POLICY BRIEF MARCH 2011

The Energy and Resources Institute

India's coal reserves are vastly overstated: is anyone listening?

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Prepared by
R K Batra and S K Chand

The Energy and Resources Institute
Darbari Seth Block, IHC Complex,
Lodhi Road, New Delhi- 110 003

Tel. 2468 2100 or 4150 4900
Fax. 2468 2144 or 2468 2145
India +91 Delhi (0) 11

www.teriin.org

Introduction

In India's energy sector, coal accounts for over 50% of primary commercial energy supply. With the economy poised to grow at the rate of 8–10% per annum, energy requirements will also rise at a level of 6% (approx.). Coal will continue to be a dominant commercial fuel two decades from now and beyond, despite our nuclear energy programme, development of natural gas supplies, increased hydropower generation, and emphasis on renewables.

There are many issues with regard to domestic coal production, including its quality, beneficiation of lower grades, transportation to distant consumers, environment impacts (both in mining and burning of coal), efficiency of thermal power plants, and so on. This policy brief, however, focuses on our domestic coal inventories. In other words, how much coal is there underground, how much of it can be extracted, how much do we need to import, and what are the associated energy security implications? India is already considerably short of coking coal for steel plants. **Table 1** depicts the projected production, demand and import of coal for 2011–12.

This brief deals exclusively with thermal coal that is used in power plants and other industries. It demolishes the myth held

Table 1 Mid-term appraisal by the Planning Commission for 2011–12

Coal production (MT)		Coal demand (MT)		Imports (MT)
CIL	486	Steel plants (coking coal)	68	
SCCL	47	Power utilities	473	
Captive mines	81	Captive power plants	47	
Others	16	Others	125	
TOTAL	629		713	*83

* Includes 42 MT of coking coal. Latest estimates by the Coal Ministry project imports rising from 83 MT to 142 MT due to lower production.

CIL: Coal India Ltd.

SCCL: Singareni Colleries Company Ltd.

by many that India has coal in plenty. In reality, the situation is just the opposite. **The coal that can be extracted—taking into account geological, technical, and economic aspects - is only a small fraction of our total coal inventories, without taking into account no-go areas where coal mining may not be permitted.**

Context and importance of the problem

India computes its coal inventory on the basis of the Indian Standard Procedure (ISP) code that dates back to 1956. It is essentially a geological classification system, where the parameters are based primarily on spacing of boreholes. The techno-economic parameters are very few, and to a great extent subjective such as amenability to beneficiation, thickness and depth of coal seams. Based on this system, India's inventory of coal resources has been estimated at 267.21 billion tonnes (as on 1 April 2009). Of this, 39.6% has been categorized as proved, with detailed exploration having been carried out in selected blocks and where the boreholes are less than 400 m apart. Indicated resources stand at 46.2%, while inferred resources are at 14.2%, based on regional and promotional exploration where the boreholes are normally placed 1–2 km apart. This assessment by the Geological Survey of India includes coal that is inaccessible because it lies in protected areas or beneath forests, villages, towns or water bodies, and even includes coal that has been extracted and burnt during the past 200 years (estimated at about 10 billion tonnes). It also includes coal at a depth of 1200 m, whereas mining of coal, either currently or in the near future, is not likely to go beyond 300 m. **It is this extremely high figure of 267.21 billion tonnes that has created a false and risky notion that India is quite comfortably placed with over 100 years of domestic coal supply at its disposal.**

How much coal is extractable?

What is of critical importance is not the total inventory of coal but how much of that coal is technically feasible to extract and can be economically mined. If the coal that exists cannot be reached or cannot be technically or legally mined, then obviously that coal is not available. Similarly, if coal can be mined, but the cost of mining is such that consumers are not prepared to pay the corresponding high price, then again the coal should be considered as 'not available'. Various estimates have been made of how much coal can be extracted from the total coal resources. These are referred to as extractable reserves (see **Figure 1**).

However, these reserves have essentially been calculated using various thumb rules. (For example, the basis used in the Integrated Energy Policy document of 2006 is provided in **Box 1)**.

BOX 1 THE CALCULATION OF EXTRACTABLE COAL RESERVES

Extractable coal from proved reserves has been calculated by considering 90% of geological reserve as mineable, and dividing mineable reserve by the reserve-to-production ratio. Extractable coal from prognosticated reserves has been arrived at by taking 70% of indicated and 40% of inferred reserve as mineable, and dividing the mineable reserve by the R:P ratio (*different ratios for CIL and non-CIL blocks have been applied*).

While the 'resources' are coal *in situ* and all of it would never be extractable, 'reserves' are a subset of 'resources' that would be available for extraction at the present status of economics and technology. **Thus, a coal reserve is the technically feasible and economically mineable part of the measured or indicated resource at the time of reporting.**

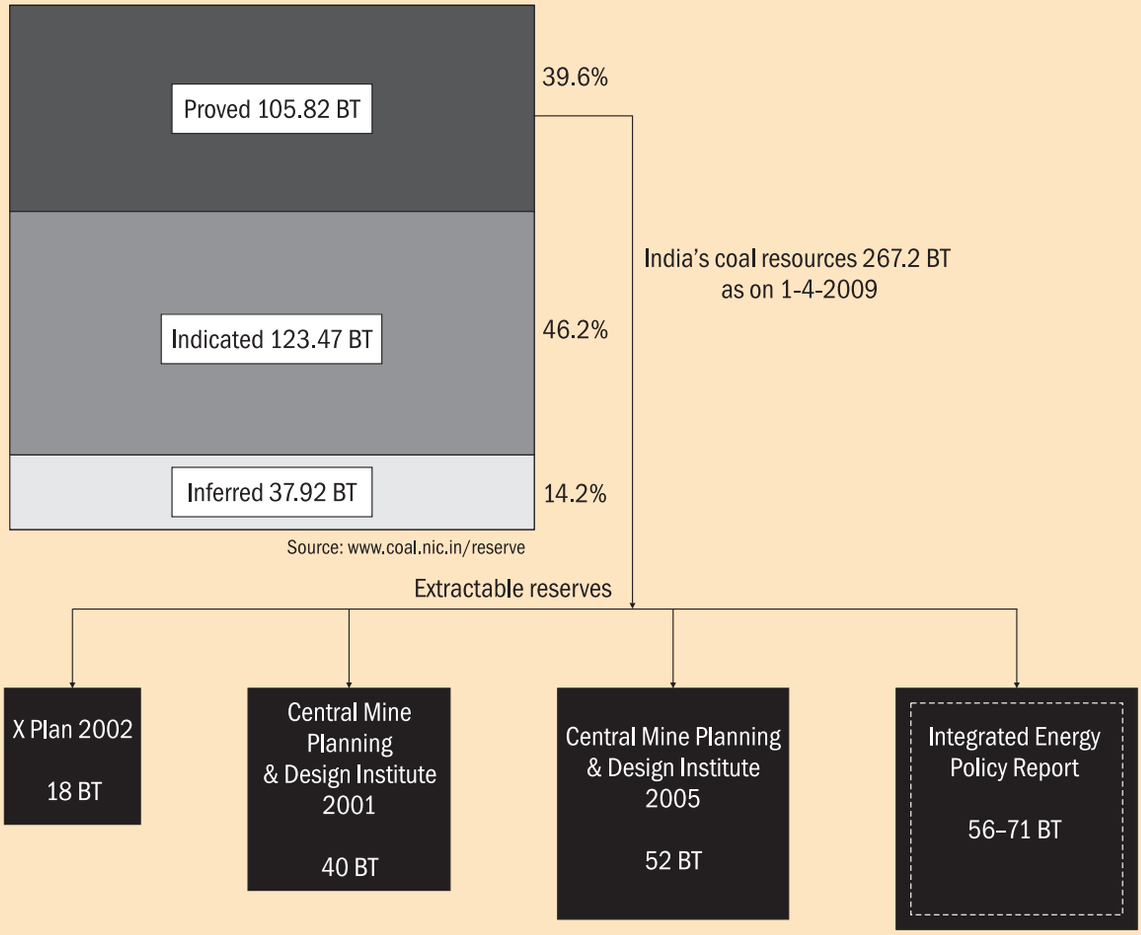
Box 2 contains excerpts from two Planning Commission documents on India's coal reserves and production.

[Note: The words 'resources' and 'reserves' are used interchangeably causing unnecessary confusion and contradictions in some places.]

CIL's extractable reserves under the lens

Coal India Ltd (CIL) is the largest producer of coal in India with a 77% share in national coal production. In its 2010 Red Herring Prospectus (RHP) for its Initial Public Offering (IPO), it had projected certain numbers of its reserves. These are examined in detail in **Figure 2** which is drawn to the same scale

Figure 1 India's domestic coal resources and estimated extractable reserves



BOX 2 RESERVES AND PRODUCTION

- Proved reserves of coal at the current level of consumption can last for about 80 years. If all the inferred reserves also materialize, then coal and lignite can last for over 140 years at the current rate of extraction.
- At a growth rate of 5% in domestic production, currently total extractable coal resources (including proven, indicated, and inferred) will be exhausted in about 45 years.
- **Large estimates of total coal resources give a false sense of security because current and foreseeable technologies convert only a small fraction of the total resource into the mineable category.**

(*Excerpts from the Integrated Energy Policy Report of the Planning Commission 2006*)

- Against the scheduled time frame of 210 days and 150 days respectively, it takes nearly 2–6 years normally to obtain environmental and forest clearances.
- Out of 208 captive blocks allotted, only 26 such blocks have started coal production.
- Out of 17,300 sq. km of potential coal-bearing area, 11,865 sq. km area has been covered by regional/promotional exploration. An area of 2791 sq. km is planned to be covered under regional/promotional exploration during the Eleventh Plan.
- **Availability of coal will be a critical constraint on the development of coal-based power plants in the Eleventh Plan. It will become much more intense in the Twelfth Plan when the projected gap between demand and supply is likely to go up by 200 MT.**

(*Excerpts from the Mid-term appraisal of the Planning Commission 2010*)

Figure 2 CIL's total and extractable coal reserves

as **Figure 1**. CIL claims a total reserves of 64.79 billion tonnes (BT), of which mining studies have been carried out for 30.36 BT and the extractable coal assessed at 21.80 BT. This can be further divided under the heads of coking and non-coking coal, with the latter further sub-divided for power and non-power use, based on the current all-India allocation. As is apparent from the flow chart, CIL's extractable coal reserves for the power sector reduces to 14.78 BT.

Considering the heavy investments required, coal-based thermal power plants need an assured supply over the plant's life (CIL has entered into a Fuel Supply Agreement with India's biggest power utility NTPC for 20 years). It is estimated that a 2000 MW plant requires 10 million tonnes (MT) of coal annually, or 200 MT over 20 years. Therefore, CIL's coal reserves for the power sector of 14.78 BT can be committed to feed approximately 148,000 MW of generating capacity, against which it is already meeting around 67,000 MW, leaving a balance of 81,000 MW. In the Twelfth Plan (starting 2013) 74,000 MW coal-based capacity is planned for which long term commitments will need to be made shortly. CIL's ability to make substantial coal supply commitments for the Twelfth Plan will depend on the reliability of its extractable coal estimates.

At current levels of production CIL's extractable reserves will be exhausted in 45 years. This may seem to be a very comfortable situation and should enable CIL to meet increasing demand despite some limitations by way of 'no go' areas. However, according to an Infraline News Team report, the Central Electricity Authority (CEA) had told the power ministry in Jan 2011 that CIL would be unable to make coal available to new power plants commissioned after 2010, which seriously questions the authenticity of CIL's reserves.

CIL, under the section on Risk Factors in its RHP, has stated 'we have historically followed the ISP guidelines for our resources based estimation, and intend to continue to follow the ISP guidelines for such reserve based estimation'. The question, therefore, arises as to how reliable are these estimates of CIL which can be considered as a proxy for the reliability of extractable reserves for all the producers in the country? (SCCL, the second highest coal producer in the country after CIL at 47 MT/annum, has stated on its website that it has 'whopping reserves of 8791 MT'. However, the actual amount of extractable reserves is not mentioned). For this, we need to turn to the United Nations Framework Classification (UNFC of 1997) for fossil energy and mineral reserves and resources.

An internationally accepted three-dimensional classification system

The UNFC is a universally applicable scheme for classifying mineral resources and reserves. The total estimated resources are categorized using the

following three essential criteria that affect their recoverability.

- Economic and commercial viability (E);
- Field project status and feasibility (F); and
- Geological knowledge (G).

The three criteria are visualized in three dimensions in **Figure 3**.

Figure 3 Principal elements of the UNFC

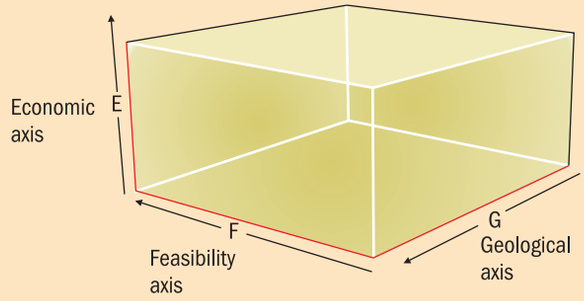
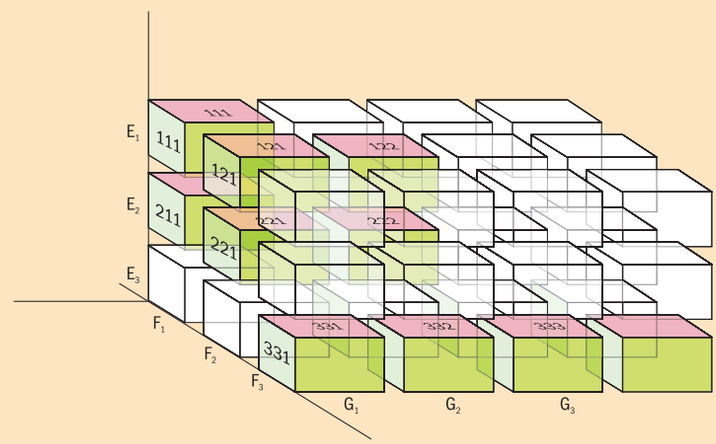


Figure 4 represents an expanded three-dimensional layout showing the codified classes and categories that are applicable to the resources.

Figure 4 UNFC, as applied to coal



Numbers are used to designate the different classes. For example, 'number 1' refers to the highest degree of economic viability on the E-axis, the most advanced project status on the F-axis, and the highest quality assessment on the G-axis.

Class 111 is of prime interest to an investor. It is referred to as a **'proved mineral reserve'**, which stands for the economically mineable part of a recoverable quantity assessed by a feasibility study or actual mining activity usually undertaken in areas of detailed exploration.

'Probable mineral reserves' are coded as 121 (where a pre-feasibility study has been carried out instead of a feasibility study) and 122 (where, apart from a pre-feasibility study, only general exploration has been conducted).

All other categories are treated as remaining **resources** (but not reserves) under various codes such as 211, 322, and so on.

The UNFC and India

In May 2001, the government of India took a decision in favour of doing away with the ISP and implementing the UNFC classification for minerals instead. The responsibility was given to the Geological Survey of India/CMPDI for coal and lignite. A decade later, there is no information available on the extent to which this more objective method of calculating reserves is being implemented. However, the UNFC system has been studied for four other minerals, namely, copper, lead-zinc, chromite, and rock phosphate. As on 1 April 2000, large parts of hitherto reported 'reserves', as per the ISP were relegated to 'resource' under the UNFC. It is, therefore, quite possible that under the UNFC system, part of the Indian coal reserves will reduce even further and be more objectively assessed.

In 2003/04, in a paper by Dr K K Chatterjee the then Chief Mineral Economist of the Indian Bureau of Mines he had observed that **"The impact of the changeover from Indian to UNFC system on the national mineral inventory is expected to be downward and very significant. This is expected to serve not only to project a more realistic picture of India's mineral resources, but also, in some cases, to rouse the planners from a sense of complacency".**

CIL, in its RHP, stated, 'Extractable Coal Reserves is the term we use to indicate the portion

of a resource for which extraction is established to be technically and economically feasible through mine studies (mine planning and feasibility studies)'. Whether the parameters are identical to that of the UNFC is not known. Nonetheless, the limited extractable reserves of CIL could be further impacted, depending on the extent to which 'go' and 'no go' areas have been or need to be factored in, especially because approximately 30% of its planned production during 2011–12 will originate from new projects.

[Note: the UNFC classification of 1997 has been regularly updated over the years and harmonized with other national codes. The 2009 version has been simplified and made generic and user-friendly. It has replaced the various classes by those more relevant to the extraction of minerals such as Commercial projects, Potentially commercial projects, Non-commercial projects and so on. But, as will be seen from the above, since there has been no visible progress in this matter, discussion in this policy brief has been confined to the UNFC 1997 classification].

Coal imports and its energy security implications (See Box 3)

The quantities required under different scenarios vis-à-vis current internationally traded volumes as projected by the IEP report are significant. If our coal production gets further curtailed due to paucity of reserves, then the need for imports increases correspondingly. In recent years, several countries (such as Germany, UK, Poland) have downgraded their reserve base, with overall world reserves of coal having reduced from 10,000 BT to 4,200 BT over 25 years (till 2007). The ability to import large quantities of coal is therefore getting increasingly restricted, and thereby impacting our energy security. This is being mitigated to some extent by the acquisition of coal mines abroad. Nonetheless, coal security needs to be given the same—if not higher—importance as oil security, as the sources of imported coal, are limited to just three or four countries, unlike oil. Also large imports by China will tighten supplies and prices.

BOX 3 IMPORTS

- At a modest growth rate of production of 5.5%..... the production of coal and lignite by 2031–32 will be around 1400 MT. Coal India Ltd. has targeted a maximum production of 839 MT by 2025 in its 'Vision 2025' document.
- Under the various scenarios, coal requirement for 2031–32 is projected from a low of 1580 MT to high of 2555 MT. A mere 5% deterioration in quality over the next 25 years would raise the coal requirement to 2689 MT.
- High quality coal (6000 kcal/kg) import needs could range from 120 MT to 770 MT by 2031–32. However, currently only about 700–800 MT of coal is being internationally traded.

(Excerpts from the Integrated Energy Policy Report of the Planning Commission 2006)

Observations and recommendations

In the Integrated Energy Policy report of 2006 and the mid-term appraisal by the Planning Commission (2010), various recommendations have been made to increase domestic coal production (these are listed in **Box 4**).

Many of these recommendations have not or may not be implemented, which makes the existing situation even more precarious. No mention has been made in these documents of the decision taken 10 years ago to switch over to the UNFC system of resource/reserve estimation, but has been reiterated in the Mineral Policy and Regulation document of 2008. Not just CIL, but all coal producers should adopt the UNFC system as quickly as possible. Failure to do so is to shut one's eyes to what may turn out to be a grim reality—**India does not have adequate extractable coal reserves required either to meet current incremental demand or to make long term supply commitments. If we remain in a state of denial, we will not take the urgent and necessary steps to augment these reserves.** But, is anyone listening?

BOX 4 OBSERVATIONS AND RECOMMENDATIONS

- Covering all coal-bearing areas with comprehensive regional and detailed drilling could bring about a significant difference to the estimated life of India's coal reserves. **The problem with coal remains as finding a way to raise the proportion of extractable reserves.**
- Detailed coal exploration is almost exclusively done by CMPDIL, which is a subsidiary of CIL. Its drilling capacity is limited. CMPDIL should be made an autonomous body.
- Driven by short-run maximization of economic benefits, if coal is mined in an opencast mine only to the depth of 150 m, and the overburden is used to fill up the void, coal lying in the lower horizon and reserves below 150 m depth in the same horizon will then get practically sterilized.
- **A large part of India's coal reserves may not be extractable with current mining technologies.**
- Clearly, a massive effort is needed to expand domestic coal production. Given that, at present, coal mines take eight years to develop and Coal India suffers from several problems, it is doubtful that Coal India can meet this need.
- Similar to exploration for petroleum, exploration for coal should also be opened up.

(*Excerpts from the Integrated Energy Policy Report of the Planning Commission 2006*)

- The drilling capacity of the Central Mine Planning and Design Institute Limited (CMPDIL) is envisaged to be increased to 0.4 million metres from the existing 0.2 million metres.
- The existing guidelines of the Ministry of Environment and Forests permit only 1–1.5 boreholes/sq. km in forest areas without the need for seeking forestry clearance by the drilling agencies. However, this needs to be increased to at least 15–20 boreholes/sq.km.
- The current economic mining practices are generally limited to a depth of 300 m, and about 40% of the reserves of the country are beyond this depth. Mining of coal under such depths has to be conducted through underground mining operations.
- Coal production from underground mines has either stagnated or has declined, despite significant investments. The proposal to increase the borehole density is to enhance the level of proved coal reserves, so that underground mining share can be progressively enhanced.
- After adjusting for calorific value, domestic coal is underpriced. There is a need to bring coal prices into alignment with international prices after adjusting for calorific value.
- The present nationalization of the coal sector needs to be reconsidered in order to open up new coal mines for private sector exploitation beyond the captive use.

(*Excerpts from the mid-term appraisal of the Planning Commission 2010*)

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http://www.infraline.com/newsearch.asp ?

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Please write to:

Mr R K Batra
Distinguished Fellow
Director-General's Office
Centre For Research on Energy Security
Email: rkbatra@teri.res.in

Mr S K Chand
Senior Fellow
Resources, Regulation & Global Security
Energy Regulation and Practice
Email: skchand@teri.res.in

The Energy and Resources Institute (TERI)
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi- 110003

Tel: 24682100 or 41504900
Fax: 24682144 or 24682145
Web: www.teriin.org