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Private Sector Participation in the Indian Power Sector and Climate Change

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Foreword

In September 2005, AFD's Research Department launched a Research Program on Public Private Partnerships with an approach combining economic analysis (contractual incentives, financing of investment, etc.) with a sociological and political approach to regulatory issues. Various case studies have been conducted in different sectors (water and sanitation, power, transport) and countries.

This study falls within the above research framework since India – like most major developing countries – has attempted to introduce market forces in its electric power systems.

At the same time, growing concern over global climate change has put the spotlight on the need for India to control its emissions of greenhouse gases (GHG). India is currently the world's sixth biggest producer of GHG emissions, but is the second biggest if one considers the rate of augmentation of its emissions. Half of India's total GHG emissions are produced by its power sector, and 70 per cent of electricity is generated by thermal power plants, mainly from coal. Climate change mitigation in the power sector is thus a strategic issue for AFD in India.

This study is structured so as to examine the intersection of these two crucial challenges in India by exploring the links between private participation in the power sector in India and the reduction of GHG emissions.

It has been conducted by India's National Council for Applied Economic Research (NCAER) and financed by AFD. Its main results were presented at a workshop organised by NCAER and AFD in New Delhi on 4th February 2009 in the presence of Mr. B.K. Chaturvedi (Planning Commission) and Mr. Anil Razdan (former Secretary, Ministry of Power).

Aymeric Blanc

Abstract

In order to pursue high economic growth, India faces the sharp dilemma over how to bring about the developmental transformation of its economy while taking into account the impact of growth on the environment. India is a signatory to the Kyoto Protocol and has articulated its concerns and approaches through several national missions for sustainable development. At the same time, the need for sustained high rates of economic growth has been set out in the various policy documents, such as the Eleventh Five Year Plan (Planning Commission, 2008). Moreover, the Millennium Development Goals (MDGs) point to the other priorities of ensuring that the minimum needs for human life are met, which in turn make rapid economic growth in developing economies a necessity. Reconciling two apparently conflicting objectives requires both using resources and mitigating the adverse effects on the sustainability of such a use.

The environmental impact of the reforms in the power sector is an area of vital concern; however, linkages between reforms and environmental concerns have not yet been established. It is well accepted that power generation is the primary contributor to GHGs in India. Parikh and Parikh (2002) note that approximately 50 per cent of India's total GHG emissions are produced by its power sector. Admittedly, the energy sector is a key element in any strategy for mitigating the adverse effects of economic growth on climate change. In this context, the choice of technologies in the generation, distribution and utilisation of electricity can have significant impacts on GHG emissions and, consequently, climate change.

This study explores the relationship between power sector reforms in India and GHG emissions. The Electricity Act, 2003 (the Act), which has enabled competition in the Indian power sector in both bulk and retail electricity supply, mandates the promotion of cogeneration and renewable energy sources.

The study seeks to assess the impact that private sector participation in the Indian power sector has on the environment. We examine this aspect of the linkages between the trends in reforms and GHG emissions using Central Electricity Authority (CEA) data on specific emissions. The CEA's General Review Data is also analysed to study the trends in fuel choices for the three sets of generating plants in the central, state and private sectors.

Other reform and environment linkages exist. Firstly, private participation in transmission and distribution upgrading may have an impact on the technical efficiency of the system, leading to an impact on the environment. Secondly, in a few states distribution reforms have resulted in concession agreements under which the private sector has to meet certain efficiency norms. An important offshoot of the reform process has been the importance accorded to renewable energy sources for electricity generation. The policy framework for investment in these sources has been supported with fiscal incentives, and preferential procurement and pricing.

Following an introductory section, this study is organised into three sections as follows: Section 1 discusses the policy framework of the Indian power sector in the post-reform period starting in the early 1990s. Section 2 has two themes. First, we analyse the data to examine fuel choices and emissions over the period of reform for all ownership

types and, second, an econometric analysis is carried out to assess the impact of ownership on CO_2 emissions. This section provides empirical evidence on the links between ownership in the power sector and emissions. Section 3 provides an assessment of the privatisation of distribution in Delhi and its impact on efficiency parameters, such as billing, collection, and the reduction of transmission and distribution (T&D) losses.

The study reviews the policy framework for the power sector and observes that the Indian power sector has not been able to attract much-needed investments from the private sector, despite the reforms ushered in by the Electricity Act and the subsequent policies. The creation of a regulatory institution, along with legislated private sector participation in the sector, is aimed at mitigating risks associated with long-term investment in the sector. The business of electricity distribution in India is characterised by higher risk on account of high transmission and distribution losses, poor operational efficiency and low revenue collection. The poor state of distribution utilities discourages investment by the independent power producers (IPPs). However, there have been a number of initiatives to open up the electricity market to suppliers. The policy framework stipulates open access to all customers requiring a minimum power level of above 1 MW by 27th January 2009. This has opened up the market for direct sales by IPPs, thus bypassing the distribution licensees. As the application of a cross-subsidy surcharge is to be progressively reduced by the State Electricity Regulatory Commissions (SERCs), the market for electricity will open up greater avenues for prospective IPPs. Increased competition and direct access to consumers through open access is set to improve the investment climate.

Competition is expected to bring efficiency into the market and provide incentives for cost reduction. Direct sales to customers will eliminate the payment risk associated with the single-buyer model whereby IPPs were only allowed to sell to the State Electricity Boards (SEBs). A number of state distribution companies have recently shown signs of a turnaround through improvements in various financial and technical benchmarks, which is a positive sign.

A review of the evolution of the power sector in the recent decade and a half shows that there have been significant improvements in technology and incentives that help improve efficiency in the power sector. The challenge lies in the fact that coal-based power generation is expected to remain the main source of electricity in the country for several decades to come.

For a variety of reasons, the private sector has come to occupy a dominant position in the renewable energy segment of power production: wind, small hydro and biomass. Although the sector has seen growth based on fiscal and regulatory support, the synergy between grid-based utilities and small producers is yet to gain strength. The private sector has also come to choose environmentally benign fuel – such as natural gas – in thermal power generation, again for a variety of commercial and policy reasons.

The analysis of emissions data shows that after controlling for fuel and the vintage of plants, the difference in the intensity of GHG emissions is not statistically significant for private producers and central sector power plants. Both these sectors have a lower intensity of GHG emissions than the state sector plants. We also find that the private sector is more likely to choose natural gas as fuel than coal. India's experience provides ambiguous support for the idea that the policy of involving IPPs alone can bring environmental gains. This analysis has its limitations insofar as very little progress has been made by IPP developers that have added new generating capacity and, in the long term, it is likely that a significant share of capacity will be fired by coal.

There is greater evidence that the privatisation of distribution, when adequately incentivised, can lead to efficiency gains. A review of the experience of Delhi in privatising power distribution shows that there has been a sharp reduction in aggregate technical and commercial losses since distribution was privatised. Indeed, the private distribution companies were able to invest in distribution infrastructure in order to reduce technical losses, and market incentives have improved billing efficiency.

Introduction

Ever since the industrial era, anthropogenic-induced greenhouse gases (GHGs) have increased alarmingly in the environment, mainly through the burning of fossil fuel and land-use change. The accumulation of these gases in the atmosphere has led to an increase in the global temperature which consequently causes environmental stress across the globe. There is a need to deliberate on the impact, mitigation and adaptation of GHGs within a global framework. This is precisely what is currently being done under the auspices of United Nations-monitored agencies, where rich and poor countries negotiate in order to formulate a treaty to curb the future emissions of GHGs and decide on mechanisms to compensate poor countries for these undesirable effects. The adoption of the Kyoto Protocol at the UN Conference of Parties held in Kyoto in 1997 was a key event in the time line of climate change negotiations. The Protocol, which became effective in 2005, specified targets to reduce GHG emissions for developed countries. In the case of developing countries, there are no specific targets for the reduction of GHGs, but there are increasing pressures to move to lower emission technologies given the fact that some of the large developing economies, such as China and India, have been growing rapidly in recent years. The sharp differences in views on strategies to address the issues of climate change among the various countries came to the fore at the recently concluded Copenhagen Summit. The Summit only led to an informal and non-binding declaration by a few influential countries – including Brazil, China, India and the US – to reduce the growth of GHG emissions.

India is a signatory to the Kyoto Protocol and has articulated its concerns and approaches through several national missions for sustainable development. At the same time, the need for sustained high rates of economic growth has been set out in the various policy documents, such as the Eleventh Five Year Plan (Planning Commission, 2008). Moreover, the Millennium Development Goals (MDGs) point to the other priorities of ensuring the minimum needs for human life are met, which in turn lead to the need for rapid economic growth in developing economies. Reconciling two apparently conflicting objectives requires both using resources and mitigating the adverse effects on the sustainability of such a use. India's approach has been to incentivise the use of environmentally benign technology choices.

Admittedly, the energy sector is a key element in any strategy for mitigating the adverse effects of economic growth on climate change. In this context, the choice of technologies in electricity generation, distribution and utilisation can have significant impacts on GHG emissions and, consequently, climate change.

This study explores the relationship between power sector reforms in India and GHG emissions. In particular, it seeks to assess the impact that private sector participation in the Indian power sector has on the environment. Proponents of electricity sector reforms have shown that reforms not only lower prices for consumers, but also lead to improvements in environmental performance (Bacon and Besant-Jones, 2001). This is most apparent in the case of electricity generation where the opening up of the grid to independent power producers (IPPs) in several developed economies has led to the commissioning of modern, clean generating plants, sometimes substituting older, heavily polluting ones in the process (IEA, 2001; Perkins, 2005). But will investments by IPPs produce similar environmental gains in developing countries? As India moves away from the era of vertically-integrated state-owned monopoly utilities to

unbundled, corporatised and occasionally privatised utilities regulated by independent regulators, what have been the environmental effects of the reforms?

This study examines the recent experience of India in order to establish whether current reforms of the electricity sector are likely to lead to an improvement in its environmental performance. We examine this aspect of the linkages between the trends in reforms and GHG emissions using Central Electricity Authority (CEA) data on specific emissions. The CEA's General Review Data is also analysed in order to study the trends in fuel choices for the three sets of generating plants in the central, state and private sectors.

Other reform and environment linkages exist. First, private participation in transmission and distribution upgrading may have an impact on the technical efficiency of the system, leading to an impact on the environment. Secondly, distribution reforms in a few states have resulted in concession agreements under which the private sector has to meet certain efficiency norms. Lastly, an important offshoot of the reform process has been the importance accorded to renewable sources of electricity. The policy framework for investment in renewable energy sources for electricity generation has been supported with fiscal incentives, and preferential procurement and pricing. This has largely been a voluntary approach oriented by the guidelines of the Ministry of Non-Conventional Energy Sources (MNES), now known as the Ministry of New and Renewable Energy (MNRE).

The Electricity Act, 2003 (the Act), which has enabled competition in the Indian power sector in both bulk and retail electricity supply, mandates the promotion of cogeneration and renewable energy sources. Interestingly, the data – which we will refer to later – shows that the incumbent traditional monopoly utilities have not generally invested in small decentralised systems and generation from renewable energy sources. Thus, power sector reform creates a space for new private players in the renewable energy sector.

Against this background, the study is organised as follows: Section 1 discusses the policy framework of the Indian power sector in the post-reform period starting in the early 1990s. This section spells out the framework for private investment, in general, and investment in renewable energy, in particular. Various policy instruments like the Electricity Act (2003), the National Electricity Policy (2005), and the National Electricity Plan (2007) are discussed. In addition, we also discuss the initiatives taken by the MNRE and Ministry of Power (MoP), specifically to address concerns relating to the environmental impact of electricity sector development. This section, therefore, focuses on the macro-level framework of laws, institutions and policies that have been driving electricity reforms in India. The changes at the macro level influence the external operating environment of firms and have an impact on entry decisions, the choice of fuels and, hence, the consequent impacts that privatisation has on climate change.

Section 2 has two themes. First, we analyse the data to examine fuel choices and emissions over the period of reform for all ownership types and, second, an econometric analysis is carried out in order to assess the impact that ownership has on CO_2 emissions. This section provides empirical evidence on the links between ownership in the power sector and emissions.

Section 3 provides an assessment of the privatisation of distribution in Delhi and its impact on efficiency parameters, such as billing, collection, and the reduction in transmission and distribution (T&D) losses.

1. Policies Toward Private Sector Participation in the Indian Power Sector

The eclipse of the state-regulated, vertically-integrated utility as the dominant institutional form in the electricity industry has now become a worldwide phenomenon. This phenomenon reflects a broader trend towards the privatisation of state enterprises and the liberalisation of markets for infrastructure industry services. The reform model predicates competitive markets for the generation and operation of transmission facilities on an open-access, non-discriminatory, common-carrier basis and retail competition among power marketers who rely on regulated distribution companies for delivery (Joskow and Schmalansee, 1983). The regulation of the wholesale and retail energy markets will be reduced to the imposition of structural requirements and operational guidelines and monitoring, while retaining substantial regulation of the "wires" market for transmission and distribution (T&D). These changes entail unbundling energy generation from T&D, thereby reversing the vertical integration of utilities.

The primary reasons for power sector reform have been different in developed and developing countries. The main driving force for electricity sector reform in developed countries has been to realise efficiency gains in the generation and distribution segments, which were made possible because of technological innovations. The main driving force in developing countries, including India, appears however to be to attract private sector investment to supplement public sector investment in the power sector.

Second, persistent shortages of power in developing countries increasingly became a politically sensitive issue which also triggered restructuring. Economic development was being arrested and could not be sustained without sufficient electricity supply. The major reason for the persistent power shortage was that power generation capacities were not being sufficiently expanded. The power situation worsened further as a substantial proportion of revenue from the power that was produced was lost either due to technical inefficiencies or due to implicit or explicit cross-subsidisation. While the existing structure of the industry did not provide sufficient incentives for power producers to improve their efficiency, the limited public resources were inadequate to pay for ever-increasing costs in expanding power generation capacities and transmission and distribution facilities. Private capital would not – and could not – come in if the state-owned and vertically-integrated monopolies continued. Consequently, if there were no reforms, there would be more power cuts and/or price rises.

In India, the reform strategy has two identifiable points of evolution. The initial strategy, implemented in 1991, was structured around the belief that capital constraints were the key problem. This explains why it focused on the entry of private management and capital into generation. A policy shift came in 1996. The experience of the intervening years showed that facilitating incremental investment in generation was not enough to reform the power sector. Moreover, such investments were themselves a function of the financial viability and overall health of the power sector. The expert group on the commercialisation of infrastructure projects noted that government policy reforms needed to go beyond financing strategies and consider the introduction of competition in order to achieve the efficiency targets.[1]

The key constraint was identified to be the absence of an appropriate business environment rather than the supply of capital alone. This realisation initiated a reform programme

[1] Government of India, 1996, p 54.

that was broader in scope and range and very much more aggressive than the one conceived in 1991. It also shifted attention from the central government to the state governments as prime movers in the reform process. India chose a path that combined restructuring and privatisation. The emphasis was placed on regulatory reforms leading to the establishment of independent regulatory commissions. The enactment of the Electricity Act, 2003 led to a deepening of the reform process through the introduction of a competitive regime in the Indian power sector.

1.1 Private Entry into Generation: the IPP Debacle

In the initial stages of reform, the generation component of the industry was opened up to private players with generally unsatisfactory results. Instead of forcing the generators to compete in the market for supplying bulk electricity – sinking or swimming depending on their competitiveness and efficiency – they were awarded contracts with seemingly ironclad guarantees regarding sales, rates of return, and prices of inputs and outputs. Such contracts maintained the vertically integrated nature of the incumbents in the industry and failed to introduce competition in the market for bulk electricity. In an exuberant rush for reforms, the government invited independent power producers (IPPs), but an appropriate market structure with the right incentives for investment was lacking.

IPPs were solicited in the early 1990s, when the first phase of reforms began within a general macro environment that was moving away from a planned socialist economy to a relatively more liberalised economy. The independent regulation of the power sector was conceived for the first time in the Electricity Regulatory Commission Act of 1998. Thus, policy credibility and the existence of a sound regulatory framework, which are required in order to lower the perceived risk of expropriation and consequently to attract private capital, were absent in the early 1990s. In the absence of such credible institutions and commitment, potential investors might avoid investing in the first place, or they may require additional premiums to account for risk, thus raising the cost of capital. This is precisely what happened in the case of the IPPs.

Thus, although nearly 250 MoUs were signed between 1991 and 1998, only 17 thermal IPPs (5,533 MW) were commissioned and several foreign companies who had shown interest left the country. The reason for this was that power purchase agreements (PPAs) with bankrupt State Electricity Boards (SEBs) entailed huge financial risks that were not manageable. This compelled investors and lenders to seek sovereign guarantees against payment defaults by the SEBs and the state governments. Such contracts clearly rendered competition superfluous.

The need for other reforms beyond simply “generation at any cost” intensified as the power situation in India began to worsen through the mid-1990s. Because the fundamentals had deteriorated so badly, foreign interest in India’s power sector (not just generation), which had been high during the early 1990s, soon waned.

Why was this decidedly flawed strategy followed? On account of fiscal constraints, the Indian state was unable to invest in electricity generation. Therefore, private investment was seen as the only way to augment generation capacity. However, private capital was rightly chary about entering an industry dominated by a politically-led, contractually unreliable, and financially suspect, state-owned monopsonist. Consequently, few private players entered, and they only did so once the pot had been sweetened with all manner of guarantees and counter-guarantees.

On the other hand, public investment was sharply cut back at the same time, i.e., in the Eighth Five Year Plan (FYP), 1992-1997. Thus, while public investment was drastically reduced, the much anticipated private investment did not materialise. The failure to attract private investment in generation led to increased public investment targets for the Tenth FYP, with a 40 per cent increase in the plan outlay. However, this shift in emphasis between private and public investment failed to

recognise that investment targets alone will not deliver until a comprehensive restructuring and liberalisation of the sector is implemented. SEBs were increasingly unable to pay for the electricity they purchased from the central public-sector power companies, or from the IPPs. This, coupled with policies such as unmetered charges in agriculture (flat rates charged based on pump capacities), often in the domestic sectors, as well as large-scale thefts, resulted in the deteriorating status of Operation and Maintenance (O&M) which was reflected in mounting T&D losses.

1.2 Policy Initiatives for Private Sector Participation: Electricity Act, 2003 onwards

In the absence of a comprehensive reform agenda for the Indian power sector, the private sector did not come forward to participate in the sector in any significant manner. Not surprisingly, even today only 10 per cent of the total gross generation of power in India is in the private sector. Private participation has remained low, despite the fact that the investment climate in the sector was strengthened through a gradual restructuring of the SEBs and regulatory reforms were initiated at the central and state levels. The Electricity Act of 2003 was the first comprehensive legislation to provide an enabling environment for enhancing competition and for private sector participation.

This Act was a measure to consolidate the existing laws relating to generation, transmission and distribution, trading and the use of electricity and to usher in further reforms. It aimed to develop the electricity industry by promoting competition in the power sector, protecting the interests of consumers, as well as electrifying all areas of the country. It also promoted environmentally benign policies. However, it did not include tariff rationalisation or transparent policies regarding subsidies. The provisions of the Electricity Act, 2003 not only initiated measures that strengthened private sector participation in generation, transmission and distribution by removing barriers for its entry, but also promoted the use of renewable sources of energy in generation, as well as rural electrification. In this sense, the Act also took into account the obligations relating to climate change set out in the Kyoto Protocol. In addition, it encouraged the setting up of "standalone systems" in rural areas in order to hasten rural electrification as well as encourage privatisation.

In February 2005, the government defined the National Electricity Policy in line with the Electricity Act of 2003. The policy emphasised private sector participation in distribution in order to achieve a reduction in transmission and distribution losses and improve the quality of service to consumers. The policy further outlined the need to allow the private sector to invest in the electricity sector by providing it with multiple opportunities for investment and returns on investment on par with other sectors.[2] An appropriate balance would also be maintained between consumer interests and investment needs. In order to enhance private sector participation in generation, transmission and distribution, the Policy outlined the need for central and state governments to develop workable and successful models for public-private partnerships.

As per the Electricity Act, 2003, the CEA formulated the National Electricity Plan (NEP) in April 2007 with the aim of achieving the objectives laid down by the National Electricity Policy of February 2005. The NEP in the generation sector has emphasised private sector participation by the provision of a fixed return on investment based on an assessment of opportunities and risks.

The NEP states that a special mechanism would be created to encourage private investment in the transmission sector to ensure that sufficient investments are made in order to achieve demand by 2012. The NEP envisages private sector participation in the transmission sector through private funding that would supplement the efforts of the public sector and benchmark the costs of the transmission projects. Private sector participation would be through the competitive route and not on the cost-plus basis.

[2] The exact percentage of the return on investment is not mentioned in the National Electricity Policy of 2005. The Private Power Policy of 1991 offered private investors a 16 per cent return on equity. In line with the market scenario, CERC has reduced the allowable return on equity to 14 per cent. The current tariff-setting norm assures a guaranteed return on investment (ROI) of 14 per cent.

In order to mobilise resources from the private sector, the Government of India issued guidelines for private sector participation in the transmission sector in January 2000 which envisaged two distinct routes for this participation: the Joint Venture (JV) route, wherein the central or state transmission enterprises shall own at least 26 per cent of equity and the balance shall be contributed by the Joint Venture Partner (JVP), and an Independent Private Transmission Company (IPTC) route, wherein 100 per cent of equity shall be owned by the private entity.

Electricity Act, 2003 and its Impact on Private Participation

The installed generating capacity of the private sector constituted only 14 per cent of the total capacity as of March 2008. The private sector contributed 20,011 MW out of a total capacity of 143,061 MW. If we take into account the figures for energy generation at the same period, the private sector contributed 5,424 MU out of the total energy generation of 61,206 MU, which represents almost 10 per cent. The contribution of the private sector has remained quite low, despite the passage of the Electricity Act in 2003 that delicensed generation. The transmission sector continues to be primarily under the public sector and it was only in 2006-07 that the first public-private Joint Venture project between POWERGRID and Tata Power, namely Tata Transmission System, was commissioned.

Despite undertaking massive expansion projects, the power sector has not been able to match the growing demand for reliable and cost-effective supply. According to the 17th Electric Power Survey, between 1974 and 2005 electricity consumption and generation in India grew by 6.87 per cent and 7.47 per cent respectively and the corresponding GDP growth stood at 5.4 per cent. The survey forecasts that electrical energy consumption will increase at a Compound Annual Growth Rate (CAGR) of 10 per cent until 2012. The nationwide energy shortage in March 2008 stood at almost 10 per cent and the peak demand shortage at over 16 per cent. To bridge this gap in energy demand, the Eleventh FYP Plan envisages a capacity addition of about 68,869 MW (excluding renewables and nuclear energy) of which 36,655 MW are to be provided by the central sector, 22,989 MW by the state sector and the remaining 9,225 MW by the private sector.

The Electricity Act provides for multiple licensing in the distribution sector and stringent provisions to control the theft of electricity. The Act has obliged the states to restructure the state electricity boards. Electricity tariffs are issued by the State Electricity Regulatory Commissions in phases. However, in spite of these provisions, distribution reform still remains the missing link that poses a severe hindrance to private entry in the sector as a whole. Investors perceive a high risk in the distribution sphere due to inefficiency and exposure to regulatory risks. Moreover, since distribution is under state jurisdiction, it remains highly influenced by local political dynamics. The problems for investors stem from the following reasons:

- High transmission and distribution losses continue due to a combination of technical and non-technical factors. The concept of aggregate technical and commercial (AT&C) loss was introduced to capture the performance of the utility. The high AT&C losses are due to high T&D losses coupled with low collection efficiency. The AT&C losses presently range between 18 per cent and 62 per cent in the various states. The losses are mainly due to theft and pilferage. The distribution sectors in most of the states have poor billing and collection efficiency.

- Reforms in various states have responded differently to the Electricity Act, 2003. The unbundling and restructuring of the SEBs has been achieved in most states. However, cross-subsidies on energy sales have been increasing over the years due to the provision of electricity at subsidised rates to agriculture and domestic consumers in many states.

- The Discoms and the State Electricity Regulatory Commissions (SERCs) do not have sufficient resources to achieve the efficiency required to ensure adequate returns on investment.

- The commercial losses in the distribution sector are caused by improper energy accounting and billing procedures, faulty metering, under-billing, theft and a lack

of accountability within the organisation. The utilities have not been able to conduct energy audits due to inadequate metering and data collection. The Discoms lack proper load monitoring and control mechanisms, such as Supervisory Control and Data Acquisition (SCADA) and Distribution Control Centres, which results in a haphazard control of demand, often leading to a loss of revenues and inconvenience to consumers.

The Electricity Act opened up the distribution sector to private sector participation. The two critical areas that can stimulate private sector investment are open access and the multi-year tariff principle. Open access in distribution has not materialised despite its being mandatory under the Act. The current state of the distribution system, which often operates at low frequencies, limits the operation of open access. While upgrading is essential, it may be delayed in order to postpone competition.

The introduction of a performance-based multi-year tariff framework is an important incentive to minimise risks for utilities and consumers, as it provides investors with a regulatory guarantee on the cost of tariffs.

The Eleventh FYP has stressed the importance of the public-private partnership model for resource mobilisation and efficiency gains. A public-private partnership is emerging in the form of franchisees in rural areas. The Act has also eased restrictions on the setting up of captive power plants which are privately owned. A capacity addition of about 12,000 MW from captive plants is expected by 2012.

A major private sector initiative has recently occurred in the form of ultra mega power projects (UMPPs) that are being developed with the help of private actors. These are coal-based power generation projects of 4,000 MW each.

Box 1

Status of Ultra Mega Power Projects (UMPPs)

Mundra in Gujarat: The project was handed over to the successful bidder, i.e., Tata Power Company Ltd., on 23.04.2007 at the evaluated levelised tariff of Rs.2.26367/kWhr.

Sasan in Madhya Pradesh: The project was handed over to the successful bidder, i.e., M/s Reliance Power Ltd., on 07.08.2007 at the evaluated levelised tariff of Rs.I.19616/kWhr.

Krishnapatnam in Andhra Pradesh: The project was handed over to Reliance Power Ltd. on 29.01.2008 at the levelised tariff of Rs.2.33/kWhr.

Tilaiya in Jharkhand: The request for qualifications (RfQ) stage in respect of Tilaiya UMPP was completed on 12.11.2007 and 13 bids have been received. The bids are under evaluation. The bidding process, in respect of the five other proposed UMPPs in the states of Chattisgarh, Karnataka, Maharashtra, Nadu, Orissa and Tamil, is contingent upon necessary clearances/tie-ups from the respective state governments which are being pursued.

Source: Annual Report Ministry of Power 2007-08.

Website: http://powermin.nic.in

In order to augment private participation in the hydro sector, several states have allotted sites to private developers on a build, own, operate and transfer (BOOT) basis.

Table 1.1. Allocation of Hydro Schemes to Private Developers by State

State	N° of Projects	Installed capacity (MW)
Himachal Pradesh	8	1,506
Uttarakhand	7	952
Sikkim	22	2,271
Arunachal Pradesh	30	13,301
Total	**67**	**18,030**

Source: Hydro Policy 2008, Ministry of Power website, (http://powermin.nic.in)

Private investors have preferred the southern and western parts of the country. The installed capacity under the private sector on 30th September 2008 in the western and southern regions stood at 8,820 MW and 9,344 MW, compared to 1,591 MW in the northern region and 1,445 MW in the eastern region. An investor's choice of a particular state is influenced by the relative investment climate in the state, which depends on the state's policy and regulatory framework, the growth potential, the financial status of the buyer utility and the available risk mitigation options.

1.3 Policy Initiatives to Promote the Environmental Sustainability of the Indian Power Sector

As India moves away from the era of vertically integrated state-owned monopoly utilities to unbundled, corporatised and occasionally privatised utilities regulated by independent regulators, how does the new legal regime take into account key concerns relating to the environmental aspects of power supply? How does the Electricity Act of 2003 address the growing environmental concerns arising from the unbridled burning of fossil fuels?

The Electricity Act, 2003 contains provisions that are aimed at promoting environmental stability. Section 61 provides that the Appropriate Commission shall be guided *inter alia* by factors, including "the promotion of cogeneration and generation of electricity from renewable sources of energy". The subsequent Section 86(1) provides that: "The State Commission shall discharge the following functions, namely:

"to promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for the purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee".

The policy addressed the development of renewable energy, as well as environmental protection, by defining the following objectives:

- To initiate measures to develop technologies and promote non-conventional sources of energy.
- To electrify rural areas in a cost-effective manner by optimising the use of non-conventional energy along with conventional energy wherever grid connectivity exists.
- To encourage private sector participation and reduce the capital costs of such projects by promoting competition in these projects.
- To create additional power generating capacity through non-conventional energy resources and fully exploit these resources, which are mainly small hydro, wind and biomass.
- To optimise the development of hydroelectricity, which is a clean and renewable source of energy. This would be achieved through the speedy operationalisation of 50,000 MW hydro initiatives. Debt financing for a long tenure would be made available. Adequate safeguards for

environmental protection would be provided through a suitable mechanism by implementing an Environmental Action Plan. Appropriate catchment area treatment would be monitored for hydro projects.

- To promote thermal plants fired by "imported coal" which has a low ash content in coastal areas on the basis of their economic viability. Suitable steps would be initiated to utilise fly ash in line with environmental guidelines and the creation of coal washeries would be encouraged.

- To promote cogeneration systems in order to bring about energy efficiency and grid stability.

This policy provided for the setting up of decentralised distributed generation facilities, together with the local distribution network, through either conventional or non-conventional methods of generation in order to electrify every rural household. The policy encouraged the "Distributed Utility Model" to achieve complete rural electrification in the country. The Distributed Utility Model places less emphasis on central generation and more on modular generation units that are strategically located close to where power is actually needed. This model encourages generation from renewable energy.

The NEP has emphasised the role of the state governments in promoting cogeneration plants and specifying a percentage of power to be purchased from non-conventional sources. Although all efforts are being made to achieve maximum capacity addition in the coming decade, the extent to which the energy conservation potential is exploited would depend on the funds available, as well as the availability of the basic infrastructure which is essential for making energy conservation a national movement.

The NEP has formulated a detailed methodology to make a maximum use of conventional generating resources, such as coal, lignite, natural gas, oil and atomic energy, as well as of renewable resources, such as wind, solar and agro waste. In dealing with conventional resources such as coal, emphasis has been laid on limiting the environmental impact by reducing greenhouse gas (GHG) emissions and promoting efficiency in generation through superior technology.

Action Plan for Energy Resources

We summarise below the NEP action plan on each conventional and non-conventional generating resource for its optimal utilisation in order to augment electricity generating capacity and, at the same time, keep environmental concerns in view.

a) Hydro power

The construction of storage-type hydro projects has been assigned the highest priority in order to achieve higher per capita storage. At present, about 300 hydro schemes with an installed capacity of 45,000 MW are either in operation or under implementation. In 2007-08 the share of the private sector in hydro power generation only reached about 5 per cent, despite several incentives written into the Electricity Act, 2003.

b) Thermal power

Thermal power continues to be the main source of power generation due to the availability of indigenous coal. In 2007-08, the share of thermal generation represented approximately 81 per cent of total generation. The adoption of the latest technologies in an environment-friendly and cost-effective manner has been emphasised. First, the Ministry of Power (MoP) has proposed the development of 100,000 MW environment-friendly thermal initiatives. Second, there are proposals to introduce higher-sized coal-based units of 800-1,000 MW using environment-friendly supercritical technology with standardised designs.

The Ultra Mega Power Projects (UMPPs) being developed with private sector participation are based on tariff-based competitive bidding and the use of supercritical technology in them is mandatory. The development of UMPPs with a capacity of approximately 4,000 MW has been identified as a thrust area by the MoP. The Ministry of Finance (Department of Revenue) has extended full exemption from central excise duty for goods procured for setting up UMPPs using supercritical

technology. These power projects would not only meet the power requirements of a number of states, but would also result in higher fuel efficiency and reduce GHGs. Nine such projects have been identified by the Central Electricity Authority (CEA), five of which are at the coastal sites and four at pithead sites. These projects are being developed on a build, own and operate basis (BOO).

The salient features of the Ultra Mega Power Projects are:

- The use of supercritical technology in order to achieve higher fuel efficiency, which would result in fuel savings and lower greenhouse gas emissions.
- Flexibility in unit size, subject to the adoption of specified minimum supercritical parameters.
- Integrated power projects with dedicated captive coal blocks for pithead projects.
- Coastal projects would use imported coal.

The UMPPs are expected to result in lower emission levels and thereby reduce the environmental risks on these projects. Based on an Ernst and Young study, the estimated baseline CO_2 emissions and reductions for the project would be 30.796 million tonnes per year (baseline value) and 29.293 million tonnes per year (with the Project), with a CO_2 savings of 1.502 million tonnes per year.

Table 1.2 below gives the indicative emission levels that can be achieved in Mundra UMPP, which has been awarded to Tata Power Limited.

The average expected tariff from the UMPPs would be lower than the present generation tariff, which would enable the government in its mission of generating "affordable power" and lowering electricity tariffs in the country. The average electricity tariff from UMPPs would be Rs.2/kWh, whereas the present generation tariff varies between Rs.3 and Rs.4/ kWh.

In terms of resources, these thermal plants will use the following:

Table 1.2. Indicative Emission Levels Achievable in Mundra UMPP

Parameter	Expected Emission	Indian Limit	World Bank Norm
SO2	400 TPD*	700 TPD	450 TPD
Nox	687.6 mg/Nm3	Not applicable	
Standards	750 mg/Nm3		
Suspended particulate matter (SPM)	50 mg/Nm3	100 mg/Nm3	50 mg/Nm3

* tonnes per day.

Sources: ADB Environmental Assessment report of Mundra UMPP, The Hindu Business Line: UMPPs: Vital Step in journey towards power for all (http://www.blonnet.com/2008/04/26).

Table 1.3. List of UMPPs for which Bids Have Been Finalised

Project	N° of bidders		Lowest bid tariff	Highest bid tariff
	National	International	(Rs/kWh)	(Rs/kWh)
Mundra UMPP	6	0	2.26	3.74
Krishnapatnam	3	0	2.33	4.20
Sasan UMPP	8	1	1.20	2.25

Source: The Hindu Business Line: UMPPs: Vital Step in journey towards power for all, (http://www.blonnet.com/2008/04/26)

Imported or washed coal: there is a new thrust to set up power plants using imported or washed coal in coastal regions; washed coal has fewer impurities, meaning there are lower CO_2 and SO_2 emissions.

Ash: according to the 15-year action plan, all existing thermal plants are to achieve ash utilisation levels of 100 per cent in a phased manner; the aim will be to achieve 100 per cent ash utilisation from the initial stage of project commissioning. It is mandatory for new thermal plants to install dry fly ash evacuation systems and old thermal plants have been asked to modify their ash evacuation systems.

Continuous efforts are being made to improve the technology and efficiency of thermal generation through higher steam parameters.

The emphasis is on using clean coal-based technologies which focus on the conversion process. This process, by either improving efficiency or increasing amenability to pollution control measures, results in reduced environmental degradation.

In order to achieve the benefits of the increased efficiency of supercritical units, the operating practices of utilities should be considerably improved.

c) Gaseous fuels

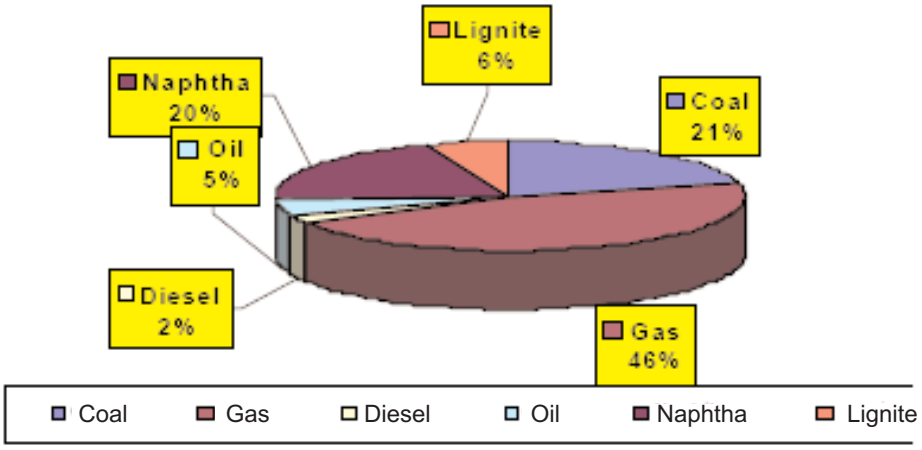
Natural gas is a less polluting[3] fuel and is easier to use than oil. There has been an increase in the use of natural gas in Combined Cycle Gas Turbine (CCGT) power stations. In order to supplement gas availability, there are plans to import natural gas in the form of liquefied natural gas (LNG).

The full potential of gas-fired generation is not being realised in India due to gas price sensitivity and the availability of gas. The government is actively encouraging the use of gas for power generation in order to promote clean fuel, which would reduce air pollution. Gas fuel costs vary greatly depending on the source of gas supply (public or private) and investments need to be made on the basis of gas prices determined by the international market. The economics of gas-fired generation need to be evaluated on a case-by-case basis. India is planning to import LNG and pipeline gas to fill the supply-demand gap. Uncertainty about gas supply is hindering the increase of gas-fired generation capacity.

The installed capacity of gas-based plants on 31st March 2007 represented 13,692 MW of the total installed capacity – 132,329 MW – or only 10.35 per cent. The private sector owns about 31 per cent of the gas plants and the rest is under the public sector. Private sector generators have preferred gas as the source of generation, especially in their choice of fuel for the plants that were set up after 1991. A large number of IPP projects under discussion are gas-based. The following chart (Figure 1) shows that for private sector plants post-1991, 46 per cent of the installed capacity was gas and 21 per cent was coal. The renewable sources of energy dominate the present installed capacity of power generation in the private sector (Figure 1.2).

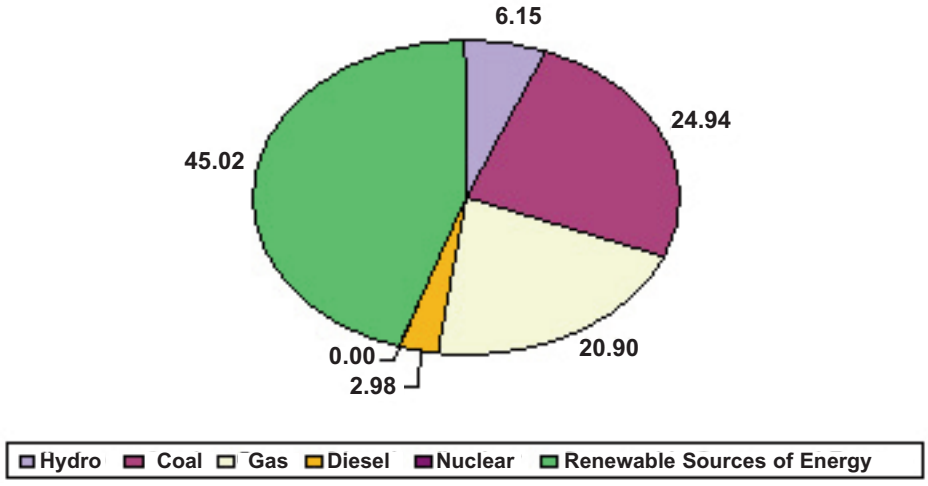
[3] Natural gas is the cleanest of all the fossil fuels. The combustion of natural gas, on the other hand, releases very small amounts of sulfur dioxide and nitrogen oxides, virtually no ash or particulate matter, and lower levels of carbon dioxide, carbon monoxide, and other reactive hydrocarbons.

Figure 1.1. Capacity Addition by Fuel: Private Sector post-Reform



Source: Based on data from Central Electricity Authority website (http://www.cea.nic.in).

Figure 1.2. Percentage of Installed Capacity by Fuel in the Private Sector at 31st March 2008



Source: Based on data from Central Electricity Authority website (http://www.cea.nic.in).

The future technology trends in thermal power generation are being driven by the criteria of efficiency, environment and economics. The issue of GHG emissions has been drawing a lot of attention in recent years. Any improvements in efficiency will result in less fuel being burnt and will consequently bring economic and environmental benefits. In order to reduce GHG emissions, the main focus is therefore to improve conversion efficiency, which is a function of turbine and boiler efficiency.

d) Nuclear technology

Nuclear power is a clean and environmentally friendly source of power generation.[4] Nuclear power generation in the current financial year is a little over 3 per cent of the total power generation in the country. In order to judiciously utilise the vast thorium potential in the country, a three-stage indigenous programme has been envisaged that comprises the following:

- Pressurised heavy water reactors using natural uranium in the first stage.
- Prototype Fast Breeder Reactors utilising plutonium-based fuel in the second stage.
- Advanced Nuclear Power Systems for the utilisation of thorium in the third stage.

The total nuclear capacity in the country at the beginning of the Tenth FYP was 2,720 MW comprising 14 units. The nuclear installed capacity programme is expected to grow to 7,280 MW by 2012 and to 20,000 MW by 2020 with the commissioning of more units. In line with the Electricity Policy of 2005, nuclear generation was opened to the private sector through the public-private partnership model, but it remains completely under the control of the central government. An increased share of nuclear power in the Indian energy mix will decrease the reliance on fossil fuels and reduce carbon emissions from India. The 123 Agreement between India and the United States of America has liberalised the technology denial regimes against India that have been in place for three decades and will end India's nuclear isolation.

e) Wind power

The gross wind power potential of the country stands at 45,000 MW and there are currently 13,000 MW of available technical potential which can be economically exploited. The wind power development programme was initiated at the end of the Sixth FYP in 1983-84 and at present India is the fifth largest country in terms of wind power generation. The wind power capacity (as of 31st December 2007) stood at 7,844 MW. Most of the generation through wind power has been achieved through private investment.

f) Small hydro power (SHP)

The development of small hydro power projects up to a capacity of 3 MW has been the responsibility of the Ministry of New & Renewable Energy (MNRE) since 1989. Since November 1999, small hydro power projects (SHPs) with a capacity of up to 25 MW have been assigned to the MNRE. The main thrust of the small hydro power programme has been to encourage private sector participation through the state sector in remote and inaccessible areas of the country. The main thrust areas include resource assessment, the setting up of commercial SHP projects, renovating and modernising old projects, developing and upgrading water mills and industry-based research and development. The Ministry of New & Renewable Energy (MNRE) is encouraging the development of small hydro projects in the state sector as well as in the private sector. The MNRE provides incentives through interest subsidies for commercial projects, along with a capital subsidy in the North Eastern region. The present potential from small hydro power projects with a capacity of up to 25 MW has been estimated at around 15,000 MW. To date, an aggregate capacity of 1,895 MW has been commissioned.

g) Biomass power/bagasse-based cogeneration

The programme for this source of generation aims to deploy grid interactive and distributed power from biomass through the various conversion technologies and to optimise the power generated from bagasse produced in the sugar mills. The setting up of grid interactive power systems for biomass power generation has harnessed 500 MW, and 595 MW have been harnessed for bagasse-based cogeneration.

[4] Currently, there are seven operating near-surface disposal facilities co-located with power/research reactors in various parts of the country for the disposal of low- and intermediate-level solid wastes. These are routinely subjected to monitoring and safety/performance assessment. The Department of Atomic Energy with the participation of Indian industry has developed all the essential remote-handling gadgets required for the operation and maintenance of waste management systems and assemblies, including decommissioning.

h) Solar power

Solar power is being developed through the Solar Photovoltaic (SPV) programme that aims to deploy this technology in urban, commercial and rural applications. The SPV has a potential of 20 MW per km² in the country and a capacity of 3.0 MW has been achieved so far. The MNRE provides support for this programme.

i) Urban and industrial waste

This source has the potential to generate about 7,000 MW of power in the country and an installed capacity of 41 MW has already been set up under this programme. In order to tap this resource, grid interactive and distributed power-cum-heat projects would be set up from urban and industrial waste.

The target for the Eleventh FYP (which ends in 2011-12) for grid interactive renewable power has been proposed at 14,000 MW. This target does not include 1,000 MW from the distributed renewable power systems. A subsidy of Rs.39,250 million has been proposed for grid interactive and distributed renewable power, including captive power.

In compliance with Section 3 of the Electricity Act, 2003 the central government notified a Tariff policy on 6th January 2006. This Tariff policy was in continuation of the National Electricity Policy of February 2005. The policy lays down that a tariff fixation for all electricity projects in generation, transmission and distribution which result in lower greenhouse gas emissions than the relevant base line should take into account the benefits obtained from the Clean Development Mechanism (CDM) in a manner that provides adequate incentives to the project developers.

This policy states the following with regard to non-conventional sources of energy generation, including co-generation:

- Pursuant to the provisions of Section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage for the purchase of energy from such sources, taking into account the availability of such resources in the region and its impact on retail tariffs. This percentage for the purchase of energy should be applied to the tariffs to be determined by the SERCs by 1st April 2006 at the latest. Procurement for non-conventional technologies by distribution companies shall be conducted at preferential tariffs determined by the appropriate commission, since these technologies will take some time before they can compete with the conventional sources in terms of the cost of electricity.

- Procurement for non-conventional energy by distribution licensees for future requirements shall be conducted through a competitive bidding process for suppliers offering the same type of energy. In the long term, these technologies would need to compete with other sources in terms of full costs.

- The Central Commission should lay down guidelines to be followed by the licensees where procurement is not conducted through competitive bidding.

The MNRE manages one of the world's largest renewable energy programmes covering the entire spectrum of renewable energy technologies for a variety of grid and off-grid applications. In 1992, the MNRE announced a new strategy and action plan to replace subsidy-driven programmes with commercialisation. Financial incentives were trimmed and fiscal incentives – such as concessional tax rates and soft loans – were introduced to encourage enterprise. The approach for the development of renewable energy relies on a mix of subsidies, fiscal incentives, preferential tariffs, market mechanisms and affirmative action by way of legislation and policies.

To encourage investment by private and public sector companies in power generation through renewable energy, the MNRE has issued a set of guidelines for consideration by the states. As a result, a number of states have announced policy packages including wheeling, banking, third-party sale and buyback. In addition, some of the states are providing concessions/exemptions on state sales taxes, octroi, etc. The State Electricity Regulatory Commissions (SERCs) of some states have notified preferential tariffs for wind power, biomass power, and small hydro power.

The Indian Renewable Energy Development Agency (IREDA) is the main financing institution for renewable energy projects. It offers financing for renewable projects at lower interest rates – which vary with the technology – depending on their commercial viability. IREDA was established on 11th March 1987 as a public limited government company under the Companies Act of 1956.

IREDA has been operating a line of credit from the World Bank[5] for the development of SHP projects. It has successfully supported the commissioning of 86 SHP projects amounting to a capacity addition of 239 MW. Power generation through small hydro projects is gaining the attention of prospective entrepreneurs due to its reliability and proven technology, which is non-polluting and environmentally benign. The sector is also considered to have potential for claiming Clean Development Mechanism (CDM) benefits under the Kyoto Protocol. IREDA has been in the forefront to promote, support and accelerate the development of power generation through wind energy in India by providing financial and technical assistance to prospective developers in setting up commercially viable wind farms. So far, IREDA has sanctioned loans for the installation of wind power projects for about 986 MW in the country. Power generation through wind energy is considered a preferred option among renewable energy sources due to the short gestation period in installation and its reliable, mature and proven technology, which is also non-polluting and environmentally benign.

1.4 Policies and Programmes for Energy Efficiency and Conservation

Energy conservation and energy efficiency are high priority areas in energy policies. In addition to being environmentally benign, it is possibly the cheapest option to augment the gap between power supply and demand, since it significantly reduces the need for fresh investment in energy supply systems in coming years.

It is estimated that nearly 25,000 MW of capacity can be created through energy efficiency in the electricity sector alone. The potential for energy conservation for the economy as a whole has been assessed at 23 per cent, with a maximum potential in the industrial and agricultural sectors. According to the Planning Commission's Integrated Energy Policy, the cost-effective savings potential is at least 15 per cent of total generation through demand-side management (DSM). Additional savings are possible on the supply side by reducing auxiliary consumption at generating plants and lowering technical losses in transmission and distribution.

The enactment of the Energy Conservation Act in 2001 and the setting up of the Bureau of Energy Efficiency (BEE) under the provisions of the Act are two significant steps that lend recognition to the high priority assigned to energy conservation by the government. BEE has proceeded to operationalise its twin mandates, which are the following:

- An energy audit to be conducted on 15 notified energy-intensive industry categories and buildings by certified energy auditors. This will eventually help these industry categories to benchmark themselves against global practices.

- Energy-efficiency labelling to inform consumers on the efficiency of the energy consuming products sold, especially domestic appliances. The objectives of this programme are to provide the consumer with an informed choice about energy savings and the cost-saving potential of marketed household and other equipment.

A beginning has also been made by state governments in designating agencies to oversee the implementation of the Energy Conservation Act and deliver energy efficiency services, including through public-private partnerships. BEE was provided with a one-time grant of Rs.500 million and it utilises the interest earned to institutionalise energy conservation activities implemented by the Government of India.

[5] KfW is one of the international lenders of IREDA and to date has allocated a loan of INR22.07 billion.

In order to tap the huge potential of energy savings in existing buildings, energy audit studies have been conducted in several office buildings, hotels and hospitals. These studies have indicated an energy savings potential of between 23 per cent and 46 per cent in end uses such as lighting, cooling, ventilation and refrigeration. But this potential remains largely untapped, partly due to a lack of effective delivery mechanisms for energy efficiency in the country. The State Designated Agencies (SDAs) are statutory bodies set up by the states to implement energy conservation measures at the state level. Most of the states have notified SDAs in the last two years. Haryana was the first state in the country to issue a comprehensive notification on 29th July 2005 on various energy conservation measures, including the mandatory use of solar water-heating systems, compact fluorescent bulbs (CFLs) and T-5 28 watt tube lights in the government/government-aided sector, the mandatory use of ISI-marked pump sets for new tubewell connections and the incorporation of energy-efficient building design. Two Indian states, Kerala (1992) and West Bengal (1995), introduced mandatory energy audits for large consumers at their own initiative by issuing orders from their respective Departments of Power to this effect. The best efficiency achieved in India reaches 37 per cent and the average stands at around 28 per cent.

Apart from the above-mentioned measures undertaken to bring about energy efficiency as well as conservation, a variety of CDM projects have also been implemented in renewables like biomass, small hydro, wind and biogas, as well as in thermal power plants and a variety of manufacturing industries, such as cement, steel and aluminium. India acceded to the Kyoto Protocol in August 2002 in order to fulfil the prerequisites for the implementation of Clean Development Mechanism projects in accordance with national sustainable priorities. India registered its first CDM project in 2005. The total number of Certified Emission Reductions (CERs) issued in India stands at 31.9 million tonnes of CO_2 and the expected average for CERs is estimated to be 27.6 million tonnes of CO_2 annually.

The total electricity energy saving by industrial units from 1999 to 2004 represented 3,211 million kWh. In India a total of 34 projects (25 per cent of the total CDM projects) have been approved through the CDM route, which can generate CERs of around 27.3 million units, i.e. 18 per cent of total CERs from India between now and 2012. In order to motivate industrial units to conserve and use energy efficiently, the Ministry of Power has instituted National Energy Conservation Awards. In the last nine years of this award scheme until 2007, the participating industrial units collectively saved Rs.70.25 billion per year and recovered investments in 18.5 months. In terms of energy, 1,420 MW of electrical power, 1.6 million kilolitres of oil, 5.2 million metric tonnes of coal and 19 billion cubic metres of gas were saved through energy conservation measures by the participating industrial units.[6]

The Integrated Energy Policy (IEP) has identified certain policy initiatives which can yield quick returns, such as allowing utilities to factor Energy Efficiency (EE)/Demand Side Management (DSM) expenditure into the tariff by regulatory commissions, the setting up of EE/DSM cells by utilities, implementing Time of Day (ToD) tariffs, facilitating grid interconnection for co-generators, improving the efficiency of municipal, industrial and agricultural water pumping, instituting efficient motor and boiler programmes, promoting variable speed drives, promoting efficient lighting initiative programmes, requiring mandatory energy audits for all loads above 1 MW, and reaping daylight savings. The Integrated Energy Policy stresses the need for the adoption of a least-cost planning and policy approach to ensure a level playing field for EE and DSM with supply options. The policy further advocates financing support for Energy Service Companies (ESCOs), partial credit guarantees or venture capital, the provision of tax breaks and the formation of a new framework for an independent monitoring and evaluation of projects delivered by ESCOs.

[6] Annual Report 2007-08, MOP, (http://powermin.nic.in), IREDA News Vol. 4, No.4 & Vol. 5, No.1 from (http://www.ireda.in/newsireda.asp), The Bulletin of Energy Efficiency, Vol. 7, Annual Issue, 2007.

IREDA has been financing energy efficiency and conservation projects for the past six years to cover industries like sugar, paper, textile, steel/sponge iron, heavy chemicals, cement and power generation, as well as Demand Side Management Programmes in electrical utilities, including ESCO projects, in performance contracting/revenue-sharing mode. To date, IREDA has sanctioned 19 projects in the energy efficiency and conservation area alone,[7] involving Rs.2.5 billion in loans, of which 10 projects stand commissioned.

1.5 The Way Forward

An amendment to the Electricity Act provides for open access to all customers requiring a minimum power of above 1 MW by 27th January 2009. This opens up the market for direct sales by IPPs, thus bypassing the distribution licensees. As the application of a cross-subsidy surcharge is to be progressively reduced by the SERCs, the market for electricity will open up greater avenues for prospective IPPs. Increased competition and direct access to consumers through open access is set to improve the investment climate. Competition is expected to bring efficiency into the market and provide incentives for cost reduction. Direct sales to customers will eliminate the payment risk associated with the single-buyer model, where IPPs were only allowed to sell to the SEBs. A number of state distribution companies have recently shown signs of a turnaround through improvements in various financial and technical benchmarks, which is a positive sign.

However, the Indian power sector has not been able to attract much-needed investments from the private sector, despite the reforms ushered in by the Electricity Act and the subsequent policies. The creation of a regulatory institution, along with legislated private sector participation, is aimed at mitigating risks associated with long-term investment in the sector. The business of electricity distribution in India is characterised by higher risk on account of high transmission and distribution losses, poor operational efficiency and low revenue collection. The poor state of distribution utilities discourages investment by the IPPs. The privatised distribution utilities are currently outside the purview of the Accelerated Power Development and Reform Programme (APDRP). Their inclusion in the APDRP incentive schemes would help enlist greater participation in the private programmes in the future.

The policies regarding regulatory developments are promising, but more needs to be done to improve the performance of distribution utilities. The autonomy required to manage these utilities in a commercial manner remains a key issue.

[7] These 19 projects have been sanctioned in energy efficiency and conservation until September 2006. At 31st March 2007, IREDA had approved 1,816 projects with 2,927 MW of generation capacity and disbursed loans worth Rs.4,429.64 crore or Rs.44.2964 billion.

2. Private Sector Participation in Power Generation and Impact on Climate Change: an Empirical Analysis

The environmental impact of the reforms in the power sector is an area of vital concern; however, linkages between reforms and environmental concerns have not yet been established. It is well accepted that power generation is the primary contributor to GHGs in India. According to an OECD study,[8] approximately 50 per cent of India's total GHG emissions are produced by its power sector. Using CEA data on emissions and generation, the present study will empirically analyse the relationship between reforms in the Indian power sector and their impact on GHGs.

At the outset, it is important to note that the environmental benefits of sector restructuring or reforms are not automatic, but depend on the presence of an enabling structural, institutional and regulatory framework. Most of the reform appraisals and studies expect a positive environmental impact of reforms due to tariff rationalisation (leading to efficiency gains), better technology choices and system management. However, some critics point out that the new legislation governing the sector does not effectively internalise environmental imperatives in its framework.

The power system in India still relies heavily on fossil fuels. As a result, while policies to promote electricity generation from non-conventional energy are being put in place, a significant shift towards low-carbon energy sources is likely to be slow. The International Energy Agency (IEA) expects that most of the increase in coal demand from now until 2030 will come from developing countries. In addition, the largest share of the increase (81 per cent) will come from the power sector. In India's case, while steam-based plants accounted for almost 54 per cent of installed capacity in 2007, they accounted for almost 70 per cent of gross generation in 2006-07 (Table 2.1).

Table 2.1. Breakdown of Installed Capacity by Fuel and Gross Energy Generation in 2006-07

Mode of Generation	Installed capacity (31.3.2007)		Gross Generation (2006-07)	
	(MW)	Percentage to Total	(GWh)	Percentage to Total
Hydro	34,654	26.19	11,3359	16.98
Steam	71,121	53.75	46,1340	69.11
Gas	13,692	10.35	63,719	9.55
Diesel	1,202	0.91	2,489	0.37
Thermal (Total)	86,015	65.00	527,547	79.03
Nuclear	3,900	2.95	18,607	2.79
Renewable sources of energy	7,761	5.86	8,000	1.20
Total	**132 330**	**100.00**	**667,513**	**100.00**

Source: All India Electricity Statistics, General Review, CEA, New Delhi.

[8] Parikh, J. K.. & K.. Parikh, 2002.

We will now examine whether the public sector and the private sector made different choices of fuels with different environmental consequences over the period of reform, and to do so, we have chosen four time periods between 1991 and 2007.

The public sector (which we define as central and state generating plants) has not seen any major change in its choice of fuel over the period of reform, with coal-based plants (steam) still accounting for 58 per cent of the installed generation capacity in 2007 (Table 2.2). However, for the private sector there has been a sharp decline from 89 per cent to only 25 per cent of installed capacity in coal-based plants; in addition, gas-based plants, which accounted for only 1 per cent of the private sector's installed capacity in 1991, accounted for 25 per cent in 2007.

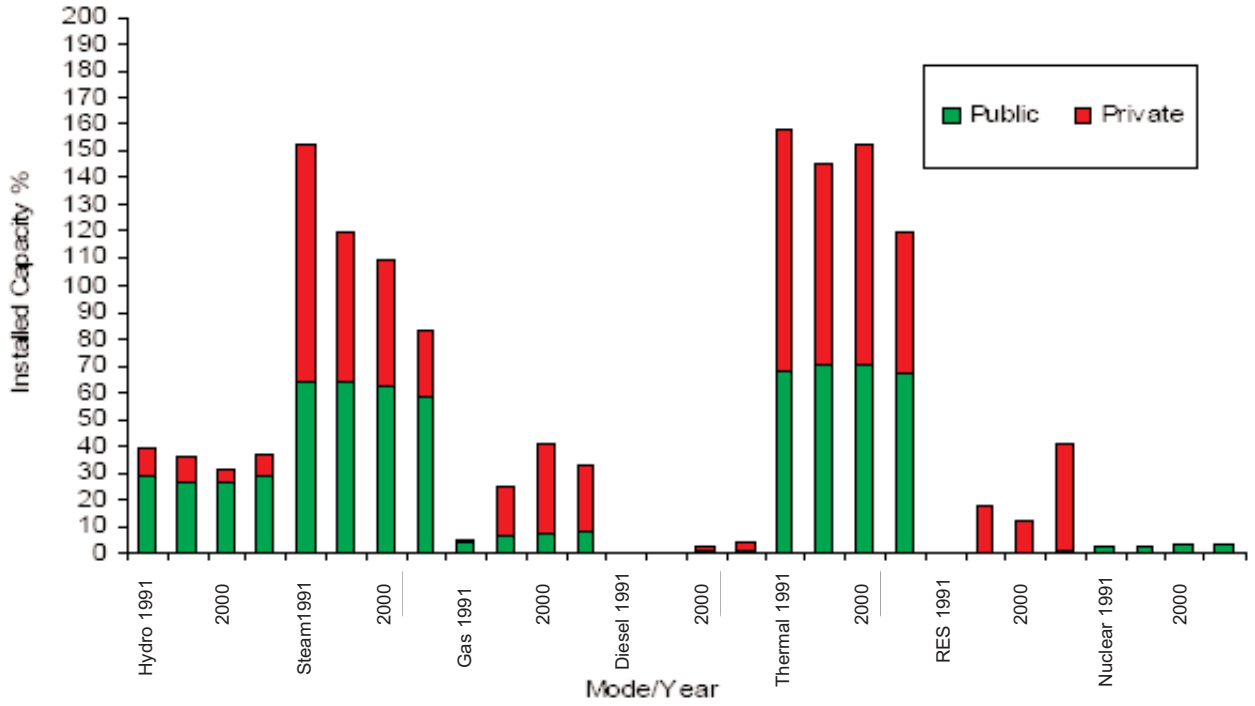
Thus, in India as in developed countries, private sector investment has increased in gas-based combined-cycle gas turbine (CCGT) plants whose low capital costs, short gestation times and modularity have made them popular with IPPs. In the UK, for example, virtually all the IPP plants commissioned since the early-1990s have used this technology (Branston, 2002). This is significant since gas-fired CCGT plants are less polluting than conventional coal-fired plants, which have long been favoured by public-owned utilities.

Table 2.2. Breakdown of Installed Generating Capacity by Mode and by Sector over the Period of Reform

Fuel/Year	Public		Private	
	Installed capacity (MW)	Percentage to sector total	Installed capacity (MW)	Percentage to sector total
Hydro 1991	18,477.42	29.17	276.00	10.06
1997	21,202.08	26.25	456.00	9.10
2000	23,379.78	26.29	477.00	5.33
2007	33,347.62	28.94	1,306.15	7.63
Steam 1991	40,572.60	64.05	2,431.38	88.66
1997	51,353.10	63.57	2,801.38	55.89
2000	55,684.50	62.61	4,171.38	46.61
2007	66,880.00	58.05	4,241.38	24.79
Gas 1991	2,519.00	3.98	33.00	1.20
1997	5,660.50	7.01	901.40	17.98
2000	6,596.00	7.42	3,000.90	33.53
2007	9,508.71	8.25	4,183.00	24.44
Diesel 1991	181.21	0.29	0.34	0.01
1997	293.56	0.36	0.34	0.01
2000	539.69	0.61	200.34	2.24
2007	604.61	0.52	597.14	3.49
Thermal1991	43,272.81	68.31	2,464.72	89.88
1997	57,307.16	70.94	3,703.12	73.88
2000	62,820.19	70.64	7,372.62	82.38
2007	76,993.32	66.82	9,021.52	52.72
RES 1991	28.78	0.05	1.60	0.06
1997	48.80	0.06	853.21	17.02
2000	54.91	0.06	1,099.97	12.29
2007	975.65	0.85	6,784.95	39.65
Nuclear 1991	1,565.00	2.47	—	—
1997	2,225.00	2.75	—	—
2000	2,680.00	3.01	—	—
2007	3,900.00	3.38	—	—

Source: All India Electricity Statistics, General Review, CEA, New Delhi.

Figure 2.1. Distribution of Installed Capacity by Fuel and Ownership (%)



Note: Steam is essentially coal-based generation; Thermal power includes steam, gas and diesel; RES = Renewable energy sources.

Source: Based on data in Table 2.2

Figure 2.1 presents the distribution of installed capacity by type of fuel and by sector post-reform.

Using the emission database, if we look at the net generation figures for all the plants (of all vintages) and for the units commissioned after 1997, a similar story emerges. The private sector has reduced its generation from coal from 47 per cent to 39 per cent and increased generation from gas; gas accounts for 33 per cent of private sector generation, while it is only 8 per cent for public sector units.

One can argue that this result is due to the fact that the public sector has a huge legacy of coal-fired plants. But if we look at the data presented in Table 2.3 (and Figure 2.2) for the units that were commissioned after 1997, it emerges that unlike the public sector, following the reforms the private sector has aggressively commissioned gas plants. Coal accounts for only 8.81 per cent of net generation in the private sector from the post-1997 units in 2006-07, while gas accounts for almost 53 per cent. But despite the growth of gas-based plants in the private sector, there are problems concerning the availability of gas. The pricing mechanism adopted for natural gas, i.e., linking the price of domestically produced gas to international prices, is an area of concern. There is a need to expedite the development of indigenous natural gas reserves, as well as to rationalise the price of LNG so that increasing numbers of private investors are attracted to setting up gas-based power plants in the country.

Table 2.3. Breakdown of net Generation by Fuel as % of net Power Generation by Sector

Sector	Fuel	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07
Public	Hydro	16.96	16.26	13.65	14.91	16.29	18.54	19.21
	Coal	67.24	67.86	70.21	69.35	68.81	67.43	67.19
	Gas	8.06	8.11	8.27	8.51	8.26	7.84	7.58
	Diesel	0.36	0.32	0.31	0.21	0.14	0.05	0.07
	Naphtha	0.04	0.04	0.06	0.02	0.01	0.01	0.01
	Nuclear	3.57	3.92	4.04	3.38	2.95	2.94	2.93
	Oil	0.49	0.37	0.30	0.27	0.37	0.24	0.21
	Lignite	3.28	3.14	3.16	3.35	3.17	2.95	2.81
Private	Hydro	3.57	4.27	3.60	5.86	6.08	7.13	8.81
	Coal	46.90	44.93	37.92	39.39	40.61	40.19	38.90
	Gas	26.57	30.54	33.48	34.68	35.69	36.07	33.27
	Diesel	0.03	1.49	1.52	0.90	0.83	0.66	0.75
	Naphtha	6.98	1.32	8.16	2.53	0.86	0.71	3.74
	Nuclear							
	Oil	12.77	14.24	11.90	10.94	10.36	9.62	8.88
	Lignite	3.17	3.20	3.42	5.70	5.57	5.63	5.66

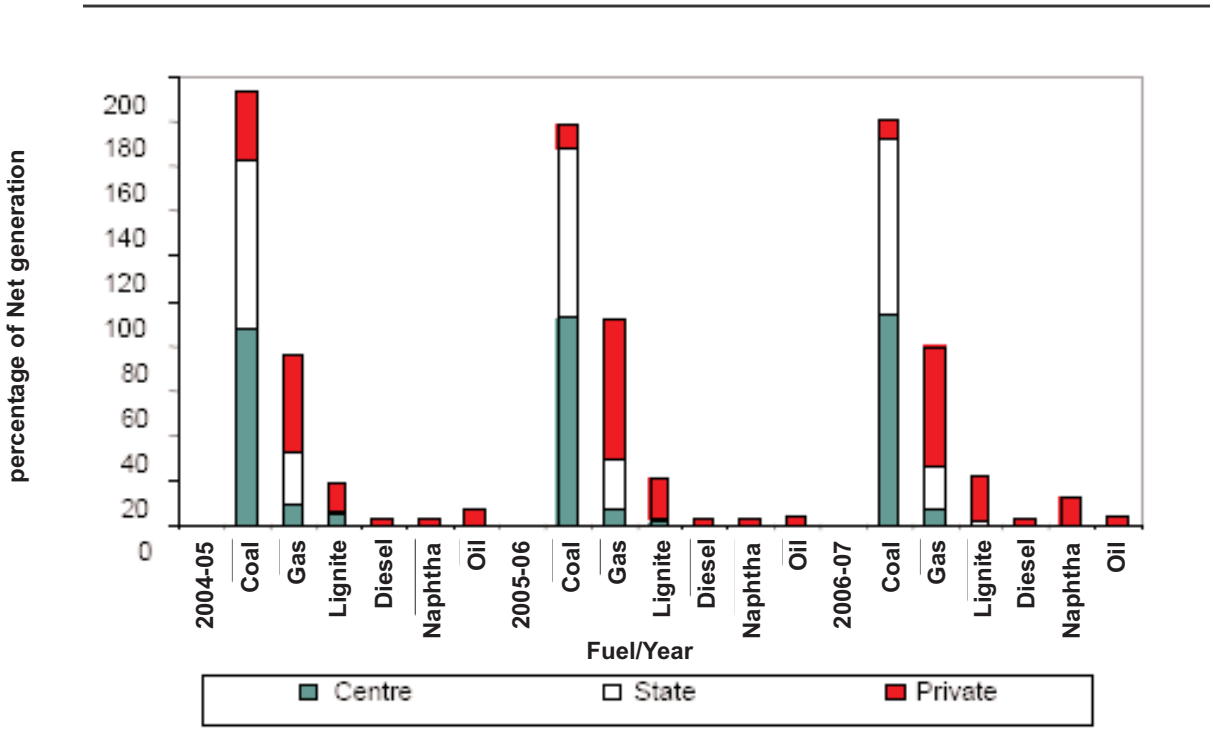
Source: CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

Table 2.4. Net Generation as % of Totals by Sector for Generating Units Commissioned after 1997

	Centre	State	Private
2004-05			
Coal	87.18	74.82	31.90
Gas	4.23	23.94	43.86
Lignite	8.60	0.90	13.59
Diesel		0.33	2.04
Naphtha			2.10
Oil			6.51
2005-06			
Coal	92.81	75.67	11.05
Gas	0.68	22.58	62.96
Lignite	6.51	1.53	18.80
Diesel		0.21	2.16
Naphtha			2.13
Oil			2.91
2006-07			
Coal	93.47	78.46	8.81
Gas	0.35	20.37	52.99
Lignite	6.19	1.16	20.08
Diesel		0.01	2.50
Naphtha			12.12
Oil			3.49

Source: CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

Figure 2.2. Distribution of net Generation by Fuel and Ownership for Units Commissioned after 1997 (%)



Source: Based on data in Table 2.4.

Many, if not most, of the new gas-powered plants that have been set up are in the states of Gujarat and Andhra Pradesh; the other states are Tamil Nadu, Maharashtra and Karnataka. In all, the post-reform period saw an addition of 4,053 MW of power being generated by the private sector, with gas as the primary fuel.

The geographical distribution of private power projects in the country reveals a preference of the private sector for the southern and western regions of the country. An investors' choice of a particular state is influenced by the relative investment climate in the state, the growth potential, the financial status of the buyer utility and the available risk mitigation options. The investment climate is influenced by the policy and regulatory framework, including various incentives offered by the state government. In terms of financial and operational performance as well as reform parameters, the power sector in the states of Andhra Pradesh, Gujarat and Karnataka have been rated among the best in recent years. In terms of overall investment attractiveness, the states of Maharashtra, Andhra Pradesh, Karnataka, Tamil Nadu and Gujarat have been rated as the top five destinations by foreign investors.

Was the fuel choice made by the private sector favouring gas-based plants to coal plants a result of a conscious choice for benign fuels, or were there structural reasons that resulted in this fuel choice outcome? First, as can be clearly seen in the following table, more of the private sector projects that have been cleared and appraised by the CEA were coal-based, with almost 52.2 per cent of expected additional private sector capacity coming from coal, but the emission database of the actual plants in operation presents another picture. Table 2.5 shows that 33 per cent of the installed capacity of the private sector that is actually generating electricity is from gas, while only 27 per cent is coal-based.

There are several reasons why the proposed coal-based plants could not be operationalised. It is difficult to obtain coal linkages for new power projects; in addition, coal linkages that are granted are not from the mines nearest the power plants and require long rail transportation resulting in increased power tariffs. Second, there are delays in securing coal linkages due to delays in the development of new coal mines by the public sector incumbent supplier; a further factor for the delay is Coal India's refusal to accept any penalty clause in the coal supply agreement, thereby putting the onus for the delays in supply and related costs on the electricity producers. Third, there is an enormous mismatch between the coal requirements for the power sector and the corresponding supplies.

Table 2.5. Comparison of Installed Capacity by Fuel in Emission Database & CEA List of Approved Projects

Fuel Type	Emission database as on 31.3.2007		CEA list at 31.1.2008	
	Installed Capacity (MW)	% of fuel to total	Installed Capacity (MW)	% of fuel to total
Hydro	1,320.20	10.97	2,796.00	9.07
Coal	3,232.50	26.86	16,095.30	52.22
Gas	4,053.20	33.68	7,611.43	24.69
Lignite	500.00	4.15	1,000.00	3.24
Diesel	189.90	1.58	106.00	0.34
Oil	1,037.00	8.62	306.00	0.99
Naphtha	1,702.00	14.14	2,909.87	9.44
Thermal	1,0714.60	89.03	28,028.50	90.93
Grand Total	12,034.80	100	30,824.50	100

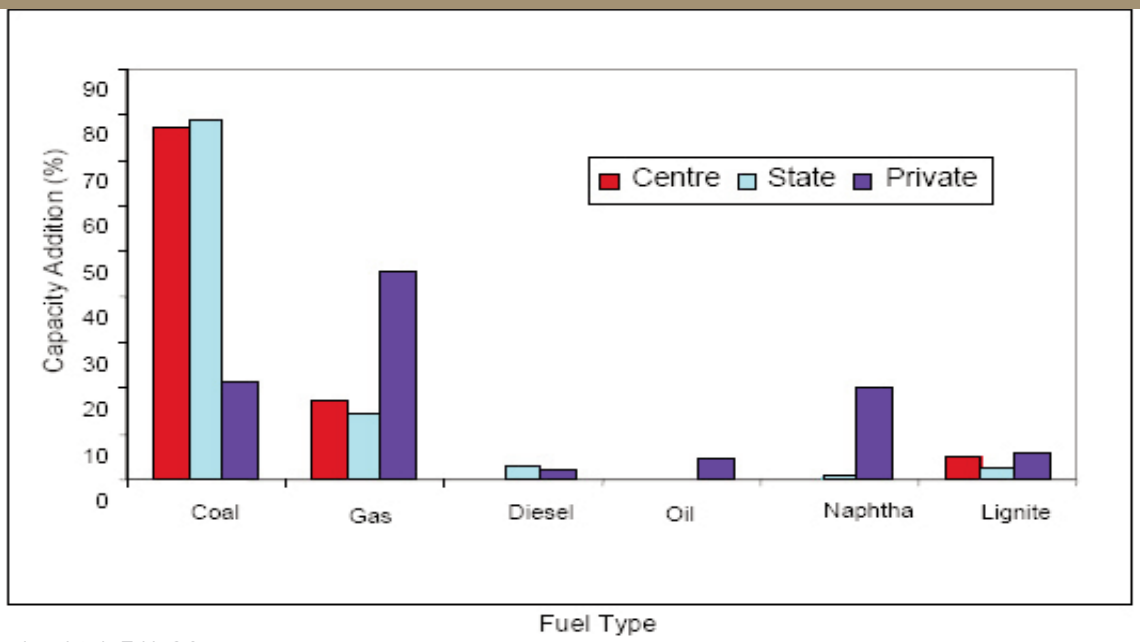
Source: CEA Emission Database & CEA List of Pvt Projects (http://www.cea.nic.in).

Table 2.6. Thermal Capacity Addition by Fuel post-1991

	Centre	State	Private
Coal	12,470 (77.14)	13,255.00 (78.96)	1,807.5 (21.47)
Gas	2,855 (17.66)	2,469.10 (14.71)	3,832.43 (45.52)
Diesel		492.42 (2.93)	189.9 (2.26)
Oil			387 (4.60)
Naphtha		120.00 (0.71)	1,702 (20.22)
Lignite	840 (5.20)	450.00 (2.68)	500 (5.94)
Total	16,165 (100)	16,786.52 (100)	8,418.83 (100)

Source: CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

Figure 2.3. Thermal Capacity Addition by Fuel post-1991 (%)



Source: Based on data in Table 2.6.

Post-reform, gas has been the preferred choice of fuel (Table 2.6, Figure 2.3). This is due to several reasons. The private sector has a preference for gas-based technology due to its lower capital costs and shorter gestation period. Second, fiscal incentives have been given to the private sector by the state governments in Gujarat and Andhra Pradesh, which are the leading states in gas-based plants. Third, private gas or cogeneration power stations cater to industrial consumers who can afford substantially higher gas prices than users in the public sector. Finally, most of the gas-based IPPs and large captive plants are located in the western region, mainly Gujarat. The region has a large amount of industrial consumers due to the presence of major industrial complexes. Industrial consumers prefer to buy power from the IPPs at a higher price, in return for high-quality power and uninterrupted supply.

Another non-negligible observation from this data is that the private sector is willing to invest in non-hydroelectric renewables. About 40 per cent of the installed capacity of the private sector is in this mode. Given that the Government of India sees huge potential for investments in renewables (Table 2.7), the power sector reforms have created space for private entry in this mode, as the public utilities are cash-strapped and have traditionally no comparative advantage in this field, with only 0.85 per cent of the public sector installed capacity in renewables.

In order to promote renewable energy in the country, various states have adopted a renewable portfolio obligation (RPO) with feed-in tariffs. RPO is a very important provision in the Electricity Act, 2003 to promote electricity generation from cogeneration and renewable energy sources. Subsequent to the enactment of the Act, the State Electricity Regulatory Commissions (SERCs) have specified an RPO, feed-in tariffs and other terms and conditions. The implementation of the RPO as envisioned in the Act is to be guided by the regulatory provisions issued by the respective SERCs. A number of SERCs have specified such an obligation as a proportion of total procurement of power by the distribution companies. The SERCs are also empowered to prescribe a tariff for electricity procurement from such sources, unless these are procured on a competitive basis. The feed-in tariff specified for electricity procured under the RPO is of a cost-plus nature. The basis for tariff determination by the respective SERCs generally includes a justifiable investment in an appropriate technology, an inflation-indexed variable cost, a normative debt-equity ratio and a "reasonable" rate of return on equity. While a normative 70:30 debt-to-equity ratio is adopted, the "reasonable" rate of return on equity ranges between 14 per cent and 16 per cent. Private developers of renewable energy sell electricity to the utilities on an MoU basis as per the agreed power purchase agreements, These agreements are now guided by the feed-in tariffs specified by the SERCs.

Table 2.7. Grid Interactive Renewable Power

Source/Systems	Cumulative Achievements (MW) 31.12.2007	Estimated Potential (MW) in 2032
Bio Power (Agro residues)	605.8	61,000
Wind Power	7,844.57	45,000
Small Hydro Power (up to 25 MW)	2,045.61	15,000
Cogeneration-bagasse	719.83	5,000
Waste to Energy	55.2	7,000
Solar Power	2.12	50,000
Sub Total	11,273.13	183,000

Source: MNRE and National Electricity Plan, CEA.

However, there are many incentive problems with the current power purchase agreements as well as with tariff-setting procedures. Singh (2007*a*) identifies the following problems in the existing system of RPO to promote renewable energy: it reduces incentives for cost minimisation by energy producers and stifles innovation and technology development in order to reduce costs; in addition, in a rate-of-return regulatory framework, information asymmetry is a challenge for regulatory institutions, which allow costs that are deemed to be "reasonable". The rate of return regulation is also criticised for overinvestment and the lack of incentives for improving efficiency in operations.

Problems Faced by Renewable Energy Developers

The Central Electricity Regulatory Commission (CERC, 2008) in its discussion paper has pointed out the following problems faced by renewable energy developers:

- In most cases, the non-conventional energy is to be purchased by the state utilities at a fixed, single-part paise/kWh tariff. Developers complain that with the plant costs having gone up in recent years, the specified tariffs are no longer remunerative.

- State utilities discourage grid absorption of non-conventional generated electricity in the following ways:

  (a) State utilities are reluctant to purchase non-conventional energy because its tariff is higher than the average cost of power procured from elsewhere, and its generation pattern has no relationship with the grid load profile. State utilities also resent the provision of escalation in tariffs for energy from renewable sources in spite of the assets being depreciated.

  The unpredictability and non-dispatchability of non-conventional generation are other features which make State utilities averse to its absorption in the grid.

  (b) In many cases, the distribution utilities resent power exports and try to block the granting of open access to generators based on non-conventional sources, with the intention of forcing them to sell the energy to the utilities at a dictated price.

- Non-conventional generators are effectively discouraged from seeking open access for the following reasons:

  (a) In terms of inter-state and intra-state open access, state utilities do not apply unscheduled interchange (UI) in a reciprocal manner. An over-supply by a captive/non-conventional plant is seen as gaming and is only paid for at a low rate, or is not paid for at all. An under-supply, on the other hand, is seen as a serious default and is sought to be penalised.

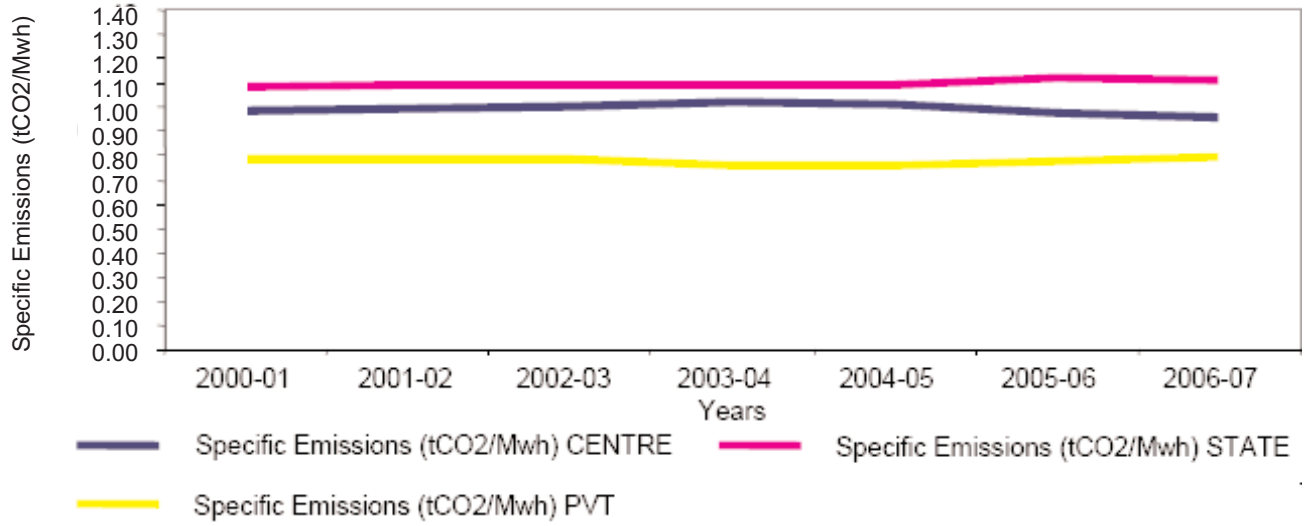
  (b) Advance scheduling is a strict pre-requisite for inter-state open access that allows dispute-free operation of the entire system; however, this is a problem for non-conventional energy producers whose generation can vary, even on an hourly basis, and is highly unpredictable in many cases.

2.1 Specific emissions: Trends

We examine here the impact of reforms on emissions by looking at the trends in average emissions for different ownerships of generation capacity. As plants are of different vintages and there are limitations in making comparisons solely on the basis of average emissions, we econometrically test the impact of ownership and other plant characteristics, such as fuel and vintage, on specific emissions.

Figure 2.4 provides a comparison of pollution intensities for all thermal plants in the state and central utility sector versus the private sector. Since this comparison is not controlled for vintage, it is possible that the emissions are low for the private sector plants as they were commissioned later, and the old plants in the state and central sector have not been upgraded. Another

Figure 2.4: All-India Specific Emissions in Thermal Plants by Sector

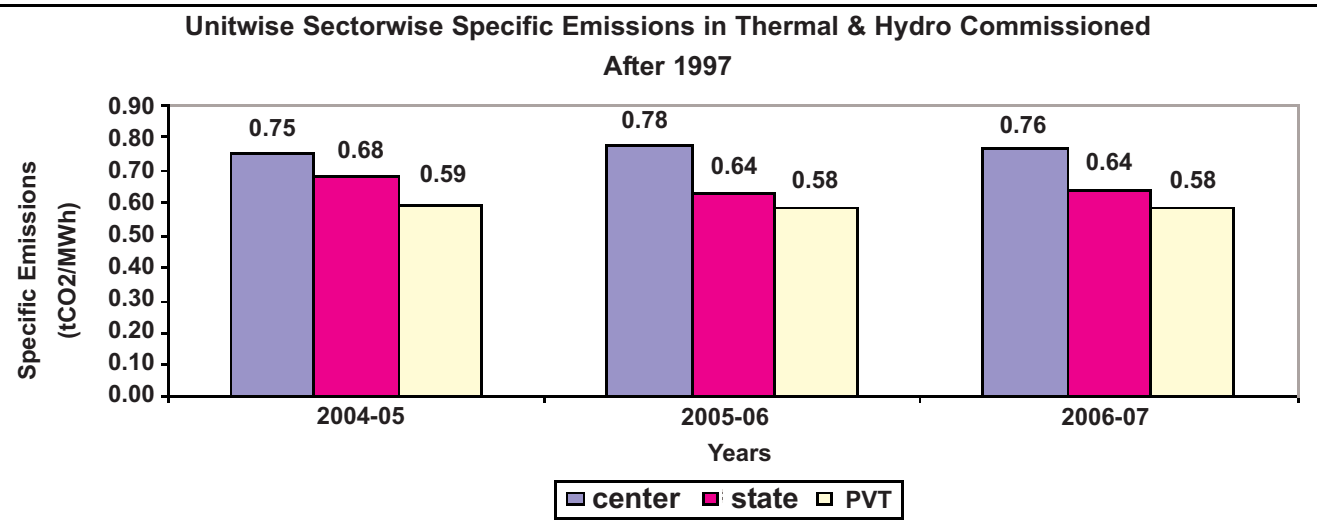


Source: Based on CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

explanation could be fuel choice, with the private sector opting for more gas-based plants that have lower pollution intensity than coal.

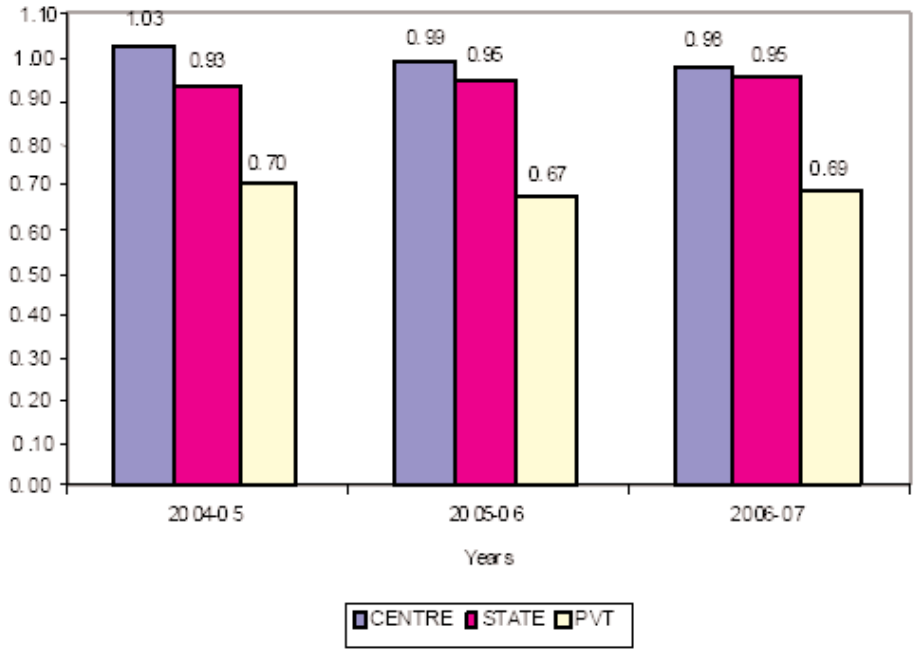
Figure 2.5 resolves the vintage problem. For all plants that were commissioned after 1997, we aggregated across their absolute emissions, as well as their net generation, to arrive at an aggregate specific emission number by ownership. A similar exercise was done to arrive at specific emissions (Figure 2.6). We took into account hydro plants so as not to penalise the state sector that has increased its hydro composition post-reforms.

Figure 2.5: All-India Specific Emissions for all Plants (thermal and hydro) Commissioned after 1997 by Sector



Source: Based on CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

Figure 2.6: All-India Specific Emissions for Thermal Plants Commissioned after 1997 by Sector



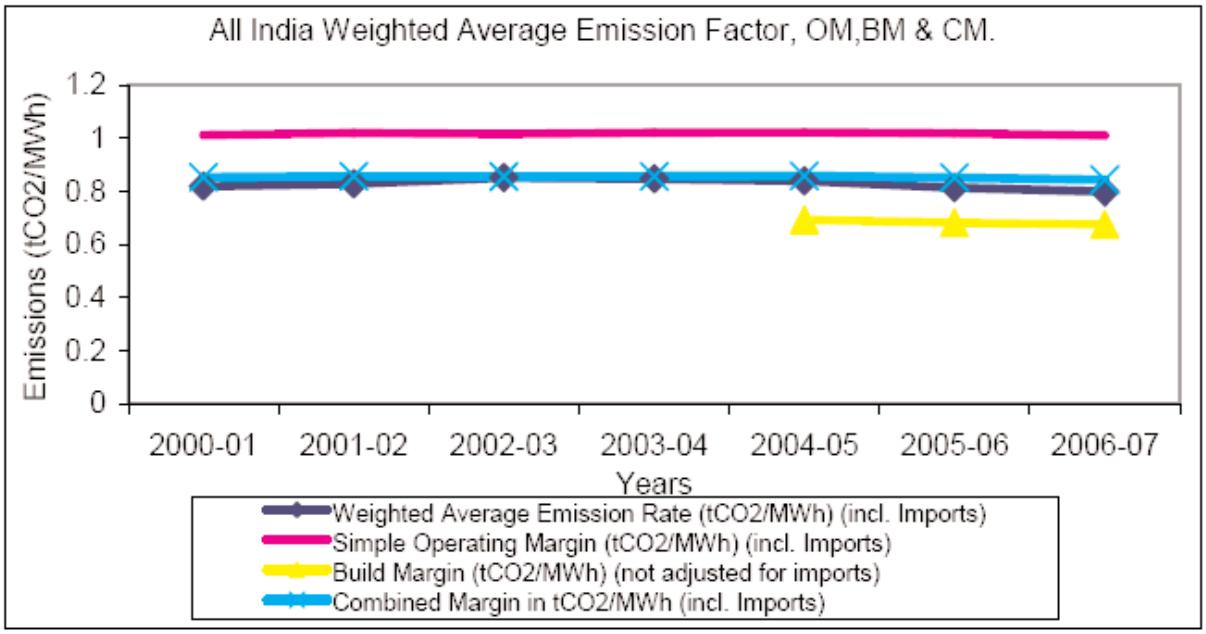
Source: Based on CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

If we look at the specific emission data for the three sectors, the private sector has the lowest, followed by the state and central sector; a similar pattern emerged after removing hydro plants from the portfolio, with the private sector emerging as the best. Thus, despite the fact that the private sector has not invested in hydro, the pollution intensity of its plants is lower than in the state- and centrally-owned generation utilities.

We also checked the performance of each sector for the units commissioned after 1997 vis-à-vis their pollution intensity for each of the important fuels to see how, for similar fuel and similar vintage plants, emissions differ with ownership. For coal-based plants, the central sector outperformed the state as well as the private sector, whereas for gas, the private sector had the lowest emissions per unit of electricity generated. The central sector coal plants under NTPC¸ India's largest power company, have taken steps to control specific emissions by the use of superior quality coal, an improved use of fly ash and the use of the latest technology. In order to reduce carbon dioxide emissions, efforts are being made to use washed coal or imported coal blended with normal coal. High-efficiency Electro Static Precipitators have been installed, along with higher plate spacing coupled with the latest control systems in most NTPC plants, which have helped reduce emissions. NTPC has established the Centre for Power Efficiency and Environmental Protection (CenPEEP) in collaboration with USAID to reduce GHG emissions from Indian thermal power plants by promoting efficient power generation technologies. During the Eleventh FYP period (2007-12), an aggregate capacity of 6,600 MW based on supercritical technology is to be commissioned, which will lead to a reduction of 0.8 million tonnes of CO_2 per annum. All NTPC plants are sized in order to limit suspended particulate matter emissions to 50mg/nm3 in compliance with World Bank norms.

Hydro development is being given an increased thrust with 1,920 MW under implementation and 4,791 MW at the planning stage, which would bring about cleaner power.

Figure 2.7: Specific Emissions – Macro Picture



Source: Based on CEA Emission database Version 3 from CEA Website (http://www.cea.nic.in).

Two measures used to capture the emission trends are:

- The weighted average emission factor, which describes the average CO_2 emitted per unit of electricity generated in the grid.

- The build margin, which is calculated as the average intensity of the 20 per cent most recent capacity additions in the grid based on net generation.

From a macro perspective, average emissions per unit of generation of power have fallen marginally over the period. This indicates that the reforms have not had a substantially positive impact on the environment. The environmental benefits in India have been limited due to the continued reliance on coal-fired combustion. The installed capacity in hydro plants has in fact declined over the period of reform, while the installed capacity in coal has only marginally declined (Table 2.8). While the installed capacity of gas-based plants has increased over the period of reform, it has not been sufficient to offset the coal-fired plants. The decline in pollution intensity of the recent capacity addition captured in the "build margin" is due to the use of internationally sourced technology, better operational performance and fuel choice. The build margin is calculated in this database as the average emission intensity of the 20 per cent most recent capacity additions in the grid, based on net generation. Depending on the region, the build margin covers units commissioned in the past five to ten years.

Table 2.8: Percentage of Fuel Mix in the Total Installed Capacity (Utilities only)

Mode of Generation	31-3-91	31-3-97	31-3-00	31-3-07
Hydro	28.38	25.24	24.37	26.19
Steam	65.07	63.12	61.15	53.75
Gas	3.86	7.65	9.80	10.35
Diesel	0.27	0.34	0.76	0.91
Thermal Total	69.21	71.11	71.71	65.00
Nuclear	2.37	2.59	2.74	2.95
Renewable Sources of Energy	0.05	1.05	1.18	5.86

Source: All India Electricity Statistics, General Review, CEA, New Delhi.

2.2 Econometric Analysis of Factors Influencing GHG Emissions

2.2.1 Data and Methodology

We analyse the emissions data from the CEA database for grid-connected power stations in India, compiled for the purpose of CDM baselines. It provides data on net generation and specific emissions for all grid-connected power stations that have an installed capacity above 5 MW in the case of hydro and above 10 MW for other plant types. The data covers power stations of both public utilities and IPPs.

For each power station, data is available on the following:

- Commissioning date: the commissioning date is provided for each unit.
- Capacity: capacity data is based on declared rated capacities in MW for each unit as of 31st March 2007.
- Region: regional grid to which the station is connected.
- Sector: this denotes the ownership status, i.e. centre, state or private.
- Type: this indicates the type of station, i.e. thermal, nuclear, hydro.
- Fuel: Fuel 1 and Fuel 2 indicate the main fuels used for power generation at each station.
- Net generation of the station in GWh.
- Absolute carbon dioxide emissions in metric tonnes.
- Specific carbon dioxide emissions in tCO_2/MWh, for the financial years 2000-01 to 2006-07.

The data on 153 thermal plants is analysed to estimate the influence the ownership of a plant has on specific emissions, after controlling for other factors like capacity and vintage. A lower average of specific emissions from the plants owned by a particular sector indicates a lower intensity of pollution in power generation.

The analysis so far suggests that private plants have the lowest specific emissions followed by central- and state-owned plants. There are many reasons why one expects lower emissions from private plants, the primary ones being the choice of clean fuels such as gas that have lower pollution intensity than coal, and the age of the plant, with these plants being newer than state- and centre-owned plants. Calculations of vintage from the data show that the average vintage of private plants is about 11 years, compared to 17 and 18 years for the central- and state-owned plants respectively. On the other hand, the centre has a legacy of coal-fired plants and both state and central plants are older and possibly not upgraded. To disaggregate the effect factors besides ownership, such as

differing fuels, vintage and plant capacity, we use an econometric approach. (Annex 1 contains details of results). The hypotheses we test are:

- Private plants have lower specific emissions and are, therefore, less polluting.
- Newer vintage plants have lower specific emissions.
- For newer vintage plants, the private sector is more likely to choose gas as a fuel.

For the analysis, two regression models have been specified: Model I specifies specific emissions as a function of various characteristics of a plant, i.e. capacity, vintage, fuel used and ownership. This model looks at the impact of ownership on specific emissions after controlling for capacity and vintage. Model II is used to analyse how fuel choice depends on the ownership of a plant, after controlling for capacity and vintage.

The data set available is panel data that has both space and time dimensions. To begin with, a panel regression of 153 plants for 7 time periods was considered. Based on a preliminary analysis of the appropriate modelling framework, we have used the pooled regression model in this analysis. The model assumes there is no unobserved effect and that the intercept and slope coefficients are constant over time, with the error term capturing differences over time and individuals. The model (Model I) is of the form:

$$Y_{it} = x_{it}\beta + c + \mu_{it}$$

In our analysis, specific emissions in tCO_2/MWh is the dependent variable; the independent variables are capacity, vintage, fuel and ownership.

For the six fuel categories, namely Coal, Diesel, Gas, Lignite, Naphtha and Oil, six dummy variables (F_k) have been generated, out of which the dummy for coal has been excluded from the regression equation to serve as a benchmark category for comparison purposes. Similarly, the centre has been omitted to serve as a reference category out of three sector dummies (S_k) for the centre, state and private sectors.

Vintage has been calculated from the data available on capacity and the commissioning date of a plant unit. To arrive at a proxy for vintage, the age of various units (as in 2007) has been weighted by their respective capacities in order to obtain the weighted age of units.

The results of the pooled regression estimation are presented in Annex 1, Table I.

The choice of fuel by a sector is an important factor in determining emissions from the plant owned by that sector. Lower emissions from plants owned by a particular sector could be due to the choice of a cleaner fuel. Fuel choice, in turn, is expected to be affected by plant ownership. For example, easy access to gas compared to coal may induce private players to opt for more gas plants than coal plants. To further explore the relationship between fuel choice and plant ownership, we specified a multinomial logit model.

Fuel choice is an outcome with six categories, i.e. coal, diesel, gas, lignite, naphtha and oil. We are analysing three independent variables – the capacity, vintage and ownership of plants. It is expected that vintage may affect fuel choice, as some fuels like gas have become available only recently. Similarly, larger capacity plants may choose fuels like coal rather than gas. We have examined the effect of ownership on fuel choice as follows (Model II):

$$\text{Log (P (F = Diesel)/ P (F = coal))} = b_{10} + b_{11}\text{capacity} + b_{12}\text{vintage} + b_{13}\,S2 + b_{14}\,S3$$

$$\text{Log (P (F = Gas)/ P (F = coal))} = b_{20} + b_{21}\text{capacity} + b_{22}\text{vintage} + b_{23}\,S2 + b_{24}\,S3$$

$$\text{Log (P (F = Lignite)/ P (F = coal))} = b_{30} + b_{31}\text{capacity} + b_{32}\text{vintage} + b_{33}\,S2 + b_{34}\,S3$$

$$\text{Log (P (F = Naphtha)/ P (F = coal))} = b_{40} + b_{41}\text{capacity} + b_{42}\text{vintage} + b_{43}\,S2 + b_{44}\,S3$$

Log (P (F = Oil)/ P (F = coal)) = b_{50} + b_{51}capacity + b_{52}vintage + b_{53} S2 + b_{54} S3

Where the dependent variable is the log odds ratio of choice of a particular fuel relative to another, P (.) = probability of choosing (.), F = fuel type, S2 = 1 for central sector plants and zero otherwise, S3 = 1 for private sector plants and zero otherwise.

In the above specification, we take coal as the base fuel and, out of three sector dummies, the state sector as the benchmark category. The results are presented in Annex 1, Table II.

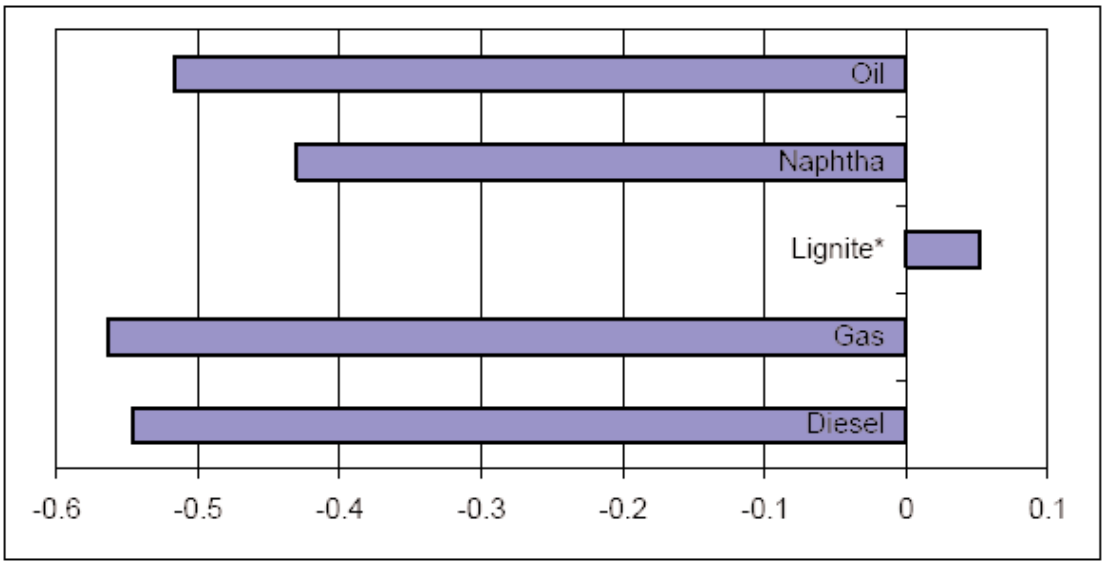
2.2.2 Regression results

The results of the pooled regression show that as vintage goes up by 1 year (plant is older by one year), the average specific emissions go up by 0.01 units. All the fuel dummy coefficients are individually statistically significant. Holding other variables constant, compared to coal, gas has the lowest specific emissions followed by diesel, oil and naphtha, whereas in the case of lignite, emissions do not significantly differ from coal.

For the effect of ownership, the results show that, holding other variables (vintage and fuel) constant, the average specific emissions from private plants are not statistically different from centrally-owned plants. Keeping the other variables constant, the average specific emissions from state-owned plants are significantly higher compared to plants owned by the centre.

These results are illustrated in Figures 2.8-2.9 below.

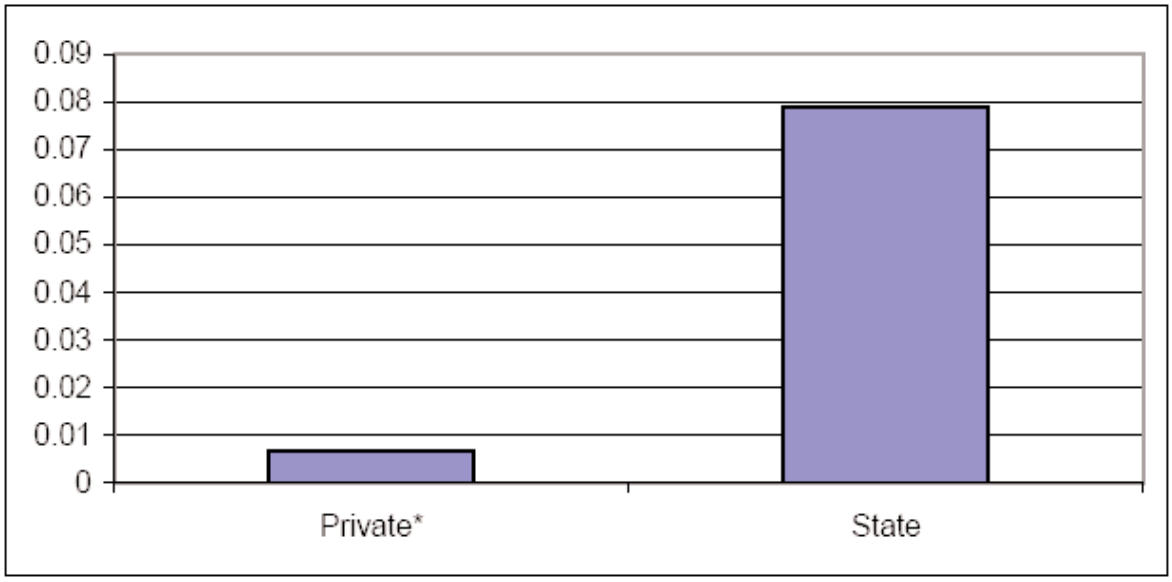
Figure 2.8: Impact of Fuel Choice on Specific Emissions Relative to Coal: tonnes of CO2 per MW Generated



Note: *reflects that the estimated coefficient is not statistically significant.

Source: Authors' calculations.

Figure 2.9: Impact of Ownership on Specific Emissions Relative to Centre-Owned Plants: tonnes of CO_2 per MW generated



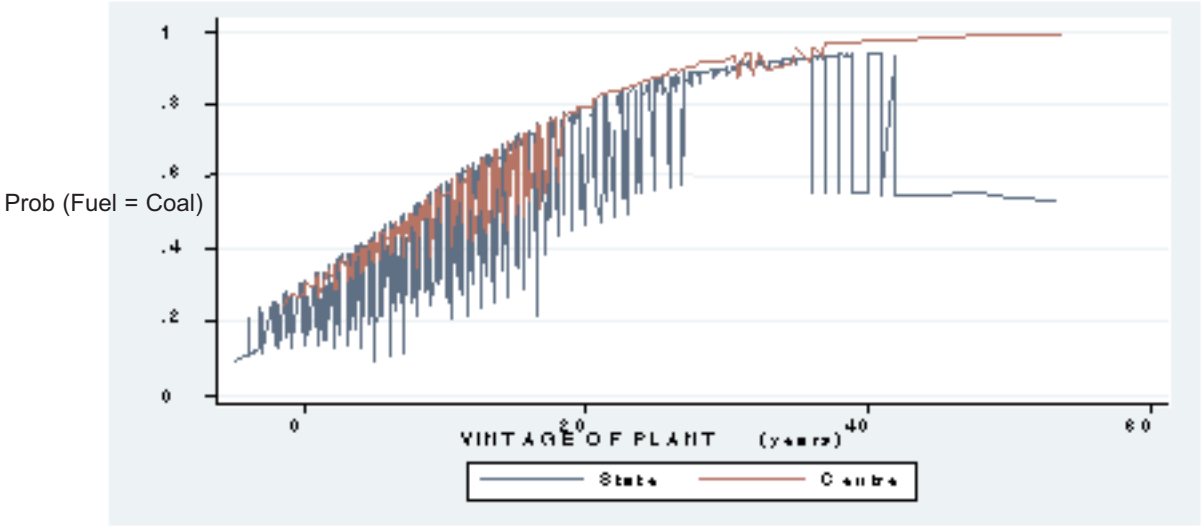
Note: *reflects that the estimated coefficient is not statistically significant.

Source: Authors' calculations.

The multinomial logit regression results (Annex 1, Table II) show that the chances of choosing cleaner fuels like gas and oil are higher for private plants compared to the state. For instance, as compared to coal, the log odds of choosing gas are significantly higher for the private sector than the state. Similarly, the log odds of choosing oil are also significantly higher for private sector plants. While for centrally-owned plants the odds of choosing gas are not statistically significant in comparison to state plants, the centre's chances of choosing polluting fuels like lignite are significantly higher.

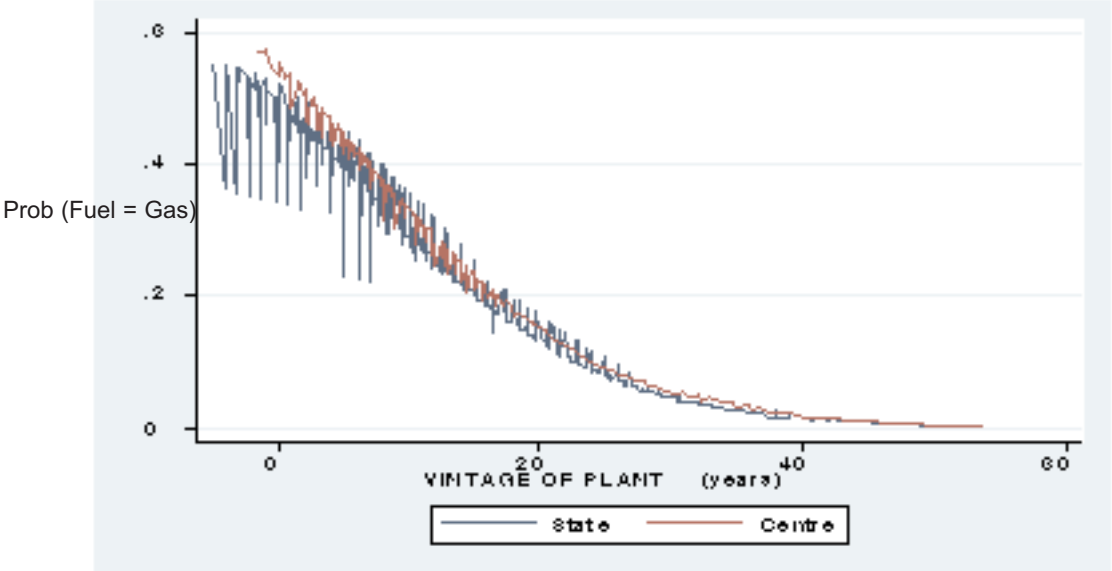
The relationship between vintage and choice of fuel is depicted in Figures 2.10 and 2.11, which show that with newer vintage, the probability of choosing cleaner fuels like gas increases for both the state and private sectors, and the probability of choosing polluting fuels like coal decreases. For all the years, the probability of choosing coal has been lower for the private sector than for the state. Similarly, a comparison of the relationship between vintage and emissions for the state vs. the centre (Figures 2.12 and 2.13) shows that with newer vintage, the probability of choosing coal decreases and, for almost all years, the probability of the state choosing coal is higher than for the centre.

Figure 2.10: Probability of Choosing Coal by Plant Vintage: State vs. Centre



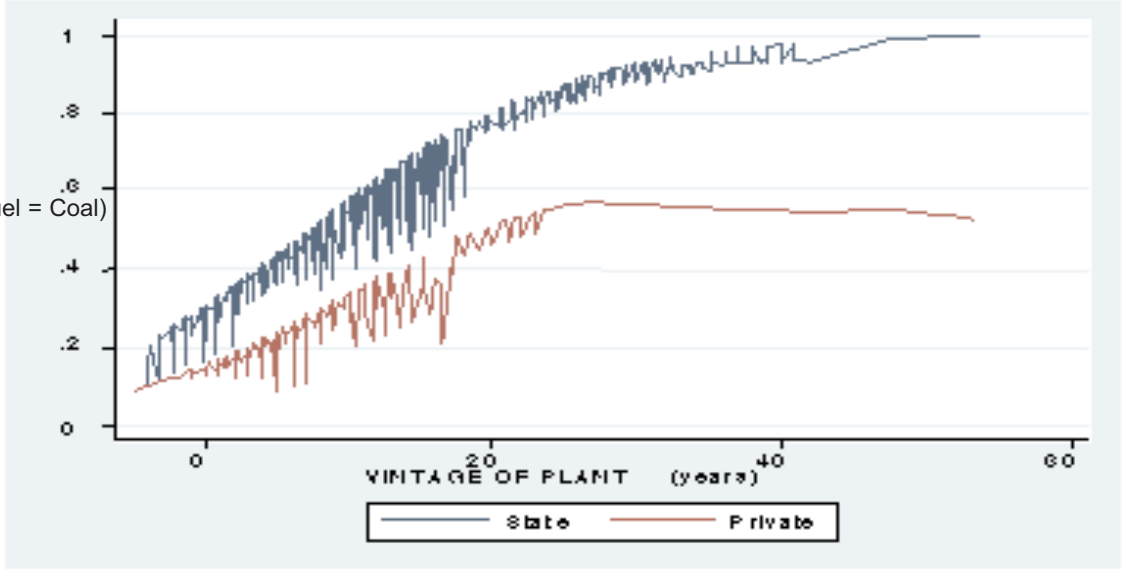
Source: Authors' calculations.

Figure 2.11: Probability of Choosing Gas by Plant Vintage: State vs. Centre



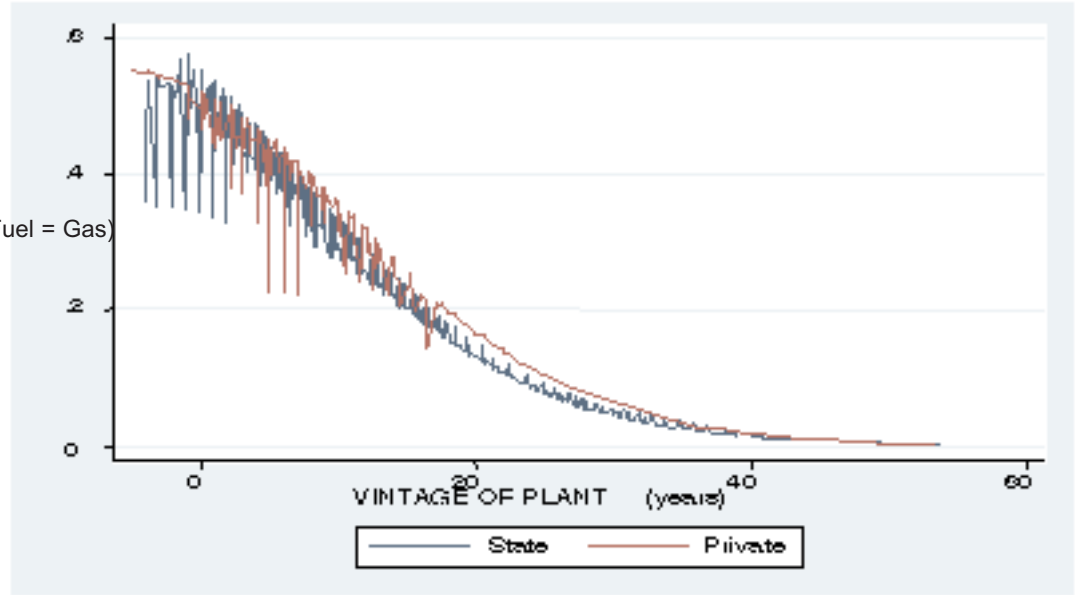
Source: Authors' calculations.

Figure 2.12: Probability of Choosing Coal by Plant Vintage: State vs. Private



Source: Authors' calculations.

Figure 2.13: Probability of Choosing Gas by Plant Vintage: State vs. Private



Source: Authors' calculations.

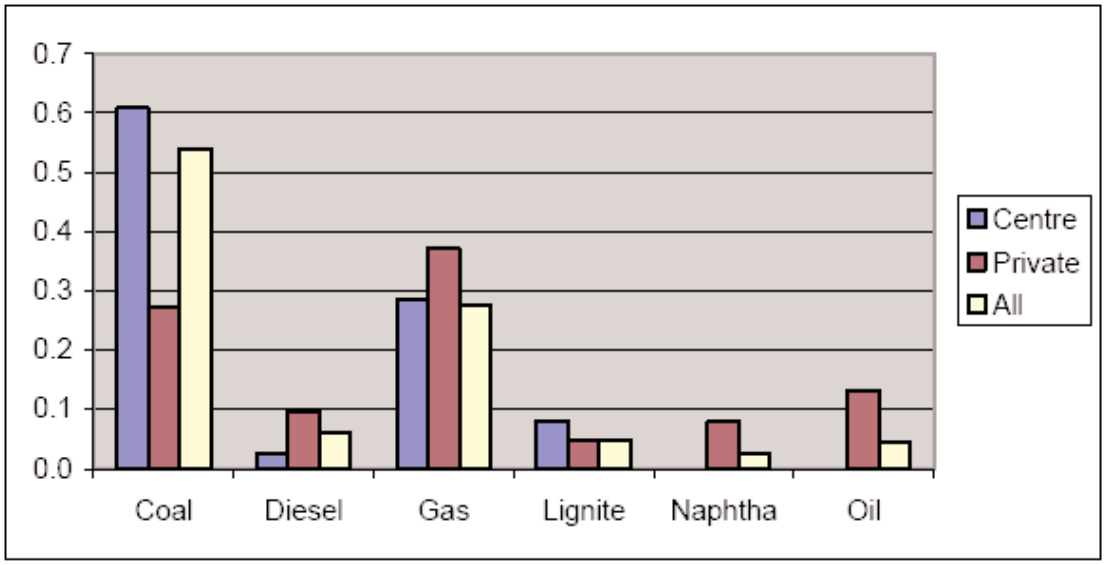
The predicted probabilities for choosing various fuels by the central and private sectors are illustrated in Figure 2.14.

The estimated relationship shows that an average capacity private sector plant has higher chances of choosing a cleaner fuel compared to other sectors.

There are significant differences in specific emissions between state government-owned power plants and private sector plants, but the difference between private sector plants and centrally-owned plants is not statistically significant.

Overall, therefore, the experience of India provides ambiguous support for the idea that the policy of involving independent power producers in developing countries can alone bring environmental gains. This analysis is limited by the fact that there is very little progress made by IPP developers in adding new generating capacity and, in the long term, by the likelihood that a significant share of capacity will be fired by coal. Though the regulatory and policy framework for attracting private investments in power is in place, the unattractive creditworthiness of the utilities is a severe hindrance for an actual inflow of investments. Moreover, the policies governing open access to transmission and distribution networks have only recently been instituted. These policies are crucial for setting up private plants as investors need to have access to paying customers.

Figure 2.14: Probability of Fuel Choice for each Fuel by Ownership for an Average Capacity Plant



Source: Authors' calculations.

3. Privatisation of Electricity Distribution: the Delhi Experience

3.1 Introduction

The distribution of electricity has remained a politically sensitive segment of the electricity sector as government interventions in tariff-setting have led to both cross-subsidisation, as well as overall subsidisation of the sector. The reform agenda has led to the unbundling of the generation, transmission and distribution of electricity in many states of the country and an expectation that distribution may also see private sector participation or operation.

In this section, we examine the Delhi power sector reforms and, specifically, its privatisation component. The main objective here is to point to the gains from the reforms with respect to the reduction in technical and distribution losses of electricity.

The objectives of Delhi power sector reforms were spelled out in the "Strategy Paper" brought out by the Delhi government in 1999 and in the Preamble to State legislation – the Delhi Electricity Reforms Act, 2000. The reforms had three components: regulatory reform, sector restructuring and the privatisation of distribution. We focus here on the privatisation of distribution.

Regulatory reforms – government exiting regulation by setting up an independent regulator – were effected in pursuance of the national policy as laid down in the Central Act of 1998. But the two other components – sector restructuring and distribution reforms – were taken up by the state ahead of (probably in anticipation of) wide-ranging policy prescriptions at the national level that culminated in the central Electricity Act, 2003.

3.2 The National Scene

Private urban electricity distribution in India has a history stretching over a century; the reasonably efficient private distribution arrangements operating in Ahmedabad and Kolkata date back to the first decade of the 20th century and that of Mumbai to the 1930s. Delhi itself had a private electricity distributor until it was replaced in 1951 by an Electricity Board, set up under a 1948 law that provided for an institutional structure under the government for the rapid expansion that the sector would undergo after the country's independence. This Board underwent some changes, chiefly in nomenclature, along with periodic constitutional changes involving the capital area. At the time of privatisation, it was called the Delhi Vidyut Board (DVB).

Nationally, the first major change to this public sector-dominated arrangement took place in 1991 when the whole sector was thrown open to private (including foreign) investment. This, and the liberalisation measures that followed, have enabled a growing private presence in electricity generation and, on a smaller scale, joint venture transmission projects.

As for the distribution segment, however, bringing in private players through the disinvestment of public entities has

been attempted sparingly, and has only been successful in three instances: in a small suburb of Delhi, in Orissa and via the major initiative in the national capital.[9] In general terms, the very limited interest by private parties to take up distribution and the lack of adequate political commitment to privatise can account for the meagre progress. The first of these reasons was evident in both Orissa and Delhi; in terms of the latter factor, the case of Delhi is special in some respects.

3.3 The Delhi Initiative

All aspects of the privatisation exercise in Delhi carried heavy political overtones. This point needs to be stressed at the outset, as most of the perceived drawbacks of the privatisation design that we shall be considering later in this chapter could be traced to the political context. A basic chronology of the reforms is given in Annex 2.

3.3.1 Deterioration Preceding the Decision to Reform and Privatise

The decision to privatise electricity distribution in Delhi was forced on the political establishment by the state of crisis that the sector had reached. The distribution segment of India's electricity sector had touched low levels of efficiency in all states, but the deterioration in Delhi was acute even by national standards. There were also certain specific factors adding to the complexity of the Delhi situation.

The most prominent aspect with regard to the decline in efficiency was the level of system energy losses, which at 49 per cent (touched in 1998) was the highest in the country. This level of losses was caused in part by a legal logjam in which the Delhi administration found itself with regard to the mushrooming of unauthorised low-income colonies (housing an estimated 3 million of the capital's 10 million plus residents), as well as innumerable instances of commercial or industrial use of property officially earmarked for residential purposes only. Laws[10] dating back 40 years prevented the electricity utility from granting official connections to such colonies and enterprises, a limitation that was circumvented on the ground by devious means, including outright illegal tapping from the distribution mains.

However, the bypassing of the official authorisation requirement for electrical connections was boosted by constitutional changes that upgraded the capital to a "state" within the Indian union and set up an elected legislative assembly in 1993.

Within the organisation, an effective loss of control over the field distribution and the steady deterioration in its finances led to underinvestment in augmenting and upgrading the assets. In addition to all these problems, the tight power supply scenario of the country's northern power grid led to acute shortages in supply, especially in the peak summer season.

It may be noted here that at the time of the reforms, the total generating capacity of power stations owned by Delhi was less than a third of the utility's base-load requirement, the remainder being met by the state's share in central generating stations located in the northern electricity region. For the peak power requirements, which are particularly high in summer and winter given the climatic pattern, the state was dependent on bilateral arrangements with adjacent states that had surplus (mainly hydro) power to spare.[11] An added constraint was that the very limited capacity that the state possessed was made up of old coal-fired units that were prone to frequent breakdowns and were generally operating much below the rated capacity.

[9] The negotiated induction in 1994 of a private distributor in the Delhi suburb of Greater Noida (part of the state of Uttar Pradesh) is on a very small scale and is not really comparable to the case of the national capital proper that we consider here.

[10] The Delhi Electricity Control Order (DECO), in force from 1959, which was largely withdrawn in 1999 in preparation for the reforms.

[11] This position continues even today, with the change that, in addition to bilateral arrangements, the purchase of "traded" electricity (under a "trading" system brought into force in 2002) is now a significant source for meeting the state's needs.

3.3.2 Implementing the Reforms

The "Strategy Paper" on reforms reflected both the sense of urgency and the willingness to take bold initiatives, including disinvestment. The four following reform objectives spelled out in the paper carried a clear indication of what the disinvestment was expected to bring about:

- The need for new investments to meet demand ("absolutely imperative to meet a maximum demand of 3,500 MW by 2002 in order to stave off a major catastrophe").
- To reduce the alarmingly high levels of power theft ("unmatched in any other part of the country or even the world").
- To improve sector finances ("DVB's extremely precarious financial position").
- To supply power on a reliable basis; modernise the power system; avoid frequency dips caused by a "peculiar load curve".

The privatisation of public services and utilities is a politically sensitive issue in India even today, and was much more so 10 years earlier. Despite this public sentiment, the aim to privatise was spelled out in the Preamble to the Delhi Electricity Reforms Act, 2000 (DERA) that listed two key objectives of the legislation that were necessary (but not sufficient) in order to achieve two aims: (a) to "depoliticise" the tariff process, and (b) to increase investment levels.

The measures identified to bring this about relate, respectively, to the setting up of the Delhi Electricity Regulatory Commission (DERC) and the promotion of private sector participation in the sector. The Preamble also spelled out the aim of "unbundling" (restructuring) the sector and echoed the Strategy Paper in regard to the need for the industry to be managed "in an efficient, commercial, economic and competitive manner".

The Reform Act was first brought into effect (October 2000) by the publication of an Ordinance – a relatively less-used constitutional provision – and was regularised through a vote in the State legislature soon after (March 2001).

Again, reflecting the urgency, an invitation for bid pre-qualification was issued in February 2001, and the selection process proper was set in motion in May 2001 by pre-qualifying six of the seven bidders who responded. In parallel with the selection process, "restructuring" was pushed through by disbanding the public utility (July 2001). In order to avoid technical delays in the actual induction of private agencies into the allotted distribution zones, shell companies were also set up by the government.

Exactly one year later, the Transfer Scheme was operationalised and the management was handed over to the two distribution companies (Discoms) under private management (technically, three separate companies: two of them belonging to the BSES group, which is owned by Reliance Energy, and the third belonging to the Tatas).

3.3.3 The Privatisation Process

We referred earlier to the Strategy Paper issued by the government, outlining the plans to re-organise and reform the sector. Most (but not all) of the concepts that figured in the Strategy Paper guided the subsequent actions towards reform. Underpinning the privatisation process were:

- The enactment (DERA) that, apart from providing for the main features of the re-organisation of the sector, also vested the state government with wide powers to determine all the provisions of the privatisation and to implement the scheme in full.
- The Transfer Scheme Rules (TSR) notified by the government (20th November, 2001) under the enacted powers; these Rules basically specified detailed arrangements for the transfer of the assets and liabilities of DVB among six successor entities.
- The Policy Directions, also issued by the government

(22nd November, 2001) in exercise of the same powers. These spelled out basic principles that would govern the functioning of the power sector in all respects, including the setting of tariffs – hence binding for the regulator as well – over the Transfer Scheme period (from the date of privatisation until 31st March, 2007).

The signing of the "Shareholders' Agreement" drawn up along the lines specified in the TSR by the Discoms and the government entities on 27th June 2002 cleared the way for the full operationalisation of the Transfer Scheme. The Discoms, which became effective at midnight on June 30th 2002, came under private management.

3.3.4 Notable Design Features

The reforms in Delhi had the benefit of experience from the reforms in Orissa and, as a result, the reform strategies attempted to remove confusion, upfront, over the actual starting level of system losses and to specify the phased improvements to be achieved in this area. On the first point, the virtual absence of any unmetered "agricultural" load in Delhi was a major advantage that enabled the outgoing entity to measure the degree of losses with accuracy. The clubbing of transmission, distribution and collection losses into one unified index of Aggregate Technical and Commercial loss (AT&C loss) meant the figure was even more reliable for the intending bidders. It also made it easier to focus the whole bidding process on the target reductions to be achieved by the private entities.[12]

The third main point of difference in design – and a contentious issue in terms of whether it marked an improvement or not – was the adoption of the business valuation method to set the price paid by the private entrants for the transferred assets. The business valuation method set the price of each Discom on its expected future earning potential. This was done by taking into account the projected efficiency improvements and reasonable retail tariff adjustments, as well as the projected government assistance. The valuation assumed that the electricity business would become self-sustaining within five years. One result of valuation based on future earning potential was that the values set for the three Discoms (and hence the payout for the assets by the respective private players) varied widely.

Vagueness about the management control of the work force taken over by the private entity was a factor which contributed to the disputes that arose in Orissa. Delhi's success in getting most of the employees of the public sector entity absorbed into the new companies, thus working under the new private management, is also to be noted as a further element of improvement.

3.4 Key Features of the Reforms

Here we shall give a brief outline of five key features of the reforms of the sector in Delhi. The application of four of them was limited in duration to the Transfer Scheme period and thus ended by March 2007. We therefore also indicate the current arrangements.

3.4.1 Loss Reduction Targets

The most unique feature of the Delhi privatisation scheme is the use of a commitment to loss reduction as the basis for bid awards. An added feature is the clubbing of transmission and distribution (T&D) loss with that relating to collection efficiency in order to arrive at one composite index – Aggregate Technical and Commercial Loss (AT&C loss).

The bid invitations specified the minimum targets of AT&C loss reduction to be met in order for the bids to be eligible for assessment and award. AT&C loss reduction targets to be achieved each year were specified for each of the three areas into which the DVB system was redrawn. The Central

[12] The Orissa privatisation had run into difficulties with the distributors finding it difficult to bring down the levels of losses, the starting levels of which turned out to be much higher than were indicated in the bid. This led to the foreign agency that took up one of the three distribution areas actually walking out of the contract. While Delhi avoided this error, differing opinions have been expressed on whether a pre-committed annual loss reduction target was the best option in the circumstances (Agarwal *et al.*, 2003). This criticism is touched upon in Section 4.

East area had a higher loss level to start with and also accounted for a large share of the "unauthorised" clusters; the targets set here were consequently stiffer than for the two other areas.

As four of the six prequalified bidders opted out of the subsequent bidding, the awarding of the licences hinged on whether the offers of the remaining two matched or bettered the "minimum" targets set by the government.[13] The bids put in by the two firms that stayed in the race did not meet this "minimum" stipulation, technically opening up the possibility of the rejection of all bids. The government decided instead to negotiate with the bidders; this resulted in revised rates that were an improvement on those initially quoted, but still higher than the "minimum" that was specified in the bids. These revised rates were accepted as the basis for the award of the Discom licences, but with the proviso that for the purpose of rewarding Discoms if they improved on the year-wise targets for loss reduction, the targets originally specified in the bidding documents would apply.

Table 3.1 below presents the figures stipulated for AT&C loss reduction – the "minimum" targets specified in the bids and those mutually agreed.

For Financial Year 2007-08 onward, fresh AT&C loss targets have been prescribed for each Discom by DERC in the respective Tariff Orders (TOs) for the period 2008-2011.

3.4.2 Incentives

As noted, the loss reduction targets were specified on a yearly basis. An incentive/penalty formula entitled the distribution licensees to retain 50 per cent of the additional revenues from any reduction in AT&C loss over and above the minimum targets fixed by the government for the bids. The other 50 per cent gain shall be passed on to the consumers of the company. On the other hand, under-achievement in the loss level bid by the selected bidder would result in penalties, thus leaving a middle band of improvement that would neither bring incentives nor invite penalties.

In practice, it worked in the following manner: the "minimum" target set for the North-North West area (now NDPL) for Year 2 (2003-04) was to achieve a 5 per cent reduction in AT&C loss reduction. The mutually agreed revised reduction target for that year was 2.25 per cent. If the actual loss reduction were to exceed 5 per cent, NDPL would be entitled to retain half of the savings in excess of 5 per cent as profit. If, on the other hand, the loss reduction fell below 2.25 per cent, the loss on this account will be borne by the Discom by setting the tariffs on the assumption that the losses were reduced by 2.25 per cent. If, however, the actual loss reduction in that year fell between 2.25 per

Table 3.1: Percentage for Targets of AT&C Loss Reduction by Area

Details	North-North West (now NDPL)	South West (now BSES Rajdhani)	Central East (now BSES Yamuna)
Reported loss level#	49.5	52.1	61.1
Opening level set	48.1	48.1	57.2
Target set*	19.25	19.25	20.75
Target quoted*	17.00	17.00	17.25
Loss at end of 5 yrs	31.1	31.1	39.95

Represents the loss levels advised by DVB in respect of the distribution areas concerned. The government referred this to the electricity regulator which corrected these numbers to the lower levels shown in the next row.

* Figures show the minimum expected reduction in losses (in percentages) to be achieved by 2006-07, as stipulated in the bids. The next row shows the corresponding figures quoted by the successful bidders.

Source: Government of NCT of Delhi (2001) – Policy Directions.

[13] The minimum targets specified in the bids were set in consultation with the Delhi Electricity Regulatory Commission (DERC), which had scaled down the area-wise opening loss levels advised by DVB.

cent and 5 per cent, there would be neither incentives to be earned nor penalties to be borne.

The arrangements specified by the regulator for the post-Transfer Scheme period are similar; while the target loss reductions to be achieved each year vary among the Discoms, a 2 per cent middle band that would neither bring incentives nor invite penalties would apply uniformly to all three Discoms.

3.4.3 Arrangements for Bulk Power Supply to the Discoms

The Transfer Scheme mandated that Discoms will draw power from the government-owned Delhi Transco Ltd. (DTL), which had inherited the long-term Power Purchase Agreements (PPAs) contracted by DVB. The bulk power supplies covered Central Generating Stations (CGSs), Delhi's own generating plants and imports from other states/regions. The failure of reforms undertaken earlier in Orissa was seen as partly linked to a similar "single buyer" arrangement; the Orissa Discoms defaulted on their payments to the Transco (due to the fact that the loss reduction targets were not met) and the government failed to provide any assistance to Transco. In the Delhi reforms, DTL was subsidised by the government up to a pre-determined level through annual advances over the first four years of the Transfer Scheme period.

Also, unlike in Orissa where the arrangement through a single procurement agency was open-ended, in the case of Delhi this monopoly of DTL was limited to the Transfer Scheme period. Transco, which became effective in April 2007 (FY 2007-08), is simply a transmission company with no role in power procurement and the Discoms are free to access other sources of supply in order to meet their supply requirements, provided the purchase is approved by the Regulatory Commission. However, the Discoms found the transition difficult at this stage; DERC, on the directions of the government, has consequently apportioned DTL's long-term PPAs among the Discoms. A Coordination Forum (Delhi Power Procurement Group), under the aegis of DERC, has also been set up in order to meet the demands that come in addition to those contracted over the long term.

3.4.4 Tariff Structure and Subsidy Commitments

The pooling of the bulk power purchase through the Transco was linked to another key reform component: the uniformity of consumer category-wise tariffs across the three distribution areas over the Transfer Scheme period. By this arrangement, the subsidy to the sector – an essential requirement until the loss levels were brought down – could be channelled to Transco. This entailed differential pricing of bulk supply to the three licensees so as to neutralise the effect of differing operating costs and loss levels and keep the retail tariffs uniform. In practice, this meant that the bulk supply price paid by each Discom was worked out after all the other parameters – retail tariffs, operating costs of Discoms as well as Transco, investments approved and returns allowed on them – had been firmed up.

As noted, the government had pre-committed loan assistance to DTL for the subsidy. Since the accepted bids did not meet the set "minimum" of loss reduction, the amount of support, initially pegged at Rs.2,600 crore, was hiked to a ceiling of Rs.3,450 crore. The disbursement schedule of the loan was heavily front-loaded on the expectation that losses would progressively decrease and that by Year 5 (2006-07) they would be low enough for DTL to achieve the full cost of supply from the Discoms. Transco revenues were expected to support the loan repayment in later years.

After the Transfer Scheme period, DTL's residual current operations are self-supporting and the only assistance it

[14] As this equity contribution does not represent the creation of any assets, DERC has not taken this into account in setting the Return on Equity allowed in the DTL Tariff for 2008-11.

3.5 Progress in Achieving Objectives[13]

receives from the government is towards new investments. However, the subsidy it received under the Transfer Scheme has been converted from a repayable loan into the government's equity contribution to DTL.[14]

3.5.1 Investments in Generation Capacity

Investments in capacity addition were an area identified as being a high priority in the Strategy Paper. From the perspective of the privatisation of distribution, the more relevant area concerns investments in the distribution network. This will consequently be the focus of this sub-section. As for investments in generating capacity, we briefly note the following:

- The scope for expanding Delhi's own generation locally is constrained by land area limitations, fuel transport costs (for coal) and environmental considerations.
- As the state forms part of the country's northern power grid, it is entitled to a share of the new capacity added to the grid through central generating stations (CGS) that are located in the states of the grid.
- This share is determined through a laid-down formula that, based on the computation method adopted, is advantageous to a densely-populated metropolitan area such as Delhi.
- In terms of the actual sharing of power from CGSs, Delhi has been able to go beyond its quota by picking up part of a residual unallocated share of power (15 per cent of the capacity of each station which, in accordance with the formula mentioned, is retained for emergent needs); Delhi has also been drawing slices from the allocated shares of other states in the grid, which the latter choose to forego due to the high cost (as in the case of output by some of the Nuclear Power Corporation's units), and the more recent gas-powered stations.

Owing to these factors, while the situation of power supply in the northern grid remained grave – shortages stood at 10.4 per cent of demand for energy supply and 9.1 per cent under "peak" demand in 2007-08 – Delhi's own situation has shown a distinct improvement over the Transfer Scheme period.

3.5.2 Investments to Strengthen the Distribution Network

Investments in the distribution network had suffered much neglect under DVB. The Strategy Paper had estimated the overall investment needs for upgrading the generation, transmission and distribution facilities to be four to five times the then current (pre-reform) level of about Rs.400 crore per year.

Discoms took time to ramp up performance in this area. In the first full year post-privatisation (2003-04), there was a three-fold increase in total capital investment by the Discoms and by Transco compared to the previous (part) year (Table 3.2). However, this increase was far short of what was committed by the Discoms in their Tariff petitions to DERC. The default was chiefly on account of the two BSES companies on which a penalty of Rs.1 crore each was imposed by DERC for poor performance in 2003-04; in that year, the shortfalls for the BSES companies were as high as 73-74 per cent of the amounts committed. However, their position improved considerably thereafter; the performance of NDPL picked up within the second year and has been sustained over the rest of the Transfer Scheme period. If we also take into account the investments by the state-owned generating companies, namely, Indra Prastha Gas Power Company Ltd. (IPGCL) and Pragati Power

[15] The discussion in this section is based largely on data contained in the various tariff submissions by DVB and the successor Discoms and the Tariff Orders issued by DERC. Here we may note that: (a) for 2002-03, we only have authenticated figures for the nine-month period that the private licensees were in place and (b) areas served by New Delhi Municipal Committee (NDMC), and the cantonment and allied facilities that remain with the Military Engineering Service (MES), have not been taken over by the private licensees. Owing to these limitations, it was necessary to make some approximations for the year-on-year comparisons, as explained through notes in the affected tables.

Table 3.2: Capital Investments by Transco and Discoms (Rs. Crore)

Company	2002-03*	2003-04	2004-05	2005-06	2006-07	2007-08
Transco	43.47	85.25	108.05	75.28	31.68	152.00
BSES Rajdhani	76.38	114.56	538.75	618.54	306.21	128.24
BSES Yamuna	56.36	87.69	414.42	298.92	209.08	117.53
North Delhi Power	48.51	299.40	338.20	431.00	271.00	325.00
Total	**224.72**	**586.90**	**1,399.42**	**1,423.74**	**817.97**	**722.77**

* Figures are for nine months (July 2002-March 2003).

Source: Multi-Year Tariff Order (FY08-FY11), DERC Website (http://www.derc.gov.in/).

Corporation Ltd. (PPCL) on their ongoing projects, the scaling up of the investment envisaged in the Strategy Paper has been reached.

The lower-than-promised investment level in the earlier years is attributed, in part, to the poor quality of information relating to the physical network furnished by DVB to the successor entities. Difficulties in obtaining land for substations, and technical constraints at Transco grid stations, are among other factors advanced for shortfalls in planned investments.

NDPL's success in mobilising its investments early on apparently paid dividends in regard to bringing down AT&C losses. This will be clearer from the breakdown of investments by NDPL over the Transfer Scheme period, given in Table 3.3 below, which shows that about 66 per cent of the investments pertained to areas directly impacting on reducing theft. These included the installation of electronic meters (replacing electro-

Table 3.3: Breakdown of Investments in System Improvements by NDPL

(Rs. Crore)

Item description	2002-03	2003-04	2004-05	2005-06	2006-07	Total
Transformation Capacity works – 66, 33 and 11 KV	25	52	115	154	98	444
HVDS, EHV works, SCADA, Metering, GIS, IT equipment	24	235	223	277	111	870
Total	**49**	**287**	**338**	**431**	**209**	**1,314**

Source: Delhi's Experience with Reforms in Power Sector Review after 5 Years 2002-2007 (Mehta, 2007).

3.6 Tariff Reform

mechanical meters), a High Voltage Distribution System (HVDS) and an Extra High Voltage (EHV) network and SCADA, GIS and IT-related equipment. Investments by the two BSES Discoms also show a broadly similar pattern weighted towards a better monitoring of electricity flows through the system and the installation of devices to check power theft and remote downloading of electricity data from the control room.

The Strategy Paper had identified the aim of "depoliticising the process of power tariff adjustments". By implication, this would mean eliminating cross-subsidies within the sector. In its first Tariff Order (May 2001) which predated the restructuring of DVB, DERC spelled out the objective of moving tariffs towards the average cost of service. These aims were not translated into practice until the end of the Transfer Scheme period.

DERC's first Tariff Order (TO) was based on submissions by the erstwhile DVB and also marked the first tariff revisions in over four years. The significant features of this TO are the steep upward revisions in the domestic and commercial categories and the lower rate of increase in the bulk consumer segments (industry and railways).[16] This was a limited effort at tariff correction, as the two latter segments had to bear the brunt of cross-subsidising the agriculture and domestic segments in the price regime of most State Electricity Boards, DVB included.

Table 3.4 above shows that attempts at tariff correction through subsequent TOs have been muted. In terms of consumer segments, the tariff revisions have stayed within a close range of the average in the first two TOs issued after privatisation, with two exceptions (agriculture in the 2003 TO and railways in 2004). The last TO over the Transfer Scheme period (2005-06) continues the effort to correct the high rates levied (historically) on the railways and also gives some relief to another public service, street lighting.

The domestic segment accounts for around 50 per cent of total energy sales by Discoms. While making modest upward revisions in tariffs for this segment, DERC has taken care to observe in each TO that "cost of service"-based tariffs[17] would warrant a steeper increase on the domestic segment and would cause a "tariff shock". This was further balanced by measures of tariff "rationalisation", which, in some cases and overall, had the effect of reducing the average tariffs even where the rates had been revised upwards. The abolition of "minimum" charges and the merger of slabs for the domestic segment are examples of this form of rationalisation.

Tariff regulation by autonomous agencies has, in other

Table 3.4: DERC Tariff Revisions: Summary

(Percentage of increase in average tariff by category)

Category	2001-02	2003-04	2004-05	2005-06*	Cumulative
Domestic	22.47	5.14	10.14	10.27	27.69
Non-Domestic (commercial)	13.04	3.91	8.86	4.39	18.08
Industrial (small and large)	9.40	5.64	10.24	5.00	22.28
Agriculture	29.42	46.86	13.82	20.85	102.01
Railways	8.46	5.71	0.00	0.00	5.71
Public lighting	21.70	4.88	6.90	(-) 15.00	(-) 4.70
Average For all Categories	**14.51**	**5.02**	**9.80**	**6.00**	**22.23**

*The rates revised in June 2005, effective from 15th June 2005, continued without further change until March 2007.

Note: Cumulative increase is worked out with the year 2001-02 as the base in order to reflect the changes over the Transfer Scheme period.

Source: Compiled from respective DERC Tariff Orders.

[16] We shall ignore the agriculture segment in this analysis as it accounts for a miniscule share (under one per cent) of energy use in Delhi.

[17] The reference is to the overall average cost of service to all segments. A detailed analysis of the cost of service to each consumer segment is yet to be carried out.

states, generally brought about a fall in "real" average rates (adjusted for inflation) charged to industry, which was the segment that bore the brunt of cross-subsidising the domestic (and agricultural) consumers, matched by an increase in average domestic tariffs (Nair, 2008). As may be seen from the cumulative column of Table 3.4, Delhi is an exception to this pattern, further underlining the cautious approach that DERC has chosen to follow, especially in relation to the domestic segment.

3.6.1 State Government Intervention

The objective of "depoliticising" the tariff process also came under some strain. In the first TO issued after privatisation (2003), DERC proposed an average 9 per cent rise in electricity tariffs for domestic consumers. The state government invoked its powers under DERA and decided to exempt domestic consumers using less than 400 units of power a month after this hike. This brought down the average increase in the domestic category to 5.14 per cent. A subsidy of about Rs.41 crore was extended to the private Discoms in order to compensate the revenue loss until April 2004.

3.6.2 Regulatory Asset

The third TO (June 2004) introduced a new concept of "Regulatory Asset" that was used to bridge the large gap between costs and revenues. DERC estimated that the tariff increase required to meet the entire revenue gap in FY 2004-05 would be around 30 per cent, which was very high and would have resulted in a severe tariff shock to consumers. Hence, the Commission confined the tariff revisions to an average of just below 10 per cent and, to cover the balance, opted for this mechanism of "Regulatory Asset" totalling Rs.696 crore (approximately 11 per cent of the total revenue requirement for the year for all three Discoms). The financing cost of this notional asset is to be reimbursed to the utilities and the principal is to be amortised from future years' earnings.

Resorting to such a mechanism was obviated in the previous year because of the heavily front-loaded government loan support[18] to DTL to meet the shortfall in revenues realised from Discoms. In introducing this new concept, DERC banked heavily on the expectation that higher investments in system improvements would lead to a far more aggressive AT&C loss reduction trajectory in the next two years compared to the committed levels of loss reduction.[19]

3.6.3 Concluding Remarks on Tariffs

The successive tariff increases between 2001 and 2004 had provoked public protests, especially since the standards of supply showed little improvement and scanty progress had been achieved in loss reduction (at that point). DERC seems to have taken this sentiment into account in moderating efforts towards tariffs based on costs, and also due to the fact that the costs themselves were inflated by the loss factor. DERC's TOs indicate that it would prefer this policy objective to be "inherently… addressed to a great extent when the loss levels reach acceptable limits and the revenue requirements on this account shall not call for tariff increase (rather they would come down)". The implication is that tariff reforms have not moved forward, because a breakthrough is yet to be made in the high levels of loss reduction.

3.7 Loss Reduction

This issue also impinges on the government/regulator interface.

As already noted, this issue figured prominently in the

[18] DTL had drawn about 76 per cent of the total committed support of Rs.3,450 crore in the first two years.

[19] In the event, this expectation has proved correct in the case of NDPL; the amounts held under "Regulatory Assets" are on the way to being fully amortised in 2007-08. In the case of the two BSES Discoms, the amount has been brought down.

Table 3.5: Percentage of Loss Reduction by Discoms

Discom	2002-03	2003-04		2004-05		2005-06		2006-07	
	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
BYPL	61.89	54.70	54.29	50.70	50.12	45.05	43.89	39.95	39.03
BRPL	47.40	46.00	45.06	42.70	40.64	36.70	35.53	31.10	29.92
NDPL	47.79	45.35	44.86	40.85	33.79	35.35	26.52	31.10	23.73
Average	52.36	48.68	48.25	44.75	41.52	39.03	35.31	34.05	30.89

Source: DERC Tariff Order.

objectives identified through the Strategy Paper. Four main categories of loss are listed in the Strategy Paper:

a. Consumers (all categories) who indulge in "fraudulent abstraction of energy";

b. Consumers in electrified colonies who do not come forward to take legal connections;

c. Consumers in jhuggi-jhopri clusters/unauthorised colonies (who cannot be given legal connections in the present legal framework) resorting to direct tapping of power from the mains;

d. Industries and commercial establishments in non-conforming areas and "urbanised villages" resorting to misuse or theft due to prevalent conditions of supply.

We shall first present the actual reductions in losses (Table 3.5) achieved by the Discoms and then try to analyse such data that is available in respect of consumer segments. The figures show that:

a. By the end of the Transfer Scheme period, all three Discoms had succeeded in meeting the targets they were committed to; and

b. NDPL has over-achieved on the target by a good margin and contributed to bringing the overall figure (for all three Discoms) down to under 31 per cent, some three percentage points better than targeted.

We noted earlier that the loss levels reported by DVB in 2000-01 were scaled down in setting the opening levels of losses specified in the bids (to which the targeted further reductions were pegged). In terms of areas, this scaling down reached 4 percentage points in the case of the South West (BSES Rajdhani), 3.9 in the case of Central East (BSES Yamuna) and 1.4 percentage points for North-North West (NDPL). This is a factor to be borne in mind when assessing the performance in the first year of privatisation in which two Discoms, BSES Yamuna and NDPL, failed to meet the targets set. By the second year, however, all three Discoms had pulled abreast of the targets.

3.7.1 Collection Efficiency

Apart from technical losses in Transmission and Distribution (T&D) and loss through theft and malfeasance (energy drawn but not billed), the composite AT&C loss measure includes the third component of collection efficiencies. This element needs to be segregated at the outset of this analysis, because collection efficiencies are relatively easier to effect and represent soft gains, and also because the limits to these efficiencies are soon reached.

The ratio of cost of energy realised to energy billed is the measure of collection efficiency. For all three Discoms taken together, this ratio deteriorated in the first year (89.2 per cent compared to 91.2 in 2001-02),[20] but improved sharply to 96.7 in the first full year post-privatisation (2003-04). Reported target and actual performance data for 2004-05 indicates that a ratio of around 96 per cent roughly

[20] In this calculation, figures for 2002-03 are worked out for the full year by adjusting, pro rata, the figures for the period 1.7.2002 to 31.3.2003, i.e., the period when the private licensees were in position.

[21] Agarwal et al. observe that in similar reforms in Latin America, the private entrants were given some leeway in regard to year-wise improvements to be effected and were not tied down to penalty-linked targets as in Delhi. The focus on improving collection efficiency in the first years is consequently not necessarily a matter for criticism.

represents the achievable ceiling. The cumulative reduction in the composite AT&C loss index notched up by the Discoms in the first two years was achieved solely by the significant improvement in the collection efficiency component in Year 2.[21]

3.7.2 Transmission and Distribution (T&D) Losses

Once bill collection efficiencies reach their limits, a reduction of total losses, both in percentage and in absolute terms, will need to be realised in the two main areas, i.e. a reduction in technical losses and loss caused by energy drawn but not billed.

To bring down T&D losses to the efficient minimum, the rate of increase of "energy input" into the system has to taper down until optimal levels of technical loss are reached, while that of "energy billed" has to keep moving upwards. Data limitations stand in the way of a precise estimation of improvements, if any, in the "technical" component of T&D losses.[22] The two tables below show the trends before and after privatisation; the only point to note is that the year-on-year increase in energy input has tapered down in the post-privatisation period to about 3 per cent against about twice that level in the final years of the DVB.

The tapering down of growth in energy input could be a reflection of technical efficiencies in transmission within the Discom systems. However, owing to a lack of adequate data, reliable conclusions cannot be drawn on growth trends in consumption by different consumer segments over the Transfer Scheme period.

3.7.3 Commercial Losses

We have made a limited attempt to estimate the extent of losses through pilferage alone with the best available data. The results are given in Box 2 which shows that allowing for unavoidable "technical" T&D losses in the 10 to 15 per cent range, unauthorised consumption could have accounted for some 70 to 75 per cent of the losses reported in 2001-02. Further, there was a gap of about 294,000 electrified households between the utility's records and the data generated by the Census of India (2001).

Table 3.6: Increasing Trend of T&D Losses before Privatisation (Selected Years)

Parameters	1980-81	1990-91	1992-93	1993-94	1994-95	1995-96	2000-01
Energy available/ Input (GWH)	2,828	8,438	10,219	10,998	12,055	13,049	17,504
Energy billed/ Consumption (GWH)	2,308	6,334	7,764	7,419	7,826	6,581	9,539
T&D loss (per cent)	18.38	24.93	24.02	32.55	35.08	49.57	45.50

Source: General Reviews, CEA for the specified years.

Table 3.7: Trend of T&D Losses (after Privatisation)

Parameters	2001-02	2002-03	2003 - 04	2004-05	2005-06	2006-07	2007-08
Energy available/ Input (GWH)	18,741	19,567	20,160	20,952	21,281	22,012	22,236
Energy billed/ Consumption (GWH)	9,798.50	10,706.35	11,903.26	12,773.39	13,423.03	14,677.14	N.A
T&D loss (per cent)	47.72	45.28	40.96	39.04	36.93	33.32	N.A

Source: General Reviews, CEA for the specified years.

[22] Technically, it is feasible through proper metering arrangements to estimate the technical loss component element accurately. In order to measure improvement in technical losses, one needs to have metered figures of total energy drawn by Discoms from DTL substations and the energy fed into the distribution network by Discoms' own substations. In order to tackle the theft menace, Discoms have installed such metering systems in several areas. However, the resulting data on purely technical losses is not available for this study. The examination here is consequently limited to trends in the. total energy inputs which we use here as a proxy for transmission efficiencies.

Box 1: Estimating the Causes of Electricity Loss in Delhi

The Strategy Paper identified four specific categories of energy loss. Two of these categories – consumers in electrified colonies whose connections remain to be "legalised" and those in unauthorised colonies who resort to direct tapping – pertain to the "domestic" category of consumers. As this analysis shows, domestic consumers also figure prominently in a third category, described as "Dishonest Abstraction of Energy" (DAE) involving metered Domestic, Industrial and Non-Domestic (Commercial) segments.

At the time privatisation took place, the "Domestic" consumer segment had a share of around 45 per cent of energy sold in Delhi. With the help of census data from the last three Censuses on households with access to electricity, we have attempted to estimate the scale of "missing" domestic consumers (who are drawing power but are not on the billing list).

Domestic Consumer Numbers (utility and census)

A. Census Figures	1981	1991	2001
Total number of households	1,193,763	1,877,046	2,554,149
Households having no electricity	285,541	385,170	182,338
Balance households with access to electricity	908,222	1,491,876	2,371,811
B. Utility Figures	**1981-82**	**1991-92**	**2001-02**
No. of "Domestic" Consumers*	913,359	1,536,540	2,077,675

* DESU/ DVB Data plus NDMC portion for years 1981-82, 1991-92 and 2001-02.

Source: Census of India, (1981, 1991, 2001); CEA General Review for respective years.

In the 1981 and 1991 censuses, the reported number of households with access to electricity was lower than the Utility numbers of domestic consumers (this difference is attributable to several households having more than one meter). However, there is a distinct shift between 1991 and 2001; in the latter year the census figures have surged ahead of those for registered "domestic" consumers. Yet, as explained below, this factor is not the principal explanation for high levels of losses in the system.

Going by the ratio of metered domestic consumers in 1991-92 to the census numbers (1991) of households with access to electricity, we calculate that approximately 365,000 households were availing of supply without being billed in 2001-02. If these households are deemed as consuming at the average household levels, they would account for some 800 million units of energy or just around 10.5 per cent of the reported T&D losses for that year. The inference to be drawn is that the bulk of the unbilled component of Technical Commercial losses is attributable to what the Strategy Paper terms as "Dishonest abstraction of energy" (DAE).

Table 3. 8: Domestic Segment Data: before and after Privatisation

Year / Growth Rate	Number of consumers	Average consumption (per year in 1000 KWh)	Total "Domestic" consumption (Gwh)
2000-01	2,021,666	2.21	4,470.07
2001-02	2,077,675	2.16	4,479.50
2002-03	2,181,296	2.06	4,492.23
2002-03*	2,069,615	2.06	4,262.23
2003-04	1,965,195	2.53	4,974.11
2004-05	2,145,219	2.62	5,628.79
2005-06	2,294,672	2.62	6,007.08
2006-07	2,451,554	2.60	6,371.02
CAGR	**2.17**	**1.81**	

* Figures for 2002-03 (Transition Year) re-worked after excluding estimated numbers for the NDMC area.

Note: All figures for 2003-04 onwards exclude areas under NDMC.

Source: All India Electricity Statistics General Review for the specified years.

Table 3.8 shows the year-on-year growth in the number of "domestic" consumers in the Discoms' jurisdiction. It shows an increase of some 382,000 consumers between 2002-03 and 2006-07. Recent pre-privatisation trends for Delhi show an annual 3 per cent increase in the number of domestic consumers through normal population growth. On this basis, about two-thirds of the increase between 2002-03 and 2006-07 could be on account of new connections being granted. The rest (about 130,000) may be deemed to be due to the regularisation of unauthorised connections, which would mean that, as of March 2007, more than half of the "unregularised" connections that the 2001 census data reveals still remained to be brought into the billing stream.

Data to draw significant conclusions from the average consumption trends reflected in Table 3.8 is lacking. The increase could be partly due to normal growth in electricity usage per connection and partly on account of better metering practices. The Discoms' initial efforts to replace the electro-mechanical meters with digital meters had run into opposition because of widespread complaints of incorrect readings that resulted in overcharging. Considerable time and effort was spent to tackle this, with the result that the loss reduction exercise suffered a setback. The accuracy of the digital meters has since been verified in various test drives conducted by the Government of National Capital Territory of Delhi (GNCTD), the Delhi Electricity Regulatory Commission (DERC) and the Discoms through the Central Power Research Institute, and the process of replacement is continuing.

3.7.4 Special Courts

In order to stem the growing menace of power theft across the country, the Electricity Act, 2003 tightened several legal provisions of the normally applicable law. One of the most important was the empowering of state governments to set up as many "special courts" as they deemed necessary to deal expeditiously with prosecutions for power theft.[23] Given the situation in Delhi, this enabling measure was of crucial importance, particularly as, according to the CEO of the BSES Discom, a major portion of the losses was attributable to theft by industrial consumers and well-to-do residential customers (quoted in Agarwal et al., 2003), who would have the resources to stall and prolong normal court proceedings.

There were delays on the government's part, most probably caused by bureaucratic procedures, in setting up the courts. And when the government did act, the special courts were disproportionately few in relation to the inflow of cases filed by Discoms. This situation was eventually rectified only after higher courts, taking note of Public Interest complaints, issued directions to the government in this respect.

According to the latest reports, the government is now extending further assistance to Discoms by providing the protection of paramilitary forces during raids on premises suspected of power pilferage.

3.8 Quality and Reliability of Supply

[23] Under the normal criminal laws of the country, it is relatively easy for persons charged with such crimes to obtain stay orders on prosecutions and drag the proceedings before the existing courts (heavily overloaded) for years on end.

3.9 Critiques of Delhi Reform Design

This aim of the reform has also been largely realised. Load-shedding over the peak summer months was the issue that caused serious unrest under the DVB regime, often spilling over into civil disturbance. Apparently, thanks to better management, improvements were effected in the very first year of privatisation: the total loss of energy through load-shedding over the summer months (April to mid-July) of 2003 reached 84.51 million units against 135.98 million units in the corresponding period of 2002.

Overall performances in shortages, both under "energy" and "peak" demand, had touched comfortable levels by 2007-08.

As for the quality of supply, DERC has issued (April 2007) guidelines on the standards to be met by Discoms.

Virtually all aspects of the Delhi privatisation experiment have come in for critical comment. Now that the Transfer Scheme period has ended with the reform expectations being substantially realised, it will suffice here to consider the more important points that these concerns address:

- Inadequate competition for the licence.
- Loss reduction targets as a bid criterion.
- Valuation of assets.
- Tariffs and incentives.
- Government/regulator interface.

3.9.1 Inadequate Competition for the Licence

It is self-evident that there was very limited competition to pick up the distribution licences. Some comments on this issue have pointed out how the situation could have been remedied. Ruet (2004) observes that there was a need to develop a market in power distribution first and holds that the induction of private players into the intermediate stage of managing distribution would be the means to do so. This is obviously a time-consuming process and would have meant putting off the Delhi exercise for a few years until a sufficient number of players interested in taking up electricity distribution had emerged. As we noted, political considerations ruled out this option. Agarwal et al. (2003) correctly observe that in India's political system of five-year election cycles, an elected government has a "window of opportunity" lasting just two and a half years to push through such major reforms, a view that is shared by Sagar (2004). They also point out that very limited competition to take up electricity distribution is not a feature unique to India.

There is also the line that the Delhi reforms could have been implemented in two phases, first as a management contract and subsequently as disinvestment. Alternatively, rather than restructuring and privatising in one go (as was the case in Delhi), Agarwal et al. (2003) note that the more normal practice is to leave an interval between the two stages. This could have enabled corporate entities in the public sector to do some preliminary cleaning up in areas such as tackling losses and would have thus generated more comfort for the intending bidders, perhaps persuading a few of the "pre-qualified" foreign firms to stay in the race.

Here, Sagar (2004) makes the following valid point from the political economy perspective:

> "A state government's decision-making is… not necessarily a coherent process: the course of policy may shift and meander with the entry and exit of different actors within the government.
>
> In Delhi, the intention to reform was as clear-cut as possible, once the government had (by early 2001) decided to unbundle and privatise distribution simultaneously, that is, without an intermediate stage of corporatisation. In other cases, where such an intermediate stage is envisaged beforehand as a necessary step in the process, the intention to actually distance the government from operational management of the power industry has to be considered as being contingent or hesitant, at least until the final step has

been taken".

If we also consider the fact that the next round of elections for the state legislature were due by the end of 2003, the rationale that drove the Delhi approach becomes clearer still. A further point to note is that the two companies that took over the licences represent arguably the most experienced and resourceful indigenous agencies in power distribution. They have an established record of efficient operations in Mumbai – BSES in the retail segment and Tatas (who own NDPL) in supply to bulk consumers.

The factor of limited competition does not, thus, seem to have seriously damaged the reforms as far as meeting the basic objectives are concerned. But this factor has linkages to the issue of loss reduction, the negative impact on which is of greater consequence.

3.9.2 Loss Reduction Targets as a Criterion for Licence Awarding

The orthodox view is that the process of disinvestment is basically one of selling off assets and, hence, the asset value offered should be the determining factor (Ruet, 2004). It is also the more common practice followed in such cases. By contrast, Agarwal et al. (2003) note that the main concern is that criteria for selection should be transparent, a condition that the choice of a loss reduction target met.

The more pertinent point is that, owing partly to the lack of competition, very conservative loss reduction targets were set. Prayas (2006) points out that the loss reduction trajectory quoted by the two bidders was very similar, but in the actual implementation NDPL has been able to improve on the targets significantly. It is obvious that the bids were very cautious on this score. Considering that the revenue implications of each percentage point of reduction is Rs.20 to 30 crore (Prayas, 2006), the potential gains to the taxpayer/consumer that are foregone are considerable.

How could better bids for loss reduction have been generated? The answer lies partly in the bid design and partly in areas of governance. In terms of the former, Agarwal et al. (2003) point out that the agreements between the government and the licensees lacked symmetry in obligations. While a formal licence required under law had been issued, the terms of the Transfer Scheme had been spelled out and a regulatory regime was also in place, a properly drawn-up agreement setting out the obligations that the government, on its part, undertook would have generated more confidence in the private party. In the absence of such commitments, and in view of the financial penalties that under-achievement would have entailed, the bidders were understandably cautious.

This argument spills over into the area of governance. The Strategy Paper contained a section that detailed the specific measures needed to combat what it termed "the growing incidence of theft of power, which cuts across all socio-economic strata in the capital". Among the measures envisaged were:

- A period of four weeks to be given to the consumers entitled to take legal electrical connection. DVB should give electric connections to these entitled persons within four weeks, after which date strict penal action should be taken including the disconnection of electricity.
- DVB should have a dedicated police force.
- A list of theft-prone areas should be publicised by DVB.

DVB is not known to have followed up on these or similar time-bound and action-oriented measures that were spelled out in the Strategy Paper. If this had been done, the demonstration effect would have created greater confidence among the private bidders.

In addition, while states like Andhra Pradesh and West Bengal (two states that, while retaining the Discoms in the public sector, have made a sizeable dent in the problem of reducing electricity theft) enacted special laws to tighten the lax provisions of the old electricity statute in order to prosecute offenders effectively, Delhi made no effort in that direction. The situation was saved partly because the

central Electricity Act, 2003 incorporated the required tough provisions which the Delhi licensees could draw upon once the Special Courts were set up, and partly – as we noted earlier – because of intervention by other stakeholders.

For an explanation of this lapse on the part of the government, we have to note that the reform process itself imposes political costs as well. In an illuminating comment from the political economy perspective, Sagar (2004) refers to the "role erosion" that the privatisation of electricity distribution causes to the political establishment. To quote:

> "…the very inefficiency of organisations like the SEBs creates an opportunity of interface with the electorate: goodwill can be earned by getting wrong bills corrected, and crisis power-supply situations may be seized upon as an opportunity for visible, hectic activity to establish one's personal credentials with the public".

Apart from the personal motivation of the top political leadership pushing the reforms, the process also depends "on their capacity to impose their decision-making on legislators, who, in this case, may feel directly affected", Sagar (2004).

3.9.3 Valuation of Assets

This was a point on which the reform design faced severe criticism from several observers. The debate is based on the premise that a price settled by bids is both more accurate in reflecting the value of the business (than a book exercise) and more transparent. Ruet (2004) has pointed out how the process could have been so ordered as to fetch the best value for the government. The lack of adequate competition for taking up the distribution would, ex post, seem to justify the process actually adopted. But here again, there is a strong view that adequate measures were not taken to enlarge the competition.

On the other hand, the assessment of whether there has been an actual loss to the government and if so, how much, is a difficult one to make. Agarwal et al. (2003) point out that the par value (per attached customer) established for the asset sale in Delhi ranged from Rs.687 (BSES Yamuna) to Rs.2,763 (BSES Rajdhani) against Rs.520 (per attached customer) which the sale (by bidding) of the Orissa Discoms yielded.[24]

In the case of Delhi, this debate shall remain inconclusive, but the perspective from the political decision-maker's viewpoint could be entirely different. After noting that "governments do not respond to financial losses the way businesses do", Sagar makes the following points:

"The pressures for reform… do not come from

Box 2: Multi-year tariffs (MYT)

Regulatory risk is one of the risk factors that intending private entrants into the electricity sector and its distribution segment in particular have to take into account. By this is meant the possibility of changes in regulatory policies over the period of the licence that, in turn, would affect the projections on cash flow earned through sales. The institution of regulation autonomous of government and backed by statutory provisions reduces, but does not eliminate, this risk when tariffs are set on an annual basis.

It is widely accepted that one way of further reducing this risk and providing comfort to both intending entrants and to existing licensees (the latter in the matter of planning and implementing investments) is to set tariffs in advance for a block of years, instead of revising them on a yearly basis. By bringing greater predictability to consumer tariffs on the whole, and restricting tariff adjustments to known indicators on power purchase prices and inflation indices, multi-year tariffs would minimise risks for the utilities as well as for consumers. Over the long term, this would attract investments and contribute to improvements in quality of supply and loss reduction, thereby promoting efficiency.

MYT does not do away with annual tariff adjustments altogether. Flexibility for adjustments is retained although the revisions required are kept to the minimum. The mechanics of doing so is by first prescribing a control period for the application of the MYT set. A control period of

[24] Competition for picking up the Orissa distribution licences was also meagre.

up to five years is normal; in the case of Delhi, the period was specified as a little over three years (March 2008 to March 2011). Discoms are thus required to file Aggregate Revenue Requirement (ARR) petitions for the control period, including planned investments.

The next requirement is for identifying expenditure items as "controllable" and "uncontrollable". By implication, tariff adjustments over the control period are limited to the latter category. To illustrate this, DERC determined that O&M expenses fall in the controllable category, so any loss or gain on account of the same will not be adjusted in the ARR of the Discom. On the other hand, because the sales quantum and consumer mix are to a large extent dependent on factors beyond the control of the licensee and, recognising the need for providing universal service obligations, energy sales were considered as uncontrollable for the first Control Period.

A further element in the MYT set for the Delhi Discoms concerns the AT&C loss reduction targets for the control period. Considering the efficient standards to be aimed at, the prevailing patterns in efficient distribution utilities in Mumbai and Ahmedabad, and NDPL's own relatively better performance over the Transfer Scheme period, DERC specified AT&C loss levels at 17 per cent for NDPL and BRPL and 22 per cent for BYPL at the end of the control period. Leaving a two -percentage- point band for sharing gains with consumers, MYT provided that Discoms could retain all gains accruing out of achieving loss levels below 15 per cent for NDPL and BRPL and 20 per cent for BYPL.

tightening budgets but, rather, are political in nature. When there is a 'need' to do something about a power situation which has become exasperating for a large number of people, the political capital that may be made from correcting a bad situation is the principal driver of reform".

As we noted earlier, the business valuation method was based on considerations of speed with transparency.

3.9.4 Tariffs and Incentives

Agarwal et al. (2003), while broadly supporting what has been done in Delhi, offer several specific suggestions on possible refinements where future attempts to privatise distribution could improve on the Delhi model. On tariffs, it is the generally held view, now endorsed through the official National Tariff Policy (6th January, 2006), that the aim should be to set multi-year tariffs (MYT, see Box 2). Several states, Delhi included, have by now adopted the MYT regime.

From the reform design perspective, the point has been made that the bidders would have had a better "comfort level" if the MYT system had been introduced beforehand. In fact, the state government did propose this to DERC, but the regulator did not concur with the suggestion on practical considerations in terms of the lack of required data.

The point that Agarwal et al. (2003) make is that it would have helped if the regulator had clearly indicated all the parameters that would govern the tariff-setting exercise from year to year. They are of the view that too many areas of doubt remained which the bidders, especially the foreign agencies (who all subsequently withdrew), would have found discouraging. They argue that it would have been legitimate for the government to take over this role and ensure better clarity on the future tariff front, if necessary by enacting a special law for the purpose. This raises the point of whether the state government was equipped, technically, to undertake such a responsibility, without delaying the whole process of privatisation.

Agarwal et al. (2003) have a similar point of criticism regarding the incentive regime (penalties and sharing of gains with respect to performance-reducing losses) of the Delhi reform design. They have expressed the fear that the design adopted has possibly "blunted" the incentives to the bidders; they are particularly critical of the provision of a middle no-sharing band that they feel could be confusing to the bidder.

The government viewpoint on this issue is not clear. Agarwal et al. (2003) themselves note that a sharing arrangement (with consumers) of gains from improved performance enhances the social and political acceptability of privatisation. This consideration would have most

[25] For the record, we may note that NDPL generated total gains of Rs.205.91 crore until 2006-07, of which they have retained Rs.71.51 crore and the balance has been passed on to consumers. Over the same period, the two BSES companies generated gains of Rs.70.75 crore, all of which accrued to the consumers.

probably weighed with the government as well.

It is also hypothetical that offering the entire profit earned and bettering the level set to be retained by the licensee would have led to better offers in regard to loss reduction. The exact opposite result cannot be ruled out, especially once it became clear that the bids were limited to two firms. In retrospect, it seems to have been a prudent step to limit the profit-sharing to improvements above the "minimum" levels set by the government rather than the levels actually quoted.[25]

3.9.5 Role of the Regulator

The regulatory regime adopted in Delhi was the one enacted through a national law (Electricity Regulatory Commissions Act, 1998). In evaluating the Delhi reforms, two specific aspects require note. First, at the outset the Delhi government issued a set of detailed instructions to the regulator. Second, in the actual practice of regulation, there are various ways in which the government can influence regulatory decision, for the better or for the worse. We shall briefly discuss both these aspects.

Government Directions

On this point, Dubash and Narisimha Rao (2007) hold that the government's approach led to some tension between it and the regulator,[26] a feature that was sharpened by the regulator's refusal to go along with the government's proposal regarding MYT. They make a valid observation by noting: "regulators have had to take on… challenging tasks without the benefit of a track record of credibility, and often with limited competence and experience". Hence, they argue, much of the regulator's attention is focused on gaining legitimacy. In their view, the position of regulators varies in this respect from state to state; in Delhi the regulator is still engaged in a "struggle for legitimacy".

As regards government directions, we have already noted that Agarwal et al. (2003) hold it as a prerogative of the government to set certain basic rules at the outset, in order to provide as much comfort as possible to the bidders.

Government/Regulator Interface

It is appropriate to highlight the political concerns that influence regulatory decisions, even where no specific directives are issued by the government. Our review of the tariff-setting in Delhi has already brought out that public sentiment had apparently weighed with the regulator at various stages.

Dubash and Narisimha Rao (2007) have some interesting comments on this that we quote below, without additional comment:

> "Regulators face not only decisions in which politics are embedded – such as those around investment, performance, and generation – but also conspicuously political decisions such as tariff-setting and the implementation of an open access policy".
>
> "Regulators side-step overtly political decisions by erring on the side of safety and defensibility, balancing pressures to accommodate while striving to maintain an apolitical façade".
>
> "There are instances of creative regulatory measures that could be interpreted as valiant efforts to limit tariff hikes and are often so interpreted. While these examples need not mean that the regulator is following government direction, they do suggest regulators have concluded that they cannot avoid the political implications of their decisions."

3.10 Assessing the Impact

Dubash and Narisimha Rao (2007) make two specific suggestions to improve the effectiveness of the regulatory regime. Both suggestions are relevant to the Delhi reforms; we consequently conclude this section by reproducing

[26] It may be recalled that DERC had questioned the government's authority to issue instructions on certain aspects, but later conceded the point on the legal ground that the Electricity Act, 2003 vested the government with the power to decide what constituted "policy".

Table 3.9: Summary of Reform Outcomes

Areas of Reform	Assessed impact
Investments	While slow to start, private Discoms have been successful in raising investments to required levels in the distribution segment. Investments are also well focussed to meeting the broader reform aims.
Loss Reduction	The targets that the Discoms were committed to achieve by the end of the Transition Scheme period have been met. But these were modest targets, so the loss levels reached are still well above even the best performances of comparable urban systems in the country itself, not to speak of international norms.
Tariffs	A tariff regime that supports the conduct of the distribution business without subsidy inputs has been secured. But tariff reforms proper – to bring about rates that closely reflect efficient costs – are yet to be addressed. This should bring down tariffs corres ponding to the extent to which losses are brought down.
Sector Finances	Discom finances are now stable with revenues adequate to meet all current liabilities. The subsidy extended by the state government over the Transition Scheme period is held in the books of the wholly government-owned Transco and remains to be liquidated. Besides, the holding company is carrying the heavy backlog of DVB dues, which includes unpaid arrears to generating companies and irrecoverables that were not transferred to the Discoms.
Quality of Supply	The severe shortages that marked the pre-reforms period have been eliminated and supply-demand ratios are now among the best in the country. But consumer dissatisfaction over frequent power disruptions remains high, indicating that much ground remains to be covered.

them :

- Governments should take extra measures aimed towards enhancing regulatory capabilities to help these institutions acquire full legitimacy and utilise "the potential for regulation as an instrument of deliberative governance".

- "Stakeholder support could potentially support regulatory legitimacy and provide a bulwark against undue government interference", but currently, "the stakeholder process falls well short of this ideal".

Infrastructure reforms are often carried out at advanced points of decline and negative concerns of arresting further deterioration influence both the decision and its timing. Admittedly, we are dealing with a very complex sector and progress could be rather slow to register. As far as the Delhi reforms are concerned, our review shows that all the documented objectives of privatisation have been broadly met. From the perspective of the underlying political objectives, the entire exercise, starting with seizing the "window of opportunity" to pushing the reforms to their conclusion, has been eminently successful.

To take a balanced view, we need to look at official and consumer perspectives on the reforms. Before doing so, we first summarise the findings presented in detail in Section 3 of this chapter on the outcome of the reforms.

The new connections granted by Discoms include the regularisation of unauthorised connections; a separate breakdown of connections to households that were not served by electricity is not available. We noted in Section 3.3 that households without actual access to electricity formed only about 7 per cent of the total in 2001. In the absence of data on the breakdown of new connections, we conclude that this category of households would have been fully covered by now, leaving only fresh additions to the population, which is a continuing feature. There are, however, complaints of delays in granting new connections to low-income categories.

We now turn to our own findings concerning the reform design and its implementation. The success with regard to

3.11 Impact on the Environment

meeting key parameters notwithstanding, our review shows that the Delhi reform design is by no means a perfect model for privatising electricity distribution.

The specific shortcomings are the following:

- A lack of due pre-privatisation preparatory work by the public utility;
- Omission to provide (before launching the privatisation) the supporting legislation needed for the drive against theft and other forms of malfeasance; and
- Failure to demarcate clear areas for the public agencies and private licensees to handle, in keeping with their respective capabilities.

The first two points also involved running serious risks in terms of the success of the privatisation scheme itself.

The Delhi reform design was a distinct improvement on that of Orissa. Future privatisations involving disinvestment would, in all likelihood, learn from the Delhi model and incorporate further improvements.

It is well recognised that at the present level of technology, none of the renewable sources of power can compete with conventional sources on a cost basis. Wind energy, the leading option at present, has other drawbacks such as seasonality and infirmity of supply. Solar energy can substitute conventional power adequately only if grid-linked plants of requisite size with energy storage capabilities are developed. Even when present limitations are overcome through improvements in technology, renewable energy sources will need significant subsidy support.

The subsidy regime currently in place focuses predominantly on the generating side. The incentives benefit generators and also consumers and are designed to encourage renewable energy and reduce drawing on polluting energy sources to the extent possible.[27] With the exception of decentralised distribution to meet the needs of remote areas (through locally available sources, including renewables), the current subsidy and incentive regime largely bypasses the distribution segment.

In considering the role of distribution utilities in the environmental context, it is relevant to note that the power system in India is marked by shortages, which are acute in several states. Against this background, even when the extra cost of renewable energy is fully allowed for when fixing the retail tariffs, Discoms, especially private Discoms charged with bringing about improvements in quality of supply, will have little enthusiasm to promote power sources that are infirm and less dependable than conventional ones. Renewable, infirm power sources can be optimally used in systems that have adequate reserve plant margins, including, preferably, a “spinning reserve”. India’s current National Electricity Plan aims to bring about such a system but, owing to delays in project implementation, this is unlikely to be achieved by 2012.

Although the shortages in electricity supply in Delhi have abated in the last two years, they are far from being eliminated. As for Discoms themselves investing in renewables-based plants, in view of the pressing need to strengthen the distribution system, the latter area is likely to have higher priority in their investment plans.[28]

Environmental gains could also result from savings in energy drawn for supply. This is an area where distribution utilities can contribute by bringing about efficiencies. Private entry into the distribution segment in particular is expected to boost the prospects for such savings. At present there are no environment-related incentives for this type of saving – on the pattern of the incentives extended to the generating segment – possibly because of the impact this could have on retail tariffs.

[27] Intermediary local government agencies such as municipalities are also entitled to financial subsidies for raising waste-based generating sources, but with a different environment-related objective.

[28] In theory, Discoms could have access to incentives provided through the Kyoto Protocol “Clean Development Mechanism”; there is better chance of this option being tried when the shortage situation eases.

It is also hard to measure how much energy is actually "saved" by a distribution utility, especially when there is steady year-on-year growth in consumption. However, a comparison of the growth trends over different periods could yield some idea of the impact – positive or negative – on energy demand resulting from a change in utility ownership or management. Here, comparison of the immediate pre-reform and post-privatisation periods (based on the data given in Table 3.8) shows a very notable shift in pattern. Over the six years ending 2001-02, energy input into the Delhi distribution system had increased by nearly 44 per cent, showing a compound annual growth rate (CAGR) of 6.2 per cent. However, post-privatisation, over six years ending 2007-08, the corresponding increase (energy input) was only 19 per cent, showing a sharp drop in CAGR to 2.9 per cent. This pattern further accentuates if the comparison takes in a longer pre-reform period: over the nine years ending 2001-02, energy input into the system increased by about 83 per cent – representing a CAGR of almost 7 per cent.

It is calculated that if the growth in demand had continued at the rate of 6.2 per cent annually after the private Discoms had taken over, the additional energy input into the system would have been as much as 13.3 billion units over six years. How much of this notional saving, approximating to about ten per cent of the total energy input, is "real" and attributable to Discoms and thereby to the factor of privatisation?

Delhi Discoms are unique in that they do have an incentive regime linked to reductions in AT&C losses; but here, the loss reduction does not lead to a corresponding drop in energy drawn. Some reduction is to be expected when consumers previously availing of free power (through unauthorised connections or stolen energy) are made to pay; likewise, the replacement of defective meters (slow-moving electro-mechanical meters, or meters that were deliberately tampered with) by accurate tamper-proof electronic meters could also lead to a drop in consumption. Indirect gains in energy savings could therefore be expected to result from the elimination of theft and the granting of regular connections to previously unauthorised colonies.

AT&C losses cover the component of "technical losses" which, because of the wide usage of low tension transmission and distribution lines and inadequate transformation capacity, is believed to be unduly high in India, Delhi included. There is significant scope for savings in technical losses; again metering and monitoring facilities available at present are not equipped to measure these savings with any precision.

In order to isolate, to the extent feasible, the private Discoms' contribution to the drop in growth in energy demand, it will be useful to see the figures of year-on-year growth in demand after privatisation. Table 3.10 below (based on energy input numbers given in Tables 3.8 and 3.9) reveals that a sharp drop in the growth rate was registered in the very first year of the Transition Scheme (2002-03) and has been sustained thereafter:

This pattern would indicate that apart from the impact of loss reduction and related investments, other factors have also contributed to the drop in growth rate of demand.

One plausible reason is that the very folding up of DVB which had come to be identified with high system losses through theft could have had a salutary lowering impact on the growth trends in demand. This is particularly likely in view of the fact that over the nine years immediately preceding privatization, when energy growth was averaging 7 percent per annum, DVB system losses doubled from 24

Table 3.10: Trends in Year-on-Year Growth in Energy Demand after Privatisation

Year:	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
Energy Input (MU)	18,741	19,567	20,160	20,952	21,281	22,012	22,236
Growth (percent)	7.07	4.41	3.03	3.93	1.57	3.43	1.02

Source : based on tables 3.7 and 3.8.

percent to 48 percent. This would point to the strong likelihood that a good part of new demand in the DVB system over the same period was stolen/ unauthorized power. Entry of private players would have shut out this type of demand.

Some other factors that may be noted in this context are:

- Over the Transition Scheme period, there was large shifting out of polluting industries from the capital as a result of specific court directions; this would have had an impact on growth of demand
- The state government had introduced generous incentives to consumers who installed solar heating systems; such systems were also widely adopted in government and other large establishments.
- The central Ministry of Power had taken initiatives in the area of energy management through the Bureau of Energy Efficiency (BEE); these measures would have generated awareness regarding energy saving potential and promoted an increased use of energy-saving CFL lamps, BEE certified electrical equipment, etc.

The contribution of privatisation to the drop in energy demand growth and thereby to energy savings can be clearly seen, but its precise quantification cannot be attempted here. It may also be concluded that the actual impact would vary according to the specific circumstances of the area and the location.

In order to enlarge this impact, the key issue lies in bringing Discoms within the ambit of "climate change" policy. Another possible route to adopt would be to promote schemes that fit into the Discoms' priorities of eliminating shortages and improving quality.

We referred earlier to recent initiatives in Maharashtra to induct "franchisees" into the electricity distribution segment under the public-private partnership concept.[29] This institutional form could provide a policy vehicle for the purpose we just identified. We therefore conclude this discussion with a brief reference to the main features of the "franchisee" model.

From the perspective of this discussion, a key element of the model is that the franchisee will also generate electricity locally to meet any shortfall (i.e. supply-demand gap) in the designated franchise area. This will be under the scheme of the "Distributed Generation Based Electricity Distribution Franchisee" (DGBDF) that is being tried out in Maharashtra to reduce heavy shortages in supply.

The other main elements of the arrangement are:

- The franchisee will not only undertake maintenance of the distribution system, but will also upgrade and strengthen the system in agreement with the main distribution licensee.
- The franchisee will manage metering, billing and collection with the help of the existing staff of the licensee, but will also be required to add its own staff to manage any increase in business.

[29] The main distribution licensee – Maharashtra State Electricity Distribution Company – is wholly state-owned; the franchisees will be private players.

Annex 1. Econometric Estimation Results

Table I: model I results

Dependent variable: specific emissions (tonnes of CO2 per MWh generation)		
Independent Variables	**Coefficient**	**p –values (level of significance of the estimated coefficient)**
Capacity (MW)	0.00006	0.002
Vintage (Years)	0.01131	0.000
F2 (D-Diesel)	-0.54547	0.000
F3 (D-Gas)	-0.56377	0.000
F4 (D-Lignite)	0.05196	0.519
F5 (D-Naphtha)	-0.43013	0.000
F6 (D-Oil)	-0.51652	0.000
S2 (D-Private)	-0.00683	0.822
S3 (D-State)	0.07906	0.008
Constant	0.90362	0.000
R2	0.5360	
Adj R2	0.5320	
Number of Observations	1052	

Note: D = Dummy for respective fuel (value = 1 if the fuel is as specified, zero otherwise); S2 and S3 are dummy variables to capture the effect of ownership.

Source : authors' summary of regression results.

Table II: model II results

Dependent variable: fuel choice (log of odds ratio of probability of choosing a given fuel versus probability of choosing coal)

Number of observations = 1,070

Pseudo R^2 = 0.1660

Diesel		
Independent variables	**Coefficient**	**p –values (level of significance of the estimated coefficient)**
Capacity (MW)	0.00084	0.000
Vintage (Years)	-0.13131	0.000
S1 (D- Centre)	-0.89278	0.044
S2 (D- Private)	0.64132	0.037
Gas		
Independent variables		
Capacity (MW)	0.00010	0.519
Vintage (Years)	-0.11571	0.000
S1 (D- Centre)	0.14109	0.487
S2 (D- Private)	0.72144	0.001
Lignite		
Independent variables		
Capacity (MW)	0.00078	0.001
Vintage (Years)	-0.10479	0.000
S1 (D- Centre)	0.70680	0.039
S2 (D- Private)	0.54003	0.164
Naphtha		
Independent variables		
Capacity (MW)	0.00028	0.485
Vintage (Years)	-0.15528	0.000
S1 (D- Centre)	-34.29079	1.000
S2 (D- Private)	2.01073	0.000
Oil		
Independent variables		
Capacity (MW)	0.00029	0.343
Vintage (Years)	0.01806	0.161
S1 (D: Centre = 1, Otherwise=0)	-34.35914	1.000
S2 (D: Private = 1, Otherwise = 0)	2.63431	0.000

Note: S2 and S3 are dummy variables to capture the effect of ownership.

Source : authors' summary of regression results.

Annex 2: Chronology of Delhi's Power Reforms

DATE	EVENT
July 1998	Electricity Regulatory Commissions Act (Central Act) passed.
February 1999	Government of NCT of Delhi brought out a Strategy Paper on power.
3rd March 1999	DERC was set up under the Central Electricity Regulatory Act, 1998.
December 1999	DERC started operating.
28th October 2000	Delhi Electricity Reforms Ordinance was promulgated.
15th February 2001	A request for qualification documents was issued to 31 parties for bidding.
11th March 2001	Delhi Electricity Reform Act came into force (replacing the ordinance).
15th May 2001	Six of the seven prospective bidders, who submitted their Statements of Qualification (SOQ), were prequalified: A.E.S., BSES, China Light & Power, CESCON, Reliance and TATA Power.
23rd May 2001	First DERC tariff order (Retail & Bulk supply) was issued.
July 2001	Restructuring commenced: Six "shell" companies were registered, i.e. a Holding Company, a Generating Company, a Transmission Company and three Distribution companies. These would become successor entities of DVB on the operationalisation of the Transfer scheme.
20th November 2001	The government of NCT of Delhi issued the Delhi Electricity Reform (Transfer Scheme) Rules 2001, which gave the Opening Balance Sheets of the new companies and laid down the manner in which the assets and functions of DVB would be transferred to the new companies.
22nd November 2001	The government of NCT of Delhi issued "Policy Directions" binding the regulatory commission to the conditions on which distribution companies would be disinvested as a result of the bidding process.
31st May 2002	Policy directions were amended by substituting the AT&C loss targets set earlier by the figures accepted through bids and by raising the loan to Transco from Rs.2,600 crore to Rs.3,450 crore in order to bridge the gap between its revenue requirement and the bulk supply price (received from Discoms). The Share Acquisition Agreement was signed with the successful bidders.
26th June 2002	The Transfer Scheme was amended with some changes in notes to accounts.
1st July 2002	The Transfer Scheme was operationalised and the management was handed over to the successor entities, including the three distribution companies under private management.
26th June 2003	The second DERC tariff order (Retail & Bulk supply) was issued.
28th May 2003	License issued to Transco, for the business of procurement, transmission and bulk supply of electrical energy within the area of supply.
11th March 2004	Licenses issued to Discoms, in replacement of the "Transfer Scheme".
9th June 2004	Third DERC tariff order (retail & bulk supply) was issued.

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- The retail tariffs will be as set by the regulator for the main licensee, but the franchisee will retain a portion of the revenue collection from consumers by agreement with the licensee.

The scheme thus introduces flexibility in the management of the distribution business and has the potential to lower T&D losses because locally generated electricity will obviate the need for transmission over long distances.

Renewables-based generating units set up by the franchisees can possibly be fitted into the scheme if the units are such that they would improve reliability at costs that can be economically justified for subsidy support. For this purpose, renewable energy systems with storage backup would be needed which would increase costs. More details will need to be worked out to establish the viability of such a model, including the extent of subsidy support that would be justified. Here the recognised employment generation potential of solar energy units, the saving in transmission costs, as well as losses and the economic gains to the local community from a reliable power supply, are positive factors to be taken into account.

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