# Coal and thermal power generation
# Background note for National Energy Policy 2015

Prayas (Energy Group)

## 1 Background

NITI Aayog is developing a National Energy Policy (NEP) for the Government of India. This policy document is expected to provide an overarching framework for the direction of India's energy sector for the near (2022) and medium (2030) term. As part of this process, NITI Aayog has invited Prayas (Energy Group) to provide inputs on coal and thermal power generation[1] based on stakeholder consultations. This background note is preparatory to such consultations being organized in Mumbai on October 19, 2015. These sectors are likely to remain important for the country in the short and medium terms, though the roles they play may undergo a change over time.

India is characterized by low levels of access to modern energy forms. According to the 2011 Census, about a third of India's households (80 million) did not have access to electricity and about 70% of households (170 million) did not use modern cooking fuels as their primary cooking source. India's per-capita consumption of modern energy – at less than 500 kg-oil-equivalent (kgoe) per-capita per-year – is less than a third of the global average of around 1,800 kgoe per-capita per-year. India's domestic reserves of conventional energy resources such as oil and gas are limited and these are reflected in rapidly growing imports with India's import dependence reaching about 33% in recent years.

India produced about 610 million tons (MT) of coal in 2014-15, with about 80% (494 MT) of this coal being produced by Coal India Ltd. (CIL). While domestic coal production in 2014-15 increased by about 8% compared to 2013-14, imports went up by about 30% from 167 MT in 2013-14 to about 218 MT in 2014-15[2]. The Government of India has announced ambitious targets to increase domestic coal production significantly in the coming years and hopes that India would produce about 1,500 MT coal by 2020. According to the "Determined scenario" of the India Energy Security Scenarios 2047 (IESS 2047) tool of the NITI Aayog, India would produce about 815 MT of coal in 2022 and 1039 MT of coal in 2032[3].

India has an installed thermal generation capacity of about 192 giga-watts (GW) as of August 31, 2015 of which about 168 GW is coal-fired and about 23 GW is gas-fired. Thermal generation capacity forms about 80% of India's installed capacity today and contributes about 83% of total generation[4]. Installed thermal capacity has grown rapidly from 92 GW in 2008 to about 192 GW in 2015. It is further expected to grow to about 285 GW by 2022 and 350 GW by 2032 according to the "Determined scenario" of IESS

[1] In this note, thermal generation is intended to mean coal- and gas-based generation. In particular, it does not include nuclear generation.
[2] These numbers do not include lignite. Data source: Ministry of Coal and Coal Controllers' Organization
[3] See www.indiaenergy.gov.in. These figures are for coal, i.e. without considering lignite. The determined scenario represents determined implementation of current policies.
[4] Data source: Central Electricity Authority

2047. The working group of the Ministry of Power for the 12th Five Year Plan also projected the addition of about 125 GW of thermal capacity by 2022 from a base of 132 GW in 2012.

While the sector has such ambitious plans for growth, it also faces multiple challenges. There are reports of significant 'stranded assets' in both coal- and gas-fired generation sectors. This is due to many reasons such as a shortage of fuel, contractual disputes and, perhaps most significantly, subdued demand[5]. There is considerable flux in the international market with the rapid growth of shale gas from the US, rapidly falling international coal prices and more recently, oil prices. In contrast, the discovered prices for coal-based generation have been steadily increasing in India while discovered prices of renewable based generation (with its variability) have been plummeting[6]. These factors call for a comprehensive re-assessment of India's energy costs, demand, supply options and hence requirement of coal and thermal capacity. While such detailed analysis is necessary, it is beyond the scope of the present exercise. Even in the most optimistic renewable capacity addition scenario, India is likely to require an augmentation of its coal production and thermal capacity and generation in the short and medium terms.

Given this assumption, there are some salient policy related issues in both these sectors that need to be addressed. The remaining sections lay out the issues for the short and medium terms for these sectors.

# 2 Coal

Ambitious targets as well as many significant reforms have been announced in the coal sector. However, these lead to other challenges and concerns that require policy responses. This section discusses policy relevant questions under three categories: enhancing domestic production; pricing and allocation; and governance and contract management.

## 2.1 Enhancing domestic production

The Government has plans to enhance coal production significantly in the coming years. It aims to do so through increasing production from CIL as well as from other sources such as captive mines and, perhaps, commercial mining by private sector miners. In this context, the following issues are important:

1. **Reserve estimation:** There is uncertainty about the exact extent of economically recoverable coal reserves in India using best available technology. India should expedite exploration of its coal bearing areas (while respecting natural constraints such as dense forests and rivers) to determine the useful coal reserves available for exploitation using internationally accepted methodologies and publish such information with GIS mapping to enable better policy formulation and planning.

2. **Productivity:** In all future coal production scenarios, CIL would almost surely remain a major player. Historically, CIL's productivity of human resources as well as HEMM has been quite low. How can CIL address this issue? Can one consider a scheme where the bulk of any extra revenues from such

[5] This demand represents the demand for power from consumers with access to reasonably reliable power supply and to the extent that they can afford. It does not account for latent or unmet demand.
[6] Recent power procurements have discovered prices of around Rs 5/kWh for both coal-based and solar power.

increased productivity are shared between CIL and its employees (rather than being shared with the Government as dividend)?

3. **Model of private participation:** The current discourse regarding private participation in the coal sector seems to be veering towards either captive coal generation in an end-use plant or commercial mining. There are many arguments such as sub-optimally sized blocks and insufficient mining expertise among end-users against captive mining as an approach. Thus, if commercial mining is to be an option in the future, what checks and balances are required to ensure that a genuinely competitive market emerges in the coal mining space? For example, it would require genuine 'unbundling' of coal mining from washing, transportation and end-use. It would also require transparent and well-defined ways of price discovery, contract management and dispute resolution.

   Another option for India to consider is a 'case II' or UMPP like bidding model for the power sector which is likely to be the largest consumer of coal even by 2030. This will help to keep electricity tariffs low in a country with severe access and affordability constraints, even if this may result in forgoing revenues (and may suffer some of the same problems as captive coal blocks).

## 2.2 Pricing and allocation

Currently, allocation of coal through linkages is controlled by the Government, while allocation for captive consumption is partially controlled by the Government (for allotments) and partially through an auctioning process[7]. Pricing of coal commercially sold is determined by CIL. However, with the changing dynamics of the coal and energy sectors, there is perhaps a need to revisit these. The Government is currently considering a process of auctioning coal linkages as a means of allocating linkage-coal. The following issues need further consideration in this context:

1. **Market structure:** In a future situation where there may be multiple coal producers, what should the coal market structure be, and how would prices of coal be determined in such markets? Should there be separate markets (and hence prices) for different end-use sectors?

2. **Role of CIL:** What role would CIL play in such a market structure, given that it is likely to be a major player in any future scenario? Would it just be another (major) market participant or would it be a 'supplier of last resort'?

3. **Pricing and allocation:** How should coal be priced in such a market? Should prices be determined by a coal sector regulator – perhaps by end-use? Will such a regulator then also be responsible for allocation within sectors, based on policy guidelines from the central government? Or should allocation and pricing be left to markets, while the regulator oversees market operations and ensures competitive efficiency? Should there be separate markets by end-use?

[7] It should be noted that even in the auction process, the actual end-user of coal from a block may be quite different from the block winner due to the possibility of "arrangements" and "diversions" that is provided for.

4. **Underground coal:** Since it is expected that over time, the share of coal mined from underground mines would gradually increase as India exhausts its easily accessible reserves, how should pricing factor in the different costs of extraction from underground and opencast mines?

## 2.3 Governance and contract management

In the past, the coal sector has faced serious problems regarding governance of the sector and enforcing contracts. Examples include the problems around allocation of coal (through captive blocks or linkages) and the strictures passed against CIL by the Competition Commission of India regarding its adherence to supplying the agreed quantity and quality of coal. In light of ongoing disputes related to coal supply contracts, and the possibility of increased production and likely changes to the market structure, these questions become more critical. Some questions in this regard are as follows:

1. **Regulation:** There has been some discussion around an independent regulator for the coal sector, but there has not been much progress regarding the issue. Should the coal sector have such a regulator? If so, the structure, empowerment, roles, responsibilities and accountability of the regulator should be devised based on lessons learnt from other energy sector regulation exercises such as the power and natural gas sectors[8]. Moreover, such a regulator's regulations and functions should dovetail with the regulations and functions of the power sector regulators.

2. **Policies and contracts:** Policies such as the New Coal Distribution Policy and contractual arrangements such as the Fuel Supply Agreement have their own weaknesses. These should be revised to become less ambiguous, more balanced and provide a level playing field for all market participants. A uniform contract structure for all coal suppliers in a future scenario with commercial miners may also be considered.

3. **Role of coal:** The role of coal in the energy sector will almost surely undergo significant change in the near to medium term due to economic and environmental reasons. Therefore, there is a need to realistically reassess the role of coal in the Indian energy basket, beginning with more realistic demand estimation under different price and technology trajectories. This should then guide future investment decisions to avoid a lock-in that may not be fruitful. Mining lease structures and fuel supply contracts should perhaps be revisited to make their durations shorter and/or more flexible.

# 3 Thermal generation

Coal based thermal generation is critical to meet base load. It will also be a critical component of the Government's plan to provide 'Power for All' by 2019. Natural gas is the second most used fossil fuel in power generation and fuels about 10 percent of India's installed capacity. However, since India only owns about 0.7% of natural gas reserves[9] and given the limited exploration of its sedimentary basin thus

[8] While independent regulation of the power sector has been a mixed success, it is generally not perceived to be very successful in the downstream natural gas sector.
[9] BP world energy statistics, 2015

far, India imports a significant amount of its natural gas requirement. Between the years 2006-07 and 2013-14, natural gas imports have grown at the rate of about 12.5% per annum. As a result, the net import bill for natural gas has increased by about 41% every year in the same duration[10]. Given the uncertainty of domestic gas production and availability, increased dependence on natural gas for electricity production is likely to put pressure on balance of payments as well exposing the sector to fuel supply uncertainties and hence an unsuitable option, at least in the short and medium term future. This perhaps is also the reason why most of the upcoming thermal capacity is coal based.

Generation cost is one of the most crucial parameters that accounts for more than 70% of the cost of electricity supply. Many of the newly commissioned thermal generating plants have high tariffs and face the danger of being backed down as per merit order despatch. The CEA published load and generation balancing report anticipates 19 states to have 'surplus' energy in the year 2015-16 alone. Further, power sector utilities are under severe financial distress with the accumulated losses of distribution companies being estimated at Rs.2.5 lakh crores. Such high and rapidly increasing financial losses have a debilitating effect on the sector, posing a serious threat to not just the sector, but economy at large, and will be a strong deterrent to higher uptake of new thermal capacity. Without major changes towards scientific demand estimation, capacity addition planning and market based instruments; many states could end up with high cost surplus power[11] and no buyers, and simultaneously huge unmet and latent demand. As against a target of 63 GW of thermal capacity addition in the 12$^{th}$ five year plan, 53 GW have already been added by 2014-15 and 20 GW is in the pipeline for 2015-16. Thus, the issue facing the thermal generation sector, in the short term (2022), is less of availability and more of affordability. Given this background and current state of affairs, we feel following are the most important issues which need to be debated in the thermal generation policy context.

## 3.1 Capacity addition planning

With the carriage and content separation being proposed under the amendments to the Electricity Act and strong policy push for renewables[12], the issue of need and demand for thermal capacity has become an increasingly complex issue. In this context, following factors need to be considered.

1. **Role of thermal generation:** Given the above background and flux in fuel sector, it becomes necessary to have a clear policy vision regarding what role we envisage for (coal based) thermal generation in the short and medium term.

2. **Possibility of lock-in:** If large investments are made in thermal generation, there will be a lock-in of such investments in the medium term. In this regard:

[10] Table I.4, Pg. 10, Indian Petroleum & Natural Gas Statistics 2013-14, MoPNG

[11] Distribution utilities routinely curtail demand by either shedding load and/or managing agriculture demand. Based on revenue considerations, these companies can choose to not supply power to certain areas or category of consumers. Presently, there is no accountability mechanism to regulate and monitor actual supply hours and hence the utilities can claim to be surplus and also undertake load shedding simultaneously, without facing any regulatory action.

[12] There is already a plan and policy commitment to have 175 GW of renewable energy based capacity by 2022. Additionally, as per India's Intended Nationally Determined Contribution submitted to UNFCCC, 40% of India's installed capacity in 2030 is going to be from non-fossil fuel based energy sources.

a. Would it be more prudent to first maximally utilise all the stranded capacity and to allow further capacity addition only after this has been achieved?
b. What contracting and bidding mechanisms can be used to factor in the costs and risks of lock-in?

3. **Managing variability and peak demand:** Given that hydro and gas based thermal generation, the standard choices for peak management, are unlikely to takeoff in the near future, the issue of managing variability and peak demand becomes critical. It will be further accentuated if the ambitious renewable energy capacity addition targets are met. If coal based thermal generation is to be utilized for this purpose, how should it be priced?

4. **Market determined capacity addition:** The changing nature of power sector, evolving market structure coupled with technology advancements and rapid changes in prices of renewables and storage systems, make the traditional CEA approach of demand forecast obsolete and unreliable. While CEA can continue to make broad estimates about overall demand and supply requirements, the distribution utilities should be strongly discouraged from relying on such estimates alone for contracting long term supply. With increased open access and carriage and content separation, the following approach can be considered for capacity addition:
    a. New thermal capacity addition should be determined by market forces, based on the demand for such capacity from the open access eligible consumers. Thus, open access eligible consumers and the new supply licensees should be the primary procurers of any new thermal capacity and their demand should be the primary factor to determine the need and extent of such capacity addition.
    b. Existing thermal capacity should be reserved for the existing distribution utilities, to the extent needed for meeting the demand of their regulated, small consumers (LT agriculture and small domestic), as even in a market based distribution sector, these consumers are unlikely to find alternate suppliers. In addition to this, coal blocks should be allocated to the states that do not have sufficient generation capacity to meet their present and future LT demand for the fulfillment of the national target of '24 x 7 Power for All'. Such blocks can be used to procure power through case-2 or UMPP like bidding.
    c. To the extent that thermal capacity addition is undertaken for meeting peak demand, fulfillment of responsibilities as supplier of last resort and/or grid stability and management purposes, such capacity should be priced accordingly and the burden of the same should not fall on the small-regulated and/or newly electrified consumers.

The proposed policy framework should factor in the above concerns and formulate supply options that are sensitive to these factors.

## 3.2 Efficiency and performance

As per CEA data, more than 32,000 MW of existing coal and gas-based capacity is older than 25 years and needs to be phased out. Further, most of the state owned thermal generating stations tend to have low plant load factors and high station heat rates, which leads to inefficient fuel utilisation and increased

per unit costs,. As efficiency improvement is a lower cost alternative to building new capacity, it should be explored as the first option. In this context the following can be considered:

1. Renovation and modernization of existing thermal capacity to improve operational efficiency and reduce emissions.

2. Better regulatory mechanisms for improving efficiency and reducing emissions:
    a. Uniform approach for fuel cost pass through based on normative parameters for heat rates, auxiliary consumption, etc. for all the regulated capacity. Existing capacity regulated under section 62 presently does not follow this approach. Complete pass through of fuel costs based on simply the audited actuals eliminates need for generators to seek proper enforcement of fuel contracts or improve their own plants' efficiencies, thus perpetuating fuel sector inefficiencies. In addition to increasing costs, this practice has adverse implications for thermal efficiency and emissions.
    b. Benchmarking of fixed and variable costs for a given unit size, technology, cooling system, normative heat rate etc. so as to promote least cost generation.

# 4 Social and environmental concerns

Coal mining is an inherently unsafe and hazardous industry and also has other social and environmental implications due to displacement, pollution (and associated impacts), deforestation etc. Historically, India's record in both these aspects – labour safety and environmental management – has not been very good[13]. If coal production in the country has to increase significantly accompanied by a change in the market structure, there is an urgent need to address these issues to promote equitable and sustainable development. Thermal generation also requires significant amount of land and water and causes human displacement and environmental pollution. Therefore, while planning for thermal capacity addition, it is of utmost importance to reduce and minimize these impacts to the extent possible. In this regard, following issues need to considered:

1. **Labour safety:** The share of contract labour has been increasing within the coal sector labour force. There has also been an increase in fatalities in the coal sector in the recent years. Given the plans to rapidly increase coal production, the issues of general safety and welfare of the labour force should gain greater prominence. What policy and regulatory measures can help to improve the safety of workers in the coal sector? Can the Directorate General of Mine Safety be made more effective or should other means – such as bringing it under the purview of the coal ministry or regulator – be thought about? How can India learn from international best practices in this regard?

2. **Air and water issues:** Coal mining and transportation results in significant particulate pollution. It could also affect local water tables. Coal-fired power generation results in air and water pollution

[13] Please see the background paper available at http://prayaspune.org/peg/publications/item/289-exploring-options-for-the-indian-coal-sector.html for more details on these and other challenges faced by the Indian coal sector.

through the chimney stack as well as ash disposal. Coal-fired power generation is also quite water intensive. While the Government has proposed new norms for emissions from power plants and for water consumption for coal-fired power generation, the current state of air and water pollution near coal mines and coal-fired power plants is very poor, suggesting a need to strengthen mechanisms and policies to mitigate the social and environmental impacts of coal mining. Some measures are suggested below:

a. It is understood that India's air and water quality norms are considerably weaker than similar WHO norms. India should tighten its norms to match world's best practices.
b. State Pollution Control Boards (SPCBs), which are responsible for monitoring and ensuring compliance to environmental management plans, should regularly publish environmental management plans, compliance reports (submitted by the industry) and inspection reports.
c. Air and water pollution levels, as well as other indicators such as ground water levels and land productivity should be monitored and published on a real-time basis in an easily accessible form on SPCB websites. MoEFCC could commission occasional third party studies to ground-truth SPCB readings and industry submissions.
d. Local citizens – most affected by the pollution – could be made partners in measuring pollution levels by training them and providing them with simple gadgets that can indicate air and water pollution levels that are above permissible levels.
e. MoEFCC has proposed stringent new norms for water consumption in coal-fired generation. In addition, India should explore and encourage ways of further reducing water use for power generation through measures such as dry cooling.

3. **Project siting**: Most the existing and proposed coal based thermal capacity addition is concentrated in few areas, which are already critically polluted and/or water-stressed[14]. Such concentration of thermal capacity is not desirable from social, environmental and even from grid stability points of view. Siting of thermal generation capacity and environmental clearances for them should be constrained by cumulative carrying capacity and cumulative impact assessments.

4. **Preventing resource lock-in:** Currently, the various steps required for setting up a thermal generation project or coal mine, such as land acquisition, fuel and water linkages, and environment and forest clearances happen in parallel with the project construction and are only loosely inter-linked. However, failure or inordinate delays on any of these fronts can result in the project getting stranded and locking-in crucial resources. Examples include the captive coal blocks that never materialized or stranded power generation capacity. To avoid this, there is an urgent need for a coordination framework that can weed out unviable projects early and unlock these resources to create a level playing field.

[14] Please see Prayas report titled 'Thermal Power Plants on The Anvil: Implications And Need For Rationalisation' http://prayaspune.org/peg/publications/item/164.html for more details.

5. **Minimising local impacts:** Projects with very high social and environmental impacts, or projects that do not have broad local acceptance, and projects leading to a sub-optimal use of transmission, fuel, land and water should be put on hold till all other options are exhausted. For example, brown field capacity addition should be preferred to green field, subject to the cumulative carrying capacity assessment for the location and other such factors. Only after exhausting all such brownfield capacity, should the option of green field projects be considered.

# 5 Coal and power sector linkages

Given the close connection between the coal and power sectors, policies in these two sectors also need to go hand-in-hand. Unfortunately, that has not generally been the case so far. For example, the initial rounds of bidding for power procurement discovered seemingly competitive tariffs. However, inconsistent understanding, interpretation and implementation of coal sector policies and contracts have resulted in many projects seeking a revision of discovered tariffs.

In light of this, the bidding framework for thermal power procurement has been modified to make fuel cost entirely a pass through element. However, such an approach goes against a competitive market since fuel costs can account for a major part of generation cost and making it a pass through eliminates possibility of efficiency gains in this important area. It also goes against India's stated goal of improving efficiency of its power generation as stated in its Intended Nationally Determined Contribution (INDC), as such a framework eliminates the incentive to reduce coal consumption in power generation. Instead, coal sector and power sector policies should be developed in an integrated manner to facilitate competitive discovery of generation tariffs. The case-II bidding approach discussed earlier in the coal section could be one such mechanism. End-to-end completely competitive markets could be another mechanism, though setting up such competitive markets along the value chain requires careful policy, regulatory and contractual design and oversight.

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