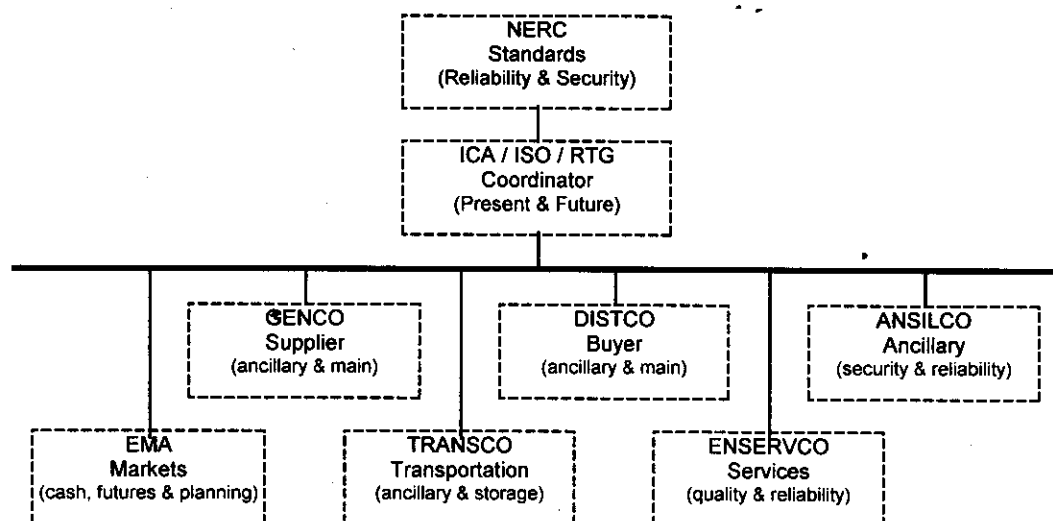


Fig. 1: The framework of the restructured electric power market

the revenues realized from the sale of public assets were critical in financing the fiscal deficit and reducing the public debt, and the continuity of the effort enhanced the credibility of the government's commitment to remedy the problems of the economy. As a result, electricity generation, transmission, and distribution were separated into their component parts and sold to private investors. The operation of a deregulated electric industry is more complex than that of a vertically integrated electric utility. There are several different ways that a government can decide to order deregulated operations to work. All are intricate, but each to a different degree and in a different way. Restructuring of the electric power industry is usually done with laws or regulations that leave the details up to the electric utilities.

The companies in the restructured competitive open market system can be typified as generation companies (GENCOs), transmission companies (TRANSCOs), distribution companies (DISTCOs), energy service companies (ENSERVCOs), ancillary service companies (ANSILCOs), independent system operators (ISOs), regional transmission groups (RTGs), national electric reliability council (NERC), national and state regulation commissions (FERC), and possibly others. Power is generated by generation companies (GENCOs), transported via transmission companies (TRANSCOs), and all power is sold to distribution companies (DISTCOs). It is expected that the customer interaction, to be competitive will be handled by energy service companies (ENSERVCOs). ENSERVCO provides the services for quality and reliability of which the energy customers buy and the customer contracts. National Electric Reliability Council (NERC) would set the reliability and security requirements, and the operation of the exchanges. NERC establishes all procedures and standards. The ISO operates the system directing operation to maintain the system security and reliability. Since many TRANSCOs and DISTCOs will actually operate the equipment, the term ISO can be misleading. EMA—energy mercantile association—matches the bids

subject to all operational constraints. The RTG plans the system to maintain the system security and reliability. Independent contract administrator (ICA) as a combination of ISO and RTG to provide a seamless transition from the future planned system to the present operational system. ICA provides the independent system operator (ISO) and the regional transmission group (RTG) for all players of the market including brokers and marketers. The ICA is responsible for maintaining the security and reliability of the system. The ICA monitors and responds to the power system limits and transmission line capabilities. GENCOs and DISTCOs are required to cooperate with the ICA in maintaining system reliability. The proposed framework for the electric power market (Illic *et al.*, 1998), (Richter and Sheble, 1998) is presented in Figure 1. The responsibilities and scope of activities of the structural components in all countries' electric power market can vary widely.

There is no universally correct choice of market structure and the preferred arrangements at a particular time will be influenced by the stage of development of the system and its operating performance. For developing countries it is important to provide the stability necessary to fund major schemes for new generation and transmission and to ensure that the basic infrastructure is established (Murray, 1998).

The goal of deregulation is to foster competition in the sale of electric power at the wholesale and retail levels. There is no one model of deregulation that applies uniformly to all situations: rules vary depending on local conditions, needs, and political whims. Electricity deregulation, especially in developing countries, has the potential to impact the production, transmission, distribution, and trade of electric power, positively and negatively. In other words, deregulation have risks and opportunities. Electricity consumers, producers, and regulators must solve a number of transitional problems before achieving an operationally reliable and financially viable competitive electric supply sector. The main problems are social, financial, institutional,

organizational, regulatory, and operational.

Conclusions

Energy will continue to play a central role in the global economic development in general and for the developing countries in particular. Energy resources are unevenly distributed. There is an imbalance in the use of energy around the world. Within the developing world, resources and population are not well matched.

Dependence on electrical energy in all facets of life has made power system planning an important and critical tool in achieving higher living standards in all countries. Besides great social and economic significance of having continuous availability of power supplies, electric power systems need heavy financial investments. In all countries investment in power systems constitute the major part of the total investments of the nation. The electric power sector is a very important sub-sector in the system of national economy and energy sector. For this reason, power system planning should be conducted under the guidelines of national and/or corporate economic planning and energy resources policy.

Electricity supply is highly capital-intensive and requires long-term investment planning, as construction of power stations can take up to a decade. A problem with restructured power markets is that it is no longer obvious who will be responsible for investing in new generation, transmission, and distribution capacity to meet demand growth and who will have an obligation to supply electric power.

The changing of the world of electricity from liberalization, privatization, deregulation, competition, operation, and public opinion point of view makes the interconnections more complex than before.

Global capital resources are more than adequate to meet the potential demands from the global energy sector. The challenge here is the ability to mobilize enough private savings on a sufficient scale to finance the energy investment needed worldwide. Private sector financing will be increasingly relied upon in the future.

Electricity has come to play an increasingly important role in the economies of the developing countries. Forecasts indicate that its role will continue to increase in importance, with the consequence that enormous amounts of capital will be needed to meet expected future electricity demand. With governments unable to fund all of that need, it is likely that the private sector begin to play an important role. If developing countries wish to attract substantial and continuous inflows of private capital, they must avoid the dangers of having to change the economic rules of the game at subsequent stages of restructuring. Otherwise, the availability of foreign capital will drastically decrease and its price will move up inexorably.

The electricity restructuring in developing nations is of utmost importance, but also that the experience from industrialized nations provides circumstantial evidence rather than clear lessons for developing countries. These lessons may not be so straightforward as is sometimes suggested. Developing countries have a vastly different point of departure in terms of basic sectoral problems in both a technical and social sense.

The liberalization and privatization may not always be for the better, especially in developing countries. Any policy prescription must closely consider the differentiating country' specific characteristics. The ongoing restructuring of the electricity sector in many industrialized countries bears testimony to the uneasy alliance between market concepts and sustainability objectives.

The industrialized countries' experience has not provided an infallible general path, and each developing country must search for the original solutions within its own context. There is a need for a national strategy focused on increasing security of supply through diversification of fuels and of sources, and this cannot be left to the international or global market forces alone.

References

- Ilıc, M., F. Galiana and L. Fink, 1998. *Power Systems Restructuring: Engineering and Economics*. Kluwer Academic Publishers, Boston, USA.
- Murray, B., 1998. *Electricity Markets: Investment, Performance and Analysis*. John Wiley & Sons Ltd., Chichester, England.
- Philipson, L. and H. L. Willis, 1999. *Understanding Electric Utilities and De-Regulation*. Marcel Dekker Inc., New York, USA.
- ✓ Richter, C. W. and G. B. Sheble, 1998. Genetic Algorithm Evolution of Utility Bidding Strategies for the Competitive Marketplace. *IEEE Trans. on Power Systems*, 13: 256-261.
- ✓ Sohtaoglu, N. H., 1999. Analysis of Created Value Added in the Electric Power Sector: A Case Study of Turkey. *Energy Policy*, 27: 195-202.
- U.S. Energy Information Administration (EIA), 1996. *International Energy Outlook for 1996*. Washington, USA.
- Zaccour, G. (Ed.), 1998. *Deregulation of Electric Utilities*. Kluwer Academic Publishers, Boston, USA.