

# Parametric Analysis of Challenges & Opportunity in Thermal Power Generation in India

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**Abstract**— Thermal plants at present account for 68% of the total power generation capacity in India. India's power generation sector is dominated by thermal power generation and it is expected to remain the main source of electricity generation in India over the next 2-3 decades. Thermal power generation plays a strategic role in the economy's growth. Also the recent technological upgradations have improved the efficiency of generation from thermal sources but still there is a long way to go.

This paper deliberates on challenges associated with thermal power generation in India and suggests possible solutions for it. A state-wise comparative analysis has been done on the basis of 3 parameters; Installed Capacity as on Sept'2015, Power Supply Position and Investment Opportunity.

**Keywords**—challenges; thermal power; installed capacity; power supply

## I. INTRODUCTION

India has adopted a blend of thermal, hydel and nuclear sources with a view to increasing the availability of electricity. Thermal plants at present account for 68% of the total power generation capacity in India. This is followed by hydro-electricity (28% share). The rest comes from nuclear and other renewable. India's power generation sector is dominated by thermal power generation and it is expected to remain the main source of electricity generation in India over the next 2-3 decades. Thus, thermal power generation plays a strategic role in the economy's growth. Also the recent technological upgradations have improved the efficiency of generation from thermal sources but still there is a long way to go. Fossil fuel is going to remain the primary source of energy in India [1]. Coal is likely to remain a key energy source for India, for at least the next 30–40 years, as India has significant domestic coal resources (relative to other fossil fuels) and a large set of existing installed base of coal-based electricity capacity [2]. India's coal reserves are not as large as previously thought, at the current usage rate, India's reserves would be depleted in 80 years and at the projected rate of growth in production, that number becomes 40 years [3]. India's main conventional energy resource that is coal, Oil and natural gas are available in limited quantities [4]. Despite huge allocation of coal reserves in the country, it is required to import it from other countries [5].

Due to the importance of thermal power generation, an analyses is required to study the challenges associated with thermal power generation, suggests possible solutions for the challenges. This paper deliberates on issues and challenges of thermal power generation in India. For this a state-wise comparative analysis has been done on the basis of 3 parameters; Installed Capacity as on Sept'2015, Power Supply Position and Investment Opportunity.

## II. CHALLENGES ASSOCIATED WITH THERMAL POWER GENERATION

### A. FUEL AVAILABILITY

While additional gas supply from KG Basin has eased shortage to a limited extend, supply constraints for domestic coal remain and are expected to continue going forward. Consequently, public and private sector entities have embarked upon imported coal as a means to bridge the deficit. This has led to some Indian entities to take upon the task of purchasing, developing and operating coal mines in international geographies. While this is expected to secure coal supplies it has again thrown upon further challenges. For example, the main international market for coal supply to India – Indonesia, poses significant political and legal risks in the form of changing regulatory framework towards foreign companies. Similarly, coal evacuation from mines in South Africa is constrained by their limited railway capacity and the capacity at ports is controlled by a group of existing users making it difficult for a new entrant to ensure reliable evacuation<sup>9</sup>. In this case it is essential to manage the risk of supply disruption by different options like – diversification of supply, due diligence on suppliers, unambiguous contracting and strict monitoring among others.

### B. PROBLEMS OF COAL BLOCKS

The failure to achieve the planned target from the captive coal blocks presents itself as a major challenge to the electricity sector, as only 24 blocks have become operational out of the total 210. Experts believe that the non-operational status of majority of these blocks is attributed to land acquisition (RULES AND REGULATIONS) issues, permit delays and infrastructure problems. In addition, the developers who have been given the charge of captive blocks are not putting diligent efforts to expedite the mining

operations due to their lack of experience in coalmine development. Coal is the mainstay of the power production in India and is expected to remain so in the future. Additional power generation is likely to require incremental amount of coal transportation by Indian Railways within the country and increasing unloading at ports in India for imported coal. In both cases India currently faces capacity shortage. Hence, a project developer has to account for and manage its logistics chain in a manner that minimizes disruption to its fuel supply. In many cases this is likely to involve self-development of relevant supply infrastructure which poses additional project execution complexity for the developer. For example, some imported coal based power plants are also forced to set up an unloading jetty for coal carrying shipping vessels. This has to be ensured before the commissioning of a power plant which requires an alternate set of project execution skills in the port sector.

### C. EQUIPMENT SHORTAGE

Equipment shortages have been a significant reason for India missing its capacity addition targets for the 10th five year plan. While the shortage has been primarily in the core components of Boilers, Turbines and Generators, there has been lack of adequate supply of Balance of Plant (BOP) equipment as well. These include coal-handling, ash- handling plants, etc. Apart from these, there is shortage of construction equipment as well. The Working Group on Power for 11th Plan has outlined the requirement for construction equipment for Hydro and Thermal power plants. To alleviate supply shortage of equipment two measures are being adopted – enhancement of domestic equipment manufacturing capability by establishing JVs between Indian and foreign suppliers and second measure is procuring equipment directly from international markets. In both cases equipment sourcing needs to be managed effectively throughout the procurement cycle. For instance, it may be a challenge for new project owners to select a reliable supplier, monitor its performance and ensure the quality of supply on a sustained basis. Also, the timelines for availability of additional domestic equipment supply has not been clearly defined.

### D. LAND ACQUISITION AND ENVIRONMENT CLEARANCE

Land Acquisition poses an increasingly significant challenge in the Indian electricity sector. Power plants and utilities face major constraints and delays regarding the availability of land and obtaining the requisite environment and other clearances for the projects. The new Bill relating to land acquisition has continued to face political opposition. While it provides for acquisition by project development agencies to the extent of 70 percent of the land required for a project, with the balance to be obtained by the Government. In addition, it has been reported that in some cases, even

after land owners were asked to sell and handover their land in 'Public Interest', the project was not completed for several years due to other delays, a fact that eroded the credibility of both the industry and the government. Consequently there is a significant mismatch of expectations from the Project Affected Persons (PAP). Stakeholders or other land owners may collectively object of the project execution. In such cases, it is essential to proactively manage the environment and stakeholders' expectations.

### E. FINANCIAL PROBLEM

Rapid builds up of the generation capacity is being aided by setting up of Ultra Mega Power Projects (UMPPs) each of which is 4000 MW. However, the execution of the Ultra Mega Power Projects (UMPP) is a significant challenge as India has not witnessed an execution of such a large scale power project before. Furthermore, with each UMPP costing above INR 16,000 Crore, financing such a large project is a critical constraint for any developer. In addition, considering the high financial stake involved through private investments, delay in payments may put severe pressure on developers/suppliers to meet the performance commitments.

### F. MISCELLANEOUS

All these issues finally result in creating slippages in the planned installed capacity and can also be attributed to some other miscellaneous factors such as:

- Slow progress of civil work
- Poor Geology
- Flash Flood
- Local Agitation
- R&R Issues
- Law and Order Problem
- Shortage of Manpower and Difficult Site conditions

Overall such factors result in long hauls and hampering the installed capacity targets or the current installed capacity of the power sector.

### III. ADDRESSING THE CHALLENGES ASSOCIATED WITH THERMAL POWER GENERATION

Despite the challenges, the government is determined to create opportunities in power sector by undertaking large projects in different segments of the sector i.e. generation, transmission and distribution. For instance the overall measures adopted by the government are summarized in table below:

TABLE I. CHALLENGES & SOLUTION FOR THERMAL POWER GENERATION

Key Challenges	Measures Being Adopted	Resulting Issue	Solutions & Remedies
Addition of significant generation capacity	UMPP	1. Technical & financial capability to execute such large projects 2. Risks increases manifold	1. Project execution costs/cash flow management 2. Risk management strategy & planning.
Ensuring fuel availability & quality	Purchase & development of coal mines abroad	1. Risks in operating in different geographies 2. Uncertainties in logistics operations	1. Risk management through effective contracting, supply diversification, etc 2. Control over supply infrastructure
Plant equipment shortage	1. Procurement from abroad 2. Setting up of new supply units	1. Vendor reliability 2. Execution timelines	1. Robust procurement management, vendor monitoring 2. Project scheduling
Land acquisition & environment clearances	Speeding up processes	Inadequate communication with stakeholders resulting in mismatch of expectations from project affected persons	Environment & stake holders management
Manpower shortage	Enhance training		Resource planning & management

Also certain other measures taken by the government includes allocation of investments such as the commencement of a 4,000MW UMPP being

planned in the states of Bihar and Jharkhand, re-allocating the coal block, etc. With transparent and rational allocations, effective regulation and competition will herald the much needed reforms.

The government is also trying to improve the financial health of the discoms by various schemes such as restructuring of the state discoms, R-APDRP programme to reduce the AT&C losses, rationalization of tariff, IPDS and DDUGJY. Such programmes are intended to strengthen the generation, transmission and distribution network and to introduce competition into the sector.

Further land acquisition is also a critical issue which cannot be addressed by the private sector. Thus the government will have to step in a major way to ensure acquisition and also make the land available on long-term leases at affordable rates. This will encourage the much needed private sector investments. For new coal mine owners land ownership, transfer of mining leases, environment clearances and the right to use explosives are becoming an hurdle. To overcome this, the central government has been supporting the companies to get the mines operational and the state government is working on speeding up of various clearance processes.

Yet another example of opportunity for the power sector is the Indian Railways which has stepped up its efforts to reduce the electricity costs and has called for bids from power producers to supply 1,010MW of electricity over three years. Thereby, acting as a potential savior for the idle power projects.

Apart from the government initiatives the private players are also not far behind. For instance private firms like Tata power, Sterlite, Ind Bharat and many more have planned various power plants in the eastern region such as the 2400MW Sterlite Sabo thermal power plant, 600MW Ind Bharat thermal power plant and the upcoming proposed power plants.

#### IV. COMPARITIVE ANALYSIS

The state-wise comparative analysis has been done on the basis of 3 parameters, namely:

- Installed Capacity as on Sept'2015.
- Power Supply Position.
- Investment Opportunity.

##### A. STATE-WISE INSTALLED CAPACITY

India is the fifth largest electricity generator with a total thermal installed capacity of 194199 MW. The state-wise installed capacity is shown in fig below. The top five states which have the highest thermal installed capacity are Maharashtra, Gujarat, Chhattisgarh, Uttar Pradesh and Tamil Nadu. The western region leads the other regions with 76326MW thermal installed capacity followed by 43640MW in northern region, 35185MW in southern region and 19948MW in eastern region.

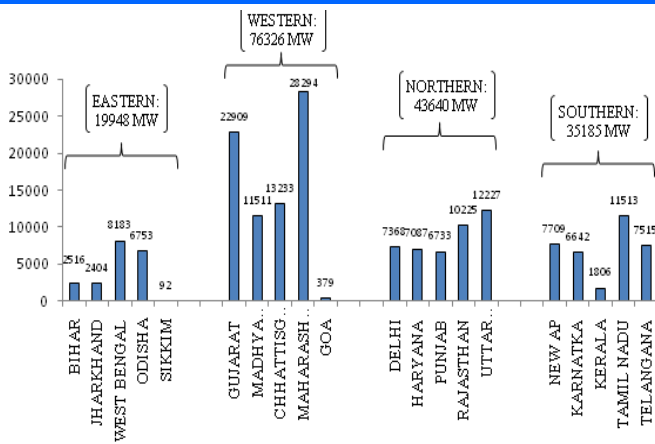


Fig. 1. State-Wise Installed Capacity As On Sept'2015

**B. POWER SUPPLY POSITION**

India's energy demand has been growing rapidly in the last two decades. This demand has been boosted by industrial growth as well as a rise in household consumption. On the other hand, supply of energy too has grown but has been outstripped by demand. The current power supply position, as on Sept'2015, in different states has been depicted in the table below. The highest deficit of 16% is seen in Uttar Pradesh followed by 12% deficit in Karnataka.

TABLE II. REGION-WISE POWER SUPPLY POSITION IN INDIA

	Requirement	Availability	Surplus/Deficit	
			(MU)	(%)
<b>Eastern Region:</b>				
Bihar	2034	2010	-24	-1.2
Jharkhand	614	606	-8	-1.3
West Bengal	4379	4370	-9	-0.2
Odisha	1997	1975	-22	-1.1
Sikkim	35	35	0	0.0
<b>Western Region:</b>				
Gujarat	8824	8822	-2	0.0
Madhya Pradesh	3213	3213	0	0.0
Chhattisgarh	2226	2174	-52	-2.3
Maharashtra	11318	11296	-22	-0.2
Goa	421	421	0	0.0
<b>Northern Region:</b>				
Delhi	3049	3044	-5	-0.2
Haryana	4921	4914	-7	-0.1
Punjab	5458	5458	0	0.0
Rajasthan	6180	6136	-44	-0.7
Uttar Pradesh	10180	8499	-1681	-16.5
<b>Southern Region</b>				
Andhra Pradesh	3931	3899	-32	-0.8
Karnataka	5045	4411	-634	-12.6
Kerala	1845	1827	-18	-1.0
Tamil Nadu	8320	8193	-127	-1.5
Telangana	4180	4170	-10	-0.2

Further southern India is expected to face a severe electricity shortage this year. The Central Electricity Authority (CEA) in its latest annual forecast anticipates the energy deficit in the southern electricity grid to be over 11 percent, equivalent to a generation capacity deficit of 4000 MW. For Karnataka and Telangana, the forecasted energy deficit is greater than 16 percent. The CEA forecasts a small deficit for the Northern region and a surplus for the Western and Eastern regions.

**C. INVESTMENT OPPORTUNITY**

The investment opportunity is estimated based on the upcoming thermal power plants till 2020 and the prevailing capital cost of INR 5 Cr/MW associated with the projects. The highest investment can be seen in western region followed by the eastern region.

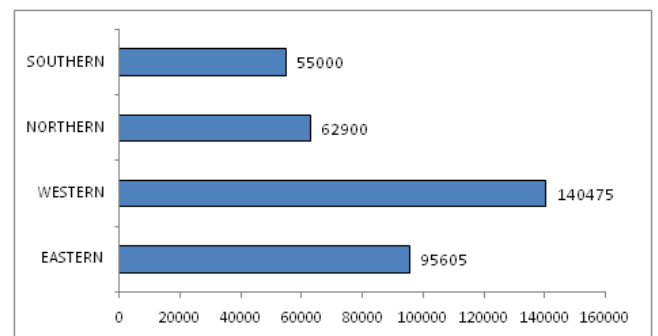


Fig. 2. Region-Wise Investment Till 2020

Further, certain major initiatives taken by the government includes:

1. Doubling coal India's production to 100 Cr. Tonnes/year by 2020 and a target to increase the power generation by 50% by 2020.
2. An Advanced Ultra Super Critical Technology R&D Project has been approved by Government at a cost of Rs.1500 Crore involving BHEL, NTPC and Indira Gandhi Centre for Atomic Research (IGCAR) to achieve higher efficiency, reduce carbon-dioxide emissions and coal consumption for coal based power plants.
3. Government of India has issued policy on automatic transfer of linkage in case of scrapping of old units and replacing them with new supercritical plants.
4. Doubling coal cess from Rs.100 per tonne to Rs.200 per tonne for funding projects under National Clean Energy Fund as announced in the Budget Speech of 2015-16.
5. Perform Achieve Trade (PAT) Scheme under National Mission on Enhanced Energy Efficiency is under implementation by Bureau of Energy Efficiency (BEE). In this Scheme, individual target for improving energy efficiency has been assigned to 144 numbers of thermal stations.



6. New gas pooling mechanism to bailout 14,000 MW of stranded power plants: According to the Government, India's current gas based capacity stands at 27,123 MW, of which 14,305 MW is stranded (operating at zero plant load factor (PLF)) and the balance 9,845 MW has been operating at abysmally PLF of ~30%. This has been due to significant reduction in the gas supplied to the power sector from 70.6 mmscmd in FY11 to 28.9 mmscmd in FY14 due to a decline in gas production from the KG-D6 basin.

7. Reallocation of coal blocks through e-auction process: As per the Supreme Court's verdict in 2014, auction of 218 coal blocks to various companies (Power, Steel and others) between 1993 and 2010 were illegal. This led to uncertainty of coal supply for existing and upcoming power plants. In order to address this issue, the government promulgated the Coal Mines (Special Provisions) Ordinance 2014 for the management and reallocation of all the cancelled coal blocks through evaluation process. The e-auction has been done in a phased manner. So far, the Government has conducted two rounds of auctions and auctioned 23 coal blocks which is expected to garner around Rs.2 trillion to the respective state governments. We think that the reallocation of de-allocated coal blocks through e-auction process has been a very positive step by the Government for Power and Coal sector. The move is likely to ensure the steady supply of coal for the existing and upcoming power projects. In order to expedite operations from the reallocated coal blocks, the Environment Ministry has allowed transfer of environment clearances granted to the previous allottees to new owners without any fresh approval which is also a step in the right direction.

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