Review on the challenges in setting up coal based power generation capacity in India

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Abstract— India has been steadily adding the power generation capacity using Coal, Gas and Renewables. While the thrust on adding up the Renewables power generation capacity is on the rise, India still needs to add the reliable Coal power generation capacity addition. Indian policy makers have come up with various schemes to stimulate power generation capacity addition viz. Right to fair compensation and transparency in Land acquisition, rehabilitation and resettlement bill -2013 and Financial restructuring package to state electricity boards,2012 .In spite of these measures ,India has not been able to add coal power generation capacities as per the 5 year plans. This paper attempts to identify the challenges in setting up coal based power capacity addition in India through review of literatures and give suggestions to overcome these challenges.

Index Terms— Coal,Equity tie up,Financial closure,Generation,Land availability,Supercritical technology,Thermal power

1.Indian Power sector:

1.1 Background and Significance:

India has been growing steadily and has the potential to emerge as a major economy. India has been growing at a higher rate compared to the other major countries even during periods of economic downturns (India Development update 2015, Report no.95979-IN, World Bank). Availability of electricity is a key factor in order to sustain this growth and grow further.

As per Tripta Thakura, S.G. Deshmukhb, S.C. Kaushika and Mukul Kulshresthac (2006), Indian power sector has gone through major transformations over the last few decades such as Abolishment of license in the power generation domain, Encouragement of private sector participation in power generation, Unbundling of the State Electricity Boards etc. This has made Indian power sector become an attractive destination for global power equipment manufacturers . Chinese, Korean, Japanese, American and European power equipment manufacturers are actively involved in building up the power generation capacity by setting up their manufacturing facility in India either directly or through Joint Ventures and through exports from their countries (Opportunities and Challenges in the BTG space, The Boston Consulting Group, 2012).

India has been adding the power generation capacity consistently from 1GW during 1947 to 307GW in 2016. Power sector of India consists both renewable and non-renewable sources and conscious efforts have been done to bridge the demand gap by all these sources. It may well be established from the Table 1 that among the various fuel sources of the installed power generation capacity in India namely Coal, Gas, Oil (Thermal), Hydro, Nuclear and Renewable Energy Sources (RES) and the coal based power generation with a contribution of 61% is the leading contributor to power generation in India.

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Table 1: Fuel wise breakup

Fuel Source	Installed capacity(GW)	% Share
Coal	186	61
Gas	25	8
Diesel	1	0.3
Nuclear	6	2
Hydro	43	14
RES	46	15
Total	**307**	**100**

Source: Central Electricity Authority, India (2016)

India has planned to implement for Supercritical technology for the coal based power generation capacity addition due to various advantages it offer viz, Reduced fuel consumption, Reduced water consumption, Reduced emission, Reduced land requirement , Increased unit capacities and High plant operating efficiencies. The Supercritical technology generation capacity addition target is given in Table 2. Indian coal based power generation capacity addition will be totally based on coal fired Supercritical technology except few captive smaller power generation capacity addition which may go for lesser efficient col fired sub critical technology owing to economic reasons.

Table 2: Supercritical technology capacity addition target

Year	Overall target*	Coal based*	Supercritical(SC)*	SC as a % of coal based
2012-17	88537	69280	41568	60
2017-	93400	63400	63400	100

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***Values in MW Source: Planning Commission (2012)**

There has been under achievement of power generation capacity addition in India and delays in commissioning of coal based Supercritical technology power plants in India which has led to electricity restriction and control measures and which has further resulted in business losses. India suffered a business loss of $68billion due to electricity shortage during 2013-14(FICCI 2014). The problem is likely to be more pronounced as the demand for electricity is steadily on the rise.

The projected power generation capacity addition required in india is likely to be 436GW in the year 2020 and 746GW in the year 2030(Ministry of Power, India). The estimated demand projection for installed power generation capacity is given in Table 3. While the share of other fuel sources will be on the rise, The coal based power capacity addition will double from the installed capacity of 204MW (2014) to 419GW (2030).

Table 3: Projections of Indian Installed power generation capacity(GW)

	2000	2014	2020	2030	2040
Installed capacity	113	289	436	746	1076
Coal	84	204	280	419	576

Source: India Energy Outlook, International Energy Agency,2015

It may further be ascertained by the fact that the per capita consumption of electricity (kwh/year) of India is 1075USD during 2015-16 which is very low and this only confirms that electricity is not accessible to the entire population of India. It only indicates there is huge latent demand for electricity that exists in India. Hence there is need for adding huge power generation capacities using coal.

Table 4:Per Capita Electricity consumption

Country	Per capita consumption(kWh)**
India	1075
China	3457
Brazil	2509
Russia	6602
US	12947
Canada	15558

****Per capita consumption figures for India is for 2015 and for rest of the countries , it is for 2012**
Source: Central Authority of India (2016) and CRISIL Insight (2015)

It is evident from Table 3 that, In spite of the increased focus on Renewables, Coal based power generation capacity addition is significant in the years to come. Hence the focus of this study is to identify the challenges in setting up coal based power generation capacities in India and to suggest remedial measures to minimise if not eliminate the business losses.

2.Literature review:

A detailed literature review covering Indian and International literatures was done to identify the major challenges faced to coal based power generation capacity addition in India.

Electricity demand is directly proportional to the economic growth. According to Shuddhasattwa Rafiq and Ruhul Salin,2009, the linkage between energy demand and income in India using Production function,Co-integration and vector error correction modeling along with generalized impulse response functions ,there exists uni-directional short-run causality from output to energy consumption for India. Hrushikesh Mallick,2006 studied the linkage between energy consumption and economic growth in India using Granger casuality test, Variance decomposition analysis of vector auto-regression (VAR) method and suggests that it is the economic growth that fuels more demand for both fuel and electricity consumption and it is the only growth of coal consumption that causes economic growth.

ICTACT Journal on soft computing,2012, through the use of Multiple linear regression (MLR) and Artificial Neural Networks(ANN), predicts that India needs to increase the power generation capacity substantially and India will have add power generation capacities totalling to 550GW by the year2025 which can be achieved only if the challenges viz. Coal availability ,Land, Environmental and Securing Finance issues are met with.

Anurag K Srivatasava, Sukumar Kamalasadan, Daxa Patel, Sandhya Sanakar, Khalid , 2011 based on a an overview and comparitive study suggests that the ongoing or forthcoming electricity sector restructuring activities in some countries including India can be better designed based on lessons learnt from existing markets and incorporating their own political, technical and economical contexts.

Hence the increase in electricity demand is a consequence of increased economic growth and has a bearing on the availability of fuel ,structural and systemic issues which needs improvement in India to ensure the targeted economic growth is achieved.

The major challenges which cause delays in coal based power generation capacity addition in India include Indian coal supply constraints, Land acquisition issues, Delays in obtaining environmental clearances and securing finance (Build India ,MCKinsey,2009).This study will focus on these major challenges.

2.1 Indian Coal availability:

Indian coal availability is a critical factor to achieve the targeted power generation capacity addition in India on a sustainable basis for long term .The coal requirement during 2012-13 was 773MTPA but the available Indian coal was 557MTPA.This has resulted in the import of 216MTPA during the same year. It is projected that the coal requirement will be 1373MTPA by 2020-21 and a lot of catching up have to be done to meet this demand.Hence this study is focussed on Indian coal availability.

The Causality Analysis of Coal Consumption & and Economic Growth by Jinke Li , Zongxue Li resources,2011 using Granger casuality analysis, ADF-Fisher and PP-Fisher unit root tests suggests that the unidirectional causality from GDP to coal consumption in developing countries like India indicates that the continuous economic growth has resulted in a continuous rise in coal consumption and leading to shortages in availability of coal.

India has abundant coal reserves. The problem lies in getting the coal to the power plants for use. The main challenges to sustainable development of the Indian coal sector pertain to (a) systems of coal exploration, extraction, and processing, (b)ensuing

environmental and social concerns, and (c) increasing and high demand for coal in the power sector as per Ananth P. Chikkatur , Ambuj D. Sagar,2009. This is further corroborated by A. P. Chikkatur and A.D. Sagar ,2010 .As per A. P. Chikkatur and A.D. Sagar ,sustainable development of the Indian coal sector require progress on a number of fronts, perhaps the most critical element will be the willingness of the various stakeholders and decision-makers to work together to reduce and manage the conflicts between the environment, the rights of local communities, and the demands of the coal sector. Through a narrative-analysis,Tai Wei LimSouth ,2012 suggests that the discourses and narratives about coal energy in India and Japan are constantly negotiated, constructed and then deconstructed again to fit and adapt to new realities, including the availability of newer technologies or priorities and concerns about the environment.

Further ,the productivity of Indian coal sector needs improvement . As per Mudit Kulshreshtha , Jyoti K. Parikh Elsevier,2001 through the use of Non-parametric index number method ,opined that ,In spite of rising capital expenditure, there have not been substantial efforts towards adaptation of new and efficient technology. Lack of technology adaptation results in meeting the increased coal demand due to economic growth.

All the above factors have resulted in reduced availability of Indian coal resulting in plant outages. As per CRISIL2015, domestic coal availability is still below than what is required to operate the installed capacities at the normative Plant Load Factor of 85% even though the coal production has improved from a CGR of less than 4% between 2009 and 2014 to 10.7% in 2015.

2.2 Land acquisition:

Land acquisition is a major issue for the power plant developers.

A study by M.M.K.Sardana,2007 to highlight the land acquisition issues in India for industrial activity indicates that there are two legislations proposed to minimise the issues in land acquisition, i.e. Bill of 2007 seeking to amend Land Acquisition Act and the Rehabilitation and Resettlement Bill are complementary. However, both the legislations define different agencies to meet the objectives of the legislations. Such a multiplicity of agencies may not be conducive for getting the desired results expeditiously and in a straightforward manner. Peasants and Project Authorities would have to interact with multiple agencies who under different dispensations may work at cross purposes. This causes delays in acquiring land for the projects.

There re various issues in the rehabilitation of land sellers . According to Lancy Lobo and Sashikant Kumar ,2009,based on the trends in land acquisition and transfer the state of Gujarat, there is an urgent need to create a people-centric developmental model, where people who have given up their land and their livelihoods could be made the immediate beneficiaries of the project. It is a model that recognises rehabilitation and resettlement with the active participation of affected persons, rather than as an externally imposed requirement.

Another issue is conversion of agricultural lands to industrial land. According to Bill Mundy and Theodore Lane,2011,after exploring the demand and supply relationship between urban and non urban land Land ,there is a need to create active development rights acquisition programme which compensates the landowner for the value of the property and at the same time allows him/her to carry on agricultural or forestry operations. This will promote overall growth of the country. Active development rights acquisition programme needs to be promoted in India.

As per Michael M. Cernea,2003, forecasting impoverishment trends is crucial for adopting and implementing policies that avoid displacement and counteract undesirable outcomes when resettlement is unavoidable which will help in avoiding delays on account of land acquisition.

As per Observer Research Foundation,in a study conducted during 2010,the key issues and legal provisions involved in land acquisition for the mega projects in India include Eminent domain provision, Adequate compensation ,Rehabilitation and resettlement, Lack of institutional capacity. To avoid the issues in land acquisition, this article suggests to Improve existing policies on land acquisition, to rebuild a climate of trust and mutual understanding between the two parties (oustee and the buyer).There is a greater need for greater clarity in the existing law. The Rehabilitation and Resettlement scheme should be treated as a right based entitlement scheme and not as a welfare scheme, Setting up of grievance redressal mechanisms. This will promote mutual trust and help in avoiding delays of land acquisition.

When governments compulsorily acquire land, they have an obligation to ensure that the process is completed in an equitable and transparent manner. People should not be impoverished because their land was acquired by Government. Equitable and transparent procedures are also needed for economic growth. Compulsory acquisition will destabilize the economy if investors perceive that their rights to land are not adequately protected by the government(Paul Munro-Faure ,2008).

With increasing private sector participation, delays due to project management is expected to reduce significantly and the focus would be left to environmental and land acquisition issues. The modifications in the regulatory framework on these issues are moving in the right direction. However, methods used for assessments related to environmental impact and land acquisition are still conducting manual surveys, making the whole process time consuming. Technology could be a good instrument in reducing the time required for these studies as well as in bringing transparency in the system. Decentralization with capacity building at the state level would also help in the long run in reducing these delays (G. Raghuram , Samantha Bastian, Satyam Shivam Sundaram,2009).

The practice of land acquisition by Government authorities present numerous pitfalls. Land development processes through the use of land consolidation, land pooling, Town Planning Schemes or land reconstitution are many alternatives available(Léna Chiaravalli,2012).

The Indian Government has promulgated "The right to fair compensation and transparency in Land acquisition, Rehabilitation and Resettlement Bill 2013 to facilitate acquiring land for projects. The Bill attempts to satisfy the woes of the land losers and simultaneously provide a systematic framework for the administration and industry players in order to acquire land. The bill acknowledges the potentially corrosive effects of development on interlinked clusters of rights that span the conventional divide between social and economic rights and civil and political rights; obliges the state to engage citizens in the process of fulfilling these rights; and calls for the establishment of special-purpose institutions to hold powerful actors, within and outside the state, accountable. However, the implementation of the provisions can be considerably challenging as land acquisition is mostly being done in rural areas where the population is fully dependent on the land and the related ecosystem. (Sheetal Sharad, Shubham Jain, Rohit Inamdar,2013).

Whether the recent Right to fair compensation and transparency in Land acquisition ,rehabilitation and resettlement bill -2013 will facilitate the land acquisition process needs to be seen as the same is likely to increase the cost of land and the gestation period of acquisition(Compensation- 4 times the market value –Rural and 2 times -Urban).

2.3 Environmental clearance:

The duration is obtaining environmental clearance is major challenge in setting up coal based power generation capacity. During 2012-13, the number of coal based power projects pending for environmental clearances is 78 which amounts to 103GW (KPMG ,2013).

The results of the exploratory survey to study the environmental challenges to thermal power industries in Indian context by Jeetendra kumar Tiwari,Rawani,2012 indicate that top management commitment and support; training and awareness of internal people, unacquainted society, and poor legislation are the few important challenges for effective implementation of environmental management practices in Indian power industries.

The environmental regulations are frequently changed. The cost of environment management is about 20% of revenues. Any change in regulation has huge cost impact. This affects the setting up of new thermal power plants as they could not do long term environment planning as per the study conducted by Ritu Paliwal,2006 using Informal talks and semi structured interviews.

NOx and SOx emissions by thermal power plants is a serious issue. There is a need to identify superior technology for new power plants based on the emissions from the running power plants. Comparison of per capita emission with Developed countries and the cost impact to adopt new technology to reduce emissions using coal as fuel needs to be studied further (Subhodip Ghosh,2010).

There is a need to improve power sector include Re-engineering of Regulatory Processes at State Level and Single Window Clearance, Dispensation of publication in the official gazette, Reduction of the time for filing objections reduced to 1 month, Fresh publication may be necessary only in case of major changes in nature and scope of the project -over 20% in cost terms excluding standard updation in cost due to exchange rate variation, changes in the tax/duty structure, etc.

Based on the case studies on the risks faced by banks and FIs who have financed projects that have environmental and social impacts, it is evident that the implementation of these regulatory rules is the major concern. The key issues are a) insufficient clearances or legal loopholes that allow for easy clearances and/or bypassing of legislations; and b) lack of authenticity and credibility of EIA reports, and lack of transparency in public consultation (Koyel Mandal Vivek Venkataramani,2013).

There is a need for change emission control norms and for delays, establish a high-power group to monitor and de-bottleneck emission control related issues in infrastructure projects, amend policies and regulation to hasten dispute resolution process to minimise environmental clearance risks and the consequent cost overruns (Prashant Gupta Rajat Gupta Thomas Netzer,2009).

2.4 Securing finance:

Regarding the finance required for setting up power projects, there is shortfall of debt (10%) and Equity (26%).But measures are taken to address debt viz. Debt restructuring schemes to Discoms and power developers. The equity tie up issues still persist. The debt-equity ratio of private gencos has risen to 2.64 in FY13 from 0.91 in FY09 . The major concern today is a lack of new pipeline of projects as most of the players are stressed and they will not be in a position to bring much equity. More than 74000MW coal based power projects are pending for want of finance closure. The leading power finance arm, Power Finance Company indicated that 40% of the sanctioned loans were disbursed in the last three years(Power Finance Corporation ,2015).
As per the literature review Availability of funds, Costs , Disbursement, and risks are the categories which affect Securing finance. Availability of funds is not a problem.PE investment in infrastructure is more frequently seen in developed countries as compared to developing countries. In developing countries, the number of sponsors is higher in projects with PE investment without any corresponding increase in project size. This indicates that PE investors role in developing countries is of risk sharing. Whereas in the developed countries, PE investment is a source of additional investment (Impact of private equity investments in infrastructure projects, Josephine Gemson, K.V. Gautami , A. Thillai Rajan,2012).

Supporting costs viz. environmental and social related costs are important. Different factors that affect setting up of a thermal power plant sometimes militate and they conduct the decision making process contrary to the environmental sensations. It is needed to look the picture with a financial point of view to understand the reasons of this. Nearly all of the decisions on type and administration of thermal power plants are made on gathering at the cost base in other words; at finance base. Therefore, it is needed to manage the factors affecting decision-making process for clearer electricity production, transform the supporting costs into investments that can create yields (An Overview of Financial Aspect for Thermal Power Plants, Soner Gokten,2012).

The role of various risks viz. Political, Country, Technology, Foreign exchange risks play a vital role in securing finance for the coal based power project. These factors play a key role in achieving the financial closure of the project(Development and project financing of private power projects in developing countries: a case study of India,Jyoti P Gupta and Anil K Sravat,1998,Infrastructure finance trends and challenges ahead ,Peter Tuving,2013).

The literature review indicates “Financial closure “is the major gap in securing finance. Further literature review was done in the category Financial closure and the details are available in Table 5.

Table 5 :Summary and research gap-Securing Finance:

Category	Author	Gap
Availability of funds	Josephine Gemson , K.V. Gautami , A. Thillai Rajan2012, Abu Naser-Chowdhury , Chotchai Charoenngam,2009	Demand side constraints by discoms and the factors t coal based supercritical power plants including externa government

	PWC 2012, European Commis-sion Director-ate-General for En-ergy.2011, World Bank ,2006,			n, Katharine Nawaal Grat-wick,2011		
			Risks	Jyoti P Gupta and Anil K Sra-vat,1998, Nancy Ati-mon,2006,	Role of Political and country risks, well structured cont in achieving financial closure of supercritical coal bas	
Costs	Soner Gok-ten,2012, Sandalk-han-Bakatjan, A.M.ASC E; Metin Stephen Pep-piatt,1995, Gordon V.Z. Beard,20 03, Director-ate of European commis-sion,1996, Mohit-Goyala,b, n, He-mantDu-jaria,c, Sarthak-Misra,201 2, KPMG-PMI,2012 ,Richard Abadie,P eter Ray-mond,201 3, Sebastian Mor-ris,1990	The supporting costs ,pre construction risks, cost and time over runs, change manage-ment costs and their role in achieving the financial closure of the projects		Victoria Svanik-ier,2008, Mario V. F. Pereira, Michael F. McCoy and Hyde M. Merrill,20 00, Montek Singh Ahlu-walia,200 9, Peter Tu-ving,2013, EfeUzezi Aza-ino,2012, Paul An-gouaa, Van Son Lai , Is-souf Sou-mar´,200 8, Shou Qing Wang,Ro bert L. K. Tiong,Me mber, ASCE,		
Disburse-ment	Mr. Jean-Michel Gauthier, 2011, McIsaac, Glenn,20 00, A.S,Baks hi,2007, Anton Eberhard	The challenges of structuring non-recourse financing for Indian merchant power projects , pre construction risks in setting up IPP and the impact of financial closure on the timely completion of the project		Sheng-Kong Ting,and David Ash-ley,1999		

2.4.1 .Financial closure:

For Greenfield projects, financial closure has been defined as "a legally binding commitment of equity holders and debt financiers to provide or mobilize funding for the project. Such funding must account for a significant part of the project cost which should not be less than 90 per cent of the total project cost securing the construction of the facility(Soucre:Reserve Bank of India).The major challenges in achieving finance closure of projects include contract terms,Delay in equity tie up,Dely in pre construction work(Sebastian Morris,1990).Equity tie up is a major cause for delays in achieving financial closure of power projects(J.Robert Branston,2002,Zhen-Yu Zhao , JianZuo ,n, GeorgeZillante,2013).Hence further literature review is done on the category "Equity tie up".Kindly refer to Table 6 for details.

Table 6 :Summary and research gap-Financial closure:

Category	Author	Gap
Financial closure	Westney Consulting Group, Inc. May 2007, Ministry of power ,2012, S.C.Mittal,2011, J.Robert Branston,2002, Zhen-Yu Zhao , JianZuo ,n, GeorgeZillante,2013, Sebastian Morris,1990, Ministry of Statistics and programme implementation,2013	The challenges faced by the developers without power sector back ground, challenges in bringing in an outside investor, the causes for delay , quantifying the estimated impact of cost and time over runs to achieve equity tie up for the coal based supercritical power projects causing delay in achieving finance closure

2.4.2 Equity tie up:

In obtaining equity tie up,the challenges include delay in the tie up of the project inputs and outputs, bankability of the project, Financial capability of the promoter and their impact on equity funding of coal based supercritical power projects in India (SandalkhanBakatjan, A.M.ASCE; MetinArikan; and Robert L. K. Tiong, M.ASCE,2003,Amol Phadke,2009). Kindly refer to Table 7 for details.

Table 7: Summary and research gap-Equity tie up:

Category	Author	Gap
Tie up of equity(Investor point of view)	Douglas Cumminga, Sofia Atiqahbinti Johan,2008, Douglas Cumming a, SimonaZambelli ,2013, Dr. K.C. Chakrabarty,2013, Joseph B. Oyedele,2014, Power Finance CorporationC,2012, Central Electricity Authority,2009, Deloite ,2012, India brand equity forum ,2013, SandalkhanBakatjan, A.M.ASCE; MetinArikan; and Robert L. K. Tiong, M.ASCE,2003, Amol Phadke,2009,	The last minute equity changes vis a vis pro rata with other shareholders without participating in upfront equity , Tie up of the project inputs and outputs, bankability of the project, Financial capability of the promoter and their impact on equity funding of coal based supercritical power projects in India and how it affects the equity tie up.
Tie up of equity(Promoter point of view)	Mr.Maheswari,2010, Emmanuel O Aideloje,2006, Animesh Pal,2013, Yunbi An, Keith Cheung,2000	The factors that affect new entrants (sponsors/developers) who have no prior experience in power sector viz. sectoral caps, group exposure limits, the techno commercial viability ,ROE and Exit strategy while tying up equity for Indian coal based supercritical power projects to achieve the equity tie up of coal based power projects.

The review of the above literatures indicate that the lack of timely equity tie up is the major challenge that affects the addition of coal based power generation capacities.

3.Findings:

It is evident from the above literature study that the major challenges to the addition of coal based power generation capacity addition in India include Coal availability,Land acquisition,Environmental clearance and securing finance. As securing finance emerged as the key challenge, further literature review was done on 'securing finance".Financial closure emerged as a key challenge.Upon further literature review on "Financial closure" ,the issues in obtaining equity tie up emerged as the major challenge.

This study has found that "Timely availability of equity tie up" affect coal based power capacity addition in India significantly. In order to facilitate Timely availability of equity tie up ,the Government needs to play a more active role in ensuring Indian coal availability,Power purchase agreements, Dispute resolution mechanisms, Land acquisition, Regulatory clearances and Transmission network.

There is no study done in India on the timely availability equity tie up post Finance restructuring package ,2012 and the Right to fair compensation and transparency in Land acquisition, Rehabilitation and Resettlement Bill,2013.Hence this can be an area of research in future.

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