

UTILISATION AND PROBABILITIES OF HYDAL POWER IN BIHAR :A CASE STUDY

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Abstract

The Bihar Hydroelectric Power Corporation has been in the vanguard of Bihar's efforts to deploy hydropower in the State. However, to achieve this in a topography characterized by plain land, the company had to innovate by using the existing canal network in regions on both sides of the Ganga. It would be no exaggeration to state that this strategy has been quite successful. Indeed efforts of the BHPC have led to a quarter of the State's small hydro potential being exploited and this figure is expected to jump even higher in the near future. With over as many as 22 projects in operation and 17 projects under construction, BHPC can pride itself on being one of the largest developers of renewable energy in India. The company has however not rested on its laurels in the small hydro domain and has now set its sights on redressing the thermal-hydro imbalance in the state in a 'bigger?way. BHPC has now embarked on an ambitious expansion programme that seeks to set up large pumped storage projects in the Kaimur region of Bihar with a total capacity of 2570 MW and run of the river projects in the potential rich Kosi Basin. Indeed Bihar's first large hydro project - the 125 MW Dagmara HEP on the Kosiriver is well on its way. This project besides yielding energy benefits will also serve to prevent the devastating floods that are a tragic but recurrent feature of North Bihar. It will also facilitate the construction of a further 17 smaller but significant projects downstream to Dagmara. The Kosi sphere of activities reiterates BHPC's larger commitment of generating sustainable businesses that yield direct benefits to the poor and the environment. Indeed the company can pride itself on its environmental sensitivity epitomized by conservation efforts in the vicinity of its numerous projects. Work has also advanced on the 450 MW Indrapuri Project which besides generating power would also act as an irrigation dam. With over 3000 MW worth projects on the anvil, clearly exciting times are ahead for BHPC and Bihar. In fact this has been attested to by numerous foreign functionaries who are very bullish on the prospects of hydropower development in Bihar.

Keywords: Bihar,Hydropower,BHPC,Transmission System,Kaimur region of Bihar

Introduction

The present installed capacity of Bihar is 586.1MW comprising 46.1 MW Hydro and 540 MW thermal. The KosiHydel Power Station could not attain designed generation and is now being operated with derated capacity. The Hydel station needs major rehabilitation and modernization efforts. There is no generation from thermal power stations in the state sector at present. All thermal units are under shut down due to refurbishment/deteriorated

condition. During the year 2006-07, Bihar faced energy and peak power shortages of 8.1% and 16.9%, respectively. During April-May, 2007, the state had energy shortage of 7.9% and peak deficit of 12.2%. Considering actual capacity addition of 21180 MW in the 10th Plan and proposed capacity addition of 78577 MW in the country in the 11th Plan, the anticipated power supply position has been worked out. It is expected that at the end of 11th Plan though the country by and large will be able to meet its energy requirement and peak demand, Bihar may face energy & peak shortage of about 41% and 58%, respectively. Final report of the 17th Electric Power Survey Committee includes electricity demand & energy of Bihar for the year 2011-12 as 3607 MW and 19905 MU, respectively and in the year 2016-17 as 5598 MW and 32857 MU, respectively. This gives a CAGR of about 19% in energy consumption which is very high and extremely optimistic.

Hydro Electric Development in Bihar

Hydro Potential and its Development

As per the reassessment of Hydro Electric Potential of the Country, carried out by Central Electricity Authority (CEA) during 1978-87, the Hydro Electric potential in Bihar is assessed at 60 MW at 60 % load factor. The corresponding probable installed capacity of these schemes is estimated at about 70 MW. About 64.1% of the total potential in terms of installed capacity has been developed and 35.9% of the potential remains yet to be developed.

Schemes in Operation

Six hydro stations namely Kosi, Eastern Gandak, Sone Western Canal, Sone Eastern Canal, Agnoor and Dhelabagh with an aggregate installed capacity of 46.1 MW are in operation in Bihar. The Kosi Hydel Power Station could not attain designed generation and is now being operated with derated capacity. R&M of this power station has to be carried out to increase efficiency.

Bihar State Power Holding Company Limited (BSPHCL), formerly **Bihar State Electricity Board (BSEB)** is a state-owned electricity regulation board operating within the state of Bihar in India. Bihar State Electricity Board (BSEB) was established in 1958 as a statutory corporation under the Electricity (Supply) Act, 1948. As of November 2012, BSEB has nearly 1,700 officers and 14,850 employees. The derated capacity comes to just 530 MW. The BSEB was unbundled on 2 August 2011.^[3] Power Finance Corporation was the main consultant for BSEB's restructuring.

BSEB formally started functioning as 5 companies on 1 November 2012 namely:

- Bihar State Power Generation Company Limited (Generation business)
- Bihar State Power Transmission Company Limited (Transmission business)
- North Bihar Power Distribution Company Limited (Distribution business)
- South Bihar Power Distribution Company Limited (Distribution business)
- Bihar State Power Holding Company Limited (apex holding Company)

Powering growth in Bihar

An important part of the answer lies in the remarkable steps the Government of Bihar has taken to bring electricity to every corner of the state. The gains in electricity access in Bihar are so large that if you compared satellite imaging from six years ago to today, the difference is clear. Patna has always been populous and bright, but what is striking in recent years is the growth in lights in second-tier cities like Bettiah, Darbhanga and Purnia and their surrounding areas. Across Bihar there is now a proliferation of night time lights.

Research from different parts of the world has shown that electrification can transform economies and reduce poverty by opening the door to commercial activity of all kinds – whether it be small-scale manufacturing or shops that stay open after dark. In Brazil, for example, the expansion of hydro-electricity led to significant improvements in income and productivity and higher levels of education. In South Africa, improvements in electricity access helped increase female labour employment.

India has been making a big push on electrification through a series of centrally-funded schemes to build out the grid and subsidise household connections. As a result, between 2000 and 2016, 80 per cent of the homes around the world that received electricity for the first time were in India.

What, then, is unique in Bihar? Bihar has achieved a rare win-win by increasing *access* and *quality* at the same time. On *access*, the Bihar discoms have expanded the grid to all corners of the state and through the Saubhagya scheme, subsidised connections to get households on the grid. The Bihar government declared universal electrification on 25th October, 2018, and has connected 1,39,66,503 households in the past two years (Saubhagya portal, October 2018). Surveys of households that we conducted, for example in north-west Bihar, mirror this finding.

On *quality* also, Bihar has made remarkable progress. Historically, supply in rural India has not come close to hours of supply in cities, negating many of the benefits of access. Many state utilities struggle to collect payments against the power they supply to consumers. As a result, most distribution companies in India lose money every time a household consumes power. State government subsidies lessen the gap between revenue and costs, but often do not close it entirely. And since the bills must be paid, discoms must ration power to limit their losses. For this reason, big electrification drives may force discoms to cut supply back further in order to serve all their new customers.

Yet, in Bihar what has happened is the opposite: Even as Bihar has increased *access*, it has also increased the quality and duration of supply. Between 2014 and 2019, the average hours of supply in Bihar rose from 12 hours to 18 hours. The promise of electricity is, therefore, fulfilled — wires are live, children can study at night, and businesses can better serve their customers. Of course, the challenge is to sustain this progress by improving revenue collection. All else equal, as more and more consumers are connected to the grid, the tension between providing power and keeping the books balanced becomes sharper. Many states in India, including Bihar, are grappling with this problem. Bihar has kept a check on aggregate

technical and commercial losses despite the remarkable increase in the number of newly electrified households, especially in rural areas. More importantly, over the past few years the state has been at the forefront of innovation and experimentation to improve revenue. For example, the utility is experimenting with a system of bonuses and collection targets for its employees to improve revenue collection. Early evidence suggests this scheme has been successful in enhancing revenue. The Bihar discoms are also testing out smart meters to leverage technology into higher revenue collection. Pilots such as these are important because they represent the path towards lasting operational improvements, a pre-requisite to long-term sustainability. Bihar is still a story in the making. But, for many other parts of India where growth remains slow, it now serves as a powerful example of what is possible.

Transmission System Development

To strengthen the sub transmission and distribution system in Bihar, a comprehensive scheme for strengthening of sub transmission system was formulated under Rashtriya Sam Vikas Yojana for Bihar in consultation with BSEB. The scheme is funded through central assistance under the Special Plan for Bihar component of Rashtriya Sam Vikas Yojana. The total scheme has been envisaged to be implemented in phases as under:

Bihar Sub-transmission Scheme Phase-1

Bihar Sub-transmission Scheme Phase-2, Part-1

Bihar Sub-transmission Scheme Phase-2, Part-2

Operation and Maintenance of Transmission System

There is an urgent need to evolve a system for maintenance of the substations by BSEB for which they should deploy trained manpower in proper strength at the various substations for operation and maintenance so that infrastructure created is properly utilized. Alternatively, BSEB may consider outsourcing this activity of O&M.

Status of Rural Electrification

Rajiv Gandhi Grameen Viduyutikaran Yojana

Central Govt. has launched a new scheme "Rajiv Gandhi Grameen Viduyutikaran Yojana (RGGVY) of Rural Electricity Infrastructure and Household Electrification" in April, 2005 for providing access to electricity to all households in the country in five years. As per the present position of Rural Electrification in Bihar, out of a total of 39015 villages, 20610 villages have been electrified by March, 2006.

Development of Franchisee in BSEB

As per the information received from BSEB, it has adopted a Phased Manner Development of Franchisee Scheme for different activities of Electricity Distribution in Rural Areas for empowerment of Rural Consumers and to improve consumer services and also to

increase revenue collection.

System Improvement Works During XI Plan

Since the works taken up under APDRP would not be sufficient to meet the power requirements by 2012, more number of 33 kV sub-stations, 33 kV, 11 kV and LT lines, re-conductoring of lines, installation of capacitors, installation of new DTs, meters, adoption of IT facilities would be required in a phased manner. Following major works are required to be taken up during XI Plan:

Completion of ongoing works under APDRP(12 circles) and APDRP works for remaining 4 circles;

Works (in addition to RGGVY) related to additional anticipated load due to agriculture, small scale industry, cold storage etc.;

Development of distribution network for meeting the load growth;

Development of Buddhist cum cultural corridor; and

Provision of IT facilities keeping in view the modernization of Distribution Systems.

Renewable Energy

Energy Scenario

The renewable energy sources such as hydro, biomass, solar, wind, etc. can meet the energy requirements, to some extent for lighting, minor irrigation in the villages, and captive power generation for industries, as there is a significant potential of renewable energy in the State. The Bihar Renewable Energy Development Agency (BREDA) is the State Nodal Agency responsible for the development and implementation of renewable energy programmes in the State. For hydropower development, the State has a dedicated corporation namely Bihar State Hydro Electric Power Corporation (BSHPC).

Small Hydro – Potential and Achievement

Among the various renewable energy resources for power generation, the State has highest potential for small hydropower projects. So far 92 potential sites with an aggregate capacity of about 195 MW to set up small hydropower projects have been identified. This potential is mainly on irrigation canals and small streams. six small hydro power projects of an aggregate capacity of 46.1 MW have so far been installed in the State.

Biomass Power and Co-Generation - Potential and Achievement

It is estimated that there could be a potential of about 200 MW to set up biomass based power projects including co-generation projects. Rice husk based biomass gasification and combustion technology for industrial application and decentralized power generation may be one of the important sources for power generation in the State, particularly in northern region of Bihar.

Wind Energy

The state nodal agency is in the process of taking up wind resource assessment programme in associate with C-WET, Chennai, to identify suitable potential sites to set up wind energy based power projects.

Other Renewable Energy Sources

Biogas is an important source of renewable energy for meeting the cooking energy needs in villages. As per the estimates, the State has a potential of about 9.4 lakhs family size biogas plants to meet the cooking energy needs, against which about 1.25 lakhs biogas plants

have so far been installed.

Remote Village Electrification Programme

BREDA, the State nodal agency for implementation of village electrification programme, has informed that about 500 unelectrified remote villages have been identified for electrification through renewable energy sources. However, these villages are yet to be verified by REC. BREDA has, therefore, not been able to prepare detailed project reports for electrification of these villages.

Financial Status of BSEB

Financial performance of BSEB/ Power Sector in the Bihar is not satisfactory. Its financial position is very weak. As per the Balance Sheet for the year 2004 as on 31st March, and for the year 2005 as on 31st March, there is a modest improvement in the net assets of BSEB in the year 2005 while the current liabilities has gone down slightly in the year 2005. There is a considerable increase in deficit in the funds on liability side. Borrowing is on a much higher side to meet the working capital requirement, thus reflecting a sizeable amount of debt service taking place, while the current assets does not generate much revenue to even meet the working capital demand. Capital expenditure has gone up significantly and so is the capital liability. There is a sizeable amount of payment due on capital liabilities which reflects poor receivables of bills of BSEB. The reserves fund position is very meagre and has shown a slight improvement.

One of the reasons for the poor financial performance of BSEB is implicit in Aggregate Technical & Commercial (AT&C) Losses, which are very high in comparison to other states. In a study regarding ranking in power sector conducted by Ministry of Power, Govt. of India, Bihar is at 27th position. Average per capita power consumption in Bihar is 75 kWh/Person (2004-05) vis-à-vis 613 kWh/Person(2004-05) at All India Level. Bihar Govt. is fully aware of the constraints in power sector reforms and appropriate course of action is being formulated. The reasons for unsatisfactory performance and poor financial health of the Power Sector in Bihar are:

High manpower levels/overstaffing not commensurate with energy generated and number of consumers;

State is lagging behind in the area of new generation capacity addition;

Low rural household electrification;

Less than 50% revenue of the cost incurred. The gap between ARR and ACS is about Rs. 2.00 / kWh.;

High interest cost and non-receipt of subsidy from Govt. has resulted in large cash losses;

State has made very limited attempts to curb the theft of power;

Consumer Metering - The action is yet to be taken for consumer metering by the BSEB;

The AT&C losses are estimated to be more than 40% for the last three years. Whereas as per the report on the performance of State Power Utilities prepared by PFC, AT&C Losses are about 70% in Bihar; and Agricultural Sector:-In Bihar the agricultural consumption/sales in million KWh was 28% of the total sales. The level of cross subsidization in Bihar for agricultural consumers is sizeable.

POWER SCENARIO IN BIHAR

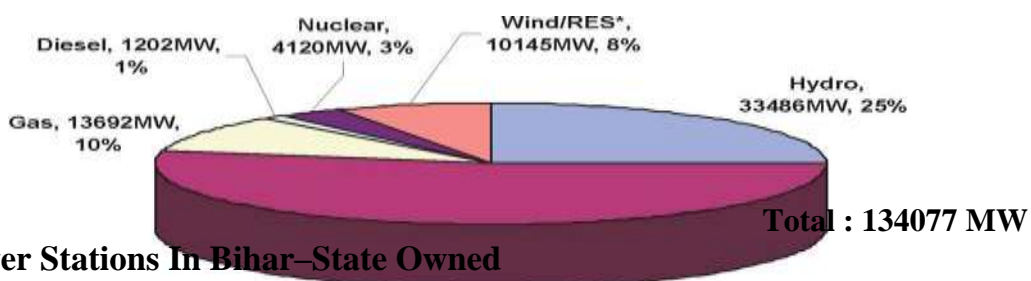
In this Chapter, an attempt has been made to show the existing power scenario in India vis-a-vis Bihar.

All India Installed Generating Capacity by May, 2007

Table-1 All India Total Capacity(Figures in MW)

Sector	Hydro	Thermal			Nuclear	Wind/RES*	Total	
		Coal	Gas	Diesel				
State	24618	38931	3610	605	43146	0	2084	69848
Private	1306	4241	4183	597	9021	0	8061	18388
Central	7562	28260	5899	0	34159	4120	0	45841
Total	33486	71432	13692	1202	86326	4120	10145	134077

*RES-Renewable Energy Sources **Figure - 1**



Existing Power Stations In Bihar–State Owned

Table-2 Existing Power Stations

Name of power station	Installed Capacity(MW)	Agency
Hydro		
Kosi (4x4.8)	19.2	BSHPC*
Sone E&W Canal(2x1.65+4x1.65)	9.9	BSHPC
East Gandak Canal(3x5)	15	BSHPC
Agnoor	1.0	BSHPC
Dhelabagh	1.0	BSHPC

Total	46.1	
Thermal		
Barauni (2x50+2x110)	320	BSEB
Muzaffarpur (2x110)	220	BSEB**
Total	540	

**BSEB transferred the project to BSHPC on 16th Nov.2003 ** Now transferred to new JV-Vaishali Generating Co.*

The KosiHydel power station could not attain designed generation and is now being operated with derated capacity. The Hydel station needs major rehabilitation and modernization efforts. There is no generation from thermal power stations in the state sector at present. All thermal units are under shut down due to refurbishment/deteriorated condition.

Forecast of Electricity Demand for Bihar

Bihar State Electricity Board furnished a detailed short term forecast of electricity demand to the Regional Power Survey Office, Kolkata and 17th Electric Power Survey Committee, in February, 2004, indicating therein a peak electric demand of 1516 MW and electrical energy requirement of 9871 GWh for the year 2011-12. Consequent to the constitution of Special Task Force in January, 2006 on issues relating to the state of the economy of the Bihar, its finances and possible development strategies, a Technical Committee was constituted at the CEA to draw a road map for development of power sector in Bihar. During the visit of the Members of the Technical Committee to Patna in June, 2006, discussions were held with the Bihar State Government regarding short term electricity demand. It was estimated to be 15076 GWh of electrical energy requirement and 2868 MW of annual peak electric load for the year 2011-12.

It was informed to the Bihar authorities that the forecast of electricity demand gives a compounded annual growth rate of about 14 % in the electrical energy requirement over the actuals for the year 2003-04 when compared with All India Growth Rate of about 8 %. It was clarified that this forecast is considered an optimistic programme of accelerated domestic household electrification resulting into about 27% CAGR in domestic consumption. The electrical energy requirement and peak load growth worked out to about 2.5 times of 2004-05 actuals, which was highly optimistic and shall pose challenging task for Bihar State Electricity Board.

The first review of the electricity demand of the State of Bihar was carried out in June-July, 2006 taking care of initiatives taken by the Government of Bihar for growth of domestic, industrial and agricultural sectors. As per this review, the electrical energy requirement worked out to 19905 GWh& 3255 MW for the year 2011-12. The revised forecast was communicated to Bihar Government on 6th July, 2006. However, the draft report of the 17th EPS Committee in

its 3rd meeting in August, 2006 approved electricity demand forecast of 3607 MW of annual peak electric load and 19905GWh of electrical energy requirement for the year 2011-12 for the State of Bihar. Final report of the 17th Electric Power Survey Committee has shown electricity demand of Bihar as tabulated below:

Table-8 Demand Forecast

Year	Peak Load (MW)	Energy Requirement (MU)
2006-07	1570	9629
2007-08	1842	11134
2008-09	2177	12874
2009-10	2575	14886
2010-11	3046	17213
2011-12	3607	19905
2016-17	5598	32857
2021-22	9567	58248

This gives CAGR of about 19% in energy consumption which is very high and extremely optimistic.

The 17th EPSC has taken an optimistic view in regard to Bihar State and given a very high growth rate for electrical energy consumption (EEC), electrical energy requirement (EER) and peak load (PL). The CAGR (compounded annual growth rate) of EEC, EER & PL is tabled below:

Power Growth Rate

Plan	CAGR - EEC	CAGR - EER	CAGR - PL
11 th Plan (CAGR-5 years)	21.98	15.63	18.10
12 th Plan (CAGR-5 years)	11.98	10.54	9.19
13 th Plan (CAGR-5 years)	13.50	12.13	11.31

The above forecast of electricity demand has been finalised despite dissatisfactory progress made in the electricity sector of Bihar which may be observed from below:

Power Supply Position

Year	Requirement (MU)	Availability (MU)	Deficit (MU)	Deficit (%)
2002-03	8096	7422	674	8.3
2003-04	7588	5878	1710	22.5
2004-05	7201	6476	725	10.1
2005-06	7955	7218	737	9.3
2006-07	8425	7741	684	8.1

FINANCIAL STATUS OF BIHAR STATE ELECTRICITY BOARD (BSEB)

1. Most of the States in the country has acted fast and took quick steps in the direction of Power Sector Reforms as stipulated in the Electricity Act 2003 and restructured/unbundled their State Electricity Boards and constituted State Electricity Regulatory Commissions to increase the pace of development, their SERCs are issuing Tariff Orders from time to time regularly, whereas the performance of Bihar in the direction of Power Sector Reforms is rather slow. In accordance with the stipulation of the Electricity Act 2003, the State Government has already moved in the directions of restructuring the BSEB with a break down of five sets and Bihar Govt. has constituted its State Regulatory Commission and it has become operational recently i.e. since 15th August, 2005. Generation Capacity is very limited. Bihar's Power Policy is yet to be finalized. Bihar has received 8 offers for IPPs, these will be considered after finalisation of its Power Policy. Financial performance of BSEB/ Power Sector in Bihar is not satisfactory. Its financial position is very weak. As per the Balance Sheet for 2003-04 as on 31st March, 2004 and for 2004-05 as on

2. stMarch, 2005 there is a modest improvement in the net assets of BSEB while the current liabilities has gone down slightly in the year 2005. There is a considerable increase in deficit in the funds on liability side. Borrowing is on a much higher side to meet the working capital requirement, thus reflecting a sizeable amount of debt service taking place, while the current assets does not generate much revenue to even meet the working capital demand. Capital expenditure has gone up significantly and so is the capital liability. There is a sizeable amount of payment due on capital liabilities which reflects poor receivables of bills of BSEB. The reserves fund position is very meagre and has shown a slight improvement in the year 2004-05. A large amount of receivables from its customers is due and this is eroding the financial strength of BSEB. Its inability to collect revenue from its customers is leading to increased borrowings, which further leads to higher interest burden on the expenditure side. On the other hand, chances of realising the arrears which are more than four to five years old, are poor. The net worth of BSEB will be affected severely, in case it decides to waive the interest and/or portion of arrears.

3. Its poor financial position is reflected in certain key areas i.e. Aggregate Technical & Commercial (AT&C) Losses, which are very high in comparison to other States. In a study regarding ranking in power sector got conducted by Ministry of Power, Govt. of India, Bihar is at 27th position. Average per capita power consumption in Bihar is 75 kWh/Person(2004-05)

vis-à-vis 613 kWh/Person (2004-05) at All India Level. It was indicated during the discussions with officials of Power Ministry of Bihar that Bihar Govt. is going to take action in this direction very shortly.

4. The major reasons for unsatisfactory performance and poor financial health of the Power Sector in Bihar are outlined below:

- a. Poor performance of power stations. The power stations are running at low Plant Load Factor (PLF) and Availability Factor (AF) is also less due to old age of plants and inadequate Renovation and Modernization activities.
- b. High manpower levels/overstaffing
- c. State is lagging behind in the area of new generation capacity addition.
- d. Low rural household electrification.
- e. Less than 50% revenue of the cost incurred. The gap between ARR and ACS is about Rs. 2.00 / kWh.
- f. High interest cost and non-receipt of subsidy from Govt. has resulted in large cash losses. Non-receipt of fresh equity support from Govt. has resulted in erosion of its net worth and defaults to lenders/ institutional loans etc.
- g. Slow progress in the area of reforms

2. State has made very limited attempts to curb the theft of power.

Although the BSEB has commenced energy accounting activities in Bihar, in the absence of adequate number and quality of meters (both at 11 KV level, DT levels and at consumer end), it is difficult to carry out comprehensive energy audit to determine real T&D Losses.

As regards Consumer Metering, the action is yet to be taken by the BSEB. The AT&C losses are estimated to be more than 40% for the last three years. These figures may be misleading in the absence of any data on the units metered and any scientific assessment of agricultural consumption. For the year 2004-05, Bihar State Electricity Board has reported 46% AT&C losses. In the report submitted by ICRA Limited, the AT&C Losses for the year 2004-05 has been indicated as 48%. Whereas as per the report on the performance of State Power Utilities prepared by PFC, AT&C Losses are more than 70% in Bihar. It has shown trend of reduction by 3% during 2004-as compared to 2003-04

The agricultural consumption/sales of power (in million KWh) was 28% of the total sales, whereas agricultural power revenue was 4% of the total revenue during the year 2004. The level of cross subsidization in Bihar for agricultural consumers is sizeable and an area of concern.

Conclusion

5. Power situation in Bihar is grim-with a total installed capacity of 586.1 MW (comprising MW from Thermal and 46.1 MW from Hydro). The general level of development is low and there is a shortage of basic infrastructure. This has led to a very low level of per capita availability (76 MW) in comparison to all-India level (1360 MW). In addition, there is a

lack of awareness about various renewable energy resources, available technologies, and systems/ devices/and programs. Bihar needs urgent attempts to expand its power generation capacity and improvements in existing facilities (Barauni and Muzaffarpur). There has been no capacity addition for last two decades. In 2006-07, peak demand was estimated at 1400 MW against the actual availability of 1162 MW – leaving a net deficit of 16.9% for the State. It had far reaching implications for economic growth performance of the State.

6. As mandated by the Central Government, Bihar must aim at electrifying all its villages during the current 11th Plan. For that, its power demand is expected to grow, on an average, more than 10% annually. Bihar would, thus, require additional capacity of roughly 2000-2500 MW by 2011-12. This would impose heavy financial burden on the State. Renovation and Modernization (R&M) should have been taken up by the BSEB on an urgent basis to make the existing plants (which have been under deterioration-both Barauni and Muzaffarpur) operative and obtain the maximum output in order to bridge the demand – supply gaps. New generation Thermal capacity of estimated 4000 MW (for the cost of Rs.16,000 crores at present level prices) is planned for XIth and XIIth Plan periods. This would require massive efforts by the State Government -both on policy and institutional side. There is a wide scope in Bihar for generation of power from hydro sources as well as from renewable/non-conventional sources of energy. This would require well planned strategy as well as innovative policy and institutional arrangements to make it economical and sustainable.

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