Improving Electricity Services in Rural India

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Improving Electricity Services in Rural India:

An initial assessment of recent initiatives and some recommendations

Vijay Modi

Abstract

This report examines the status of the rural electricity sector and provides recommendations on possible reforms in India with a focus two states: Uttar Pradesh and Madhya Pradesh. The current state of electricity services across India can be said to be acute, if not in a crisis mode, impeding both economic and social development. The immediate manifestations of this crisis are severe shortcomings in: access to electricity for rural and urban poor, shortfall in generation capacity and poor reliability of supply. This report attempts to address the key question: What policy reforms may make it feasible, within the envelope of political, institutional and financial acceptability, to bring the benefits of electrification to the rural population?

Foremost, a climate of confidence must be fostered in the electricity sector that reflects a sustained commitment to a long term plan and stresses the importance of adherence to policies. A move toward greater cost recovery must be accompanied by reliable service that meets the specific needs of agriculture, while concurrently curtailing waste of energy and water services. Life-line rates should be instated for residential users, with higher cost-recovery rates for greater consumption, to allow for provision of basic electricity services to all rural households. Information technology should be adopted to lower costs of bill collection and for accurate metering. The need to develop supply chains for products and parts by working closely with industrial partners to fulfill demand created by rural electrification schemes is discussed. These reforms, combined with a focus on capacity building within and modernization of electricity infrastructure, provide a roadmap to re-invigorating India's energy sector. The evolution of the power sector in India, the role of SEBs, and the outcomes of key rural electrification schemes are also detailed in the report.

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Improving Electricity Services in Rural India:
Public Investment Requirements and Electricity Sector Reform[1]

Case Studies of Uttar Pradesh and Madhya Pradesh

Key Recommendations

1. Adhere to the Electricity Act 2003 (EA2003) with the aim of creating a climate of confidence within the electricity sector that reflects commitment to a long term plan based on the Act. The effect of this sustained commitment will be to send a clear message to all actors involved of the seriousness for adherence to a policy. This will pave the path for sustained district and state level planning, with emphasis on monitoring and decentralized accountability, as well as encourage the private sector to vigorously participate in the power sector and take on a profitable role as a franchise for installation and/or distribution.

2. Earlier power sector schemes such as the APDRP (Accelerated Power Development and Reforms Programme) show low uptake of project funds, i.e. the funds utilized are frequently a small fraction of the project funds sanctioned. Even though the program was not exclusive to rural areas, this ratio was below 30% for states such as Bihar, W. Bengal, UP, Jharkhand, MP, and Chattisgarh. These are also the states where nearly 45 million of the 78 million people without access to electricity reside. Now with the Rajeev Gandhi Grameen Vidyutikaran Yojana (RGGVY), a dramatic increase in availability of funds will occur with the goal of reaching nearly every village and household. The funds will target rural electrification (RE), a more human resource intensive proposition due to the inherently disperse nature of RE. The low uptake of funds in the past may point to capacity constraints in electrification planning, working with suppliers/contractors, project preparation, implementation and monitoring within the district level staff. Perhaps recognizing this constraint, the REC and MoP encourage franchisee development for the maintenance of distribution systems and for the collection of tariffs at the village level. However envisioning that "tens of thousands of franchisees are created within the next 3 to 5 years seeking an enlarged role and opening immense business opportunities" (from speech by Chairman of REC[2]) is a task of Herculean proportions. This will change the role of the SEBs which will have to increasingly manage and oversee contracts between public and other (NGO, co-operatives and private) providers as well as with users, ensuring the legal rights and obligations of parties in terms of service and tariffs. It will require managerial and technical capacity to engage with franchisees, inspection of installation, verification of delivery of service to standards, performance monitoring, legal expertise, establishing bulk power purchase agreements with generators with fuel

[1] This report is based on the work undertaken for a project entitled 'Scaling up Services in Rural India' that is housed at the Center on Globalization and Sustainable Development (CGSD) of the Earth Institute at Columbia University. CGSD is grateful to The William and Flora Hewlett Foundation for providing financial support to this project and especially thanks Smita Singh, Program Director, Global Development, and Shweta Siraj-Mehta, Program Officer for discussions and their keen interest in this project.

[2] Powering Rural India, Speech of the Chairman of REC at the 36th Annual General Meeting held on September 22nd 2005.

cost provisions, minimizing the risks and lowering transaction costs in general. We recommend that capacity building of this nature be part of the RGGVY scheme.

3. Irrigated agriculture is critical to the Indian economy. Hence a nuanced approach to reforming agriculture pumping (AP) tariffs is needed. A move towards greater cost recovery must be accompanied by reliable service that meets the needs of agriculture. A two-step approach is proposed, with the first being recommended in the short term in areas where metering of AP with 24-7 supply is not immediately feasible.

    a. The first step would be to separate the three-phase AP supply from household single-phase supply and then this AP network would be energized by scheduling power supply when it is needed most through reliable timed-delivery (determined by rainfall and soil moisture requirements) in accordance with the local agriculture needs and during off-peak hours to reduce costs. This will allow the system to better meet agriculture needs while at the same time reducing the supply of electricity for agriculture and hence effectively curtailing agriculture subsidies (allowing flat-rate tariffs to become closer to cost recovery) and at the same time reducing wasteful use of energy and groundwater. This will require co-ordination of the utility with local agriculture/water experts along with a campaign and community dialogue that would promote the benefits of such an approach. This approach has been advocated Shah (2001) and as suggested in the Tata-IWMI water policy briefing, "if well managed, such a strategy could cut wasteful use of groundwater by 12-18 km3 of water/year in western and peninsular India alone, reducing power use in groundwater extraction by some 2-3 billion kWh of power—valued at Rs 4,000-6,000 crores/year (US$0.8 billion-1.2 billion/year). Plus, it could actually improve farmer satisfaction with the power industry".

    b. The next step would be to move toward agriculture subsidies that are provided directly to the consumer in the form of a "smart card" that incorporates low tariffs for the first block of "lifeline" consumption. Smart-card metering technology makes is possible to provide the subsidy directly to the consumer as opposed to the service provider. The higher initial investment of such a technology is already cost-effective for consumption levels typical of agriculture. The "lifeline" electricity consumption level would correspond to the demands and sustainable water yields of small farmers in a region. In aggregate, this would then pave the way for substantially higher cost-recovery from agriculture while ensuring that the small farmers growing non water-intensive crops are not adversely impacted. Metering technologies using smart cards are already used in South Africa. Higher cost recovery would pave the way for facilitating greater generation capacity as well as in reducing the adverse impact on industry of higher tariffs and poor quality supply.

4. Current pricing of metered and un-metered household electricity in most states also ends up subsidizing middle to high electricity consumers while not adequately meeting the basic needs of the poor at a low price. It is worth noting that a 100W load (e.g. two CFL light bulbs and a radio/TV) for 5 hours in the evening corresponds to a household consumption of less than 20 kWh per month. This initial level of consumption could be provided at a low flat monthly price of say Rs. 20 per month to any consumer. Technical means to do this would be either through a combination of timed-supply and load-limiters where metering is not immediately feasible OR through metering with an initial "lifeline"

consumption of 20 kWh per household provided at a flat price of Rs. 20 per month with higher levels of consumption charged at cost-recovery rates. Instead UP Power Corporation tariffs are Rs 105 per month for un-metered rural supply OR 90 paisa/kWh in addition to a flat monthly charge of Rs. 20, with a minimum bill of Rs 150/month per connection for metered supply. This imposes a minimum monthly payment that could be unaffordable for the poor. This tariff provides increasingly higher subsidies with energy consumption to those who consume more than 30 kWh per month (assuming a rough cost of supply to be close to Rs 3 per kWh).

5. In a high population state with very low coverage of household electricity, a program such as RGGVY would attempt to bring electrification to nearly 18 million households over the next five years. The magnitude of this undertaking is immense, but it also presents a unique opportunity to take advantage of information technologies in implementing social safety nets and low cost of bill collection. There are measures that can be implemented in parallel to those listed above. These would be at an initial unit cost that is higher than that budgeted in RGGVY but has long term benefits. These measures are:

    a. Promote the use of smart prepaid card based electric meters. This technology makes it possible to implement lifeline tariffs for the poor (ensuring a social safety net), an electronic form of a voucher or "water stamps" used in Chile. The system would allow consumers to pay in small amounts for incremental use and would eliminate the cost of meter-reading, billing and bill collection. These costs can otherwise make it difficult for a utility to service (i.e. maintain service) a small rural consumers even when the first costs may be paid through a scheme such as RGGVY.

    b. Promote use of state-subsidized energy-efficient lighting such as compact fluorescent lamps that represent a cost-effective investment for the utility but may not be so for a household.

6. Use information technology to monitor metering at feeder and distribution transformer levels to allow proper auditing of power supply. This will make it possible to detect abnormalities and create local incentive structure for minimizing losses by making it possible to enhance monitoring/collection efficiencies. The goal would be that feeders can then be operated using principles of "stand-alone business units" that will be accountable for quality of power and reliability, metering, billing and collection (MoP, 2005). This can be implemented immediately in the new 125,000 villages to be electrified providing a cost-effective jump-start of the program.

7. For domestic supply in rural areas, the RGGVY scheme has set an ambitious challenge. For this to succeed the political climate will need to be created that empowers the SEBs to enforce the rules of the EA 2003. This will require that rural household connections receive reliable service at least during evening hours when domestic rural supply is most needed. One way to carry out this tricky balancing act while generation capacity constraints are being met and AT&C (aggregate technical and commercial) loss reduction requirements are met is to supplement timed evening hour supply with installation of load-limiters in households that were connected with Kutir Jyoti scheme or for new households that are going to be covered under the BPL provisions of the RGGVY.

8. Develop close co-operation with equipment manufacturers, suppliers and contractors so that demand arising from large scale policy initiatives can be anticipated, allowing time for the development of supply chains in a timely fashion in order to deliver the vast volume of meters, limiters, bulbs, and electrical hardware needed during the installation phase (whether carried out by a franchisee or the utility) and the anticipated human resources to ensure that distribution mechanisms are in place for the supply of such hardware. The same applies for contractor skills in carrying out the task. Mechanisms also need to be in place to quickly change financing requirements if costs of particular materials change.

9. There has been substantial investment in the physical electricity infrastructure of the country since independence. There have been numerous programs in just the last decade for accelerating rural electrification. These programs have focused on infrastructure investments but not on management; on ambitious coverage targets but not on financing or creating incentives for sustainable maintenance of infrastructure stock; on triage of emergency measures and not on providing reliable services. The windfall if any from reduced subsidies would have to be invested back in the maintenance of the crumbling infrastructure, in modernization of the system for transparent accounting and in new infrastructure. Additionally, investment in building management skills within newly created Distribution Companies (DisCom) would be needed. With a missionary zeal on the quality and reliability of electricity supply, it will be possible to charge industry (large and small) tariffs that will ensure full cost-recovery and more - resources needed to cross-subsidize social goals of the electricity sector. The economies of scale in power production have a unique advantage in that the cost of captive power for industry and the cost of coping mechanisms adopted by medium level consumers (SMEs, commercial enterprises, shops or wealthy households) is significantly higher than the bulk costs of electricity generation that a large DisCom would have to otherwise pay.

10. Reliable 24-7 supply to schools, clinics, hospitals, water schemes (where needed), telecom facilities, government offices, rural markets and small businesses (e.g. grinding and agro-processing) is essential to meeting the services that the rural populations need. Many of these institutions are public facilities and a close dialogue with the district officers and the representative local bodies is needed to ensure that the supply to these institutions is reliable, and that costs of supply are accounted for through either transparent “subsidies” or funds transferred between the appropriate government body and the service provider.

Improving Electricity Services in Rural India:
Public Investment Requirements and Electricity Sector Reform[3]

Case Studies of Uttar Pradesh and Madhya Pradesh

Vijay Modi[4]

This report is based on the work undertaken during Year I of a two-year project on scaling up electricity services in rural India. The report focuses on two states: Uttar Pradesh and Madhya Pradesh. Unnao district in UP and Raisen district in MP were chosen for in-depth studies. Detailed questionnaires were administered in five distinct villages in each of the two districts so that they could be reasonably extrapolated to the district. The report focuses on the rural sector which is home to 70% of the population in India and nearly 80% of the poor.

Specifically, this report attempts to address one key question: What policy reforms may make it feasible, within the envelope of political/institutional/financial acceptability, to bring the "benefits" of electrification to the rural population. The "benefits" here are understood to be the provision of services that electrification provides, i.e. reliable and timely electric supply for the water pumping needs of agriculture; reliable supply to adequately meet the lighting and other domestic needs of households and to meet the needs of industry, government and social service delivery institutions. The author is providing recommendations to the Government of India with the hope that this will ensure the rapid and systematic improvement in access to energy services in rural India. Recommendations are based upon an analysis of rural energy attributes that highlight key limiting factors and the efficacy of possible strategies to address them.

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[3] This report is based on the work undertaken for a project entitled 'Scaling up Services in Rural India' that is housed at the Center on Globalization and Sustainable Development (CGSD) of the Earth Institute at Columbia University. The report was prepared with the assistance of TERI under the leadership of Ibrahim Hafeezur Rehman. The assistance of Rupesh Agrawal, Ruchika Singh and Ronnie Khanna of TERI in organization and analysis of field surveys, collecting and documenting background materials for the report and the editorial assistance of Samina Akbari of Columbia University is gratefully acknowledged.
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Section I: Introduction

Expanding electrification and scaling up electricity services is critical to both the economic and social development of India. The current state of electricity services across India can be said to be acute, if not in a crisis mode. The immediate manifestations of this crisis are severe shortcomings in: a) access to electricity for rural and urban poor, b) generation capacity that cannot meet peak demand and c) reliability of supply, in terms of predictability of outages and quality of power supply. The goal of this report is propose a set of policy levers that can aggressively reform all three of these issues at once.

National statistics tell a story of problems afflicting generation, transmission, *and* distribution of electricity. Shortages in energy demand and peak power demand have been around 8% and 12% on average between 2000 and 2003. Industry, farmers and households have invested in a substantial amount of equipment and capital in the form of captive power plants, generators, inverters, and voltage stabilizers to address issues of supply and its quality. India, with an average annual per capita electricity consumption of 400 kWh, is far behind countries such as China (900 kWh), Malaysia (2500 Kwh), and Thailand (1,500 kWh).

While large-scale reforms have repeatedly been attempted in the past, India's achievement in the field of rural access to electricity leaves much to be desired. India is home to 35% of the global population without access to electricity (Table 1) and only 44% of all rural Indian households are electrified. According to the 2001 Census, 6.02 crore households use electricity as the primary source of lighting out of a total of 13.8 crore households in the country.

Table 1. Countries with large population without access to electricity

Country	Population w/out access to electricity (Million)	% of world total	Per capita electricity consumption (kWh)
India	579.10	35.44	393
Bangladesh	104.40	6.39	102
Indonesia	98.00	6.00	390
Nigeria	76.15	4.66	85
Pakistan	65.00	3.98	374
Ethiopia	61.28	3.75	24
Myanmar	45.30	2.77	74
Tanzania	30.16	1.85	55
Kenya	27.71	1.70	107
Nepal	19.50	1.19	61
DPR of Korea	17.80	1.09	1288
Mozambique	16.42	1.00	47
World Total	1634.20	100.00	2343
Source: IEA, 2002			

Transmission and Distribution (T&D) losses in India have risen from 25% in 1997-1998 to around 30% in 1999-2000. In countries such as China, Malaysia, and Thailand, they are less than 10%. The State Electricity Boards (SEBs) that bear primary responsibility for distribution face irregularities in billing and rampant theft of electricity. It is estimated that of the total power generated, only about 55% is billed, and around 41% is realized[5]. Cost recovery has declined from 82% in 1992-1993 to 69% in 2001-2002. The loss per unit of power sold increased from 23 paise in 1992-1993 to 110 paise in 2001-2002. It is ironic that over the period 1991-1992 to 2001-2002, when so many reforms were introduced, the gross power subsidy to agriculture, domestic consumers, and on inter-state sales has increased by 364% (or 4.6 times) – from Rs. 7,449 crores to Rs. 34,587 crores (or about 1.5% of India's GDP). While just about everyone agrees on the end-point, (restoring the financial health of the SEBs and power utilities, increasing generation capacity, and lowering T&D losses) how to tread the narrow and difficult political path to achieving that goal remains a challenge.

The Kutir Jyoti Scheme released in 1989 connected nearly 60 lakh households in 15 years or at a rate of approximately 4 lakh households per year. The goal of the RGGVY scheme is to bring similar coverage to 2.34 crore BPL households (and an overall total of 7.8 crore households) within the next five years. This is equivalent to a rate of 46 lakh new BPL households per year (and a total of about 156 lakh households per year) for the next five years. This is a rate that is more than ten times the past rate of electrification for Kutir Jyoti. The additional generation capacity that will be needed over the next five years if this accelerated pace (annual rural electrification rate ten times that of the past 15 years) of rural household electrification is maintained would require about 14,000 MW of evening hours capacity addition over the next five years[6]. An additional 14,000MW of required generation capacity in the next five years amounts to about 2800 MW/year. This new capacity would have to be planned for, whether it comes from conservation, reduced losses, higher PLF, or new power plants. It is also worth noting that nearly half of this new capacity would be needed just in the three states of U.P., Bihar and W. Bengal. The additional capacity requirement from the RGGVY would be comparable to the capacity additions since 2002.[7] These requirements would be over and above the additional generation that would be needed to fuel the increase in electricity demand that results from robust economic growth and the demand that would result if reliable 24-7 grid power were actually available.

Why is rural electrification important?

Both the Government of India Planning Commission's strategy for the development of rural India as well as the United Nation's Millennium Development Goals[8] (MDGs) for the next ten years are inherently dependent on the integration of electricity services to achieve a set of varied development goals. Viable and reliable electricity services result in increased productivity in agriculture and labor, improvement in the delivery of health and education, access to communications (radio, telephone, television, mobile telephone), improved lighting after sunset, facilitating the use of time and energy-saving mills, motors, and pumps, and increasing public

[5] The Infrastructure Challenge In India. Paper contributed by Louis de Jonghe, Country Director, India Resident Mission for the J.R.D. Tata Special Commemorative Volume released by the Associated Chambers of Commerce and Industry (ASSOCHAM) on the Occasion of the Sixth J.R.D Tata Memorial Lecture, 26 August 2003, New Delhi.

[6] Here I have assumed that each household would need an end-use capacity of 100 Watts (corresponding to about one unit or kWh of electricity per day- a stated goal of the MoP and the government as well as a reasonable estimate) and a generation capacity considering PLF and T&D losses of about twice that per household.

[7] http://indiabudget.nic.in/es2004-05/chapt2005/chap93.pdf

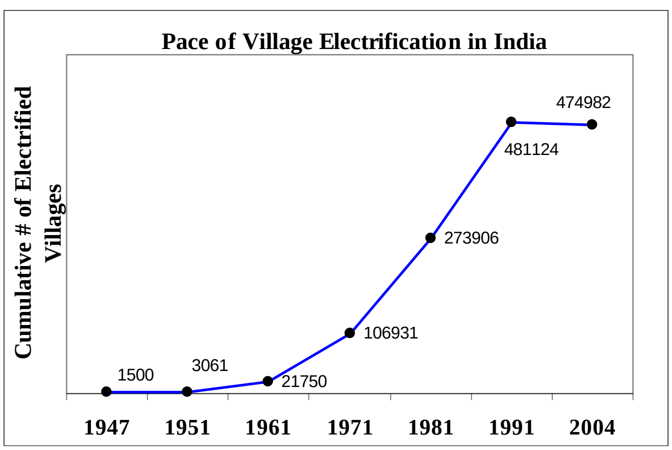
[8] The Millennium Development Goals (MDGs) were developed in conjunction with the United Nation's Millennium Declaration, signed by 189 countries in September 2000, as a commitment to pursuing poverty reduction and good governance, and to garner support for increasing aid, fostering trade, and providing debt relief to developing countries. Most importantly, the MDGs have also set the challenging goal of halving worldwide poverty and hunger by the year 2015.

safety through outdoor lighting[9]. Rural electrification at a household level provides at the very minimum services such as lighting and communications (e.g. radio/television) and can increasingly meet the aspirations of the rural populations to own other household appliances. Household electrification also increases the likelihood that women will read and earn income[10].

Under the current 5-Year Plan, the Planning Commission states that rural electrification and power service reforms are high development priorities. The central government also recognizes that the current state of energy services could significantly impede India's economic growth on a national scale – beyond the rural and agrarian contexts. This realization, along with India's gradual economic upswing, has brought the depressed state of energy service providers into the forefront of energy sector reforms. The failures of past Plans to revitalize power services (less than half of the goals of the Eight and Ninth Plans were implemented)[11] underscore the sense of hopelessness that surrounds discussions of the state of electricity in India today.

Successes in electrification and electricity services can be achieved, nonetheless, by boldly confronting the difficulties that have incapacitated the power sector for decades and by adopting a multi-pronged approach to re-vitalizing energy services in India. Future efforts must implement best practices and address setbacks in all of the following areas: distribution, power generation, tariffs, subsidies, monitoring and implementation of government schemes – in effect by addressing all aspects of energy generation and distribution. While electrification rates have generally increased over time (recent setbacks recognize that a village as electrified using a stricter definition of at least 10% hh as being electrified), as seen in Figure 1, household electrification nationally is still below 50% and the states such as Uttar Pradesh with significantly lower rate of electrification as measured by fraction of households that use electricity for lighting. While this figure for U. P. is about 30% for rural households it is 20%. The per capita GDP and electrification rates of all major states (population greater than 1 million) are shown in Figure 2.

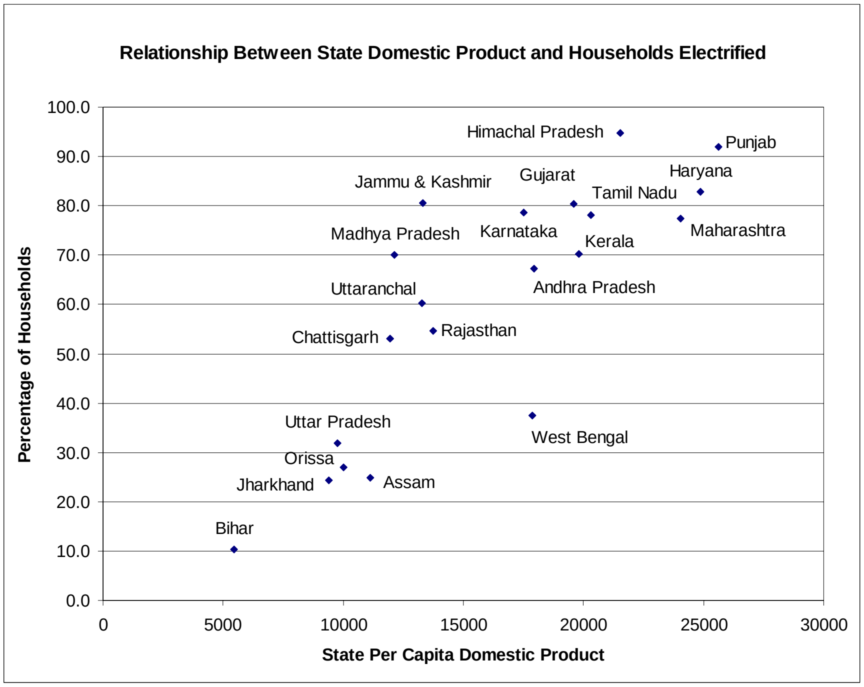
Figure 1. Decrease in # of electrified villages due to de-electrification



Source: Ministry of Power, RGGVY pamphlet, 2005

[9] In a recent report, Modi (2005) provides detailed analytic evidence of the benefits of access to reliable electricity.
[10] ESMAP, 2004
[11] Planning Commission, 2002

Figure 2. Domestic product and percentage of electrified households



Source: Census of India, 2001

Household electricity services and the rural poor

A recent World Bank[12] study articulates the inability of current methods of providing reliable and affordable electricity to the rural poor. Agriculture's mis-use of power and large government subsidies have frequently been blamed for the poor state of power supply in rural areas. While the agricultural sector has received the highest power subsidies (Table 2), blaming agriculture and particularly the rural poor for the failure of the SEBs is misleading.

Table 2. Retail power tariffs by sector as per Planning Commission, 2002

(ps/kWh)	1996-97 Actual	1997-98 Actual	1998-99 Actual	1999-2000 Prov.	2000-01 Revised Est.	2001-02 Annual Plan
Domestic	**105.7**	**136.2**	**139.1**	**160.7**	**183.1**	**195.6**
Commercial	**239.1**	**293.6**	**330.2**	**369.9**	**404.2**	**426.3**
Agriculture	**21.2**	**20.2**	**21.0**	**22.6**	**35.4**	**41.6**
Industry	**275.5**	**312.7**	**322.8**	**342**	**366.5**	**378.7**
Traction	**346.8**	**382.2**	**410.3**	**415.3**	**435.9**	**449.2**
Outside State	**151.4**	**138.1**	**163.8**	**190.1**	**187.9**	**194.4**
Overall (average)	**165.3**	**180.3**	**186.8**	**207**	**226.3**	**239.9**

[12] World Bank, 2002

Poor rural households and poor farmers are among the populations most in need of immediate relief. Currently, the vast majority of poor rural households do not have access to electricity in India. Electrification rates vary dramatically between the urban poor (33% without connection)[13] and rural poor (77% without connection), and obviously between the rural poor and the urban rich. This inequity impedes the development of poor rural populations and underscores the fact that India's rural electrification programs have not reached the most marginalized and needy sections of society. Because such a low number of rural households have grid connections, only a small percentage of rural poor have benefited from subsidies, with the majority of subsidies benefiting richer households[14]. The GoI recognizes that for many rural households the only source of lighting is kerosene based and hence kerosene at subsidized prices is distributed through PDS in most states. Box 1 describes kerosene consumption of rural households in greater detail.

Box 1 Primary sources of energy for lighting.

National figures[15] per 1000 distribution of rural households by primary source of energy for lighting shows 506 households use kerosene, 488 using electricity and 10 using other sources for lighting. The corresponding figures for rural households in MP are 369 households using kerosene and 625 using electricity while in UP 750 households use kerosene and 235 use electricity as primary source of lighting. The all India monthly per capita consumption[16] for kerosene in rural areas is reported at .61 liters and that of electricity is 6.35 kWh while in UP it is .48 liters of kerosene and 1.44 kWh and in MP .51 liters and 4.72 kWh. These low levels of per capita electricity consumption are inclusive of all electricity consumption in rural – domestic, commercial and agricultural. The figures can be misleading since the per capita rural consumption is averaged over the entire rural population and not just those who have access to electricity. Given that the NEP seeks to provide 1 kWh/ household/day for domestic consumption alone as lifeline consumption and the average rural household size[17] is 5.4, this would entail scaling up domestic per capita consumption of electricity in rural areas to approximately 5.5 kWh/month.

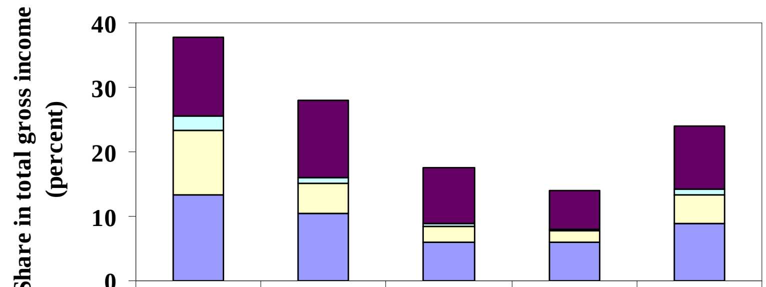
Source: NSS, 1999

Irrigation pumping for agriculture has been cited by many as one of the principle causes of poor cost recovery of SEBs and a prime cause of the poor financial health of the SEBs. However, one needs to acknowledge that irrigation reduces poverty by increasing employment, incomes and real wages and by reducing food prices for rural and urban poor18. In India, in un-irrigated districts (less than 10% area irrigated), 69 % of people are poor, while in irrigated districts (more than 50% area irrigated), poverty level drops to 26%. Agricultural performance is fundamental to India's economic and social development and will critically determine the success of efforts in poverty reduction. Hence a sudden and substantial shift away from current pricing of electricity for agriculture could have jeopardize agriculture, an activity that is the primary source of livelihood in rural areas, accounting for 72% of India's population. Irrigated areas in India contribute two- thirds of food grains output and provide livelihood and income to more than 650 million people in India. Of the 57 million ha net of irrigated area, as much as 34 million ha is

[13] World Bank, 2002
[14] World Bank, 2002
[15] NSS Report No. 464: Energy Used by Indian Households, 1999-2000, Statement 5 Page 23/24
[16] TEDDY 2003-04 Table 2.96 Page 324
[17] http://www.censusindia.net/hh_series/web/data_highlights_hh1_2_3.pdf
[18] From Note prepared by Ramesh Bhatia, President, Resources and Environment Group, New Delhi for InfraPoor Workshop , 27-29 October 2004 in Berlin, organized by DAC/POVNET Task Team on Infrastructure for Poverty Reduction.

from private investments in tubewells, pump sets and water distribution channels. The poor frequently pay a high fraction of their gross farm income for irrigation as seen in Figure 3.

Figure 3. Irrigation costs as a % of farm income - Haryana electricity pumps.



	Marginal	Small	Medium	Large	Overall
Electricity tariff	12.1	11.9	8.6	6	9.7
Pump maintenance	2.22	0.93	0.43	0.37	0.94
Motor burnout	10.15	4.56	2.39	1.64	4.52
Purchase of Water	0	0.1	0	0	0
Fixed cost of pump	13.27	10.42	6.09	6.08	8.84

Source: World Bank, 2002

Section II: Evolution of the power sector in India

State Electricity Boards

Both the central and respective state Indian governments enjoy legislative rights on the subject of electricity. Electricity distribution,[19] however, is the exclusive domain of state governments. Prior to 1991, the electricity business in the states was in the form of vertically integrated State Electricity Boards (SEBs). SEBs were owned and operated by the states and were responsible for generation, transmission and distribution services within the state. SEBs operated under the proviso of the Electricity Supply Act of 1948, and were supplemented in their efforts by the Central Public Sector Utilities (CPSUs) like the NTPC (National Thermal Power Corporation), the NHPC (National Hydro-electric Power Corporation), and the PGCIL (Power Grid Corporation of India).

The 1st Plan emphasized that support for projects that ensure that irrigation potential is met. At this point, only 1 in 200 villages were connected to grid supply across the country. The 2nd plan named rural electrification as an area of special interest, and proposed to cover all towns with a population of 10,000 or more. Only 350 out of a total of 856 of were eventually electrified. The 3rd Plan for the 1st time raised the issue of efficiency in the sector. The REC (Rural Electrification Corporation) was created in 1969 with renewed focus on poverty alleviation. The target based approach of rural electrification was developed in the 4th and 5th Plan periods, with focus on pump set energization and guidelines for village grid connectivity for all villages with a population of at least 5000.

The early 80's saw major changes in conjunction with the creation of the Commission for Additional Sources of Energy (CASE) in 1981, which evolved into a full-fledged Ministry for Non-Conventional Energy Sources (MNES) in 1992. The 6th and 7th Plan periods witnessed the launch of innovative rural energy programs like the National Program on Improved Chulha (NPIC) in (1983), The National Project on Biogas Development (1981-82), Special Program Agriculture (SAP) and integrated energy programs like IREP (Integrated Rural Energy Planning) and Urjagram.

With the institutionalization of the MNES in the early 90s, rural energy provision now largely rests with the RECs and MNES. Covering a wide range of technology and fuel options including renewable sources, national efforts at rural energy provision offer a variety of programs to address the range of energy requirements of rural populations.

Growth in the period from 1947 until reforms were instated in 1991 was impressive in increasing capacity generation from 1362 MW in 1947 to nearly 74 699 MW by 1991-92.[20] Despite a per capita power consumption increase from 15.55 Kwh to 252.7 Kwh, SEBs were financially weak. The 4th Plan and the findings of the Venkatraman Committee report (created to examine the financial working of the SEBs), concurred that SEBs should at the very least aim at revenues sufficient to cover operational and maintenance charges, depreciation of reserves and interest charges on the capital base.

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[19] Distribution Policy Committee Report, MoP, GoI March 2002
[20] pib.nic.in/archieve/factsheet/fs2000/power.html

Table 3 highlights the performance of the 2 target SEBs for the year 2001-2002. It is clear that the SEBs have made an overall negative rate of return. This has severely constrained their capacities for making investment in generation. Table 4 highlights the performance of SEBs at the national level. It can be seen that for all 5 years, the recovery percentage has been between 67 to 77%. The gross subsidy per unit distributed has remained constant at 34% of the cost of delivery and on average realizations from a subsidized sector like agriculture make up only 10% of the cost of supply.

Table 3. Financial performance of the MPSEB and UPPC (2001-02).

SEBs	Commercial Profit/Loss with Subsidy	Commercial Profit/Loss without Subsidy
Madhya Pradesh	**-3183**	**-3682**
Uttar Pradesh (Power Corporation)	**-1887**	**-2687**
India	**-24837**	**-33177**

Source: www.indiastate.com, Rs. in crores.

Despite repeated warning by the Planning Commission and subsequent committees examining the power sector such as the Committee on Power (Rajadhyaksna Committee) and the Planning Commission Working Group on Energy Policy (1979), the crucial issue of rational pricing of electricity was left un-addressed. Increasing SEB losses, pressure on scarce public resources and the reforms of 1991 ultimately forced the opening of the hitherto monopolistic SEBs to private participation.

Even as the 40 year period saw nearly 80% of the country connected to grid supply, up from the few urban pockets of electricity supplied at the time of independence, the SEBs cumulatively were being given an annual gross subsidy of Rs.7,450 crores[21] by 1991-92, losing about Rs.4,021 crores [22]a year and showing an average rate of return (without subsidy) of about -12.5%. By March 31, 2001 the gross subsidy had shot up to Rs. 38,000 crores a year with total SEB outstanding to CPSU and others at Rs.27,760 crores[23].

The SEBs incorporated under the ESA 1948 were government owned. While electricity was perceived as a public good, there was lack of clarity as to who should pay for it. The lack of transparent and well defined subsidies that would be paid from the exchequer to the SEBs to implement specific government policies led to tariffs that were not sustainable. Despite the recommendations of the Venkataraman Committee (1964), which suggested that SEBs should aim at an overall return of 11 percent, and the 6th Plan's calling for an energy pricing policy, the commercial principles underlying tariff revision more often than not were superseded by political considerations.

The share of the electricity sector in the five-year plans has been in the range of 15%-20%. However investment has gone into generation rather than transmission and distribution. In terms of actual investments 72% has gone toward generation, 18% towards transmission and only 10% toward distribution.[24] The GoI has consequently launched the APDR,[25](Accelerated Power Development and Reform Program), to ensure matching investments in T&D.

[21] MoP, Distribution Policy Report 2002
[22] http://www.ciionline.org/Common/91/Images/StateOfStateFinances.PDF
[23] MoP, Distribution Policy Report 2002
[24] Report of the Task force on Power Sector Investments and Reforms, 2004
[25] http://www.apdrpbestpractices.com/

By 1991-92, T& D Losses (with difficult to separate technical and non-technical components such as theft, and un-metered consumption), stood at over 20% [26] officially and about 30% unofficially, [27] taking into account the inaccuracy of non-metered consumption and losses sometimes disguised as agricultural consumption. The Distribution Policy Committee Report in 2002 paints a similar picture, with actual losses ranging between 40%-50%, including technical losses of about 15%-20%, and commercial losses of about 25%-30%. Thus, for every 2 units of energy consumed, one unit was lost due to T&D losses.[28] The GoI, in accordance with its LPG (Liberalization, Globalization & Privatization) policy opened the sector for private participation in early 1992 with amendments to the Electricity Supply Act of 1948. But private participation was encouraged only in generation, protecting SEBs from competition. This change necessitated a comprehensive new set of regulations covering generation, transmission, trading and distribution. The culmination of a decade of piecemeal efforts[29] at reforming the power sector finally passed in Parliament as the Electricity Act 2003.

Table 4. Financial Performance of SEBs in India

Description	1996-97	1997-98	1998-99	1999-2000	2000-01	2001-02
	(Actual)	(Actual)	(Actual)	(Actual)	(RE)	(AP)
Cost of Supply (Paise/Kwh)	215.6	239.73	263.05	305.12	327.16	349.85
Average Tariff (Paise/Kwh)	165.3	180.3	186.77	206.98	226.26	239.92
% of Recovery	76.7	75.21	71	67.84	69.16	68.58
Average Agri. tariff (Paise/Kwh)	21.2	20.22	21.01	22.61	35.38	41.54
Commercial Losses (with subsidy) (Rs. Crore)	-4674	-7597	-10508	-15088	-17793	-24837
Commercial Losses (without subsidy) (Rs. Crore)	-11305	-13963	-20860	-26353	-25259	-33177
Net Internal Resources (Rs. Crore)	-2090.7	-6209	-8954.4	-13316.3	-15620.6	-19103.9
Subsidy for Domestic Consumers (Rs. Crore)	4386.01	5258.43	6332.48	8121.11	10036.07	12238.51
Subsidy for Agri. Consumers (Rs. Crore)	15585.2	17706.67	20693.87	22508.61	24699.18	28123.27
Gross Subsidy*(Rs. Crore)	20209.96	23422.23	27482.23	31003.28	35079.85	40721.59
Subvention Received(Rs. Crore)	6630.6	6364.8	10351.55	11264.53	7465.33	8339.62
Uncovered Subsidy (Rs. Crore)	5805.03	8046.61	8785.42	14431.69	21867.29	26638.42
Gross Subsidy/Unit (Paise/Kwh)	75.4	82.57	92.8	103.81	111.42	119.75

Source: http://powermin.nic.in/distribution

[26] http://planningcommission.nic.in/plans/planrel/fiveyr/9th/vol2/v2c6-2.htm
[27] http://www.indiainfoline.com/infr/spfe/sebs.html
[28] Source: Report of the Task force on Power Sector Investments and Reforms, 2004
[29] Orissa Reform Act 1996, CERC 1998, SERC 1999

History of Rural Electrification in India

Review of electrification in the 1950's and 60's shows that despite their implied Universal Service Obligation (USO), rural electrification was essentially an attempt by the SEBs to connect cities and towns. The gradual interconnection[30] of towns and cities was expected to ensure universal electrification in due time. However, with a realization of the potential benefits of electricity by villagers and elected representatives jockeying for electrification of villages in their political constituencies, the planning process was reduced to a numbers game[31] by politicians intent upon declaring as many villages 'electrified' as possible. Although the number of electrified villages has increased rapidly, the number of households electrified has not matched the pace. The MoP's paper[32] on rural electrification (RE) states that 87% of villages are electrified, while only 42-44% of rural households are electrified.

With growing financial constraints and increasing demand for RE, the GoI used USAID assistance to create the Rural Electrification Corporation (REC) in 1969. The REC, built upon the Tennessee Valley Authority (TVA) experience in the United States, is mandated to facilitate availability of electricity in rural and semi-urban areas. During its thirty-five years of existence, the REC has financed numerous village electrification, pump set energization and Low Tension system improvement projects. However, with the focus being extensive (number of villages electrified) rather than intensive (% of households covered), large gaps[33] remain in rural electrification. With the change in definition[34] of an electrified village, the mid-term review of India's Tenth Five-Year Plan has acknowledged that the year-end figures as of 31st March 2004 of 84.3% village electrification would reduce to less than 70%. An all-party consensus[35] recommended complete rural electrification by 2007 and complete coverage of all households by 2012 (Box 2).

Metering at 11-kV feeder reached 94% and at the consumer end was reported to reach 86% at the national level. Thirteen states (Andhra Pradesh, Gujarat, Goa, Haryana, Karnataka, Kerala, Madhya Pradesh, Punjab, Rajasthan, Tamil Nadu, Tripura, Uttar Pradesh, and Uttaranchal) achieved 100% metering status at 11-kV feeder, and in four states (Delhi, Himachal Pradesh, Kerala, and Punjab) at the consumer level. [36]The improvements can be attributed mainly to the APDRP (Accelerated Power Development and Reform Program) launched by the Union Government, with 100% metering being one of the major objectives under the distribution reform segment of the program.

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[30] ADB Policy Research Network, Draft Paper on Rural Electrification, TL Shankar January 30,2005
[31] The 2nd Plan mentioned small town and rural electrification for the first time in a plan document and proposed to cover all towns with a population of 10,000 or more. The 3rd plan went on commit electrification of all towns and villages with population exceeding 5,000.
Source http://planningcommission.nic.in/plans/planrel/fiveyr/default.html accessed on 15/09/2005
[32] Ministry of Power, Government of India, Discussion Paper on Rural Electrification Policies (Pursuant to Sections 4&5 of the Electricity Act 2003). The draft remains to be notified as on 28/09/05.
[33] http://planningcommission.nic.in/midterm/english-pdf/chapter-10.pdf accessed on 24/09/05
[34] http://powermin.nic.in/JSP_SERVLETS/internal.jsp accessed on 24/09/05
[35] MoP, Discussion Paper on Rural Electrification Policies, November 2003. Page 9 .The draft has not been notified as on 28/09/05
[36] MoP, 2004b

Box 2. Chief Ministers Conference, 2001

To build a national consensus, the Prime Minister of India convened a meeting on March 3, 2001 of all Chief Ministers. Important resolutions that were adopted included:

Rural electrification

- Electrification of all villages and households, and rural electrification to be treated as a basic minimum service
- Rural electrification to be completed by 2007 and all households by 2012
- States to be given flexibility for using funds under Rural Development Programs with the consent of village/block panchayats for undertaking electrification
- Electrification of remote villages to be included under a special mode of financing including a grant

Distribution reforms

- Full metering of all consumers to be completed on a priority basis
- Handing over of local distribution to panchayats / local bodies / franchisees / user associations, wherever necessary
- Privatization of distribution
- Efforts by states, at inviting private investment in the power sector

Tariff determination by regulatory commissions and subsidies

- Tariffs orders by CERC and SERCs to be implemented fully
- Subsidies to be given only to the extent of the state government's capacity to pay through budget provisions
- Move away from providing free power
- Decision of Chief Ministers of a minimum agricultural tariff of 50 paise to be Implemented

Source: Report of the Task force on Power Sector Investments and Reforms, 2004.

The Electricity Act 2003

Conceptualizing the growing domestic and global concerns over the increasing divide between rural and urban areas, the Electricity Act 2003 (EA03) for the first time mentions rural electrification in a law. Section 6 of the act mandates the hitherto implied Universal Service Obligation by stating that the government shall endeavor to supply electricity to all areas including villages and hamlets (see Box 3). Section 5 further mandates the formulation of national policy on RE focusing specially on management of local distribution networks through local institutions. Subsequently, the GoI has released a draft paper on National Rural Electrification Policy. Giving a further boost to RE, the EA03 in Section 4 also frees stand-alone generation and distribution networks from licensing requirements.

The new definition[37] of an electrified village reflecting the commitments under EA03 are:

- Basic infrastructure such as distribution transformers and distribution lines are provided in the inhabited locality as well as in all Dalit bastis/hamlets. (For electrification through Non-Conventional Energy Sources a distribution transformer may not be necessary)

[37] http://powermin.nic.in/JSP_SERVLETS/internal.jsp

- Electricity is provided to public places like schools, panchayat offices, health centers, dispensaries and community centers.
- The number of households electrified should be at least 10% of the total number of households in the village.

Box 3. Goals of the Electricity Act 2003

Stated objectives:

Competition, Protection of Consumers interests & Power for all Areas

Create liberal framework for power development.

Create competitive environment.

Facilitate private investment.

Delicense generation except for hydro: Captive free from controls.

Rural Areas : Stand alone Generation and Distribution delicensed

Multiple licensing in distribution.

Stringent provisions for controlling theft of electricity.

Focus on revenue recovery in cases of unauthorized use of electricity.

Oblige states to restructure SEBs.

Mandates creation of Regulatory Commissions.

Retail tariff to be determined by regulatory commissions.

Open access in transmission from outset.

Open access in distribution to be allowed by SERCs in phases.

Gradual phasing out of cross subsidies.

Trading distinct activity permitted with licensing.

Source: Indian Ministry of Power website http://powermin.nic.in

The broad goals of RE as set out in the draft REP, referred to as **AARQA** goals, are as follows:

- **A**ccessibility – electricity to all households by 2012
- **A**vailability – adequate supply to meet demand by 2012
- **R**eliability- ensure 24 hour supply by 2012
- **Q**uality- 100% quality supply by 2012
- **A**ffordability- pricing based on consumer ability to pay

While the REP seeks to achieve 100% household electrification by 2012 primarily through grid extension, stand-alone systems are also envisioned for areas where grid extension may not be possible on account of techno-economic factors. Pursuant to the REP all state governments are required to formulate state level strategies and notify the same within 6 months from the notification of the REP. The draft policy also seeks to provide at least 1 kWh/day to all BPL households[38] and ensure that quality as against the prevailing problem of blackouts.

The Planning Commission's mid-term review of India's Tenth Plan[39] states that the current practice of 40% capital subsidy for rural electrification programs has been far from successful. The plan review has accepted and recommended the Ministry of Power's proposal of a 90% capital subsidy scheme for 100% household electrification over the next 5 years as envisioned in the National Common Minimum Program (NCMP)[40]. However, the mid-term review goes on to qualify the 90% capital subsidy will be successful only if a sustainable revenue model is in place.

Similarly, the first report of the Standing Committee on Energy[41], Fourteenth Lok Sabha 2004-05, had identified rural electrification as an essential infrastructure input for improving production-oriented activities[42] and speeding up the pace of development of the rural economy. In its submission to the committee for the year 2004-05, the Ministry of Power outlined a new strategy[43] involving creation of a Rural Electricity Distribution Backbone (REDB), Village Electricity Infrastructure (VEI). This also included distribution transformers in each village where grid access was feasible, and a decentralized distributed generation (DDG) and supply for villages where grid connectivity or NCES (non conventional sources of energy) might not be possible or cost effective. The committee, while accepting the Ministry of Power's new proposal, had, however, highlighted that despite the availability and sanctioning of funds, the actual utilization of funds for rural electrification projects was low.[44]

Review of Select Rural Electrificaton (RE) Schemes[45]

Rural electrification is the backbone of rural economy and a basic input for rapid rural development. It is also the main infrastructure for ensuring speedy growth of the agriculture sector and agro based industrial structure in rural areas. By March, 31st 2004, 86% of villages had been electrified. In addition, out of the total estimated pump set potential of 195.94 lakh, about 141.15 lakh pump sets (63%) had been energized. During 2003-04, about 2,706 new villages had been electrified and about 2.5 lakh pump sets were energized.

The main sources of funding for current rural electrification programs are:

(i) The Rural Electrification Corporation
(ii) Plan allocation to the States.
(iii) Funds support from Government as loan and grant
(iv) Institutional financing bodies like commercial banks
(v) International financing agencies like OECF etc

[38] Ministry of Power, Government of India, Discussion Paper on Rural Electrification Policies (Pursuant to Sections 4&5 of the Electricity Act 2003). The draft remains to be notified as on 28/09/05.
The National Electricity Policy goes further and envisions a minimum lifeline consumption of 1 unit/household/day as a merit good by year 2012.
http://powermin.nic.in/whats_new/national_electricity_policy.htm
[39] http://planningcommission.nic.in/midterm/cont_eng1.htm accessed on 24/09/05
[40] http://nac.nic.in/ncmp.htm accessed on 12/09/05
[41] http://164.100.24.208/ls/CommitteeR/Energy/1Energy.pdf Demand for Grants (2004-05)
[42] http://164.100.24.208/ls/CommitteeR/Energy/1Energy.pdf page 45 accessed on 24/09/05
[43] http://164.100.24.208/ls/CommitteeR/Energy/1Energy.pdf page 52 accessed on 24/09/05
[44] http://164.100.24.208/ls/CommitteeR/Energy/1Energy.pdf page 53 accessed on24/09/05
[45] Ministry of Power, Government of India, Discussion Paper on Rural Electrification Policies (Pursuant to Sections 4&5 of the Electricity Act 2003). The draft remains to be notified as on 28/09/05.

The Rural Electrification Corporation (REC) was established as a public sector undertaking in July, 1969. Initially, the principal objectives of the corporation were to finance RE schemes and promote rural electricity co-operatives for funding rural electrification projects across the country. The tasks assigned to the corporation have occasionally been expanded. The main objects currently are:

(i) To subscribe to special rural electrification bonds that may be issued by the State Electricity Boards on conditions to be stipulated from time to time.
(ii) To promote and finance rural electricity co-operatives in the country.
(iii) To administer the money received from the GoI and other sources such as grants.
(iv) To promote, organize or carry on the business of consultancy services and/or project implementation in any field of activity in which it is engaged in India and abroad.
(v) To finance and/or execute works on small/mini/micro-generation projects, to promote and develop other energy sources and to provide financial assistance for leasing out the above sources of energy.
(vi) To finance survey and investigation of projects.
(vii) To promote, develop and finance viable decentralized power system organizations in cooperative, joint, private sector, panchayat and/or local bodies.

Select RE schemes that have shown varying degrees of success are reviewed below.

Pradhan Mantri Gramodaya Yojna (PMGY)

The PMGY launched in 2000-2001 provided additional financial assistance for minimum services by the central government to all states on a 90% loan and 10% grant basis. These included rural health, education, drinking water and rural electrification. The PMGY, with an outlay of about Rs 1600 crores during the 10th Plan period, was being coordinated and monitored by the Rural Development Division of the Planning Commission. More importantly, under PMGY states had the flexibility to decide on the inter-reallocation of funds amongst the 6 basic services. Thus states could enhance allocations to expedite the pace of rural electrification. The scheme has been discontinued[46] from 2005 onwards.

Kutir Jyoti Program (KJP)

KJP was initiated in 1988-89 to provide single point light connection (60 w) to all Below Poverty Line (BPL) households in the country. KJP provides 100% grant for one time cost of internal wiring and service connection charges and builds in a proviso for 100% metering for release of grants. Nearly 5.1 million households have been covered under the scheme to date. The scheme was merged into the 'Accelerated Electrification of One Lakh Villages and One Crore Households' in May 2004 and now into the RGGVY.

Minimum Needs Program (MNP)

The MNP, exclusively targeted states with less than 65% rural electrification (by the old definition)[47] provides 100% loans for last mile connectivity. The program resources are drawn

[46] Presentation on Rural electrification, RE Division, Ministry of Power, 6th October 2005
[47] Old definition of an electrified village: *A village will be deemed to be electrified if electricity is used in the inhabited locality, within the revenue boundary of the village, for any purpose whatsoever*.

from the Central Plan Assistance. Rs. 775 crore was released during 2001-03 for rural electrification under the MNP. The scheme was discontinued in 2004-05 on account of difficulties in implementation.

Accelerated Rural Electrification Program (AREP)

The AREP, operational since 2002, provides an interest subsidy of 4% to states for RE programs. The AREP covers electrification of un-electrified villages and household electrification and has an approved outlay of Rs. 560 crore under the 10th Plan. The interest subsidy is available to state governments and electricity utilities on loans availed from approved financial institutions like the REC (Rural Electrification Corporation), PFC (Power Finance Corporation) and from NABARD under the Rural Infrastructure Development Fund (RIDF).

Rural Electricity Supply Technology Mission (REST)

The REST was initiated on 11th September 2002. The mission's objective[48] is the electrification of all villages and households progressively by year 2012 through local renewable energy sources and decentralized technologies, along with the conventional grid connection.

REST proposes an integrated approach[49] for rural electrification and aims:

- To identify and adopt technological solutions
- To review the current legal and institutional framework and make changes when necessary
- To promote, fund, finance and facilitate alternative approaches in rural electrification, and
- To coordinate with various ministries, apex institutions and research organizations to facilitate meeting national objectives

Accelerated Electrification of One Lakh Villages and One Crore Households, MNP and Kutir Jyoti have now been merged with the RGGVY, discussed in detail ahead.

Conclusion

A review of state-wise targets and achievements in village electrification and Kutir Jyoti connection figures show that targets have not been met in the last three years. Although major programs have been targeted in states such as Andhra Pradesh, Assam, Bihar, Uttar Pradesh and West Bengal, the achievements are short of targets and in cases and in some instances, nonexistent. Furthermore, as mentioned above, the pace of village electrification has been slowing down with only 18,500 villages electrified during the 9th plan compared with 120,000 during the 6th plan. However, the same period saw a rapid increase in pump set energization with states declaring 'zero' tariff for power supply to agriculture. For example in UP[50], the number of energized pump sets rose from 4.03 lakhs in 1980 to 6.36 lakhs in 1990.

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http://powermin.nic.in/JSP_SERVLETS/internal.jsp definition of an electrified village accessed on 20/09/05

[48] http://powermin.nic.in/JSP_SERVLETS/internal.jsp REST mission accessed on 20/09/05

[49] TERI, National Strategy for Rural Electrification, September 2003

[50] ADB Policy Research Network, Paper on Rural Electrification, TL Shankar January 2005

The Chief Ministers conference held on 3rd March 2001 recognized the need to take approach RE in a de-politicized manner. This political commitment towards achieving the goal of 100% village electrification in a sustainable manner is evidenced through the passage of the Electricity Act 2003, through changes in the definition of an electrified village and through the merging of a number of RE programs into one umbrella program - the Rajiv Gandhi Grameen Vidyutikaran Yojna (RGGVY).

Section III: Rajiv Gandhi Grameen Vidyutikaran Yojna

The RGGVY is the latest[51] national RE scheme launched by the Ministry of Power to execute the vision for rural electrification as enunciated in the NCMP and recommended by the Chief Ministers conference in 2001. The plan was instated in April of 2005 with the following objectives:

- 100% electrification of all villages and habitations in the country
- Electricity access to all households
- Free of cost electricity connection to BPL (Below Poverty Line) households

For achieving the said objectives, the RGGVY envisions creating a:

- Rural Electricity Distribution Backbone (REDB) with at least one 33/11 KV (or 66/11 KV) substation in each block
- Village Electrification Infrastructure (VEI) with at least one distribution transformer in each village/habitation
- Decentralized Distributed Generation (DDG) systems where the grid is not cost-effective or feasible

Upon launching the RGGVY Smt. Sonia Gandhi, Chairperson of the National Advisory Council, stated:[52] "Rural electrification in all its aspects forms a key - I would say the key - component of Bharat Nirman. The diversification of the rural economy, so very essential to manage the demographic pressures in the countryside, depends critically on the easy availability of reliable power."

Salient features of the RGGVY

The RGGVY positions rural electricity as a necessary component for broad based economic and human development, looking beyond the prevalent RE framework of increasing agricultural production through irrigation. The program, in addition to meeting the household electricity needs, looks at 24 hours supply of quality grid power to rural areas for spreading industrial activity, provision of modern healthcare facilities, and the use of IT.

The RGGVY recognizes the need for revenue sustainability for RE projects and boldly states that *Electricity supplied must be paid for.*[53] The scheme proposes the management of rural distribution through franchisees who could be user associations, cooperatives; NGO's or even individual entrepreneurs. Further, the distribution utilities under the new RE framework are required to enter into Bulk Supply Tariff agreements (BST) with the proposed franchisees to ensure commercial viability. The state governments are also required to make adequate provisions for revenue subsidy to the utility. RGGVY thus, for the 1st time, even while providing

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[51] The Minimum Needs Program, Accelerated Electrification of One Lakh Villages and One Crore Households Scheme and Kutir Joyti Programs have been merged with the RGGVY.

[52] http://www.renewingindia.org/newsletters/bee/current/bee_apr_06_05.htm

[53] http://recindia.nic.in/download/RGGVY_brochure.doc

capital subsidy for RE projects, links subsidy provision to revenue sustainability barring which the REC could convert the said capital subsidy into interest bearing loans[54].

Universal Service Obligations (USO): Physical and Financial dimensions

In terms of targets for achieving the USO under the electricity access goals over the next 5 years, the number[55] of un-electrified villages in the country is estimated at 112,401. The ministry estimates that the number of un-electrified villages is likely to rise to 125,000 as per the new definition of village electrification. The Census of India 2001 puts national rural household electrification at 43.52%, leaving around 78 million to be connected to the grid. The picture however is not complete without taking the wide-ranging disparities in village and household electrification across states into account.

The Census of India 2001 reports household electrification at 10.30% in Bihar and 24.30% in Jharkhand, and 32% for UP and 70% for MP. Several states like Himachal Pradesh and Punjab show over 90% household electrification (see Table 5). A two-pronged approach is required to address, first, villages that are already electrified and those that need intensive household electrification and, and second, extending the grid to the remaining un-electrified villages.

Table 5. Reported status of Rural Electrification, March 2004[56]

Electrified states			Electrified states		
States	Electrified villages (%)	Electrified households (%)	States	Electrified villages (%)	Electrified households (%)
Punjab	100.00	91.90	MP	97.43	70.00
Haryana	100.00	82.90	Rajasthan	98.38	54.70
Gujarat	100.00	80.40	Chhattisgarh	94.0	53.10
Maharashtra	100.00	77.50	West Bengal	83.63	37.50
Tamil Nadu	100.00	78.20	Orrisa	80.15	26.90
Kerala	100.00	70.20	North-east	75.32	33.20
AP	100.00	67.30	UP	58.73	31.90
Himachal P	99.38	94.80	Bihar	50.00	10.30
Karnataka	98.91	78.50	Jharkhand	26.00	24.30

Source: Planning Commission, 2005

While information on the number of villages under these categories is still being compiled by the MoP,[57] the RGGVY presents the following outline for the resources required to achieve 100% household and village electrification (Table 6):

[54] Ministry of Power, Government of India, Discussion Paper on Rural Electrification Policies (Pursuant to Sections 4&5 of the Electricity Act 2003). The draft remains to be notified as on 28/09/05 page 21
[55] http://recindia.nic.in/download/RGGVY_brochure.doc, Annexures II and III
[56] http://planningcommission.nic.in/midterm/english-pdf/chapter-10.pdf
[57] ADB Policy Research Network, Draft Paper on Rural Electrification, TL Shankar,2005

Table 6. Cost estimates for village and HH electrification under RGGVY

S. No.	Particulars	Amount: Rs. in Crores
1	Electrification of 125,000 un-electrified villages which includes development of backbone network comprising Rural Electricity Distribution Backbone (REDB) and Village Electrification Infrastructure (VEI) and last mile service connectivity to 10% Households in the village @ Rs. 6.50 lakh / village	8,125.00
2	Rural Households Electrification (RHE) of population under BPL i.e. 30% of 7.8 crore. Un-electrified Households, i.e. 2.34 crore households @ Rs. 1500/H/H as per Kutir Jyoti dispensation	3,510.00
3	Augmentation of backbone network in already electrified villages having un-electrified inhabitations @ Rs. 1 lakh / village for 4.62 lakh villages	4,620.00
	Total (1+2+3)	16,255.00
	Outlay for the scheme	16,000.00
	Subsidy component@ 90% for items 1 & 3 and 100% for item 2	14,750.00
	Component of subsidy to be set aside for enabling activities including technology development @1% of outlay	160.00

Source: RGGVY Rural Electrification Corporation, 2005

Sustainability

While one-time grants are proposed under the scheme, it also recognizes the need for a revenue model to sustain the rural electrification process. A franchisee model along with contractual obligation for O&M is proposed under the scheme to ensure sustainability of the REDB and VEI. However, with detailed guidelines on the size and revenue model for proposed franchises not yet in place, the REDB and VEI set up under RGGVY could just end up being a linear extension of rural electrification schemes of the past.

Criticisms of RGGVY for Scaling-up Electrification Efforts

To reach the goals set by the GoI in an efficient manor, well-planned central-level schemes are necessary to aide in bringing grid connections to all rural households. Geographic isolation and lack of infrastructure leave rural households the most energy poor citizens, having the least access to energy services and their benefits. In order to bring the benefits of electricity to the rural poor while maintaining a sustainable and profitable electricity industry, policy initiatives must ensure that the fixed costs of electrification are largely borne by the state. The most effective way to achieve this is to subsidize the initial hookup and hardware costs.

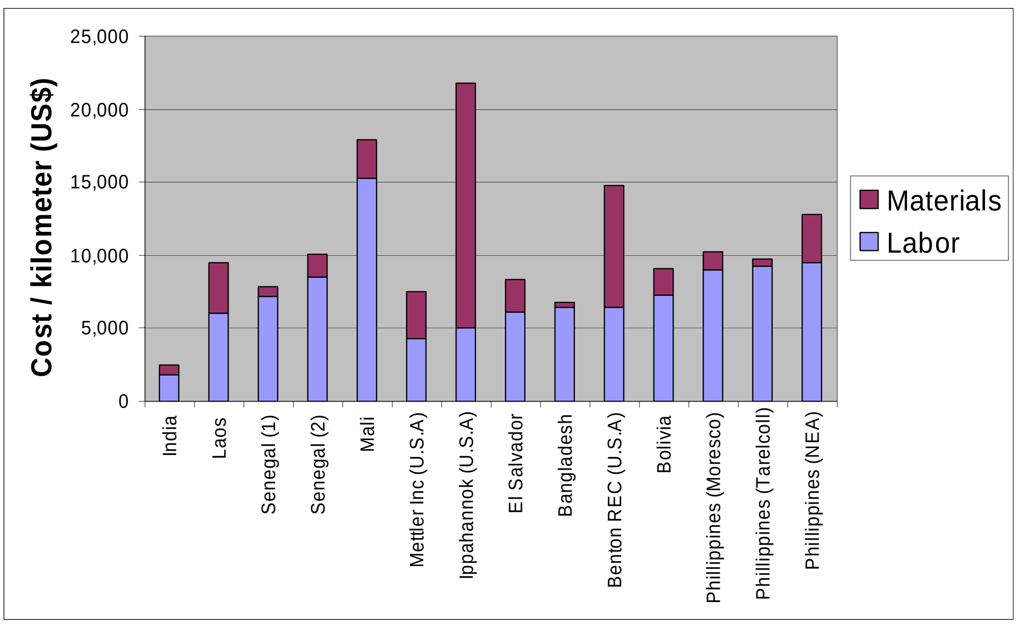
The RGGVY scheme has a similar approach. A review of the RGGVY scheme costing suggests that the current costs for a single household grid connection (effectively Rs. 1500/HH or $30/HH) may only be barely adequate for households that are within 25 meters of a distribution network. A careful analysis of the cost structure would be needed since the geographic distances assumed are not supported by data and the costs of new metered hookup are lower than an approximate factor of four compared to the lowest costs of rural electrification found anywhere in the world. Low voltage distribution wire and poles alone can cost $1 to $1.50/meter. While India has one of the lowest costs of extending the grid (see Figure 4), the rising costs of materials needs to be accounted for. If a franchisee model is to succeed, the labor costs, and the costs of meters (or load limiters) installation would either need to be included or a means to pay for them gradually be incorporated. The pitfalls of a scheme being under-funded are that the funds will either not be effectively used or final targets will not be met.

The new definition of an "electrified village" now requires that at least 10% of HH in the village are electrified. While the scheme includes funds to electrify the 2.34 crore BPL households, what is unclear is how the remaining rural households will be electrified. Field experiences in UP and MP confirm that almost all rural households there want electricity connections, with the largest barrier being adequate funds to pay for the initial cost of the connection. With a focus, on being extensive (no of villages electrified) rather than intensive (% of households covered), large gaps may remain in rural electrification.

While the RGGVY presents a comprehensive and standardized method for actual installation of grid connections and meters and proposes a large scale involvement of franchisees, one of the programs weaknesses is its lack of an explicit plan for the monitoring of new installation and follow-up. One possible solution is to pay private companies to install lines, meters, and to hold the state responsible only for monitoring.

For an order of magnitude higher rate of rural electrification than has been successfully carried out in the past, one also needs to develop supply chains for products and parts by working closely with industrial partners. RGGVY, along with all past RE programs, needs to develop these partnerships from the start.

Figure 4. Variation in total three-phase, MV line cost (labor and materials).



Source: ESMAP, 2000

Section IV: Case Studies

To get sense of on the ground reality in the two states of UP and MP, one district in each state and five villages within each of these districts were selected for field studies. The outline of the methodological approach for the study includes following major steps:

Selection of districts – Unnao district in Uttar Pradesh and Raisen district in Madhya Pradesh were identified by the Earth Institute at Columbia University for the purpose of the study.

Selection of villages –Attempting to capture the impact and attributes of energy services provision, the developmental indicators used for the purpose of village selection were:

- Percentage of SC/ST population in the villages
- Percentage of literacy level
- Percentage of marginal workers

As per information available from the Census of India 2001, villages in both districts were ranked on each of the three indicators. The individual indicator ranking for each village was aggregated to develop a composite integrated rank indicator for each village in the district. The integrated rank indicators were statistically segregated over 4 quartiles. Ten villages were selected from each of the three inter-quartile boundaries and 10 each from the lowest and highest aggregated ranks. The final 5 villages were chosen to ensure that the villages were geographically spread across tehsils.

Data Collection

Surveys were conducted in the ten sampled villages (five in each district). Focus group discussions were held in the communities to assess the status of services. The following sources were tapped to collect relevant information about electricity services in rural India:

Madhya Pradesh State Electricity boards, circle office Bhopal and Raisen.
Uttar Pradesh State Electricity boards, Unnao.
Public Health and Engineering Department, Bhopal and Raisen
Rajiv Gandhi Mission, Bhopal
District Agriculture department, Raisen
District water resources department, Raisen
Uttar Pradesh Jal Nigam, Unnao
District NIC office, Raisen and Unnao
Census of India office, Delhi
NSSO

Consultation with key stakeholders - The key stakeholders that were consulted for the purpose of the study are:

Chief Engineer, Madhya Pradesh SEB, Raisen
Chief Engineer, Uttar Pradesh SEB, Unnao

District Collector, Raisen and Unnao
PHED officials in Bhopal
UP Jal Nigam, officials, Unnao
Panchayat members- Sarpanch

Despite the fact that the team visited the PHED/Jal Nigam office several times, officials of the PHED / Jal Nigam, Raisen and Unnao were not available for discussion.

The primary data helped in assessing the current ground realities, quality of access and constraints faced at the field level. Data was used to identify gaps in planning and implementation. The secondary data and discussion with the utility officials has helped understand the point of view of end users and providers. While the sample size may be too small to extrapolate, the village surveys and studies were instrumental in providing a snapshot of the conditions on the ground. Data was collected from various sources, which resulted in problems in comparing data sets that did not use the same scale.

Electricity Services in the State of Madhya Pradesh

Madhya Pradesh was the largest state in India and had the forth largest population until it was bifurcated into two states, Madhya Pradesh and Chattisgarh, on 1 November 2000. The state economy has shown robust growth averaging 4.4 percent since 1980/81, accelerating to 5 percent during 1990/96. The contribution of the primary sector in state domestic product has declined gradually over time and the contribution of services and industry has risen consistently. Similarly, the share of manufacturing and construction has risen from 21.4 percent to 23.0 percent during the same period. Despite its growth, MP is still one of the poorest states in India. In 1999/2000, the per capita annual income was Rs 11,244 as compared with Rs 14,682 at the national level[58]. The percentage of the population living below the poverty line was 37.4 in 1999/2000, much higher than the national figure of 26.1 percent.

The 2001 census states that 97% of MP is electrified.[59] The census data also shows that only about 70% of households across the state use electricity as a primary source of lighting - 90% in urban areas and about 60% in rural areas. Nearly 1.32 million pumps have been energized in the state,[60] which constitute 9.6% of all pump sets energized across the country.[61]

Key issues in current electricity services

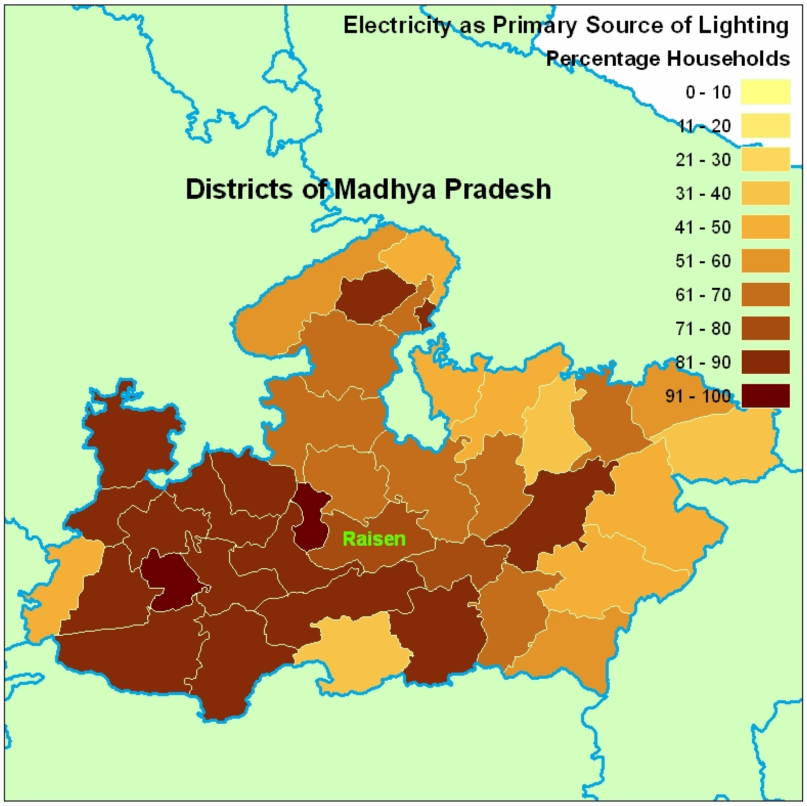
Table 7 provides a snapshot of the state of the Madhya Pradesh State Electricity Board's (MPSEB) service capacity. The accompanying map (Figure 5) provides district-wise data on electrification.

Table 7. MPSEB figures

Generation	Total (MW)
Installed Capacity [62]	
• Thermal	2272.5
• Hydro	835.0
• Mini/Micro hydel	5.45
• Total	3112.95
• Total generation in 2003-04[63]	15801.214 MkWh
Transmission[64]	
▪ Length of transmission lines in circuit kms	17951 Kms
▪ Number of substations	158
▪ Capacity in MVA	18801
Distribution	
▪ Total no of consumers[65]	6493541
▪ Total connected load	8897864 kW
▪ Total No of employees[66]	58774
▪ Weighted average distribution losses- half early up to June 2005[67]	36.19%

[58] http://www.mp.nic.in/des/es2001-10.htm. National figure from 1998-99
[59] http://www.mp.nic.in/energy/mpseb/comapre.htm
[60] http://www.mp.nic.in/energy/mpseb/comapre.htm
[61] http://www.mp.nic.in/energy/mpseb/comapre.htm
[62] http://www.mppgenco.nic.in/mpgenco-install-detail.htm
[63] http://www.mp.nic.in/energy/mpseb/mpseb%20graph/Total-Generation-graph.htm
[64] http://www.mptransco.nic.in/
[65] http://www.mp.nic.in/energy/mpseb/mpseb%20graph/consumer-load-graph.htm
[66] http://www.mp.nic.in/energy/mpseb/mpseb%20graph/Employment-graph.htm
[67] http://mperc.org/losses-jul05-weighted.html

Figure 5. District-wise use of electricity as primary source of lighting



Source: FAO and Census 2001

Load Restrictions

The 2003-04 energy balance sheet[68] shows that in addition to the load relief of 2,230 million units, the Madhya Pradesh State Electricity Board (MPSEB) undertook load shedding of 1,438 million units that year. Power demand grew by 6.4 percent in 1999-2000. According to the SLDC[69], while the registered maximum demand was 4,984 million units in January 2004, the unrestricted maximum demand would be 6,033 million units during the same period.

Despite the sound operating performance[70] of MPSEB generating plants, the peak demand-supply gap in the state has been growing. This unserved demand results from planned (load relief) and unplanned (load shedding) cuts. In response to the shortage, MPSEB resorts to load restrictions for high tension, low tension, and rural consumers. According to the SLDC[71] energy balance sheet for the year 2003-04, while average supply at divisional headquarters ranged between about 20 to 23 hours, supply at the tehsil level varied from about 14 to 23 hours per day. Rural 3-phase supply during the year, however, fluctuated from an average supply of 3.26 hours in January 2003 to about 23 hours in August 2003. Quality of supply has also suffered due to growing demand and overloading of the transmission and distribution network; the transmission system was operating at lower than normal frequency and voltage for over 50 percent of that year.

[68] http://www.sldcmpindia.com/load_despatch/energy_balance_sheet_0304.htm
[69] http://www.sldcmpindia.com/load_despatch/energy_balance_sheet_0304.htm
[70] http://powermin.nic.in/reports/pdf/Rating%20of%20State%20Power%20Sector-January%202003.pdf
[71] http://www.sldcmpindia.com/load_despatch/energy_balance_sheet_0304.htm

Private sector participation

In response to growing supply gap, the Government of Madhya Pradesh (GoMP) initiated a policy to invite private power producers to enter into power purchase agreements with a total of 17 sponsors[72]. However, the IPPs have been finding it difficult to achieve financial closure due to the insufficient escrow capacity of the MPSEB. The term escrow used here refers to the deposition of the revenue stream from a specific revenue collection center, e.g., a distribution unit, into a separate account in an identified bank, an escrow agent. In the power sector this mechanism is mostly used to guarantee payment of an independent power producer, to whom the primary claim on a revenue stream from a distribution zone is transferred or escrowed.

As per the MPSEB status on private sector participation in generation, of the 11 projects under consideration aggregating 3308.9 MW of capacity addition, only 4 projects aggregating 1426 MW have achieved closure. The MPSEB also acknowledges 73 that 7 of the proposed 11 projects are likely to depend upon the future escrow capacity of the MPSEB.

Tariff, subsidies and financial restructuring

The immediate reasons for the financial problems of MPSEB appear to be an outcome of the GoMP policy to provide free power to single-point connections (un-metered connections intended for operation of a single power outlet point only) in urban and rural areas and for agricultural pump connections of up to 5 horsepower[74]. Moreover, GoMP instructed MPSEB to supply almost free electricity to rural electricity cooperative committees (Rs .07 per kWh) and to pursue a vigorous rural electrification program. This resulted in lopsided growth rates in the domestic and primarily agriculture sectors at the expense of the industrial and commercial consumer categories. Industrial consumption was 82.7 percent of total energy consumption in 1970-71, but dropped to only 20 percent of consumption in 1999-2000. During the same period, the percentage of agricultural consumption rose from 3.4 percent to 41 percent.

The situation has been corrected to some extent with the formation of the Madhya Pradesh Electricity Regulatory Commission (MPERC) in 1998 and the subsequent passage of 3 tariff orders emphasizing efficiency improvements and reduction in cross subsidy levels. The State Power Sector Rating report of the MoP[75] has highlighted the MPERC’s latest tariff order (2005-06) as a key positive influence. The timing of such tariff orders, however, deprives the utility the benefits of the revised tariffs for the full financial year[76]. With low levels of subsidy payments in cash by the GoMP to the utility (about 45 percent) and estimated Aggregate Technical and Commercial (AT&C) losses of 46 percent[77] the finances of the restructured utilities are further strained.

Utilities that default on loan payments to both the state government and external agencies is a continuing cause for concern. The GoMP needs to resolve the issue of past liabilities as part of

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[72] Report and recommendation of the President to the board of directors on proposed loans to India for the MP power sector development program, November 2001- ADB, MPSEB
[73] http://www.mp.nic.in/energy/mpseb/private.htm
[74] Report and recommendation of the President to the board of directors on proposed loans to India for the MP power sector development program, November 2001- ADB, MPSEB
[75] Power Sector Rating Consolidated Report to the Ministry of Power 2005, ICRA/CRISISL
[76] In this case the MPERC passed the tariff order for 2004-05 in December 2004. The financial year in India ends on March 31st
[77] Power Sector Rating Consolidated Report to the Ministry of Power 2005, ICRA/CRISISL

the restructuring and unbundling exercise. The financial restructuring plan for the restructured utilities, awaiting clearance form the GoMP, is expected to address a number of these issues.

System Losses

From 1994-95 to 1998-99, transmission and distribution (T&D) losses have varied within the range of 19.6 percent to 20.9 percent. The State Power Sector Rating Report for 2005 has estimated AT&C losses[78] in the state at 46 percent and assigned the utility a score of 3.25 on a maximum of 21 on T&D parameters. According to the tariff petition of 2005,[79] the MPSEB has achieved 100% metering at 33 KV (2,791 nos) and 11KV (5,726 nos) feeders. Furthermore, in FY04 the utility generated a total of 14,523.56 million units and purchased an additional 14,035.32 million units. Despite this, of the aggregated 28,559 million units input into the system during the year, sale was recorded for 15,996 million units, showing a loss of 44 percent.

The MPERC's multi-year goals for reduction[80] in losses are unlikely to be achieved. In FY04, while the average cost of a unit sold was Rs. 4.03, the average revenue excluding subsidy was only Rs. 3.42. Because subsidized sale accounts for 61.8 percent of all electricity sold and 33 percent[81] of all electricity sold is un-metered, collections are minimized. The 2004 Management and Information Systems (MIS) report of the MPSEB estimates that 22.7 percent of all consumers are un-metered.

Conclusions

Despite noticeable progress, the sector's financial variability and sustainability remain an area of concern. The GoMP's commitment to reform in the sector has been consistent but progress on critical parameters including settlement of past arrears and unfunded pension liabilities requires immediate attention. In addition, the efforts of the MPERC to rationalize the tariff structure needs to be supplemented with the GoMP's commitment to timely release of the full subsidy in cash. The generation sector has shown the best performance since restructuring and the state government has supported the growth in state-owned generation capacity by 18 percent (base year 2002). However, in the absence of concrete actions to check the high AT&C losses, the desired impact of restructuring and unbundling the MPSEB may continue to elude the consumer.

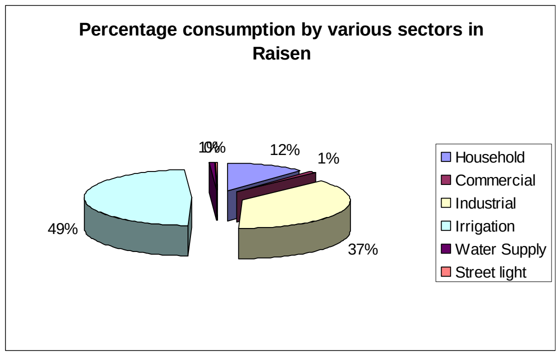
Raisen District

The district is comprisesd of 7 blocks, namely Sanchi, Gairatganj, Begumganj, Obedullahganj, Silwani, Badi and Udaipur. Raisen is spread over an area of approximately 7,600 sq. km. According to the 2001 Census data, the district supports a population of 197,496, with 82% of households classified as rural. Around 50% of electricity usage across the district is attributed to agriculture (Figure 6), illustrating the domination of irrigation in the district's economy.

[78] Power Sector Rating Consolidated Report to the Ministry of Power 2005 ,ICRA/CRISISL
[79] http://mperc.org/TariffPetition05.pdf
[80] http://mperc.org/Tariff%20Order%20ver%201.98.pdf page 23
[81] http://mperc.org/Tariff%20Order%20ver%201.98.pdf page 58

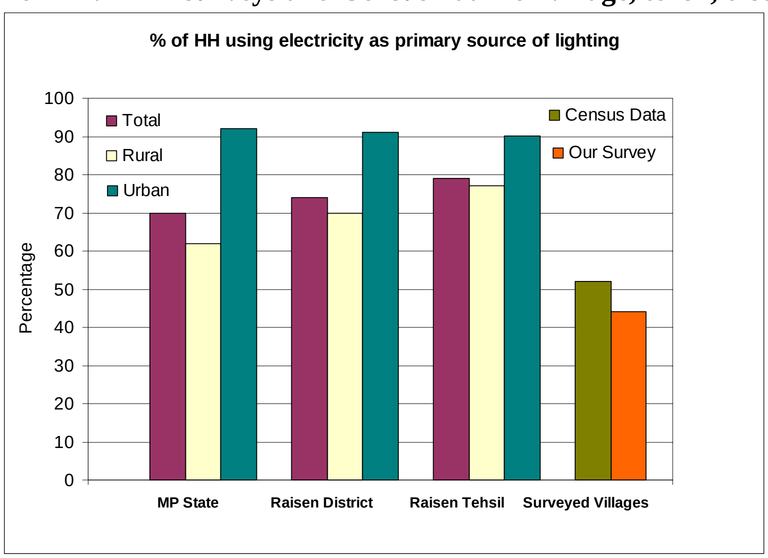
Figure 7 provides a comparison of electricity use for lighting across state, district, tehsil, and village levels. Table 8 describes distribution of households across the district according to primary source of lighting. The last pair of bars represents the actual number of grid connections in the villages surveyed by Earth Institute/TERI. According to the 2001 Census, about 71 percent of all households in the district use electricity as their primary source of lighting, implying that an equivalent percentage of households have a grid connection. The district-wide electrification percentage mirrors statewide figures. But while 60 percent of rural households are electrified, field studies in five villages conducted by the EI/TERI reveal that only about 45% of households surveyed had a grid connection, painting a very different picture of electrification within the district.

Figure 6. Electricity consumption by sector



Source: Census 2001

Figure 7. Data from EI/TERI surveys and Census 2001 for village, tehsil, district and state.



Source: Census 2001, last bar EI survey 2005

Table 8. Distribution of HH by source of lighting					
Raisen District					
Source	**Electricity**	**Kerosene**	**Solar**	**Other oil**	**Other**
% of households	**70.8**	**28.7**	**0.2**	**0.1**	**0.0**
Source: Census of India 2001					

Ground Realities in Raisen Villages

The state of Madhya Pradesh is comprised of 55,841 villages. Five of these villages, Gadarwara, Imaliya Gondi, Pati, Salahpur Surbarri, and Gurariya, were chosen by the EI for studies on ground realities in the district. The five villages combined comprised of a total of 619 households and have a combined population of 3,869 (demographic details are listed in Table 9). The primary occupation in all of these villages is agriculture. The main crops grown in the villages are wheat, gram, soybean, maize and tuar/arhar. The average yield across the villages is 12 quintals of wheat per acre and 5 quintals of gram per acre. Table 10 summarizes the characteristics of sampled villages in the Raisen district in relation to the amount of land owned. Of the surveyed households, 14% own 2 - 4 ha of land, 47% own 1 - 2 ha, 14% own less than 1 ha, and 26% of households are landless. Members of the 47 landless households work as agricultural or casual labor for their sustenance. The unskilled wage rate for men and women is Rs.50/day. Few villagers are involved in services or business.

According to the 1991 census, 1,462 of 55,841 villages in the state are un-electrified.[82] Of all rural households in the Raisen district, about 30% do not have electricity. Of all surveyed households, 45% were electrified, and only 40% of those with electric connections have a metered connection.[83]. The primary sources of lighting in the villages are kerosene lamps and electricity. Table 11 breaks down the use of kerosene and electricity for lighting in each village.

Power service conditions are similar in all of the villages. Field study revealed that the electricity supplied to these villages is highly erratic and often nonexistent for days at a time. At times the voltage level is too low to light a light bulb, while other times high voltage causes damage to appliances. Erratic and irregular power supply has led vexed villagers to justify suspending their bill payments. No commercial activity which uses electricity has been developed in the villages, partly due to the poor quality and unreliability of the power supplied.

Table 9. Demographic details of sample villages in Raisen District

Name of Village	*Tehsil*	# of HH	Total Population	% of SC\ST Population	Literacy Rate	Female Literacy Rate	Working Population	Worker-Population
Gadarwara	Silwani	43	256	57.42	0.449	0.352	146	0.570
Imaliya Gondi	Goharganj	76	403	84.62	0.524	0.435	188	0.467
Pati	Raisen	112	689	43.39	0.578	0.481	198	0.287
Gurariya	Baraily	303	1943	16.88	0.435	0.321	701	0.360
Salahpur Surbarri	Gairatganj	86	580	93.10	0.676	0.643	259	0.447
Raisen District	Rural areas	162,945	918,354	-	0.571	0.477	349984	0.381

Source: Survey conducted by the Earth Institute in April 2005

[82] http://www.powermin.nic.in/JSP_SERVLETS/internal.jsp accessed on May 31, 2005
[83] Source: MPSEB, Raisen.

Table 10. Characteristics of surveyed villages in relation to land ownership										
Category	**Unnao district**					**Raisen district**				
Amount of land owned	**0 ha**	**< 1ha**	**1-2 ha**	**2-4 ha**	**Total**	**0 ha**	**< 1ha**	**1-2 ha**	**2-4 ha**	**Total**
Total no. of HHs	**6**	**103**	**85**	**8**	**202**	**47**	**25**	**86**	**26**	**184**
Total population	**56**	**654**	**652**	**73**	**1435**	**281**	**184**	**611**	**226**	**1302**
Avg. family size	**9.3**	**6.35**	**7.67**	**9.13**	**8.11**	**5.98**	**7.36**	**7.11**	**8.69**	**7.29**
Avg. land per landowning families (in ha)	**0**	**0.62**	**1.27**	**2.02**	**0.98**	**0**	**0.53**	**1.39**	**2.02**	**0.99**
HHs having cement house % of households	**42.9**	**35.9**	**40**	**50**	**42.2**	**2.1**	**3.5**	**3.8**	**19.2**	**7.2**
HHs having electricity Connection (%)	**0.0**	**10.7**	**10.6**	**0.0**	**5.3**	**27.7**	**42.1**	**45.3**	**76.9**	**48.0**
Literacy rate (%)	**85.7**	**63.8**	**67.6**	**55.1**	**68.1**	**64.8**	**76.1**	**78.1**	**79.2**	**74.6**
Source: Survey conducted by the Earth Institute in April 2005										

Table 11. Source of lighting by village in Raisen district

Village	Tehsil	*Block*	Total no. of HH	Source of lighting %[84]	
				Electricity	Kerosene
Salahpur Surbarri	Gairatganj	Gairatganj	43	76.0	23.3
Imaliya Gondi	Goharganj	Obedullahganj	76	28.0	52.0
Gadarwara	Silwani	Silwani	43	88.4	0.0
Pati	Raisen	Sanchi	53	22.6	77.4
Gurariya	Baraily	Bari	280	42.1	57.1

Source: Customized data from the Census of India 2001 consultancy services

In the summer season, power supply is available for around 6-8 hours, while during the monsoon and winter seasons power supply is available for about 10-12 hours. Power is mostly available in the morning and afternoon regardless of the season. Electricity is generally unavailable in the evenings, when it is most needed for lighting. During the cropping season, the duration of power supply falls and is incredibly irregular. When asked why only a few people use energized , many villagers explained that they must to take a temporary power connection for 3 months in order to irrigate agricultural fields. Consequently, during the irrigation season (July and August) there is a rush to apply for connections at the MPSEB office. The government administration is unable to handle all applications at the last minute, leading to delays in allocation of connections. Due to the unreliable nature of electricity service and complications in acquiring temporary connections, villagers prefer diesel to electricity powered .

It is notable that villagers were clear about the specifics of their power problems, but were not at all proactive in taking up issues with relevant agencies. They have resigned themselves to the government's plans to make necessary changes to the failing electricity services. It is also notable that the wealthier segments of the community have easier access to both information and services. This was obvious in the village Gurariya, where the *harizan basti* living conditions were pathetic compared to other parts of the village. The *harizan basti* had no water source or electricity connection, illustrating that, in this instance, the schemes targeting the most vulnerable segments in society are, in fact, not benefiting them.

[84] Customized data from the Census of India 2001

Electricity Services in the State of Uttar Pradesh

The northern Indian state of Uttar Pradesh (UP) is the 4th largest state in the country (236,286 sq km) with population of nearly 166 million,[85] nearly equal to the population of all of western Europe combined and greater than all other states in India. [86] UP is a politically important state because it sends 80 members of a total of 543 to the Lok Sabha[87]. Nearly all of the prime ministers of independent India have hailed from UP, and yet the state continues to lag behind the national average of most development indicators. UP's per capita income is about Rs. 6,500 against the national average of Rs. 11,900. Nearly 40% of the population lives below poverty line.

Of the 97,122 villages in UP, 18,042 are un-electrified, leaving almost 80% of the population in the dark. Approximately 25% of rural households use electricity for lighting across state. UP contains about 841,951 energized pump sets, consuming 4951.63 GWh of power.

Despite political shifts, the momentum of electricity sector reforms has been largely maintained throughout the evolution of the UP electricity sector. The erstwhile vertically integrated Uttar Pradesh State Electricity Board has been trifurcated into three corporations: The UP Power Corporation Limited (UPPCL), in charge of transmission and distribution, the UP Rajya Vidyut Utpadan Nigam Limited (UPRVUNL), the operator of thermal generating facilities in the state, and the UP Jal Vidyut Nigam Limited (UPJVNL), the owner of hydro generating stations. The Kanpur Electricity Supply Corporation, (KESC) was also created to operate distribution in Kanpur, but continues to operate as a state owned entity that buys power from UPPCL for supply to Kanpur.

The GoUP announced a new power policy in December 2003 that is to remain in force till March 2009. The 3rd such policy in less than a decade, it delineates the state's power sector objectives[88]:

- 100% metering by June 2004 (not achieved)
- Annual state outlay of 800 crores/annum for 100% rural electrification by 2009
- Minimum 14 hours of electricity supply/day to rural areas in the meantime
- Energy Task Force(ETF) headed by the Chief Secretary as a single window empowered committee to grant all state level approvals
- The GoUP provides 7 year interest free loans for capital outlay between 150-1500 crores in order to attract private investment in generation
- Targeted subsidies wherein GoUP directly compensates the consumer

Key issues in current electricity services

Table 12 provides a summary of the Uttar Pradesh State Electricity Board's service capacity. The accompanying map (Figure 8) presents district-wise data on electrification.

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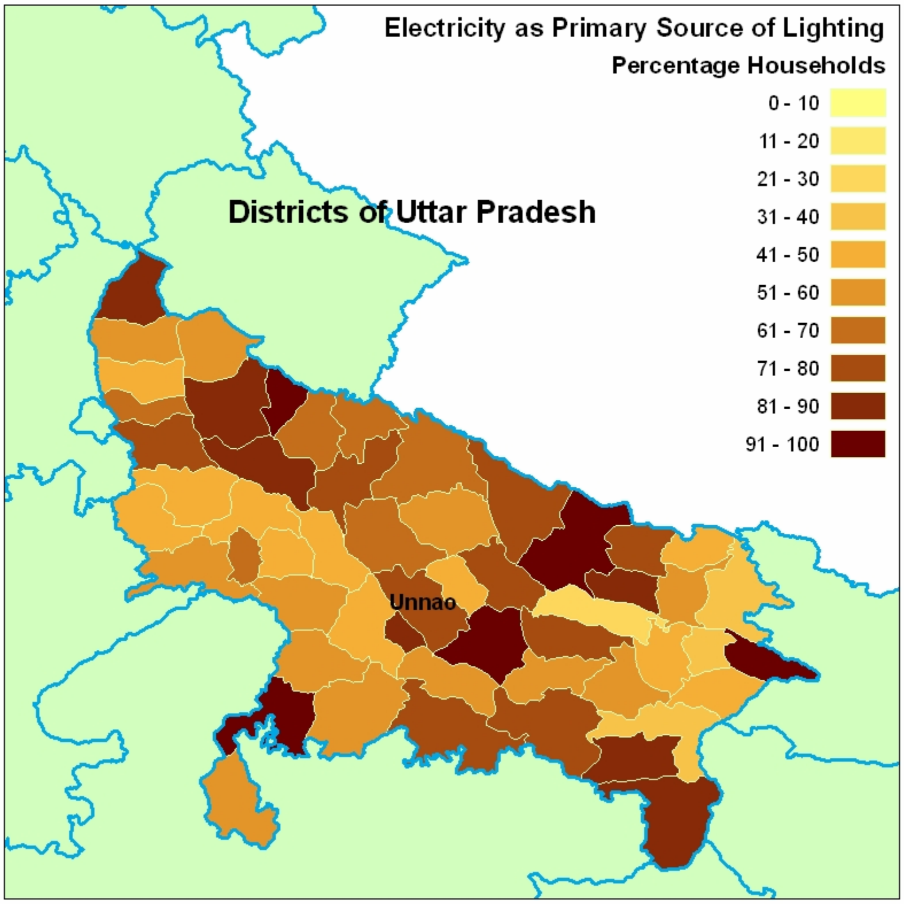
[85] Census 2001
[86] http://www.unfpa.org/swp/2001/english/indicators/indicators2.html, The population of western Europe is 183.4 million.
[87] The Lok Sabha is the lower house of the Indian Parliament.
[88] http://www.upgov.nic.in

Table 12. UPSEB at a glance

Total Customer base [89](2003-04)	8,462,364
Per capita annual power consumption	316 kWh[90]
Total installed capacity MW	4,425[91]
Length of energized transmission lines, kms 2001-02	20,842[92]
T&D Losses[93]	32.8%
Collection efficiency [94]	84%
ATC Losses[95]	+43.6%

Figure 8. District-wise use of electricity as primary source of lighting



Source: FAO and Census 2001

[89] http://uppcl.org/commercial.htm- category wise consumer served
[90] 2002/03 Source TEDDY, 2003/04 as per UN methodology per capita consumption equals gross generation/population
[91] Includes Thermal 3909 & Hydel 516 MW only. UP Power Policy 2003 http://www.uppcl.org/niti.htm
[92] http://www.uppcl.org/transmission.htm energized transmission lines
[93] Estimated figure for FY 04.Source multi year performance UPPCL tariff order for FY 05
[94] Estimated figure for FY 04.Source Performance Indicators UPPCL tariff order for FY 05
[95] Estimated figure for FY 04.Source Performance Indicators UPPCL tariff order for FY 05

Privatization

While the GoUP has mapped out reforms that will encourage privatization of distribution services, genuine concerns linger given the magnitude of the exercise yet to be undertaken. The employees of the erstwhile UPSEB made their intentions clear during the 11 day strike in Jan 2000 to oppose the process of privatization.[96] A similar situation arose again in December 2004 and January 2005, when employees opposed privatization of discoms and the sell-off of the Anpara 'C' generating station. There have consequently been frequent disruptions of power supply in the state.[97] The commercial viability of UPPCL is also extremely poor at present and the power sector rating report for the year 2005 has assigned the utility a score of 8 of 20 on financial parameters.

Lack of resources and supply

UPSEB is bleeding and is facing a resource crunch. Once again, the primary reasons seem to be flat tariff and un-metered consumption. The Uttar Pradesh Power Corporation Limited (UPPCL) is suffering from high transmission and distribution loss, poor collection and high AT&C losses. The problem in collection of tariffs is compounded by limited attempts at recovering arrears and inadequate investment in metering, system improvement and capacity augmentation. Power consumption (2667 kwh) in the state is greater than production (2280 crore kwh), creating a power deficit. The PLF of state owned generating stations continue to remain below the national average.

Unnao District

The Unnao district lies in the heart of the state between two major urban centers, Kanpur and Lucknow. The state has a relatively high groundwater level, providing huge potential for pump set-based irrigation. 4,214 state and 5,241 private tube wells have already been energized. The household electrification rate is 9.81%. A measely 9.5% use electricity as the main source of lighting, compared to 70.8% in Raisen, while most of the remaining population depends upon kerosene (Table 13).

Table 13. Distribution of HH by source of lighting

Unnao District

Source	Electricity	Kerosene	Solar	Other oil	Other
% of households	9.5	89.8	0.5	0.1	0.1
Source: Census of India 2001					

Source: 2001 Census

Table 14 describes power consumption by activity. Electricity availability in rural areas from 2001-03 dropped from 9.82 to 9.55 hours, and from 13.78 to 13.3hours in urban areas. The fall in per capita consumption is primarily is due to the drop in commercial light and small electric power consumption from 8,560 units in 2000-01 to 5,401 units in 2002-03. Industrial electrical power has fallen almost by half. The status of electricity based services in almost all villages

[96] On concerns exist regarding the GPF(General Provident Fund) of the employees which has reportedly been used by the UPSEB to fund new investments.
[97] India Power Reforms Update, March 2005

where amenities are available has shown a downward trend with the exception of public water supply.[98]

Table 14. Power consumption by various activities in the Unnao district[99]

	Item	2000-01	2001-02
1	Domestic light & small electric power	36%	48%
2	Commercial light & small electric power	4%	6%
3	Industrial electric power	30%	22%
4	Public light system	1%	1%
5	Rail/Traction	0%	0%
6	Agricultural electric power	27%	23%
7	Public water supply	1%	1%
	Total	100%	100%

Field level observation in surveyed Unnao villages revealed a lack of infrastructure and long replacement periods for damaged equipment. Consumers were forced to endure the failure of services for extended periods of time. Data gathered from the district in April 2005 shows that almost 1.8% of transformers are damaged each month. At the time of the survey, almost 2.7% of transformers were out of commission, and the repair rate was 44% per month. Box 4 describes the scenario in one village in particular.

Box 4. Failures in the village Behta.

Field study conducted in the village Behta during in June 2005 revealed that the distribution transformer (DT) had failed about 25 days prior to the team's arrival. The villagers were aware that the DT had failed on account of overloading; the DT of a nearby village had failed around 2 months prior and the utility had simply transferred the load to the DT serving Behta. The villagers both collectively and individually had approached the utility officials in Unnao and had submitted written complaints but were returned with assurances that the DT would be replaced with receivables from stores in Lucknow.

Initial project team queries with the utility were met with a curt response that the DT in Behta village was working. On being probed further, the utility conceded that the DT was indeed not working. They acknowledged that they had a written complaint from the village but also expressed helplessness with an average failure of nearly 3-4 DTs per day in the district and lack of adequate resources from the SEB headquarters in Lucknow.

Of 4,789 DTs in the district 45 were not working at the beginning of the month, and an additional 87 failed and were reported as not working later on. Only 58 of the total were replaced or repaired during the month. The utility also reported that on an average it takes 15-30 days to replace a DT and only 11% of the failed DTs were replaced in less than 7 days during the month. In this case, personnel from the utility had not even visited the village to assess the damage. The villagers recalled a similar transformer failure about 3 months before, when the SEB had taken over 45 days to repair the transformer.

[98] http://upgov.up.nic.in/engspatrika/qsystem/dtable2.asp accessed on June 17, 2005.
[99] http://upgov.up.nic.in/engspatrika/tab47.asp?formd=31+Unnao&formy=0203 accessed on May 28, 2005

The joint interactions with the District Collector, Unnao, and the Divisional Engineer at the UPPCL also revealed the lack of discretionary powers and autonomy at the district level to upgrade electricity services. The DC under a discretionary quota for development had sanctioned Rs 40 lakhs to the district SEB for distribution network strengthening. Yet despite upfront transfer of money the local utility has not been able to utilize the said amounts as procurement for utility requirements are done centrally from Lucknow. This has also created some administrative friction between the district administration and the utility.

Source: From discussions with: DC Unnao Ms Anita Chaterjee IAS, Divisional Engineer UPPCL Mr. Rashid Abrar and the villagers of Behta- June 2005 & August 2005

Ground Realities in Unnao Villages

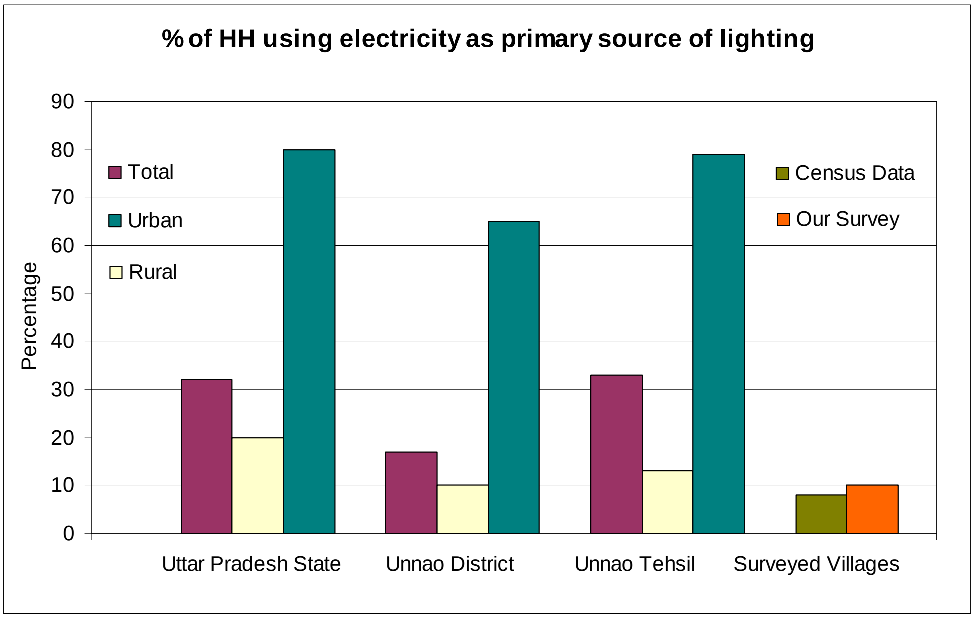
Five villages, Baruaghat, Behta, Bilahaor, Digvijayapur, and Majharia, across five tehsils in the Unnao district were chosen by the Earth Institute for a study of ground realities in the district. Table 15 outlines the village population, electrification status and other demographic data for the sampled villages. The five villages combined are comprised of a total of 1,157 households and have a combined population of 6,910. Table 10 in a previous section summarizes the characteristics of sampled villages in Unnao districts in relation to the amount of land owned. In the surveyed Unnao villages, 3% of households are landless, 51% own less than 1 ha, 42% own 1-2 acre of land, and 4% own 2 - 4 ha. As is the case in Raisen, members of the 6 landless households work as agricultural or casual labor for their sustenance.

Table 15. Demographic details of sample villages in Unnao District

Demographic Details of Sample Villages in Unnao District								
Name of Village	***Tehsil***	**# of HH**	**Total Population**	**% of SC\ST Populati**	**Literacy Rate**	**Female Literacy Rate**	**Working Population**	**Worker-Population Ratio**
Baruaghat	**Safipur**	**364**	**2009**	**41.70**	**0.434**	**0.259**	**796**	**0.396**
Behta	**Unnao**	**430**	**2731**	**29.50**	**0.546**	**0.473**	**1037**	**0.380**
Bilahaor	**Hasanganj**	**100**	**510**	**88.80**	**0.276**	**0.176**	**310**	**0.608**
Digvijaipur	**Bighapur**	**79**	**600**	**0.00**	**0.582**	**0.419**	**248**	**0.413**
Majharia	**Purwa**	**184**	**1062**	**27.90**	**0.417**	**0.272**	**354**	**0.333**
Unnao District	**Rural**	**407,323**	**2,288,781**	**-**	**0.425**	**0.309**	**814741**	**0.356**
Source: Survey conducted by the Earth Institute in April 2005								

Figure 9 compares the percentages of households electrified on the state, district, and block levels against the percentage of villages electrified from the actual sample surveyed by the EI/TERI team. While state level rural electrification is nearly 30 percent in UP, only 8 percent of surveyed village households were electrified. This partly reflects the fact that only three sets of samples from the five villages had access to electricity. In two villages, hamlets that were unelectrified were chosen for the survey. In the three villages that are electrified - Digvijaipur, Baruaghat and Behta – combined Census data shows that 90.5% of households use kerosene as the main source of lighting, 7.4% use electricity, and 2.1% use solar lighting systems. Primary data highlighted the presence of illegal connections in the villages where the electricity infrastructure existed.

Figure 9. Data from EI/TERI surveys and Census 2001 for village, tehsil, district and state



Source: Census 2001, last bar EI survey 2005

Issues in electricity service delivery: electrified villages

Access to electricity services was poor in all three electrified villages. Obtaining an electricity connection was found to be quite expensive due to the high upfront costs (Rs. 700+). Additional investments included 'facilitation costs' of Rs. 100-500 for application approval. Even when paid, there was no guarantee when the connection would be installed and no standard for the quality of service. A substantial number of villagers were thus discouraged from pursuing a connection at all.

It was estimated that power was available on an average 4-5 hours a day in Baruaghat and 1-2 hours a day at Behta, at intermittent levels, at low voltage (80-100V on average). Blow-outs were a persistent problem. Almost 100 connections existed in Behta, but no bills had been paid for years regardless of the nominal flat billing rate of Rs. 150 per month. There was no mention of a metered domestic connection in any of the three electrified villages. Lack of infrastructure, slow response of the state utility, poor conditions of the distribution system, high rates of transformer failure and the indifference of the local utility officials toward repair were some of the issues highlighted by the Behta and Baruaghat residents.

In the village Digvijaipur, the team found that electricity connections in the village were used only for water pumping for agricultural uses. None of the households had a grid connection even though the distribution network had been extended to the village. Though there was a demand for household connections, the primary concern expressed by villagers was the high upfront connection cost. Problems related to the lack of maintenance of the distribution network and the lack of redressal of grievances seen in neighboring villages were also cited. For example, villagers were expected to arrange transport for utility employees to come to the village as well as transport the transformer and other equipment themselves.

Issues in electricity service delivery: un-electrified villages

In both of the electrified and un-electrified villages the primary source of lighting was the soot-producing kerosene lantern (*dhibri*). Most households used 4-6 liters of kerosene per month with the lower and upper limits hovering around 2-4 and 6-8 liters per month per household. Kerosene supply in the villages was met through the PDS outlet @ Rs 10.25 per liter. However, in Behta surveys revealed that though the average supply was between 2-4 liters, certain influential residents received as much as 22 liters per month. Two heads of household admitted to this, albeit offering the excuse of having a large family. Box 4 provides a detailed discussion of transformer failures in Behta.

A typical example of conditions observed during the field visits was the electrification of village Majharia. Majharia electricity poles and a single phase line had been laid in 2003. No domestic connections were installed by the villagers as they felt that "the installation cost is too high due to levy of unauthorized charges; it is beyond our reach."[100] Such corruption deters villagers from pursuing a bad needed grid connection and further debilitates rural electrification reforms.

Other areas where demand for electricity exists

Demand for electricity exists in the form of agriculture and small enterprise. In Majharia, electricity was available only for business purposes, which were in fact limited by the unavailability of electricity. In Behta, two flour mills (around 10 hp) and an oil expeller (7.5 hp) were run on diesel, which could easily be shifted to electricity to make the operation more profitable for the entrepreneur. Other demand exists for lighting and associated uses in the form of small shops and the dairy business.

Field observations highlighted that villagers regularly spent time and money on recharging batteries from the nearest market. These batteries were used for operating a number of devices, including radios, fans, and televisions. Although no electricity service was delivered, appliances and services that consume electricity were nonetheless in use, illustrating that villagers relied on alternative methods of obtaining the requisite energy.

[100] Field survey – TERI team June 2005.

Section V: Scaling up rural electrification in India

Impediments to scaling up

Large numbers of HH with no electricity

Going by the current rate of electrification nationally about 1 million new connections are added each year, whereas the annual growth in households is 1.85 million. Approximately 78 of the 138 million rural households do not have access to electricity services. With the number of households likely to grow to 157 million by 2012, in order to achieve the goal of electrifying all rural households would imply that about 97 million households would have to be electrified by 2012 or about 10 million household per year (based on 2002 figures). This implies an order of magnitude higher rate of electrification.

Lack of capacity

There appears a lack of adequate and properly trained manpower at the district level. For instance in Unnao district of UP the erstwhile UPSEB had a sanctioned listing for 25 Junior Engineers (JE's) but as of today there are only 11 JE's of which 3 are scheduled to retire shortly. The other aspect relates to linemen and meter readers who have not been hired by the department for a long time (Unnao and Raisen). With the restructuring of the SEB and pressure on Divisional Engineers to show recoveries the short route is either a preference for 'Bulk buyers' with a dedicated feeder and/or disconnection to rural consumers.

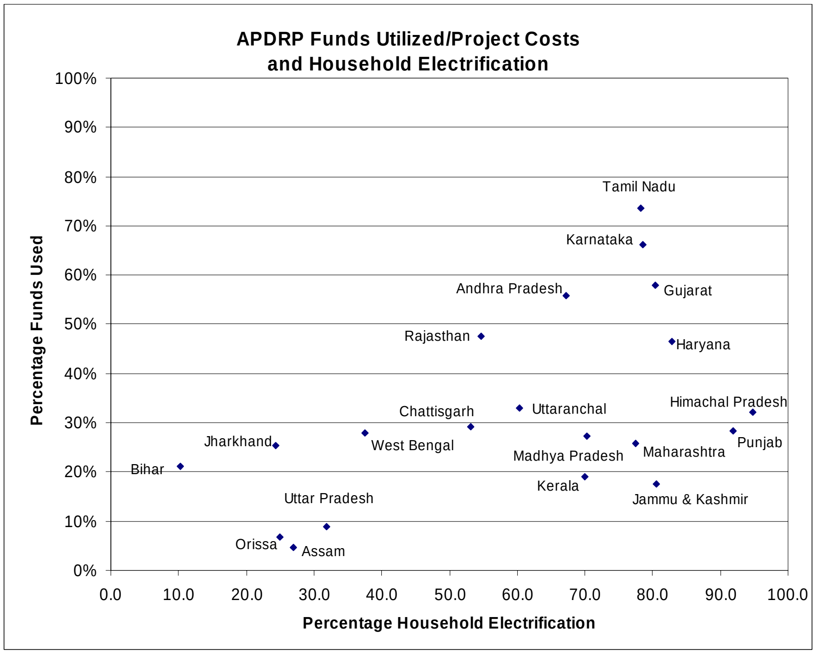
At the same time utilities either have limited equipment and operational resources like vehicles and block and tackle which need to be hired if a transformer has to be taken down. Most meter readers/ linesmen use bicycles. For moving equipment the customers are usually asked to bear costs.

Shortage of material is also a chronic problem and a bottleneck in the speedy implementation of RE programs. This shortage is usually of materials such as conductors, aluminum, cement, steel and insulators. It is only after the funds are received that the order for material is sent to the supplier. Release of funds through the central government, state government, utility head quarters route takes time, causing delay and implementation problems at the SDO level.

Lack of adequate infrastructure with the SEBs: While the expectations from the utility run sky high; consumers, the district administration; the infrastructure available with the local utilities leaves a lot to be desired. The district level utility offices visited by the project team were in a bad shape; mostly rented premises, poorly lit and not well ventilated. In fact the utility offices which were visited by the project team on a number of occasions (3 times each of the utility offices in Unnao), and not once was the grid supply on. More disturbing was the fact that the offices had no back-up /generator service (in UP). The project team also found most field offices especially the SDO extremely shabby, there was no proper organization of information and information was sent up the hierarchy on a piece of paper (most of these were scribbled applications sent by a villagers coming to the office). Office conditions are mostly very dingy, infrastructure is limited, no support service like (copier) or staff is available as no new recruits have been hired for the last few years (in UP no meter readers have been hired since 1989)

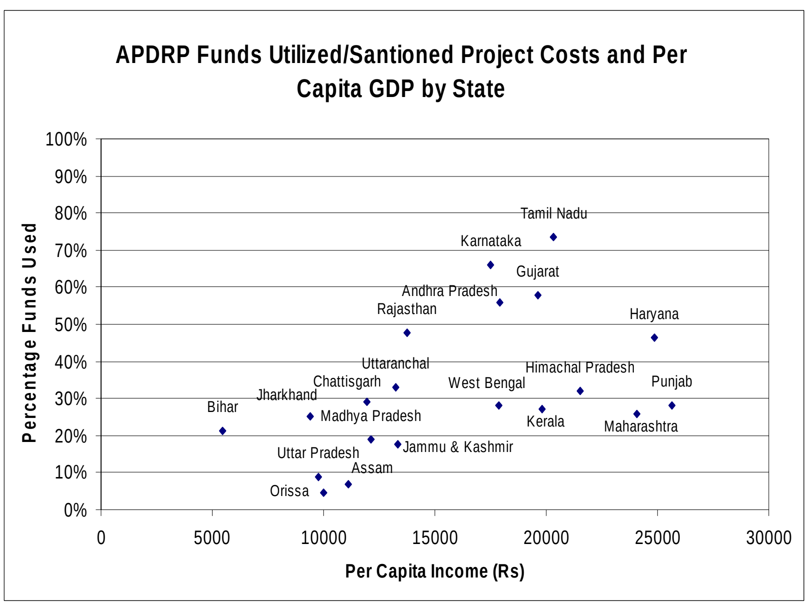
Past use of APDRP funds even when available is found to be low. In fact the ratio of utilized to sanctioned funds was below 10% for U. P. when the need was perhaps the greatest there. Figure 10 and Figure 11 below show the relationship with both the existing levels of household electrification and with income in all major states.

Figure 10. APDRP funds utilized and HH electrification



Source: APDRP documents and Census data

Figure 11. APDRP funds utilized and per capita GDP



Source: APDRP documents and Census data

Franchisee development

The RGGVY scheme anticipates two types of decentralization: 1) Commercial decentralization, e.g. tariff collection, and 2) Technical decentralization, e.g. maintenance of distribution. The idea is that individual businesses (or NGOs or co-operatives for that matter) will become profit centers that are locally run. To move towards a decentralized, competitive market, SEBs must aid in this effort to create district-level or village profit centers that manage distribution. The low uptake of funds in the past may point to capacity constraints in electrification planning, working with suppliers/contractors, project preparation, implementation and monitoring within the district level staff. Perhaps recognizing this constraint, the REC and MoP encourage franchisee development for the maintenance of distribution systems and for the collection of tariffs at the village level. However envisioning that "tens of thousands of franchisees are created within the next 3 to 5 years seeking enlarged role and opening immense business opportunities" (Chairman of REC[101]) is a task of Herculean proportions. It will require managerial and technical capacity to engage with franchisees, defining business rules and executing contracts, inspection of installation, verification of delivery of service to standards, performance monitoring, legal expertise, establishing bulk power purchase agreements with generators with fuel cost provisions, minimizing the risks and lowering transaction costs in general. We recommend that a small fraction (say one percent) of the RGGVY scheme be set aside for capacity building, information dissemination and franchisee development and that this activity is critical to the success of the scheme.

Agricultural Sector Reforms

Success in electricity services in the agricultural context depends upon a number of inter-related factors including reorganizing SEBs, rethinking subsidies, tariff rates, and metering. When efficient, accurate metering of all is not yet possible, reforms should focus on other methods that will support agriculture effectively.

The Energy -Water Nexus

An issue of extreme importance to both energy and water sustainability in India is the relationship between electricity and groundwater pumping for agricultural irrigation. Groundwater and energy economies are inextricably linked in the Indian context as India has emerged as the largest extractor of groundwater in the world, pumping 250 cubic km of groundwater a year.[102] Groundwater irrigation has helped almost all nations in the South Asian region achieve self-sufficiency, and has contributed to the creation of wealth in rural areas. [103]While a thriving groundwater economy has invigorated rural economies, such high and unregulated extractions of groundwater seriously threaten the sustainability of the groundwater economy itself. Additionally, pumping large amounts of water has serious environmental implications whose effects are not immediately recognizable. Water and energy resources have become interdependent requires an in-depth review of the inter-dependence of the energy and water sectors in India - an idea termed the "Energy-Water Nexus"[104].

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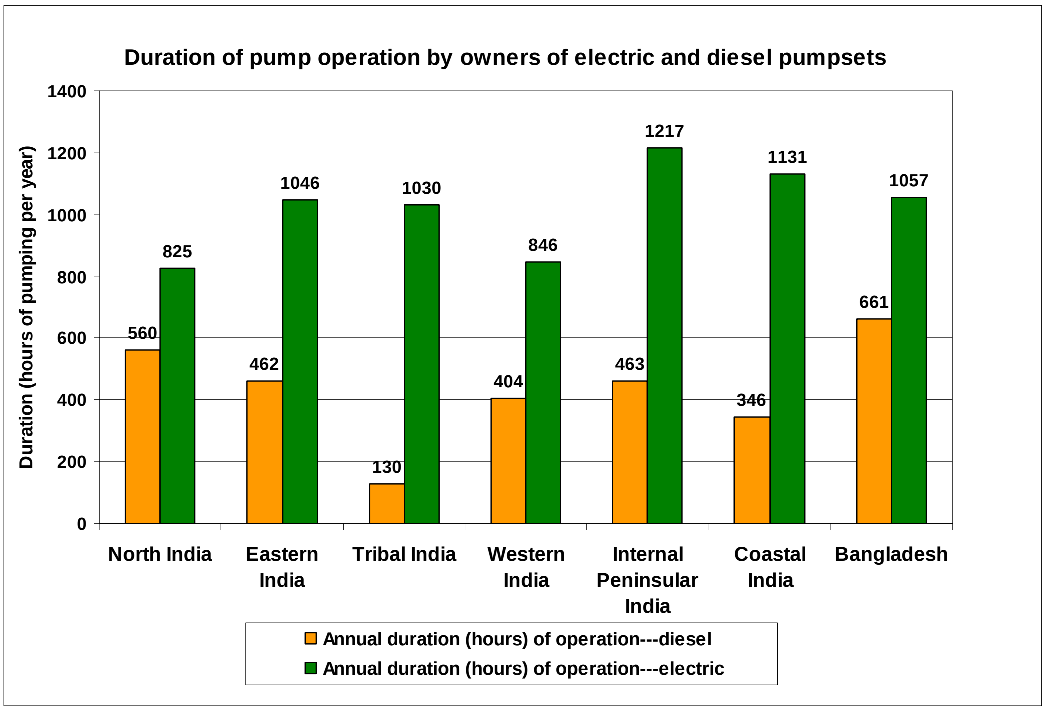
[101] Powering Rural India, Speech of the Chairman of REC at the 36th Annual General Meeting held on September 22nd 2005.
[102] Narayana, 2004
[103] Shah, 2003
[104] Shah, 2003

The agricultural sector has been widely blamed for one of the reasons for the lack of financial health of SEBs and for retarding the growth of India's power sector on the whole. Reforming electricity use in the agricultural sector is thorny and involves striking a balance between satisfying the economic needs of the farmers, small and large, and the electricity provider.

While data for actual use of electricity for agriculture pumping is hard to come by, it appears that diesel pump sets are used for fewer hours per year compared for electric pumps across India. Figure 12from Shah (1003) plots the results of a survey of 2,234 tubewell irrigators across India and Bangladesh in late 2002, showing that electric tubewell owners paying a flat tariff operated their pumps for 40-250 percent greater hours per year as compared to diesel tubewell owners. These numbers are not indicative of a proportionate additional water flow or agricultural output but they do provide some qualitative evidence that electric pump sets while may be leading to some additional output may lead to wasteful use of electricity at no or low additional costs.

Figure 12. Duration of pump operation by owners of electric and diesel pump sets



Source: Shah, 2003 (primary survey of 2,234 tubewell irrigators in the year 2002).

In the study entitled *The Energy-Irrigation Nexus in South Asia: Improving Groundwater Conservation and Power Sector Viability (Shah et al 2002)*, the authors point out that the agricultural sector use of electricity is comprised of approximately 14 million tube-wells. Metering is indeed the long term goal, even if agriculture tariffs are subsidized since metering allows for quantifiable supply to agriculture, a necessary condition for a transparent subsidy mechanism. In the short term however it may be advisable to adopt the above report's recommendation that it is better to transform current pricing (generally subsidized flat tariffs) and supply (generally erratic and undependable and hence actually prone to frequent breakdowns, excessive use and possible detrimental to both groundwater and the crop) into a system of timed, reliable scheduled delivery of electricity for agriculture that would be in accordance with local agricultural needs and soil moisture conditions. This strategy would address the needs of farmers; and provide a path for gradual transition to cost-recovery. In un-metered regimes one could easily reduce supply hours from the 3,000 hours per year to 1,000 hours per year while still meeting the agriculture needs effectively increasing the cost-recovery even with the same flat tariff.

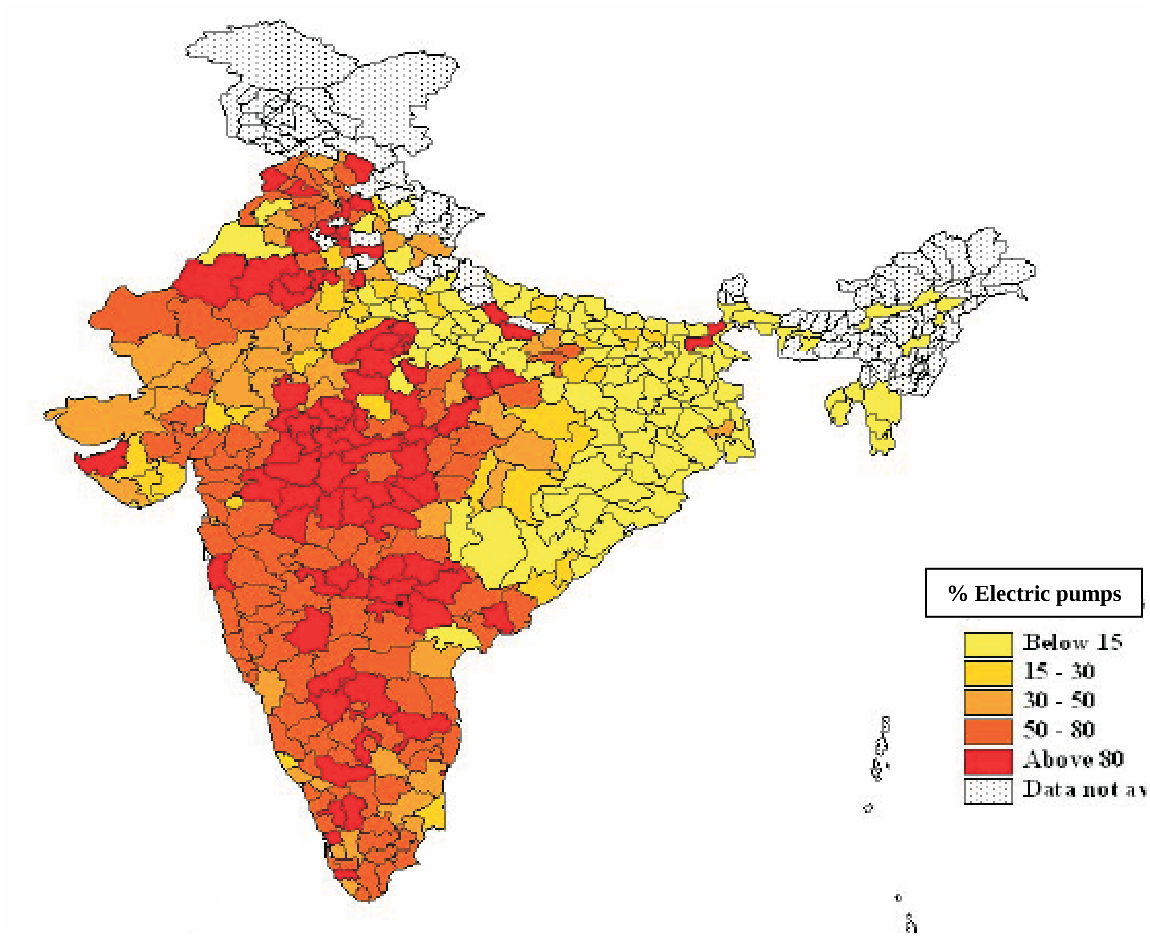
As and when metering of pump sets becomes regionally feasible, one could transition to a tariff regime that allows a low rate for "lifeline" electricity consumption levels that correspond to the demands and sustainable water yields of small farmers in a region. This would then pave the way for charging higher rates beyond the lifeline levels to farmers who may be growing high-value water-intensive crops. So if a household owning 2 acres of land needs 1000 kWh (e.g. a 5 hp pump for 250 hours a year) of supplementary pumping beyond water requirements met by monsoon rains for a Kharif crop, that household could be given a smart card for an agriculture pump set meter with a built in low rate of say one rupee per off-peak kWh for the initial "lifeline" consumption level of 500 kWh/acre i.e. for 1000 kWh at 1000 rupees. This could also be administered in smaller incremental payments if needed. Moreover the same meter could be used for electricity consumption beyond "lifeline" levels at higher cost-recovery tariffs.

This approach will require that determining tariffs by working closely with agricultural and water experts to determine minimum water needs of smallholder farmers and corresponding electricity needs. A strategy for proactive management of rationed power supply will assist in allowing transparent accounting, reducing commercial losses due to bill collection, reduce groundwater depletion caused by over-pumping and possible even increase farmer satisfaction with the utility if reliability of supply is dramatically improved.

A region specific approach to reforms

There are considerable disparities among states in the level of metering, income from agriculture and the reliance on groundwater for agriculture. The use of electricity as opposed to diesel for agricultural pumping is itself regional as seen in Figure 13, where the proportion of pump sets that are electric in any district is shown. The actual availability of reliable supply, socioeconomic status of farmers, agricultural conditions, crops grown and groundwater use changes across states, electricity reforms and the particular approach to agriculture electric supply (tariffs and whether they should be metered immediately or not) should likewise take on a nuanced approach. Electricity provision targets (how much, when) and tariffs should reflect that changes from current pricing would have to ensure that the farmers, especially the smaller farmers are not severely impacted in the short term. This will require close co-ordination of the agricultural, water and energy sectors, along with a campaign that would promote the benefits of such an approach to utilities, farmers and consumers from other sectors.

Figure 13. Percentage of electricity operated groundwater structures to total mechanized groundwater structures, 1993-94



Source: Shah, 2003

Household metering and reforms

It is worth noting at the outset that in practice where poorer households are under flat rate regime for un-metered supply, the combination of unreliable supply and low hours of service may actually put the poor effectively in a regressive high tariff regime. So when a low-income household receives 2 hours of supply during evening hours and consuming 100 Watts of power only during those evening hours and receiving 5 hours of supply during the day when the consumption could be as 40 Watts, pays a flat rate of 100 rupees a month, they are effectively paying a tariff of about 8 rupees a kWh. This does not include the cost of damaged appliances from poor quality of supply. A household with much higher consumption levels under the same flat tariff regime is effectively paying a much lower tariff. This mix of consumers and the high cost of meter reading, billing and collection can create a loose-loose trap for the utility and will continue to do so for a franchisee as well. Moreover this regime has no incentives for energy efficiency either.

An approach described above for metering of agriculture can also in principle be used for household supply. A region-specific approach can be devised keeping in mind the short-term politically acceptable tariff structure and technical/human current capacity constraints of the utility as well as the longer term goals of EA 2003 and RGGVY. The status of metering is shown in Table 16 (from the Ministry of Power's Ninth Report on the APDRP) for each state. Half of the states and union territories represented show a 90% or higher rate of meters installed per total consumers. While this may indeed be accurate, the site specific surveys we carried out in MP and UP paints a very different picture (see Table 17). In Raisen district of MP only 40% of households with a grid connection had a meter installed. This falls much below the statewide statistic of 72% of consumers electrified in MP. In Unnao district, only 14.3% of households with a grid connection had a meter installed as compared with the statewide MoP's figure of 91% of consumers electrified in UP.

In the short term where timed supply inevitable and smart metering is expensive, low cost load limiters, including products such as the LRA and LRM current limiters designed especially for the rural electrification context[105], allow the utility company to limit consumption of electricity and impose a pre-set value defined by the distribution company. This technology allows the implementation of fixed tariff bills with limited consumption and billing without the use of meters.

New franchisees areas where there is little existing household coverage could transition to smart metering in the household sector reducing/eliminating meter reading and billing. Such metering could also reduce theft. Utility providers should install metering at 11 kV feeder and distribution transformer levels to allow proper auditing of power supply. Feeders would then be operated using principles of "stand-alone business units" that would be accountable for the quality of power service, metering, billing and collection. This can be implemented immediately in the new 125,000 villages to be electrified providing a cost-effective jump-start of the program is initiated. It is critical though again with this approach that low initial levels of consumption are charged at a lower lifeline rate.

Smart cards have been successfully used in South Africa as an alternative form of metering and payment. Smart cards are pre-paid cards that the consumer inserts into a specialized meter for connection at the household level. Smartcards eliminate the need for metering or meter reading, and allow consumers to monitor energy use and their expenditure on electricity.[106]

[105] For a description of specific products see Neumayer, 2004
[106] Gaunt, 2005

Table 16. Metering status figures - MoP, ARDRP Ninth Plan, 2005							
	State	**11 kV Feeders**			**Consumers in lakhs**		
		2004-05			**2001-02**		
		Number	**Meters**	**%**	**Number**	**Meters**	**%**
1	AP	7401	7401	100	198.60	181.20	91
2	Arunachal Pradesh	201	1	0	1.13	0.52	46
3	Assam	708	708	100	11.77	10.56	90
4	Bihar	1125	465	41	12.50	6.23	50
5	Chattisgarh	1293	918	71	22.13	14.19	64
6	Delhi	1850	1850	100	26.65	26.65	100
7	Goa	179	179	100	3.96	3.86	97
8	Gujarat (GEB)	5307	5307	100	74.77	69.57	93
	Gujarat (Torrent / Surat)				5.2	5.2	100
9	Haryana	3888	3888	100	39.17	36.12	92
10	HimachalPradesh	726	651	90	16.46	16.46	100
11	Jammu&Kashmir	1558	630	40	10.00	4.00	40
12	Jharkand	461	396	86	6.53	4.02	62
13	Karnataka	4570	4570	100	128.89	105.68	82
14	Kerala	1320	1320	100	74.19	74.19	100
15	Madhya Pradesh	5660	5660	100	64.92	46.50	72
16	MaharashtraMSEB	8146	8146	100	135.32	118.12	87
	Maharashtra REL	598	147	25	23.73	23.73	100
17	Manipur	193	40	21	1.70	1.40	82
18	Meghalaya	175	170	97	1.68	0.84	50
19	Mizoram	127	92	72	1.28	1.23	96
20	Nagaland	164	66	40	1.88	1.14	61
21	Orissa	1723	1475	86	21.49	17.45	81
22	Punjab	5928	5928	100	58.36	49.08	84
23	Rajasthan	8411	8411	100	58.45	54.78	94
24	Sikkim	113	55	49	0.60	0.52	87
25	Tamilnadu	3508	3508	100	161.33	131.25	81
26	Tripura	197	197	100	2.28	1.84	81
27	UP	8507	8507	100	88.06	80.38	91
28	Uttaranchal	743	743	100	9.01	8.14	90
29	W. Bengal	2347	2347	100	47.27	45.89	97
30	Chandigarh	174	174	100	1.97	1.97	100
31	Daman/Diu	51	51	100	0.52	0.52	100
32	Pondicherry	89	89	100	2.19	2.11	96
Total		77744	74393	96	1313.99	1145.34	87

Table 17. Household connections and meters installed in sample villages

Category	Raisen District	Unnao District
Total no. HH surveyed	190	208
No. of HH surveyed that are in electrified villages	152	120
No. of HH with grid connections	81	21
No. of HH with meter installed	32	3

Source: Primary survey conducted by the Earth Institute, 2004

Other household sector approaches for rural electrification

There have been successful rural electrification programs in Tunisia and South Africa that demonstrate that the use of appropriate standards, through a large-scale mission-oriented approach, and use of a combination of load limiters, smart meters, prepaid cards, and community billing techniques can make rural electrification succeed in reducing costs per connection, increasing the efficiency of billing and other aspects of management, and otherwise establishing a set of best practices to be studied in future planning (see Boxes below).

Box 5. Tunisia's rural electrification program

A recent program undertaken by the Tunisia Electricity and Gas Company (STEG) achieved dramatic cost savings, which in turn contributed to a remarkable rate of cost-effective electricity grid expansion (Cecelski, 2004). As part of a multisectoral approach to the extension of a range of infrastructure and services to rural communities, Tunisia's electrification program expanded services from 6 percent of the population in 1976 to 88 percent in 2001, including bringing electricity to 35 percent of people living in rural areas. The technical strategy of the program was to use a combination of three-phase and single-phase power lines, preferentially extending less expensive single-phase wire to rural communities. This approach saved an estimated 30–40 percent over the cost of medium voltage (MV) lines, 15–20 percent on MV/LV substations, and 18–24 percent on the system overall relative to what the same expansion would have cost with the previous ratio of MV and LV lines. In addition, the Tunisian program carried out other aggressive cost-cutting measures, such as use of single wire earth return (SWER) design, shorter poles (saving 20 percent on cost), equipment standardization, and bulk buying. Administrative innovations, such as decentralized planning and improved corporate management practices, contributed to efficiency at the institutional level. As an indication of the program's success, Tunisia has set rural electrification for all as a minimum standard for public service and has set a goal of 100 percent electrification, through a variety of grid-based and off-grid technologies, by 2010. Source: Modi, 2005

Box 6. South Africa's rural electrification program

South Africa's national electrification program showed similar successes to Tunisia, driving down costs of both connections and payment schemes by reducing administrative overhead and loss. Electrification in South Africa grew from about 36 percent of households in 1990 to 67 percent in 2000, with more than 3 million new customers. Dramatic reductions in the capital investment costs per customer of rural electrification suggest that appropriately planned rural systems need not be much more expensive than urban systems (Gaunt 2005). Between 1996 and 2001, the national average cost per rural electric connection decreased by 40 percent in current terms and 70 percent after taking into account inflation, eventually becoming the same as an urban connection cost. The savings were achieved by adopting designs that match the network technology and capacity more closely to the requirements of the customers (greater application of single-phase instead of the traditional three-phase distribution at medium and low voltage), broad application of prepayment metering, and revised industry standards and implementation procedures. Using low-capacity, low-cost grid connections, South Africa's rural electrification program can supply substantially more energy than photovoltaic systems for a similar or lower cost. The South African experience with prepayment metering is a development of significant note, since this can allow consumers to purchase a service in small quantities and at the same time ensure low cost of bill collection. These payment methods dramatically reduce the fraction of costs that are purely administrative for servicing a household with low consumption.

From these and other examples, a wealth of knowledge is now accumulating regarding best practices in structuring the roles of government, investors and donors, service provider institutions, and NGOs. Some of these are lowering or eliminating tax burdens; standardization and certification of systems; supporting programs for training in the design, maintenance, and safe use of these systems; and credit and delivery mechanisms.

The 1.6 billion people worldwide who are without electricity access may take heart in the examples set by Tunisia, (See Box 1) where the electrification program expanded service from 6 percent of the population in 1976 to 88 percent in 2001; Morocco, where electrification rates reached 72 percent in 2004 (Morocco, Office National de l'Electricity); and China, where electrification rates reached 97 percent in 2004, thanks to sustained political commitment, public funding that combined domestic resources and borrowings from the Development Banks and other sources, and effective cost recovery tariffs and mechanisms from users.

Source: Modi 2005

Power Generation and Privatization

Rural electrification will place additional demands on power generation. This additional demand on power generation must be estimated and brought within the planning envelope of the MoP. This additional demand will be region specific and while financing for a robust distribution network will have to be public (regardless of who actually operates/maintains the distribution), there would be significant private sector interest in generation as per EA 2003 rules.

Increased generation capacity is likely to derive from a diverse set of sources through multiple different institutional and financial arrangements. India has the unique advantage of high population densities in rural areas, endowing it with the unique advantage that the country can benefit from economies of scale derived from power generation at scale. The EA 2003 provides the proper framework for increasing generation capacity and a long-term sustained adherence to the terms of the act can addresses the proper incentives needed to ultimately allow multiple entities to provide electricity through varied means of generation and institutional arrangements.

While reducing losses and encouraging energy conservation/efficiency are very cost-effective means to increase availability of power, in the short term, the human resources required to achieve a substantial transformation of this nature is likely to be difficult. One attractive proposition is to ensure that new household connections if metered are simultaneously offered energy efficient lighting at below cost.

A report on privatization and power sector reforms prepared by The Energy Resources Institute in Delhi (TERI) is attached in the Appendix.

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Appendix 1. Privatization of the power sector[107]

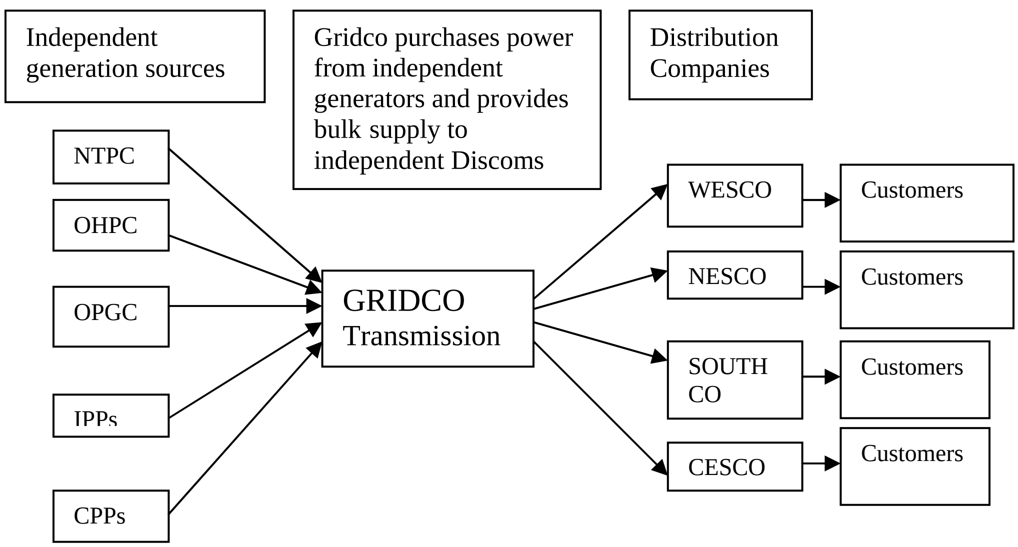
The following section discusses power sector reforms in the states of Orissa and Delhi.

Orissa

In 1997, the generation capacity in the state of Orissa was insufficient to meet growing demand. Energy deficits were recorded at 23.9% and 7% respectively in 1997, when the national averages were estimated at 18.8% and 7.8% respectively[108]. The plant load factor of Orissa's generating stations declined to 29% in 1994-95 compared to the national average of 60%. The financial performance of the Orissa State Electricity Board (OSEB) was deteriorating and the gap between average cost of supply and average tariff was increasing[109]. The OSEB was also becoming increasingly dependent on government subsidies.

Orissa was the first state in the country to pursue comprehensive restructuring and reform of the electricity sector. This process of restructuring began with the Orissa Electricity Reform Act, 1995 and specifically the unbundling of the OSEB into generation, transmission and distribution entities. This was followed by the corporatization, commercialization and privatization of the distribution entities and the creation of the Orissa Electricity Regulatory Commission (OERC). The new structure of the power sector after the reform process is illustrated below:

Figure A. Structure of the power sector after the reform process



Source: Overview of Reforms in Orissa, ICRA

[107] The reforms sections are cited from TERI report 2004RP28 'Power Sector Study in India' submitted to the Japan Bank for International Cooperation(JBIC) in May 2005

[108] TERI Publication; Privatization of Electricity Distribution: The Orissa Experience: K Ramanathan, Shahid Hasan

[109] The gap between average cost of supply and average tariff rose from 8 paise in 1989/90 to 18 paise in 1991/92 (World Bank 1996; OSEB Annual Reports)

Table A. Performance Rating of the Power Sector in Orissa

Parameters	Maximum Score	Score Assigned
State Government Related Parameters	17	2.00
SERC Related Parameters	15	5.63
Business Risk Analysis	27	4.00
-Generation	6	1.50
-Transmission & Distribution	21	2.50
Financial Risk Analysis	20	2.00
Others	5	-
Progress in attaining commercial viability	16	-
Total	100	13.63

Source: Power Sector Rating. Consolidated report to the Ministry of Power March 2005.
Prepared by ICRA Limited and CRISIL Ratings

Many problems arose during the Orissa reform process:

- The entire capacity added in the last few years has been carried out by the state with no private sector investments. In the absence of any fresh capacity addition, the energy shortage in the state has worsened.
- The demand for industrial power, which subsidized domestic demand, was grossly under realized while domestic and commercial demand with high losses grew fast.
- Higher than anticipated T&D losses were largely responsible for the current situation in Orissa wherein private discoms are unable to pay GRIDCO and have hence retarded reforms.
- The state government provided little support to discoms to counter illegal tapping of electricity. Rampant hooking of electricity in suburban and rural areas remained unabated.
- Billing and collection efficiency under the privatized discoms are still far from improving.
- On the whole, there has been considerable increase in the average tariff at a cumulative rate of 15.5% annually over the last 9 years. Cross-subsidy has decreased in the post-reform period creating a heavier burden on domestic consumers. This unabated increase in tariff in the absence of any perceptible reduction of technical and commercial loss or improvement in quality of service has led to growing public discontent with reform.

A team leader now heads each division of a discom to whom groups of technical and commercial people report. Customer Care Centers (CCC) have been set up in urban areas. CCCs have computerized complaint registration system and operate through their own mobile troubleshooting units with trained staff and equipment. For better customer relationship management, the CCCs have interactive voice response systems, wireless communication set ups, and total networking facilities. Similarly, in rural areas village committees have helped to improve service efficiency.

The discoms have developed innovative systems for collection of electricity charges from the consumers, particularly in rural areas. Before privatization, the OSEB would collect money from households in rural areas. In urban areas consumers paid their bills at selected counters around the city. The micro-privatization program has led to some innovations in this area. NESCO and WESCO have tried this program on an experimental basis. Under this program customer relations and revenue collection skills have improved, with the responsibility of collecting revenue transferred to Village Bidyut Sangha (VBS) (an electricity committee consisting of 5 to 6 members from the electricity users of the rural areas) and to distribution companies.

After privatization and implementation of reform measures, improvements have taken place in a number of areas. Some of these include metering, strengthening of the distribution network, and introduction of micro-privatization for rural areas. Yet while the restructured electricity sector was expected to help introduce competition, improve efficiency, add capacity, rationalize tariffs and enhance consumer welfare through lower price and enhanced services. On the contrary, it has raised tariffs, denied consumer choice and constrained investment.

Overoptimistic evaluation of key data and faulty baseline data at the onset of reforms led to serious problems in financial engineering, which in turn affected the workings of corporatized distribution agencies. This has clarified that baseline data on performance parameters such as losses and bill collection must to be accurate, and a comprehensive assessment of receivables must be undertaken at the time of privatization and financial restructuring. A major lessen learned from the Orissan experience is that governments should ensure that the distribution sector is financially viable through state support in the transition phase to privatization.

Delhi

The key drivers of the reform process that led to the privatization of distribution in Delhi in 2002 are discussed in this section.

The performance of the Delhi Electric Supply Undertaking (DESU, later DVB) steadily deteriorated from the mid-1970s onward, reaching its nadir in the year 1997-98. This can be attributed to a large number of un-metered customers, massive under-billing and poor collections. In 2001, it was estimated that 14% of Delhi's power consumption was going unbilled to un-electrified colonies and squatter settlements. The T&D losses were approximately 22.3% in 1990-91 and deteriorated to 47.5% in 2001-02.

The commercial performance of DVB was steadily degenerating, as the utility's retail tariffs were clearly insufficient to cover its costs. The financial performance of DVB in the last two years of its existence is summarized in the table below:

Table B. Financial Performance of DVB (Rs. Million)

	2000-01	2001-02
Income	31,945.10	35,496.20
Total Net Expenditure	45,736.80	52,095.20
Surplus/Deficit	-11,044.10	-11,960.40
DESU Period Liabilities (Up to February 25, 1997) – Rs. 129,530 million DVB Liabilities – Rs. 101,840 million Accumulated Liabilities (As in July 2001) – Rs. 231,370 million		

Source: India Infrastructure Report 2004

Moreover, audited financial statements of DVB had not been prepared for more than a decade. There was no register of assets or an accurate master list of customers. Information about the customers that were in arrears was like poor.

The Delhi Electricity Reform Bill was passed by the Delhi Assembly and got presidential assent on March 11, 2001. The Delhi Electricity Reform (Transfer Scheme) Rules unbundled the functions of DVB into a generating company (Genco), a Transmission Company (Transco), three distribution companies and a holding company.

The main concerns presented by potential investors that needed to be addressed at the time of reforms were that:

- There was a need to provide reasonable and realistic annual efficiency improvement targets.
- In the absence of up-to-date registers or annual accounts, it was difficult to undertake any asset valuation.
- Tariff shocks after undertaking reforms needed to be avoided. Simultaneously, investors required a reasonable return if they were to achieve efficiency improvements.

Salient features of the Delhi reform model

The Delhi privatization process was structured to overcome some of the concerns arising out of the Orissa privatization. The privatization process in Delhi attempted to reduce the tariff uncertainty by fixing a loss curve to be used by the regulator in setting tariffs. The methodology followed for arriving at the losses in distribution business was devised in accordance to the policy directions known as the 'Aggregate Technical and Commercial Losses' (AT&C).

As an incentive to the private players, on an additional reduction (i.e. beyond the negotiated reduction targets), the utilities would retain 50% of the additional revenue realized, the remainder being passed on to the consumers as a rebate on tariffs. The investors were also assured a fixed return of 16% on the issued and free reserves till the end of 2006-07, subject to all expenses as permitted by the DERC.

The following table compares the average tariff levels pre- and post-privatization of distribution as follows:

Table C. Comparison of Pre and Post Privatization Average Tariffs

S.No	**Consumer Category**	**Ave. Tariff (1999-00)**	**Ave. Tariff (2000-01)**	**Ave. Tariff (2003-04)**	**CAGR**
		(In Rs./kWh)			(In %)
1.	Domestic	1.49	1.49	2.88	24.57
2.	Commercial	4.03	4.15	6.19	15.38
3.	Street Lighting	-	-	4.04	-
4.	Agriculture	0.50	0.50	1.34	38.90
5.	Industry	4.03	4.24	5.25	9.22

Source: Planning Commission, 2002

Table D. Trend of actual AT&C Loss Reduction

	2002-03 (9 Month period)		2003-04	
	AT&C Losses (As per target)	Actual/ Achieved	AT&C Losses (As per target)	Actual/ Achieved
North Delhi Power Limited (NDPL)	47.6%	49.12%	45.35%	44.86%
BSES Rajdhani Power Limited (BRPL)	47.55%	47.40%	46%	45.06%
BSES Yamuna Power Limited (BYPL)	56.45%	61.89%	54.7%	54.29%

Source: Order on ARR for FY 2003-04 & 2004-05 and determination of Bulk, Retail and Generation Supply Tariffs, DERC

Table D shows that all the three distribution companies have over-achieved in reducing AT&C levels during the financial year 2003-04. As part of its efforts to drive down AT&C losses, NDPL is undertaking energy measurement at grid stations and all sub-stations receiving energy from these stations. It is also undertaking energy measurement at each Distribution Transformer and LT Feeder. Similarly, initiatives for energy audit are also being undertaken by BSES.

A comparison of load shedding and distribution transformer failure in the summer of 2003 as compared to the previous summer (when distribution by handled by DVB) shows that overall power reliability has improved drastically in Delhi. Simultaneously, an augmentation of overload transformers, load balancing and maintenance of distribution transformers has resulted in a decrease in the number of failures of transformers for both BSES and NDPL. The performance of Delhi on various parameters as reflected in the latest CRISIL-ICRA Report is presented in the table below:

Table E. Performance of Delhi on various parameters

Parameter	**Maximum Score**	**Score Assigned**
State Government related parameters	17.00	12.88
SERC related parameters	15.00	10.88
Business Risk Analysis		
Generation	6.00	2.25
Transmission and Distribution	21.00	11.65
Financial Risk Analysis	20.00	10.00
Others	5.00	4.25
Progress in attaining commercial viability	16.00	0.00
Total	100.00	51.91

Source Power Sector Rating. Consolidated report to the Ministry of Power March 2005, Prepared by ICRA Limited and CRISIL Ratings

The report has highlighted the following areas in Delhi's power sector that need improvement:

- The loan support by the GNCTD to the Transco is leading to a skewed capital structure and heavy losses on the revenue account. It is therefore necessary to provide support in terms of subsidy grants or clarity of transitional loans being extended to the Transco. There have also been delays in the implementation of certain targets as per the Electricity Act 2003, such as notification of district level committees or the designation of assessing officers.
- At the Electricity Regulatory Commission end, the timeliness of tariff orders needs to be improved as tariffs for both 2003-04 and 2004-05 were delayed.
- Most generation plants are aged and have low Plant Load Factor (PLF) of 59.35% (2003-04) and high levels of manpower with over 2.33 employees per MW of capacity.

The power sector in Delhi has a negative net-worth due to accumulated losses of Rs. 27,460 million including Rs. 24,480 million in Transco's books. This along with low cost coverage of 52.5% reflects unfavorably on the financial health of the sector as a whole.

Conclusion

Though it is still early to judge the outcome of the power sector reforms undertaken in Delhi to arrive at any definitive conclusion, some of the key lessons learned from its privatization experience are as follows:

- AT&C losses are a better measure of estimating energy losses than the conventional T&D losses.
- The unambiguous government commitment to provide financial support to private distribution companies through subsidized power purchases during the 5-year transition period instilled confidence in prospective investors.
- A well-specified multi-year tariff setting regime based on realistic loss targets was introduced, which could be clearly and accurately measured.
- Given the rising demand and lacking capacity addition, there is an immediate need to augment energy availability in Delhi.

Appendix 2. Household Electricity and Water Survey

Energy and Water Questionnaire

State :		District :	
Tehsil :		Block :	
Village :		Panchayat :	

I. Area Profile

II. Households details (use code wherever indicated)

1. Name of the respondent: ____

4. Caste:
[Code: SC- 1, ST- 2, OBC- 3, General- 4]

6. Number of Family members:

Number of family members		Total
Adult	Male	
	Female	
Children	Male	
	Female	
Total		

Education:

Code	Education	Total members		Total
		Male	Female	
1	Illiterate			
2	Primary			
3	Graduate and above			

8. Type of dwelling:

Code		Write the appropriate code/number
1	Type of house: [Code: *Kutchha* – 1, *Pucca* –2]	
2	Do you have a separate kitchen *	
3	Do you have a bathroom in the house? **	
4	Do you have a latrine in the house? **	
5	Do you have a household water source **	

[Code: Yes, have a separate kitchen (*pucca* room) –1, Kitchen is in the open (thatched roof) – 2, any other (specify) –3]   **[Code: Yes –1, No –2]

III. Livelihood details (use code wherever indicated, also write the actual figure)

Primary occupation:
[Code: Agriculture – 1, Service – 2, Labour – 3, Business –4, any other (specify) – 5]

Secondary occupation:
[Code: Agriculture – 1, Service – 2, Labour – 3, Business –4, any other (specify) – 5]

How much of land do you own? ____
[Code: No land –1, less than an bigha–2, 1 to 3 bigha–3, 3 to 6 bigha – 4, 6 to 9 bigha 5, 9 to 12 bigha, 12 and above – 6]

5. (a) How much of agricultural land is irrigated? ____________________________
[Code: less than a bigha –1, 1 to 3bigha–2, 3 to 6bigha– 3, 6 to 9 bigha –4, 9 to 12 bigha –5, 12 bigha and above – 6]

(b) What are the constraints in extending land under irrigation?
[Code: Hire , hence depends on availability of pump set–1, low water table, water not easily available –2, any other (specify) -3]
____

6 (a) Means of Irrigation:
[Code: Manual –1, Energized –2, diesel –3, animal –4]

(b) What are the water sources for irrigation?

Code	Water source (prioritize according to usage)		
1	River		
2	Canal		
3	Ground water	Electric	
		Diesel	
4	Water/irrigation tank/pond		
5	Spring		
6	Any other (specify)		

(e) Major crops grown in Kharif(monsoon) season

(g) Major crops grown in Rabi (winter) season

(j) How much hiring charges do you pay per hour for water/pump set?

Cost of running a pump set	Owned	Hired	Hiring/ running charge (in Rs.)		Total
			Water	Pump set	
Diesel					
Energised					

(i) What are the problems faced in hiring the pump set?
[Code: irregular electricity supply –1, dependent on pump set owner –2, any other (specify) –3]
____

7 (a) What make of pump set do you own and when did you purchase it? _______________

About the pump set		Tick the appropriate selection, use code wherever necessary, or the actual amount/numbers
Type of pump set	Submersible	
	Sub-surface	
Fuel used	Diesel	
	Electricity	
Make of the pump set	Kirloskar	
	Locally assembled	
	Any other (specify)	
Cost of the pump set	a. Actual cost	
	b. Labor cost	
	c. Cost of boring, etc.	
	Total cost (a+b+c)	
Capacity (in hp)		
Hourly consumption of diesel*		

*[Code: Less than a liter –1, 1 to 2 liter –2, More than 2 liter –3, any other (specify) –4]

(b) In case of using energised , what is the duration of the bill?
[Code: Monthly –1, Bi-monthly –2, Any other (specify) –3]

(d) How much cost do you incur in operation and maintenance of the yearly and on what?
____

Code	Amount in Rs. (tick the appropriate selection)	
1	Less than 500 Rs.	
2	500 – 1000 Rs.	
3	1000 – 1500 Rs.	
4	More than 1000 Rs.	

IV. Energy details (use code wherever indicated, also write the actual figure)

(a) Do you have a grid/power connection
(Code: Yes - 1, No - 2)

(a) If answer to question 1 is yes, then under what scheme did you get the grid/power connection?
____

[Code: Kutir Jyoti –1, any other government scheme (specify) –2, private connection paid for it –3]

(b) Did you face any problem in getting the power connection? _________________
[Code: paid high deposit for getting the connection –1, had to pay bribe –2, long bureaucratic procedures –3, any other (specify) –4]

4 (a) Is meter installed to take the reading?

[Code: Yes –1, No –2]

(b) If answer to question 3(a) is No, then do you pay a flat rate, if yes, what amount? ______________

[Code: Yes –1, No –2]

6. How much did you pay for getting the grid connection? ____________________________

Code	Cost incurred to get the grid connection (tick the appropriate)	
1	Less than 250 Rs.	
2	Rs. 250 – 750/-	
3	Rs. 750 – 1250/-	
4	Rs. 1250 – 1750/-	
5	More than Rs.1750/-	

7. How much time did it take to get the grid connection (tick the appropriate)? _____________

Code	Time taken to get the grid connection		Code	Time taken to get the grid connection	
1	Less than 3 months		4	1 to 1.5 year	
2	3 to 6 months		5	1.5 to 2 years	
3	6 months to a year		6	More than 2 years	

8. How many hours in a day do you get electricity (tick the appropriate selection)? _________

Code	Hours of electricity	Summer	Monsoon	Winter
1	Less than 4 hrs			
2	4 – 8 hrs			
3	8 – 12 hrs			
4	12 – 16 hrs			
5	16 – 20 hrs			
6	20 – 24 hrs			

12. (a) What is your monthly consumption of (tick the appropriate)?

Code	Type	Consumption			Mention means used to light	Use code and also write the actual amount spent monthly*
1	Kerosene	1	Less than 2 liter			
		2	2 to 4 liter			
		3	4 to 6 liter			
		4	6 to 8 liter			
		5	8 to 10 liter			
		6	More than 10 liter			
2	Candles	1	Less than a dozen			
		2	12- 24			
		3	24 –36			
		4	More than 36			

3	Batteries for lighting	1	Less than 2			
		2	2 – 4 batteries			
		3	4 – 6 batteries			
		4	More than 6			
4	Any other source used (specify)					

*[Code: Less than Rs. 20/- -1, Rs. 20 to 40/- –2, Rs. 40 to 60/- –3, More than Rs. 60/- – 4]

(a) List all the appliances that you own that work on either electricity or dry cells:

Code	Appliances owned	Quantity	Make	Cost incurred on purchase	No of annual repairs	Amount spent for repairs (annually)	Cause for repair/reason for equipment failure (use code)*	Changes made in appliance to suit electricity supply
1	TV							
2	Fan							
3	Torch							
4	Radio /tape recorder							
5	Mobile							
6	Refrigerator							
7	Bulb/tube light							
8	Iron							
9	Cooler							
10	Wall clock/time piece							
11	Washing machine							
12	Pump set							
13	Chaff cutter							
14	Any other (specify)							

* [Code: voltage fluctuation –1, faulty parts –2, poor repairs –3, local make –4, any other (specify) –5]

15. What is the source of lighting for you (prioritize according to usage)?

Code	Source of lighting	Rank	Code	Source of lighting	Rank
1	Electricity		5	Kerosene lamps and Solar lighting system	
2	Kerosene Lamps		6	Any other (specify)	
3	Electricity and Kerosene lamps		7	LPG/petromax lamp	
4	Solar lighting system				

16. (a) Usage of energy for household consumption (use code)

Use of energy for	Summer		Monsoon		Winter	
	Option I	Option II	Option I	Option II	Option I	Option II
Cooking						
Heating water						
Space heating						

[Code: fire wood –1, electricity –2, dung cake –3, coal –4, kerosene –5, LPG –6, farm residue –7, any other (specify) – 8]

16. (b) How much do you spend a month on all forms of cooking fuel combined?

Code	Money spent on cooking fuel (tick the appropriate)	
1	Less than Rs. 100/-	
2	Rs. 100 – 200/-	
3	Rs. 200 – 300/-	
4	Rs. 300 – 400/-	
5	Rs. 400 – 500/-	
6	More than 500 Rs.	

V. Water details (use code wherever indicated, also write the actual figure)

(a) What are the water sources you primarily have access to/use for meeting your drinking water needs (prioritize according to usage)?

Code	Water source	Drinking water					
		Summer		Monsoons		Winter	
		Rank	Distance	Rank	Distance	Rank	Distance
1	Hand pump						
2	Open well						
3	Village pond						
4	Tap stand (public supply)						
5	River						
6	Canal						
7	Spring						
8	Tube well						
9	Household connection						
10	Any other specify)						

(b) What are the water sources you primarily have access to/use for meeting your household consumption needs (prioritize according to usage)?

Household water needs	Household consumption					
	Summer		Monsoons		Winter	
	Water source*	Distance	Water source*	Distance	Water source*	Distance
Washing						
Bathing						
Cleaning utensils						
Washing cattle						
Any other (specify)						

*[Code for water source: Hand pump –1, open well –2, village pond –3, tap (public supply) – 4, river –5, canal –6, tube well –7, tap stand –8, public supply –9, any other (specify) –10]

(a) Is there a problem in accessing a certain water source for instance hand pump, village pond, etc?

Code	Problem in accessing a water point	Drinking water	Household consumption needs
1	Yes, have problem of access		
2	No problem		

(b) If yes, what are the problems? ____

Code	Problems	Drinking water	Household consumption needs
1	Too many people use the same water point		
2	Too far from the house*		
3	Can not take water from nearby water point because of social barriers		
4	Nearby water point dry up in the lean season		
5	Any other (specify)		

Mention distance from the house

5 (b) How do you store water for household consumption?

Code	Storing water	Drinking water	Household consumption needs
1	Plastic container		
2	Steel container		
3	Clay container		
4	Overhead tank		
5	Do not store water		
6	Any other (specify)		

5. (c) Daily water consumption for household (liter/day) ________________________

6. Do you have access to running water for sanitation?

Code	Access to water (tick the appropriate selection)		
1	Yes, latrine has water	Running tap water available	
		Fetch water through buckets	
2	No, latrine does not have water		
3	Hands washed with soap after each visit to latrine		

7. (a) Has there been a change in the access to major water points over the last five years (specify the change)?

____

Code	Change in access	Drinking water	Household consumption needs
1	Yes, there has been a change		
2	No, change has been observed		

7 (b) If yes, then indicate the old and the new source (rank the selection):

Code	Sources	Drinking water		Code	Sources	Household consumption	
		Old source	New source			Old source	New source
1	Hand pump			1	Hand pump		
2	Open well			2	Open well		
3	Village pond			3	Village pond		
4	Tap (public supply)			4	Tap (public supply)		
5	River			5	River		
6	Canal			6	Canal		
7	Spring			7	Spring		
8	Tube well			8	Tube well		
9	Any other (specify)			9	Any other (specify)		

8. What is the reason for change in the water source?
[Code: earlier water point dried up –1, too far –2, new water points near the house –3, can not access the old water point because of village conflict –4, getting water from the earlier source was a problem –5, any other (specify) –6, not applicable –7]

____
____

9. (a) Has there been any scheme by the government for improving the water services in the village?[Code: Yes – 1, No –2]

Name of the investigator: ____________________
Date of survey: ____________________________