

Energy Sector Reform in India– A Study of Socio-Economic and Environmental Sustainability

PARIMAL PAL* & MOUSUMI ROY**

Despite initial hesitation and resistance, worldwide changes in economic and financial imperatives and enactment of Electricity Act, 2003, have led to gradual acceptance by almost all the states of India the need for reform in power sector to face challenges of achieving financial viability and to attract FDI or private capital for modernization and capacity expansion. In the states, which are pioneer in reform, results so far have been mixed. Therefore, an immediate evaluation of the reform process is essential for taking corrective measures towards successful conclusion of the reform as this power sector being vital to the economic growth of the country can no longer be allowed to maintain its status quo. This paper focuses on the

INTRODUCTION

India the largest democracy of the world with a growing population of over one billion is targeting an ambitious economic growth at the rate of 10 per cent over the next two decades. This economic growth coupled with the growing population needs a massive increase in supply of energy– the basic input to the socio-economic development. To bridge the gap between demand and supply (which is conservatively estimated at 11% to 18% during the peak hours at the end of 2005) and to ensure supply of this crucial input to development in a cost-effective, efficient and yet sustainable way India started its power sector reform in 1991 with the amendment of Electricity (Supply) Act. Initially such reform process faced resistance. However, when power sector was repeatedly being pointed out as a major constraint to economic development, when the sector continued to be a huge drain on state budget and when the Electricity Act 2003 forced the inevitability of total reforms in the electricity sector almost all the states accepted the need for reform at least in principle amidst the worldwide changes in economic and financial imperatives. But the model of reform that stresses on mandatory unbundling or dismantling of the SEBs is still being opposed in many states

* Prof. Chemical Engineering Department, National Institute of Technology, Durgapur-9, W.B. parimalpal200@yahoo.com

** Reader Economics, Khandra College, B.U., W.B.

power sector reform in India and investigates socio-economic and environmental sustainability of such reform in the light of experience in some selected states. It is observed that reform in this sector is passing through difficulties and amidst controversies particularly, in respect of the model of reform. In the reform process, environmental soundness seems to have taken back seat and down slide in rate of return on public sector assets continues raising doubt as to the correctness of the World Bank prescribed model of reform. Eco-friendly technology development needs to be integrated with the ongoing reform process and a perfect mix of renewable and nonrenewable energy resources utilization is essential. In view of the threat to India's energy security from the volatile petroleum market, a paradigm shift is required in the energy use pattern particularly, in the transport sector. Given the demography, social sustainability of power sector reform can be ensured by rationalization of power tariff through selection of an appropriate methodology and by provision of an explicit scheme for rural electrification.

as out of eight SEBs that have gone for unbundling, five SEBs still continue to be plagued with high level of technical and commercial losses.

This paper attempts to investigate under which macro-economic conditions such power sector reform was initiated in India, how and to what extent such reforms have been implemented so far and to what extent they have been successful particularly in the light of socio-economic and environmental sustainability.

THE BACK GROUND-ENERGY SECTOR IN INDIA PRIOR TO REFORM

In pre-independence India, Indian Electricity Act, 1910 provided for private participation in the energy sector. But up to the independence period, India's vast rural population had hardly any access to electricity. In post-independence India, the Electricity (Supply) Act, 1948 (with subsequent amendments) and Industrial Policy Resolution, 1956 paved the way for development of the current vertically integrated state-owned public sector electrical utilities - the State Electricity Boards (SEBs). For efficient techno-economic system planning, a central Electricity Authority was set up. The state-owned electricity industry made significant efforts to bring energy services to its vast population and the compounded annual growth rate in per capita electricity consumption reached 6.04% (2002). Through formation of Rural Electrification Corporation, all attempts were made to enhance access of the rural poor to electricity. Government efforts were also directed towards development of renewable energy technologies like biogas, solar energy, wind energy etc. Often high subsidies were provided for development of the renewable and clean energy technologies. To meet energy needs of the poor sections of the population, subsidies and cross subsidies were provided by the Government. Subsidies were also provided to certain categories of domestic consumers, agricultural consumers etc. Subsidies were resulting in

heavy pressures on the state treasuries. Cross subsidies often resulted in high tariffs for the industrial consumers. Power sector started incurring heavy losses on account of payment defaults for long times. Many industries were forced to close down. State government treasuries could no longer provide for such subsidies. Government support, political interference, absence of competition, inefficiency, rampant corruption, over-manning, lack of fund for modernization and capacity expansion virtually plagued most of the SEBs. SEBs could hardly take up the challenge to meet the ever-growing demand of quality electricity. Such poor fiscal health of the state-owned power industry compelled the Government of India to look for private participation in this energy sector. But very limited response for private participation was forthcoming in the absence of proper legislation and structural reform of the power sector. Government of India then started enacting appropriate laws for comprehensive reform of the power sector in the mid 90s.

METHODOLOGY ADOPTED AND EXTENT OF REFORM IN INDIAN STATES SINCE 1991

Reform in India is based on World Bank ideology in which ill health of the public sector power industry is attributed to excessive size, over-manning, excessive centralization, government monopoly, absence of competition, political interference, inefficiency and subsidies. Naturally, methodology adopted in reforming the power industry consisted of removal of government control, removal of subsidies, privatisation and unbundling generation, transmission and distribution of electricity. In India, energy sector is in the concurrent list of the state governments and the central government hence both can enact legislation. Government of India initiated the reform process through amendment of the Electricity (Supply) Act in 1991. Reform at the state level has either been carried out or are being carried out through organizational restructuring aimed at unbundling generation, transmission and distribution, their commercialization and management through small, manageable entities. Organizational reforms at the national and regional level is being carried out by freeing the central sector agencies from tight government control, by reducing government's equity enabling private participation on joint-venture basis. A central electricity regulatory commission was set up 1998 to rationalize power tariff. Subsequently state level Electricity Reform Acts were passed. Orissa, one of the poorest states in India was the first state to start reform in 1995. Orissa set up an independent regulatory commission, unbundled generation, transmission and distribution. Distribution was privatized in 1998-99 when the state was divided into four zones for the purpose. Gradually other states followed Orissa State level Electricity Reform Act was then gradually passed by the states of Haryana, Andhra Pradesh, Uttar Pradesh, Karnataka, Rajasthan, Madhya Pradesh, Delhi and Gujarat. The State Electricity Reform Act basically provide for unbundling and

corporatisation of SEBs and setting up of State Electricity Regulation Commission (SERC). The SEBs of Orissa, Haryana, Andhra Pradesh, Karnataka, Uttar Pradesh, Uttaranchal, Rajasthan, Delhi and Madhya Pradesh have been unbundled and corporatised. Twenty two states out of 29 states of India accepted power sector reform policy of the central Government and have set up State Electricity Regulation Commission.

Tariff orders have been issued in as many as eighteen states.. Most of the states have constituted State Electricity Regulation Commission, signed MOU with Government of India, passed anti-theft law and are in the process of unbundling vertically integrated SEBs. Power distribution has been privatized in Orissa, Andhra Pradesh, Delhi and Haryana. Though power sector reform has been going on for almost a decade in two states namely, Orissa and Andhra Pradesh, in most of the states of India such reform is still in its nascent stage.

To make the reform comprehensive, Government of India enacted Electricity Act 2003. The aim was to introduce competition, to increase total power generation to cater to the growing demand of the economy, to protect consumers' interest and to ensure power for all. This act provides for license free generation, transmission and distribution of electricity, mandatory setting up of State Electricity Regulation Commission (SERC) and rural electrification. As commercial losses continued to plague the power industry, stringent provisions were made in this Act to curb power theft and for compulsory metering of all power supply. This comprehensive legislation replacing Electricity Act 1910, Electricity (Supply) Act 1948 and Electricity Regulatory Commission Act 1998 aims to push the power sector onto a trajectory of sound commercial growth where the states and the central government will move in harmony and coordination. As the World Bank prescribed reform model did not attach much importance to rural electrification and amidst the ongoing reform the tempo for rural electrification was being lost, criticisms against the negligence of rural electrification were being raised from different quarters. To address this issue of rural electrification after the enactment of the Act 2003, the National policies on standalone system for rural areas, rural electrification and local distribution in rural areas have been formulated.

EVALUATION OF THE DECADE LONG REFORM PROCESS IN TERMS OF SOCIAL, ECONOMIC AND ENVIRONMENTAL SUSTAINABILITY

The power sector reform initiated with the onset of economic liberalization in the beginning of the 90s has so far passed through difficulties and amidst controversies. There were serious objections against such reform in India as it was apprehended that privatization or market-driven reform would lead to the total neglect of the poor; it

would lead to large-scale retrenchment of the employees engaged in the sector ; it would lead to escalation of the tariff of electricity which eventually would deny access to electricity by the poor people. Success of this reform depends mainly on its social, economic and environmental sustainability.

Social Sustainability

In general, experience of the Asian power sector reform shows that such reform results in loss of jobs (South Korea) [2], hike in power price (Orissa, India)) and hinders rural electrification and instead of widening access reduces accessibility to electricity by the poor (Orissa). All these obviously go against the social sustainability of power sector reform in a country like India where out of 1033 million strong population, 26.1% are below poverty line [1], and 50 million people are educated registered unemployed. 70% of the people live in the villages (Table 1.).

Table 1

Total Population India, 2001 (millions)	1033
Population growth rate (%)	1.70
% population below poverty line	26.10
Rural population (% of total population)	72
Urban population (% of total population)	28
% of population with access to electricity	46
Rural access	33
Per capita consumption of electricity, (kWh /year), India, 2001	379
World Avg. per capita consumption (kWh/year)	2252

Source: Census Report 2001.

It was argued that power sector reform in India would lead to quantum jump in the productivity and efficiency of the sector, ensures ample power at competitive rates and would have multiple effects on the economy of the states. Expectation was that with the turn around of the ailing power sector, the states would be in a position to utilize its resources in poverty alleviation, socio-economic upliftment of the poor and investments in education, health and social welfare program. But nothing of the sort has happened so far.

Social sustainability of the reform in energy sector may be measured in terms of widening of access to electricity by the people, extent of electrification, levels of electrification, and consumption of electricity and direct or indirect benefit that trickle down the masses. In 2002, compounded annual growth rate in the per capita electricity consumption in India was 6.04% [3]. However, per capita consumption of only 379 kWh per annum (as on 2001) was far below the world average of 2252 kWh. Only 46% of the total population [1] had access to electricity where the access to electricity by the

rural population was limited to only 33%. In the pre reform era, rural electrification received serious attention from the government. Rural Electrification Corporation provided all financial assistance to the SEBs in such electrification.. Under this scheme, out of 5.9, 000 villages, 305 000 villages were electrified. Government of India launched the KJ (Kutir Jyoti) program in 1988 for providing single point connections to the BPL (Below Poverty Line) families with one time 100% subsidy on installation charges. Up to 2002, 4.85 million people were benefited under the scheme. It is true that subsidies and cross subsidies had helped a vast cross section of the common people to get power at a cheap rate. But to get power at a cheap rate they had to accept very poor quality of power which used to be frequently interrupted. Prolonged power cuts, overloading of transformer, frequent failure of transformer and inordinate delay in replacement of a damaged transformer were almost routine affairs in rural electrification. Hundreds of villages still could not be electrified due to inability of the sick SEBs to expand capacity.

Out of the 29 states of India, power sector reform has been most extensive in the state of Orissa which first started reforming its power sector in the early 90s. In Orissa with the highest BPL population of 47.15%, electrification levels for the poor has decreased from 3.67% in 1999-2000 to 3.31% in 2000-2001 though the electrification level has witnessed an increase of 9% over the same period for the no-poor category. Electrification rates for the poor has also gone down drastically in the post reform era in Orissa though the same has increased from 7.7% in 1998-99 to 9% in 2000-2001 [4].

In other states of India, like Himachal Pradesh, overall electrification levels and electrification rates have witnessed down fall (from 6.8% CAGR in pre-reform era to 3.8% in post reform era). However, electrification levels for non-poor has increased in the post reform era. Consumption level by the poor has only marginally increased (0.88%) against 1.77% for the non-poor (over the reform period of 2000–2003).

In the state of Karnataka, which passed Electricity Reform Act in 1999, both levels as well as the rates of electrification for the poor section of the population has witnessed decline. Compounded annual electrification growth rate (CAGR) of 6.4% for the poor achieved up to pre-reform era came down to 3% in the post reform era (2002-2003). Electrification rate and consumption level have also witnessed decline over this period. Shifting of electrification from the rural area to lucrative area is the reason behind such drop. Subsidy burden of the Karnataka state government has increased by eight fold (US\$ 78.28 million in 97-98 to US \$ 652.26 million in 2002-2003). After initiation of reform at the beginning of the 90s, the state of Andhra Pradesh has witnessed a massive increase in power generation and the overall electrification level has reached 100%. Only in this state power sector reforms till date have no negative impact on the rural electrification level. Rural electrification level is also very high (>99%) in this state [5].

This may be traced to huge subsidy provided by the state government to its consumer's bulk of which is rural population. Per capita consumption of electricity in Andhra Pradesh has reached 391 units per annum against all India per capita consumption level of 355 units. In this state, agricultural sector is the major consumer indicating widening of accessibility to electricity by the poor rural people. The level of electrification reached in Andhra Pradesh may not be sustainable in the long run in the event of phasing out of heavy subsidy and cross subsidy.

The Electricity Reform Acts of the government of India, lack explicit commitment to expand electricity access to the rural areas and to supply power to the poor at life line rate as has been provided in the Reform Acts of the Philippines [6]. So extension of electricity services to the rural mass is largely depending on the policies of the state governments. Some of the states are providing heavy subsidy which is ensuring extension of the electricity services to all sections of the society as is reflected in the electrification levels of the states of Andhra Pradesh and Karnataka. Cross subsidies are still there in all states and this is giving relief to the poor, marginal and certain other categories. In some of the states like Orissa being one of the poorest states in India, the local government is not in a position to provide for heavy subsidies for the poor. The Orissa government has privatized the distribution of electricity and has accepted an annual tariff hike 15% for straight 9 years. This has possibly affected level of rural electrification and per capita consumption of electricity by the poor category.

Market reform is expected to result in cheaper power because of efficiency as a result of competition. Within the period of reform, however, such a trend is still not noticeable. The reason may be absence of adequate number of competitors in the field and continued high level of techno-commercial loss of the power sector. Often such losses are due to theft and unmetered supply to agricultural sector. It has particularly been observed in Orissa where total techno-commercial loss has reached almost 50% level. This has resulted [8] in steep upward trend [8] in power tariff and despite such hike in tariff, reform could bring about no turn around in the sector. In no other state, reform has been so extensive. Since in all states of India, reform is still being strongly buttressed with subsidy or cross subsidy, its social sustainability could not yet be tested in the true sense. However, in the light of experiences in other Asian Countries, and at least in one state of India (only where it has been extensive), it may be concluded that power sector reform in India is certainly going to turn into a contentious affair so far social sustainability is concerned. Given the socio-economic conditions of a vast cross section of the population, it seems that cross subsidy will have to continue for long (Prime Minister of India, Power Secretaries Conference, Shimla, May 29, 2005) so that certain

sections of society, for whom power is a necessity and cannot afford it, can continue to get power at affordable rates.

Economic Sustainability

Power sector reform in India was taken up in the 90s, largely out of economic compulsion rather than conviction. Rapidly deteriorating financial health of the power sector on one hand and the need for FDI or private capital for capacity expansion on the other hand to bridge the growing supply-demand gap of energy served as the driving force of the reform process.

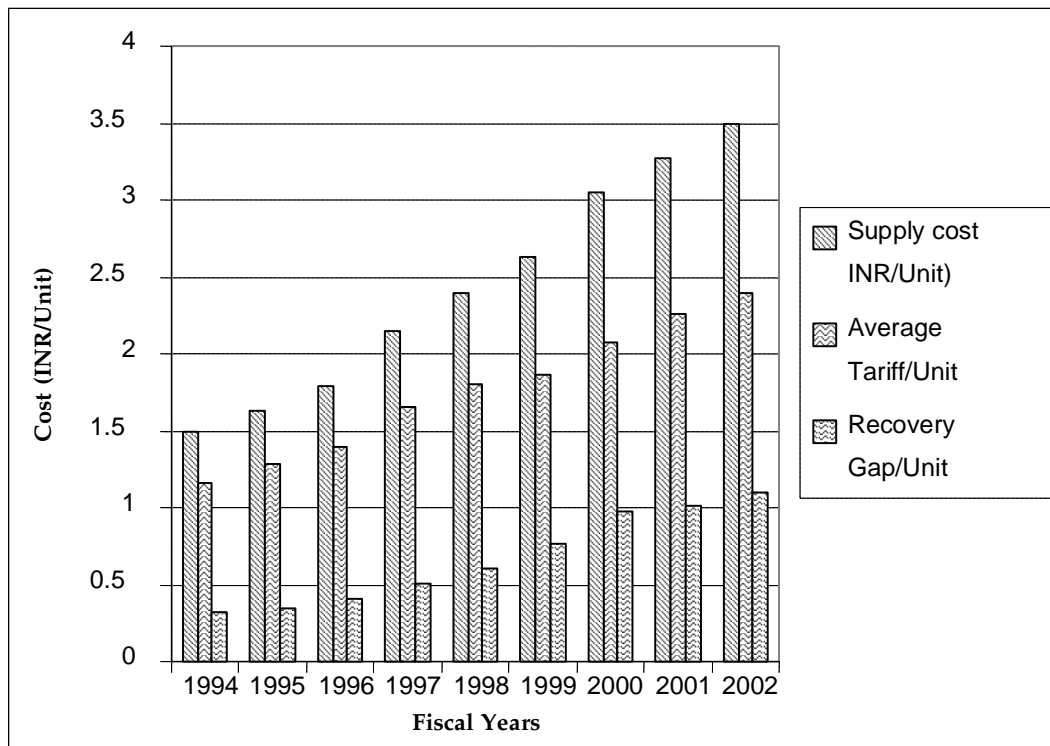
Very low level of efficiency, high transmission and distribution loss and poor cost recovery are in general diagnosed as the major causes of poor financial health of Indian power sector.

Improvement in efficiency of operation is of paramount importance for the financial viability of the Indian power sector which is plagued by inefficiency resulting from the decades-old tight government control in total absence of competition in a monopoly regime. The very low level of operational efficiency gets reflected in the abysmal financial performance of the sector.

Since the SEBs account for almost 80% of commercial electricity sales in the country, the financial performance of the entire sector, including that of the central sector agencies, is heavily dependent on the performance of the SEBs. Under the Electricity (Supply) Act of 1948, amended in 1984, the financial performance of the SEBs used to be measured in terms of rate of return (ROR) on the net fixed assets with a mandated minimum ROR of 3%. However, none of the SEBs could achieve this ROR without government subsidy. The state of Karnataka achieved this 3% ROR with government subsidy only. The major reasons for such dismal performance are increasing gap between the cost of supply and the average tariff as shown in Fig.1. Since the mid Nineties, supply cost of energy has increased steadily and the total rise is by a whopping 230% over the period 1994 to 2002. It is observed that hike in average tariff has been fairly regular so as to cover inflation. But the gap between supply cost and average tariff shows a continuously increasing trend even in the post reform India. This is due to ever-increasing operational costs that include transmission and distribution loss and other commercial losses. Such increasing gap between supply cost and average tariff results in diminishing rate of return (ROR) as is exhibited in Fig. 2. Fig. 2. shows that ROR declined by a massive 400% between 1994 and 2002. What is most worrying is that even in the post reform era, the rapidly declining trend in ROR could not be arrested. Deterioration in the financial health of the power sector, despite implementation of

many of the World Bank prescriptions, raises doubt as to the correctness of the World Bank diagnosis of the ill health of Indian power sector. A major cause of the poor financial condition of the power sector is the ever-increasing transmission and distribution loss (T & D) as is exhibited in Fig. 3. The poor financial performance of the SEBs and the resulting shortage of liquidity has also adversely affected their operational efficiency and led to further transmission and distribution losses (T & D). With the limited finance available, the tendency of the SEBs had been to invest a larger proportion in generation to address the ever increasing demand-supply gap and less in transmission and distribution. This resulted in inadequate distribution facilities leading to overloading, inadequate maintenance, repeated transformer failure, high transmission and distribution loss and poor supply reliability which in turn led to insufficient revenue and a vicious circle. Though sustained modernization and heavy investment in this sector in the 90s, has resulted in substantial improvement in the plant load factor from

Fig. 1: Cost Recovery Trend in Electrical Energy supply in Reform era India



Source: Planning Commission of India, Annual Report 2002, on Working of State Electricity Boards & Electricity Departments.

Fig. 2: A Declining trend in % Rate of Return (ROR) on fixed public sector assets in Electrical Energy Sector in India

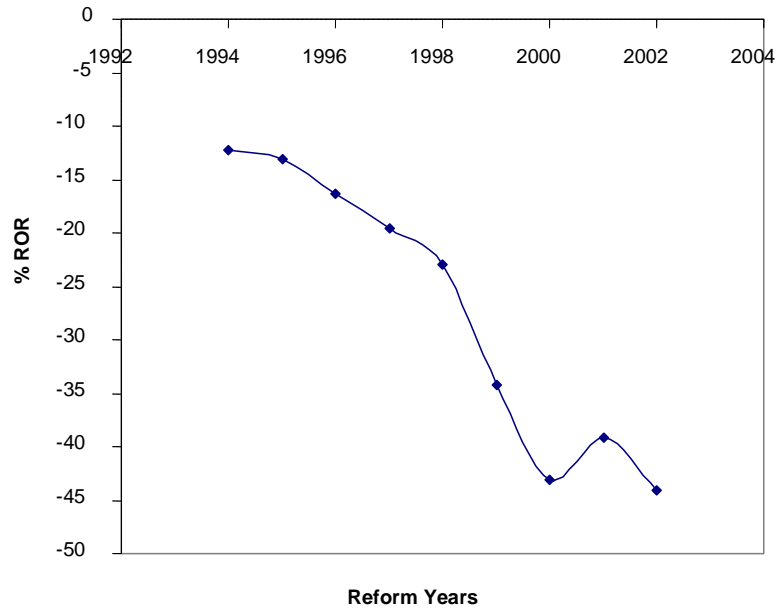
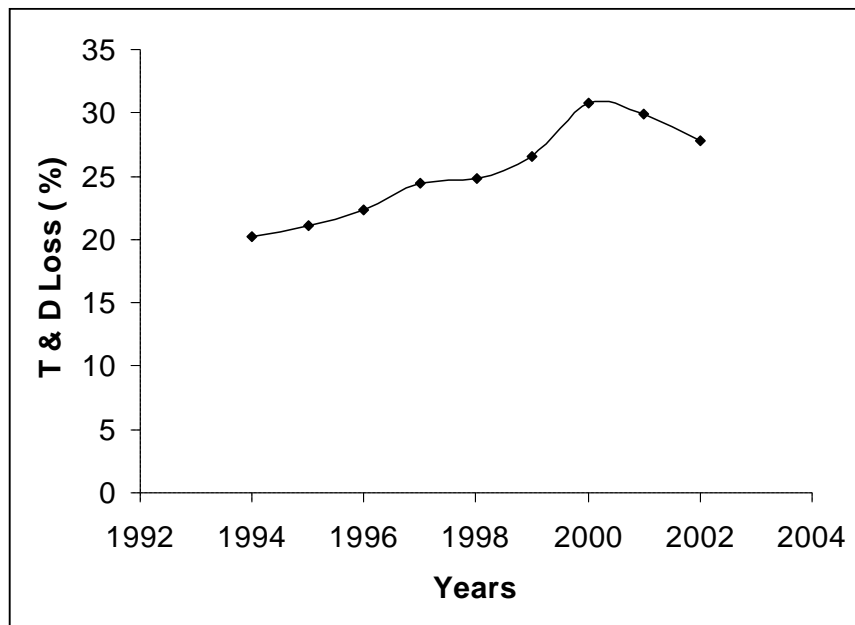


Fig. 3: Transmission & Distribution Loss (T & D loss in %) over the years



Source: Annual Report, Planning Commission of India, 2002.

55.3% in 1992 to 64.7% in 1998 and a massive capacity expansion, the transmission and distribution losses suffered by the SEBs remain crippling. Where 1% T & D loss corresponds to 4000 million units of power, such losses in the states of Haryana, Punjab, Uttar Pradesh, Karnataka and Gujrat stand at an alarming 40% level and at 30% level in most of the other states of India. The most disturbing fact is that even in the post reform era, the average T & D loss have increased from 24.5% in 1997 to 27.8% in 2002 against the international standard of 8% and the average Asian standard of 11%. Such losses are largely attributable to pilferage of energy through unauthorized connections, tampering of meters and technical losses originating from overloaded distribution networks. The heavy commercial losses have resulted in a gap of Rs. 1.10 per unit of power between supply cost and recovery cost in 2002. The recovery rate as a result stands at only 68.6% [9]. Electricity Act, 2003 addresses this issue of under recovery of cost adequately. For curbing theft and pilferage, this Act (2003) provides for strong penalties. Most of the states in India have now enacted legislation to prevent power theft. Electricity Act 2003 provides for compulsory metering of all power supply.

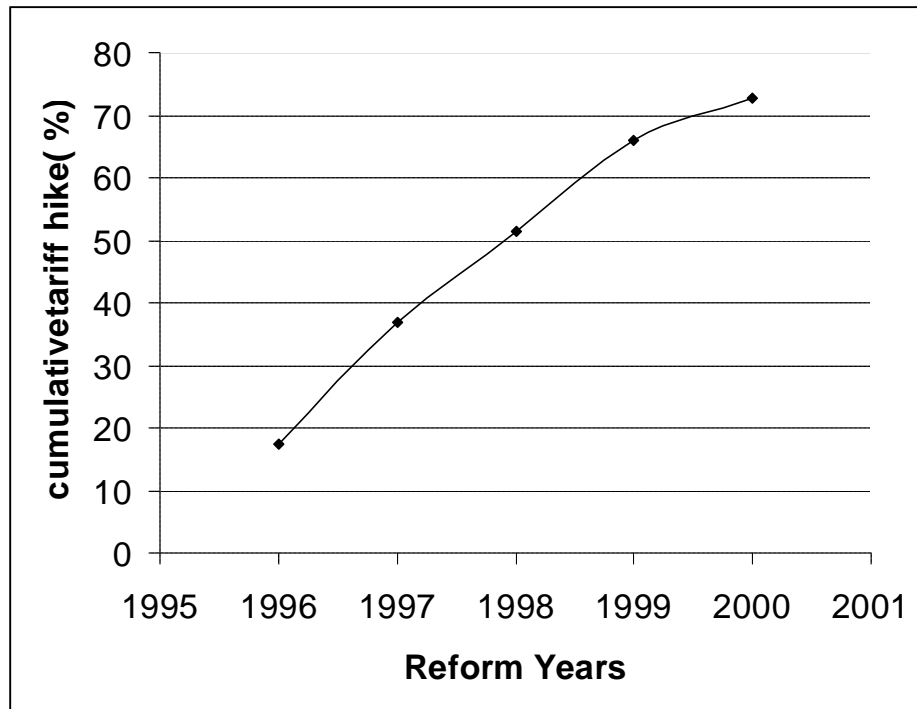
In matters of economic sustainability of the Indian Power sector the most serious issues are unbundling, privatization, efficiency, tariff and subsidy.

Efficiency Enhancement through Unbundling and Privatization

To induce efficiency in the ailing power sector, vertically integrated SEBs are being unbundled and separate entities for generation, transmission and distribution have either been formed or are in the process of formation following World Bank guidelines. Distribution is being privatized gradually. In a few states like Orissa, such privatization of distribution has been extensive. Tariff is on an upward trend as shown in Fig. 4. It is observed that compared to 1995 (base year) cumulative retail power tariff hike has been quite steep. Despite such steep hike in tariff, distribution companies in Orissa have accumulated unsustainable losses. The distribution companies have turned payment defaulters to the state-owned transmission company, GRIDCO. GRIDCO in turn failed in its payment obligation to the generating companies.

Difficulties faced in the power sector reform in Orissa are traced to the absence of truly independent regulatory body, highly inaccurate assessment of transmission and distribution losses, un-metered supply to the agricultural sector, failure on the part of the government to provide transition phase financial, administrative and moral support, improper evaluation of assets prior to privatization leading to increase in bulk supply tariff, failure of the government to plough back privatization proceeds to the power sector and total negligence of the human resource aspects (employees left totally demoralized). The reform difficulties in Orissa give a good lesson for other states. 100

Fig. 4: Cumulative power Tariff hike (with 1995 as base Year) in Orissa



Source: OERC, 2001.

per cent metering, rationalization of tariff, transition phase government support, accountability and transparency of all transactions between generation, transmission and distribution companies are crucial to the economic viability of the power sector.

After unbundling, it is the step of privatization through which efficiency is expected to rise as per World Bank prescription. Though by encouragement through incentive schemes, by fixing responsibilities and accountability of the employees and by imparting proper human development training and updating the skills of the employees, overall efficiency of the power sector can be enhanced to some extent, abysmal performance of Indian power sector and its rapidly deteriorating health demands immediate overhaul in the entire structure to seriously address the issue of very low level of efficiency prevailing in the power sector. That unbundling and privatization does not always guarantee economic sustainability of the power sector is evident from the exit of multinational AES corporation from the power sector of Orissa and failure of Enron in Maharashtra. Internal restructuring, stringent provision for transparency and

accountability at all levels are must for financial turn around of the power sector. However, with proper approach, independent power producers (IPP) may be successful also as is evident in cases of Calcutta Electricity Supply Company in West Bengal and BSES in Maharashtra.

To attract huge private capital for massive capacity expansion of the power sector, the latest Electricity Act, 2003, has strongly encouraged privatization and has allowed license-free generation and distribution. This has, however, resulted in strong reaction from the existing power sector employees unions apprehending that Electricity Act, 2003 will allow private entities to distribute power in the lucrative market of the cities and towns leaving only rural areas to the SEBs who will only incur loss and turn sick.. National policy document on rural electrification attempts to address this issue.

Tariff Rationalization

Distortion in tariff structure is cited as the major cause for poor cost recovery in the electricity sector in India. Therefore, power sector reform in India has been basically driven by tariff philosophy [11]. Electricity Regulation Act, 1998, stipulates phasing out of cross subsidies for rationalization of tariff. In the Electricity Act, 2003, elimination of cross subsidy has been strongly advocated and has been made mandatory for all states for harmonious development of power sector all over the country. Tariff rationalization is a very delicate issue in India. An appropriate methodology needs to be selected in rationalization of tariff. Cost of service methodology (COS) has proved highly successful in case of two big private power companies, namely, BSES in the state of Maharashtra and CESC in West Bengal as mentioned in Section 4.2.1. In this methodology, cost, sales, revenue and investment data are examined by independent regulator for comparison and determination of tariff. No inefficient costs are allowed to pass through to the consumers. But it ensures a certain return on the investment made by the utility. Though it is to some extent away from the free market concept, it seems to be best suited option for a country like India. This methodology has been specified in the Electricity Regulatory Commission Act, 1998 as the guide for tariff determination. Under this Act, all the states have enacted state level legislations and have set up regulatory commissions for tariff regulation. But functioning of the regulator bodies remains highly questionable because of selection of the regulatory commission members based on their political affiliation and because of dependence of the commission on the state governments for their financial and human resources [12]. Regulator bodies, for their truly independent and democratic functioning, should consist of representatives of all categories of consumers, stake holders, veteran experts and the government.

Subsidies and Cross-Subsidies

In tariff regulation, subsidies and cross-subsidies play very significant role. In orissa, the state government withdrew subsidy even during the transition phase resulting in hardships for the consumers. Again continuance of such subsidies in the long run affects the target groups in terms of poor, inefficient, inadequate and highly interrupted power supply. There must be rationalization of tariff without which both the suppliers and the consumers will suffer. In the state of Andhra Pradesh, subsidy has been provided to the highest extent benefiting the rural and agricultural consumers. Level of electrification, rural electrification has substantially increased. Overall performance of the power sector has improved following some of the prescriptions of the reform process. But the reform is not founded in true efficiency as it is still heavily buttressed with subsidy and cross subsidy. Thus across the country there are wide variations in the economic performances of the power sector. However, the latest central legislation, the Electricity Act, 2003 makes it mandatory for all states to phase out cross subsidy. This is likely to free Indian power sector from tariff distortions in near future. However, neither any time frame, nor any path has been clearly defined for progressive reflection of supply cost in the tariff. Even the Electricity Act, 2003 that mandates a national Electricity Policy does not define a specific path though elimination of cross subsidy has been strongly advocated. The Electricity Acts in the reform era India, fail to define any life line rate or subsidized rate for the poor that seems a must in such a country where a vast cross section of the population is out side the market. Given the socio-economic background, economic sustainability of the energy sector reform in India can be ensured by improving operational efficiency, by protecting right of the customer to reasonably priced, good quality power, ensuring universal supply, including supply to the rural areas and the poor, by facilitating incremental investments particularly from the private sector to meet the demand-supply gap in energy, by rationalization of tariff and above all by setting up efficient, accountable and corruption-free management for the energy sector.

Environmental Sustainability

By default, ongoing power sector reform in all most all the Asian countries - India, Indonesia, Malaysia, Taiwan, South Korea, Thailand etc. is contributing significantly to environmental degradation. Dogmatic insistence in raising FDI [13] is almost invariably translating into justification of new fossil-fuelled power plants. The inextricable link between the environment and development that when people are poor the environment suffers and vice versa has further aggravated this environmental degradation [14]. The general perception that market-driven reform sets aside long term vision for development of the technology for the future has proved true. In India,

more than 60% of the total electricity requirement comes from coal, the fossil fuel having the highest carbon dioxide emission coefficient (26 kg) among the fossil fuels coal, gas and oil. A growing population coupled with a fast growing economy has gone in favor of fossil-fuelled power plants only. Against 50-55% recorded generation of hydel power in the Fifties, hydel power generation in the recent years has drastically come down to 30-35% though India has vast potential for this clean energy resource. Capacity addition in the recent years, has largely been through installation of thermal power plants only and this has taken the ratio of hydel to thermal generation to 25:75 against the prescribed 40:60. In the state of Andhra Pradesh [15] alone, hydel power generation has come down by 27% over the period 1991-2000 against increase of coal based generation by 14% and gas based generation by 12%. Though India emits only 0.2 ton per capita carbon dioxide from fossil fuel burning (against 5.2 tons by U.S.A. and 1.2 tons world average), its growing population, fast growing economy, predominance of coal in the energy sector and low energy efficiency are some of the factors causing concern among the international community about its GHG (Green House Gas) emission potential in future. The increasing trend of fossil fuel use is clearly going against the scheme of CDM (Clean Development Mechanism) of Kyoto protocol that seeks to encourage investment leading to lower emissions. In the pre-reform era, when expectations were not there for FDI or private capital investment in the energy sector, a number of incentive schemes were floated by the state and Central Government to harness renewable energy resources (like solar, photovoltaic, bio and wind). But in the reform era, when expectations are high for FDI or private capital towards development of infrastructure for large-scale generation, hardly funds are forthcoming.

Electricity Act 2003 gives a number of incentives for the captive power plants. But such captive power plants are widely believed to be less efficient and less eco-friendly. Such plants so far have gone for fossil-fuelled power generation only. The recent (2006) Government of India plan for setting up of at least four big power plants of more than 4000 megawatt each are poised for development as fossil-fuelled plants only. In view of the threat to the energy security of India from the volatile petroleum market, nuclear energy option is gaining tremendous acceptance. The Indo-US nuclear deal (2006) is a big step in this direction. So it is now clear that India is largely tilted towards development of coal-based mega power plants and nuclear power plants to meet its growing energy requirement. While coal-based power plants are known to contribute significantly towards green house gas emission and particulate pollution, the nuclear power plants generate radiation hazards during mining, milling, processing, reprocessing of nuclear fuel material and disposal of spent fuel. However, nuclear power plants do not emit green house gases and have tremendous power generation potential that can largely reduce combustion of fossil fuels directly and indirectly. Development

of the fossil fuelled and nuclear fuelled power plants in India can offset the adverse impacts from the emissions and discharges of these plants if the generated electric power is utilized in massively developing mass transport systems based on trolley bus and railway network. Petroleum oil-based transport sector contributes a major share (70%) of air pollution. Carbon monoxide alone contributes 90% of the total emission. Given the limited petroleum reserve (732 million ton oil and 768 billion cubic meters gas), road based and private transport system is not at all a feasible for India. But instead of going for a comprehensive energy planning, India has largely gone along with the tide of economic reform policy. Growth of rail way net work in the country has been at a snail's rate. Given the vast coal reserve (210 billion tones, 1999) and expertise in nuclear technology, India can certainly develop its mega power plants and bring benefits to the environment by switching over to electricity-based tram, trolley and rail transport. Integration of these two major fossil and nuclear-fuelled power plants with the vast renewable energy resources like solar, wind, tidal energy and biofuels can not only ensure energy security of India but can also turn the overall energy sector development an environmentally sustainable one. India receives 5000 kwh/year solar energy which is more than total energy consumption of the country indicating the vast potential of the use of solar energy in the country. Though solar photovoltaic cells have become ten times cheaper over the last two decades, the installed solar capacity is only 62 MW. Total wind energy potential of India is 45,000MW, but installed capacity is only a fraction of it (1267 MW). Potential for bio-fuels is also very high in India. According to GOI Economic survey, 2002, India has 175 million hectares of waste and degraded land where bio-diesel producing jatropha variety of plant can be cultivated. Bio-fuels are eco-friendly and 100% natural energy alternative to petroleum fuel. Bio-fuels being ideal synergistic partner for oxidation catalytic conversion, can reduce CO₂ emission by 78% when compared to conventional diesel.

Supply side management and demand side management (DSM) are the two broad options of turning energy sector development process environmentally sustainable. On the supply side, sustainability can be best ensured by switching over to eco-friendly technologies and environmentally benign fuels. When it is obvious that coal will remain the major fuel for power in India, there are no alternatives to coal-based clean technologies like circulating fluidized bed (CFB), Pressurized Fluidized Bed Combustion (FBC), Supercritical Boilers, Catalytic Combustion and Integrated Gasification Combined Cycle (IGCC). These eco-friendly technologies will not only mitigate the pollution problems associated with coal combustion but will also have higher thermal efficiency leading to positive environmental as well as economic benefits. But the truth is that, in India, power sector reform is basically tariff-driven and not technology-driven as has happened in the Western countries. So activities towards developing eco-friendly energy

technologies has not been adequately integrated with the ongoing reform activities amidst preoccupation for the short term.

Given the constraints with respect to capital, the ongoing reform process can still go a long way in turning itself environmentally benign by improving thermal efficiency and by reducing transmission and distribution losses. Thermal efficiency which is measured by heat rate is, however, limited by design efficiency and therefore, within a given facility such efficiency cannot be substantially improved. However, sustained renovation and modernization of the existing plants in all the states undertaking reform process has improved thermal efficiency to some extent in the reform era. Switching over to new facilities can only allow substantial gain in thermal efficiency which is expected to go in favour of environment through reduction of total fossil fuel burning. Substantial gain in this area can only be achieved if the current high level of transmission and distribution loss can be brought down to internationally accepted level.

But transmission and distribution loss, the major area of weakness threatening the financial viability of the Indian power sector continues unabated showing no sign of down ward movement even in the reform era.

With fuel shift, uses of coal bed methane, nuclear fuel and CNG (Compressed Natural Gas) seem to be the other options towards achieving environmentally sustainable energy sector development in India. Fuel shift in the state of Andhra Pradesh has been environmentally beneficial to some extent as 1.3% share of gas and naphtha based power generation in 1990 has gone up to 13% in 2000 [5]. Discoveries of new gas reserves in this state have contributed to such fuel shift in the recent years. But such fuel shift all over India is largely constrained by non-availability of natural gas. Government of India has off late, initiated significant steps towards procuring natural gas from Iran and Myanmar through pipelines. But laying of such pipe lines will involve huge capital investment as well as long time and success of such projects will also depend on international relations, peace and stability in the region.

As coal is likely to dominate primary energy sector in India in the years to come, use of beneficiated coal in the thermal power plants can play a significant role in turning the power generation process an eco-friendly one.

In this direction, Government of India has mandated use of beneficiated coal in the power plants of the sensitive areas and such steps are likely to improve environmental sustainability of the energy sector reform albeit, marginally.

Demand side management through enhanced end-use efficiency and energy conservation measures also have high potential of energy saving (20 %) in India as has

been established in some studies [16]. But market which generally attempts profit maximization through sales maximization is opposed to such end-use efficiency enhancement concept.

However, that the issue of environmental pollution is now being addressed with all seriousness as is evident in recent 'Sustainable Energy Policies for Clean Air in India' [17] only shows some light at the end of the tunnel so far environmental sustainability of the ongoing power sector reform is concerned.

CONCLUSION

Worldwide changes in economic and financial imperatives, deteriorating financial health of the sector and overwhelming dependence on the state budget on one hand and requirement of capital for capacity expansion to bridge the growing demand-supply gap of energy on the other hand have played vital role behind the on going reform (from the 90s) in the Indian power sector. So far twenty two states of India out of twenty nine states, have accepted power sector reform policy of the Central Government, enacted state level legislation and set up electricity regulation commissions.

Reform in the state level has been either carried out or is being carried out through organizational restructuring aimed at unbundling generation, transmission and distribution of power, commercialization and management through small entities. Distribution of energy has already been privatized totally in Orissa and partially in some other states. Apart from the state of Orissa, two other states—Andhra Pradesh and Karnataka have moved substantially in the path of reform. Overall reform process is passing through difficulties and controversies. In the state of Orissa, such reform could not achieve the expected success in terms of public benefit imperatives, financial viability of the utilities, level of electrification and its quality while the same has succeeded to a great extent in raising the level of performance, level of electrification, capacity addition and widening of access to the poor in the states of Andhra Pradesh. But the power sectors of Andhra Pradesh and Karnataka are heavily buttressed with subsidies and cross-subsidies and the overall performance is not founded in real efficiency. Even in the reform era, rate of return on the net fixed assets (ROR) of most of the State Electricity Boards (SEBs) continues down slide. High level of unsustainable transmission and distribution losses continue to plague Indian power sector. Such alarming losses are attributable to operational inefficiency, corruption and lack of investment in transmission and distribution infrastructures. To meet the massive energy needs of the growing economy, the SEBs cannot be allowed to continue in the state where they were for decades. A major overhaul of the entire power sector is essential. But blindly unbundling and privatization is not the only way in causing a turn around

of the power sector. Internal reform, stringent provisions for transparency and accountability may also go a long way in improving the status of the ailing power sector. Modernization of any industry with time is essential to sustain its operational efficiency and the responsibility for doing so lies with the management. Setting up a corruption-free, accountable and efficient management is of paramount importance for financial viability of the power sector in India.

Environmental sustainability of the reform process has remained questionable. Reform has encouraged fossil-fuelled power plants setting aside long term vision for the eco-friendly technology of the future. Hydel power generation has substantially gone down against sharp increase in thermal generation. Much of the pre-reform thrust on eco-friendly technology development and tapping of renewable energy resources has been lost amidst short term preoccupation. India has vast potential for renewable energy sources like solar, wind and bio-fuels. A perfect mix of renewable and nonrenewable energy resources in power generation can turn the energy sector development environmentally benign. In the back drop of inevitable present and future dominance of coal in power sector, use of beneficiated coal, switching over to eco-friendly technology (CFB, PFB etc.) should be accorded high priority. Recent steps of the Government of India for setting up of giant fossil fuelled power plants and going for nuclear energy option (through Indo-US nuclear energy deal, 2006) in a big way to ensure energy security seems to have no alternative reduce the overwhelming dependence on imported petroleum from a volatile oil market. However, both these energy options go against the concept of environmental sustainability. But an overhaul in energy use pattern can to a large extent offset the adverse impacts of fossil and nuclear fuelled power plants if the energy generated in these two types of plants are utilized to replace the road-based transport system into rail-based transport system as automobiles on the road sector are responsible for 70% of the air pollution. To drive the entire energy sector towards sustainable development, a comprehensive energy planning is essential that may necessitate a paradigm shift in the energy use pattern, major overhaul in the administrative set up of the power sector and integrated approach in developing the renewable as well as nonrenewable energy resources.

Across the states, results of reform so far have been mixed. It raises doubt as to the correctness of the World Bank diagnosis to the ill health of Indian power sector and their prescriptions thereof. Highly skewed tariff structure is diagnosed as a cause low recovery in this sector. Adequate legislation both at the state and central level have been enacted for phasing out subsidies and cross subsidies and for tariff regulation. Tariff, in a country with 300 million people living below poverty line (BPL), is a very delicate issue and social sustainability of the reform cannot be ensured without provision

for life line rate or subsidized rate for the poor. Demography of India demands that in the irreversible reform process of the power sector, the invisible hand of market should be assisted by the visible hand of regulation of an independent, corruption-free and truly democratic regulatory body consisting of members of all categories of consumers, stake holders, veteran experts and the government.

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