

Restructuring Choices for the Indian Power Sector

The interest in restructuring and reform of the power sector is a worldwide phenomenon that is being pursued in different formats, depending on the structure and condition of the economy and political institutions in those countries. Yet the core of the reform remains the same, i.e., the establishment of a transparent regulatory structure, unbundling of the power sector, creation of national and state grids with a transparent and efficient dispatch, entry and exit systems for participants, wholesale market in the power sector, more choices regarding the sales to consumers, and other measures that can improve the competition and the efficiency of the sector.

The experience of reform/restructuring in different countries has shown that the restructuring generally fails on account of missing pieces in the reform legislation. The restructuring programs were less successful if they were not clearly defined in a reasonable time schedule or if they led to setting up ambiguous regulatory structures that decided on rules regarding tariffs, entry to the power sector, etc. The other possible reason for failure was attributed to the fact that reform was not an integrated program that could look at the restructuring requirements of all the players, i.e., generation, transmission, and distribution in the power sector, or the reform program did not remove the potential for political interference in the working of entities and in areas other than policies.

The Indian power sector is presently going through a process of reform and restructuring, as is the trend in many other parts of the world. Independent regulatory commissions are being set up, and vertically integrated utilities are being unbundled into corporate entities. Efforts are also being made to facilitate competition wherever feasible, and the choice of an appropriate power market model assumes significance in this context. The recent reforms in the Indian power sector have exemplified changes in the players' role for providing policy directions, regulating, and running the sector for over 50 years. New institutional entities are being established in the

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power sector, and a healthy relationship between these institutions is presumed crucial to ensure a sustained development of the sector and to realize the reform goals.

Indian Power Sector

The power sector in India has been regulated and owned for many years by various government agencies and organizations. The role and the participation of private industry in the Indian power sector has been limited and confined to specific areas of small jurisdiction and consumer base. The subject of electricity is covered under the concurrent list in the Constitution of India,

implying that both the central and state governments have the power to legislate the sector. The power supply industry in India is now over a century old and experienced a slow and fragmented growth during the first 50 years of its existence. The enactment of the Electricity (Supply) Act in 1948 led to the consolidation of the power industry, initially at the state level and later at regional levels, which also led to the public sector ownership of almost the entire industry. Although the industry made rapid strides under this setup, it is found in-

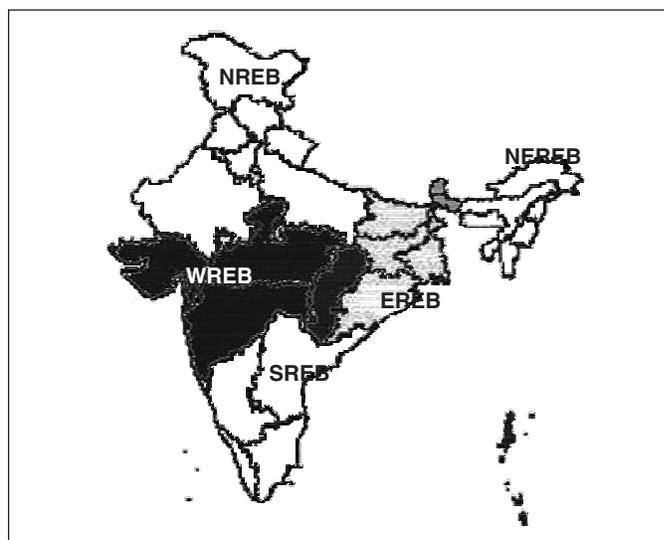


Figure 1. Regional electricity boards of India

This article summarizes a full report that is available at on the Web, <http://motor.ece.iit.edu/India>. A. Srivastava and M. Shahidehpour are with the Center for Electric Power and Power Electronics, Illinois Institute of Technology, Chicago, Illinois, USA.

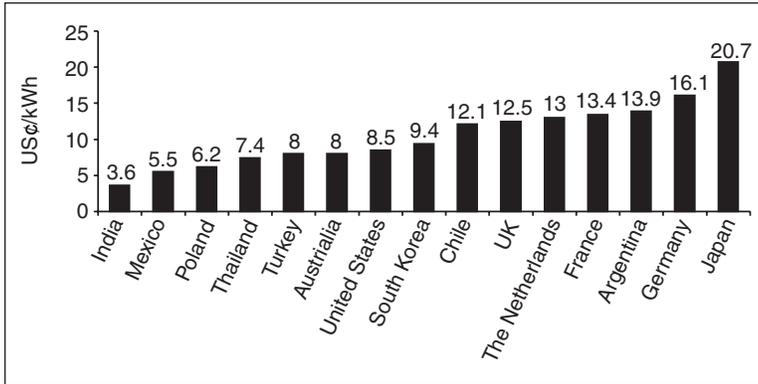


Figure 2. Household electricity prices in 1997

2001-2002		2006-2007		2011-2012	
Peak Load (MW)	Generation (GWh)	Peak Load (MW)	Generation (GWh)	Peak Load (MW)	Generation (GWh)
85,132	529,013	115,705	719,097	157,107	975,222

creasingly inadequate to meet present-day challenges. There are currently serious concerns about the electricity industry's performance, regulatory efficiency, and ability to finance additional projects.

Indian Power Sector Organization

The Indian power sector is organized into five Regional Electricity Boards (REB), each consisting of several State Electricity Boards (SEB) as depicted in Figure 1. The Central Electricity Authority (CEA) is responsible for power planning at the national level. CEA advises the Ministry of Power (MoP) on national power policy, national power planning and regulatory matters.

Electric Power Delivery in India

Transmission and distribution losses in India stood at about 21% in 1995-1996. This level of losses is considered to be very high, and efforts are being made to reduce losses. Electricity prices for households in India has been very low in the late 1990s as shown in Figure 2. On the other hand, electricity prices for commercial applications are very high, and only Japan has a higher electricity price among developing countries. In the late 1990s, the installed power generating capacity in India included 67,617.5 MW of thermal capacity, 22,438.5 MW of hydropower, 2,225 MW of nuclear, 968 MW of wind, and a total capacity of 93,249 MW. However, the demand for electricity exceeded the level of supply during the period between November 2001 and March 2002, leading to 39,187 GWh (7.5%) of energy shortage (compared to the available generation) and 10,293 MW (12.6%) of peak capacity shortage (compared to the available capacity). The peak demand and energy requirements forecasted for India are shown in Table 1.

Performance of the Power Sector in India

The power sector in India is beset with severe problems of non-payment by customers at all levels, increasing fiscal losses at REBs, large-scale thefts of power, over-staffing, under-investment in transmission and distribution, increasing power outages due to inadequate transmission, etc.

The poor performance of SEBs is vastly attributed to low tariffs set by state governments, poor revenue collections, and increasing costs. The extremely low levels of tariff set by state governments yield revenues well below the average cost of generation. According to the present Electricity (Supply) Act, state governments are to prescribe power tariffs that permit SEBs to generate a minimum return of 3% on their net fixed assets after meeting fixed and operating costs, interests, and tax liabilities. However, current tariff levels do not meet even 80% of the total cost of supplies.

The unsatisfactory financial health of SEBs has precluded adequate investments for improving the utilization of existing capacities and for establishing the additional generating capacity. Over the years, most SEBs have become unwieldy due to the increase in generating capacity, massive transmission and distribution network covering nooks and corners of states, and ever-increasing consumption. It is perceived that the management of such huge utilities involving technical, commercial, managerial, personnel, and industrial relations is becoming increasingly difficult. Private power projects are deemed to be too expensive for SEBs to afford, some SEBs have signed up on power projects that are far in excess of their capabilities, and a small portion of proposed initiatives will be implemented successfully.

As part of the power sector reform, generation was the natural starting point of introducing the private participation, under the 1991 policy by amending the electricity legislation. Initially, generators were allowed entry on the basis of the memorandum of understandings (MOU). In 1995, the policy was provided for the entry of generators on the basis of competitive bids. Competitive bidding procedures allow authorities to easily evaluate the proposals. The response to the government's energy policy has been encouraging. Since 1991, both domestic and foreign developers have evinced a keen interest in the Indian power sector. Altogether, 83 private power projects are presently being monitored by the central government, amounting to 37,148 MW of installed generation capacity.

Healthy reform developments are attributed, to some extent, to the establishment of the Central Electricity Regulatory Commission (CERC). The functions of CERC include

- Regulating the tariff of generating companies owned or controlled by the central government
- Regulating the interstate transmission of energy including the tariff of transmission utilities
- Promoting competition, efficiency, and economy among the power sector activities
- Advising the central government on the formulation of tariff policy.

The central government and a few state governments have appointed regulators, and some states have unbundled the sector into transmission, generation, and distribution through state enactments. However, a number of reform measures have not yet been attempted at the central or the state level. These measures include setting up a wholesale electricity market, the introduction of competition, and the determination of generation tariff in a competitive market environment. There is a need to make an easy entry of different players into the competitive market supervised by regulators.

Restructuring of the Indian Power Sector

Keeping in view the pros and cons of different restructuring processes in various countries, it is recognized easily that India is not yet ready for electricity restructuring. The first and major restructuring problem is the gap between demand and generation.

Thus, this study suggests the following steps towards the restructuring of the Indian power sector:

- Bridge the gap between power demand and electricity generation
- Decentralize the planning process for an easy entry of generators
- Increase the intrastate transmission lines
- Increase the tariffs incrementally
- Reduce the direct government control
- Establish an independent regulating authority
- Unbundle SEBs as generation, transmission, and distribution entities
- Privatize and commercialize the power entities
- Establish a competitive power market.

The restructuring process as a whole is a very complex process, and steps suggested here are overlapping and interrelated. The first four steps will prepare a background for restructuring, i.e., after implementing phase one, India will be ready for restructuring in a real sense. Steps five to seven are part of the second phase, and steps eight and nine constitute the third phase. Many of the steps suggested here are already underway in India either directly or indirectly as part of ongoing reforms. These steps are further discussed as follows.

Bridge the Gap Between Demand and Generation

To bridge this gap, the following measures could be taken.

Tariff Setting. The current pricing method used by most utilities in the Indian power sector is the traditional cost-plus method. The cost-plus method starts with the identification of costs, which include the fixed costs related to capacity, the variable costs related to fuel, and other customer related costs. Then these costs are allocated as equitably as possible among consumers through the tariff structure. Typically, electricity prices in India are less than the cost of electricity production and substantially less than the cost to build and operate a new power plant. The poor power factor leads to the increased transmission and distribution (T&D) losses, thereby raising the cost of power delivery. Any analysis of power tariffs should consider both the structure of tariffs and the costing methodology for ratemaking. On the consumption side, energy pricing is a very important tool for demand side management, especially in the long run. Incentives should be established for maintaining a high power factor and for conservation during peak hours and seasons. This study suggests the introduction of a time-of-the-day metering.

Develop an Integrated National Grid. The development of a national grid will lead to the better utilization of resources. The five existing REBs are not fully interconnected. The development and operation of the Indian power sector are at present limited to the regional level. The development of a national grid could avoid the generating capacity expansion by 2,784 MW with a total cost of \$4,912 million for installation, fuel, operation, and maintenance. Further study shows that generation system reliability will also increase tremendously, and the expected unserved energy will decrease from 5158 GWh in REBs to 26 GWh in the case of the national grid.

Decentralize the Planning Process for an Easy Entry of Generators

At present in India, it takes a long time for new private power projects to be approved and initiated. Previously, the independent power project (IPP) approval was through MOU, on behalf of the Government of India. Now as part of the reform process, the government has also started competitive bidding routes. The competitive bidding process involves the request for qualification (RFQ) and the request for proposal (RFP) stages. The competitive process takes much time currently and needs to be decentralized. Our study suggests the establishment of new functionary, i.e., the Regional Bureau of Investment Promotion in Power (RBIPP), which will be responsible for the approval of IPPs. RBIPP will be working as a government organization with autonomy and will merely report its activity to SERC. RBIPP will work with SERC to approve IPPs. IPPs will be encouraged to contact RBIPP of the region where they are willing to set up the project.

Increase the Interstate and Intrastate Transmission Lines

Any reform to increase the generating capacity in India could be futile so long as there is an insufficient transmission capacity for transferring the added generated power to demand sites. Before embarking on the open electricity market, a sufficient transmission line capacity should be made available to avoid congestion. Thus, private investment for adding transmission capacity should be encouraged in India. The proposed RBIPP can work out a plan for adding transmission lines and then request bids for implementing the plan. The participation of the private sector in transmission system will be conceivably limited to the construction and the maintenance of transmission lines under the supervision of the Power Grid Corporation of India Limited (PGCIL) and RBIPP. Transmission charges payable to private owners will be directly proportional to the availability of transmission lines. Furthermore, special attention should be paid to the northeastern region of India where large potentials for hydropower exist for the foreseeable future.

Increase Tariffs Incrementally

At present, the household electricity price in India is minute due to government subsidies. It is expected that restructuring would lead to higher electricity prices. It is critically important for the people of India to recognize that subsidies have resulted in a substantial loss to SEBs and to the economy as a whole, and SEBs' financial conditions should be improved by a hike in household electricity prices. To have the support of the general masses for restructuring, the reform process should lead to lower prices for electricity. Thus, our study suggests that the government of India should increase the electricity prices in six-month steps (perhaps to a greater extent in urban areas and a lesser extent in rural areas) to the level that, when electricity markets are in operation, would lead to comparatively lower market prices for electricity.

Reduce Direct Government Control

Current planning strategies in India are centralized and political. The political timeframe causes a mismatch between planning and the responsibility for its implementation, limits long-term thinking, and neglects the distribution system planning. Most of the already implemented restructuring models around the world limit the government's involvement in the regulation and the co-

ordination processes. Thus, the government role should be reduced in the restructuring of the Indian power sector, and most of the government functions like tariff setting, granting licenses, and taking care of the interests of consumers and investors should be delegated to independent regulators. This also involves limiting the government's role in the planning and implementation of new resources, which currently involve many government functionaries in India.

Establish an Independent Regulating Authority

An independent regulator is already in place in India at the central level. There is also a need for establishing an independent regulating authority for the power sector at the state level. CERC, which was established in 1998 by the Electricity Regulation Commission Act, is charged with the responsibility of increasing the competition and efficiency in India. Electricity regulations that are issued by CERC can provide different reform measures for adding the competition and efficiency by allowing easy and transparent entries of participants in the interstate power market and grid under clearly defined principles and rules. A few states like Orissa, Haryana, and Andhra Pradesh have established SERCs already. Other states should start the process of setting up SERCs urgently.

Unbundle SEBs as Generation, Transmission, and Distribution Entities

The activities of an SEB should be broken into separate divisions, which would operate on commercial principles or as separate profit centers. This step is relatively easy to accomplish, as it does not require any legislative actions or staff reallocations. The SEB's activities can be divided into separate divisions based on their functional roles, i.e., generation, transmission, and distribution. It is possible to further subdivide the divisions. The generation business can be divided based on the nature of the generating plants, i.e., thermal, hydro, nuclear, nonconventional, etc. The distribution business can be divided on geographical lines into zones of manageable size. The divisions must operate as separate profit centers with a full financial autonomy and functional independence. Many states in India are in the process of unbundling; however, this process must be implemented more unilaterally.

Privatize and Commercialize the Power Entities

It is well recognized that reforms cannot be meaningful unless the competition and the privatization are initiated. The central government must, therefore, break up its generating PSUs into smaller companies and introduce measures to enable the competition amongst these companies. Generation companies will be responsible to participate in an open market for trading power, which will be created by the unbundling of SEBs.

Establish a Competitive Market

The central government has to take initiatives to set up the wholesale power market, create an electricity pool and enforce market-like competitive pressure. The power markets operating in different parts of the world include: monopoly model, single buyer model, bilateral contract, poolco model, and hybrid model.

In a single buyer model, a single entity purchases the power from all generators on a competitive basis. This is the simplest model, but buyers do not have any incentive to seek out the most economical source of supply.

The bilateral contract model allows generators to have direct contracts with distributors and large consumers without an intermediary. This model requires an open access to transmission lines, which leads to a complex transmission system development, concerns for access costs, and critical regulatory control on transmission access.

The poolco model envisages different generators to sell power to a pool and distributors or large consumers to buy from the pool. This model also requires open access on transmission lines.

The hybrid model is a combination of power pool and bilateral contract model.

The choice of an appropriate market structure for India has to be necessarily related to the present operating environment and the extent of competition that is feasible/desirable for India. Our study suggests applying the single buyer model at the state level, which consists of one agency to buy all the necessary power. This agency will be the upshot of the unbundling of REBs. The single buyer model will ensure better coordination in transmission system planning and a uniform tariff throughout the state. By applying this model, REBs will be able to either follow contractual commitments made with various generating companies or renegotiate the existing agreements.

In the future, the single buyer model can gradually evolve into a power pool model, with a provision for a hybrid model in which bulk consumers will be allowed to acquire power directly from generators.

Conclusions

Our study presents a detailed analysis of the current power sector in India. The study discusses lessons to be learned from the restructuring process in other countries. The study suggests a restructuring process for the Indian power sector in three phases. The three phases of the suggested restructuring process involve a nine-step action plan that serves as guidelines for the ongoing reform process in India. The suggestions for restructuring are summarized as follows.

- In the first phase, the Indian government should establish an appropriate background needed for restructuring, which involves bridging the gap between power demand and generation, decentralizing the planning process, increasing the number of transmission lines, and increasing the tariffs in steps.
- In the second phase, the direct government control should be reduced, SEBs should be unbundled, and an independent regulator should be established.
- In the third phase, the privatization and commercialization of newly formed entities should be considered, and a free electricity market should be established.

The suggested steps for restructuring are to be implemented in a time-bound manner. Learning from the experience in Australia, the central reform can encourage states to follow suit. These reforms can be initiated within the present laws by CERC and central government actions. The government and CERC must set a time-bound schedule for the central reform planning and implementation. It is expected that the reform patterns already initiated in Orissa, Haryana, Andhra Pradesh, and others can provide answers to complicated policy issues. However, once a successful model is implemented in a single state, the other states in India are bound to follow suit to make the reform process a success story.

The development of an integrated national grid, tariff setting, DSM options, energy conservation, and T&D loss reduction are

suggested as possible strategies to overcome the problem of power deficit. The single buyer model consisting of one agency to buy/sell all the necessary power is found to be the most suitable model for the present Indian power sector, which could gradually evolve into a hybrid model in the future.

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2003 PES FACTS Award and 2003 PES Custom Power Award

Call for Nominations

Deadline: 31 January 2003

The IEEE Power Engineering Society (PES) calls for nomination of outstanding individuals to receive the 2003 PES FACTS Award and the 2003 PES Custom Power Award. The intention is to give two awards per year, one for FACTS and other for Custom Power.

Description: Power electronics and other static controllers are making a major impact on future power systems through application in transmission, distribution, and small generation. Applications in transmission and distribution include HVDC, FACTS, and Custom Power. Since the introduction of the flexible ac transmission system (FACTS) and custom power concepts, the technology has been moving ahead at an increasing pace. Very significant near- to long-term benefits of FACTS and custom power technologies are now recognized in the industry.

The FACTS and Custom Power Awards will be for individuals who have made a major contribution to the state of the art of FACTS and Custom Power technologies and their applications. The FACTS or Custom Power Award consists of a plaque and an honorarium of \$1,000.

Administration: PES will administer these awards through its Awards and Recognition Committee and the FACTS and Custom Power Awards Committee.

Eligibility: Individuals who have made a major contribution to the state of the art of FACTS or custom power technologies and their applications, will be considered. A nomination must be for one or the other award, FACTS or Custom Power, depending on where the nominee accomplished most. It is recognized that there is overlap in various power electronics technologies, and pioneering engineers are apt to be involved in more than one area. Therefore, the nomination for one or the other should also state accomplishments in the other areas of power electronics. The committee may decide not to give either award if no qualified candidate is nominated.

Selection: Factors to be considered in selecting the FACTS and Custom Power Awards include: candidate's contribution to FACTS or Custom Power technology, originality or innovative nature of the contribution, impact of the contribution on FACTS or custom power technology and its applications, significant publications in FACTS or custom power, stature in FACTS or custom power, achievements in other fields or power electronics technologies, and professional activities or involvements.

Nomination Procedure: A nomination (1 hard copy duly signed and e-mail) written in English, along with at least four supporting recommendations must be received as a package by the chair of the FACTS and Custom Power Awards Committee on or before 31 January 2003. These nominations will be considered for the award planned to be made during the PES General Meeting. The above listed selection factors should be carefully considered during preparation of nominations and recommendations. They must be complete and provide sufficient information to establish the candidate's contributions and role in FACTS or custom power technologies. Nominators are encouraged to format the nomination package in sections addressing each of the factors bulleted above. Each supporting letter of recommendation should not exceed two pages.

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