Developing better policies for the sustainable development of the Indian Coal Sector

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Coal accounts for about 70% of total electricity generation in India and is likely to remain a key energy source for at least the next 30-40 years. A significant growth in India's coal use is predicted in consonance with the country's continued development. Such an increase must occur through (and, indeed, is dependent upon) environmentally and socially sustainable development of this sector. The main challenges to such a transition pertain to a) high demand for coal in the power sector, which would speed up coal exploration and extraction, and b) current and past socio-environmental concerns. Areas that need particular attention include: a) managing the demand for coal, b) strengthening data collection and analysis (especially coal reserve estimates), c) developing a technology and policy roadmap for efficient extraction, along with a visioning exercise, and d) better resettlement & rehabilitation and environmental impact assessment policies.

Introduction

Electric power is critical for almost all modern economic activities, as well as for broader human development. The availability of electricity in India, however, lags far behind industrialized and even many industrializing countries: the per-capita electricity consumption in the country was only 480 kWh in 2005, which was just over one-quarter that of China and just over one-twentieth that of the OECD average (IEA, 2007). Also, India has long suffered from an insufficient supply of electricity in relation to the demand – in 2005, the total shortage of power was estimated to be 6-8%, and the peak shortages were as high as 11-12% (Ministry of Power, 2006). The quality of power supply in the country is also very poor, with unstable voltages and routine frequency excursions. In fact, the lack of adequate and reliable supply of power is often viewed as a critical constraint to industrial development.

Coal use currently accounts for more than 50% of total primary commercial energy consumption in the country and for about 70% of total electricity generation. It 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 existing installed base of coal-based electricity capacity, although recent experiences have thrown into sharp relief the uncertainties and concerns regarding the adequacy of coal supplies to satisfy the growing hunger for power.

While there are a number of daunting issues that need to be addressed as India attempts to increase coal supply to meet its growing energy needs, perhaps none present as much of a hurdle as the environmental and social challenges resulting from mining of coal. Sustainable development of the Indian coal sector will require developing the ability to sustain the increased production of coal in the country, and to do so in an environmentally and socially acceptable manner. It is with this perspective that this paper briefly reviews the Indian coal sector and discusses key challenges for its development, and proposes policy approaches and suggestions to move it towards a more sustainable path.

Challenges and constraints

The Indian coal sector faces two key challenges for the future: 1) meeting the high demand for coal, particularly in the power sector; and 2) resolving current and past environmental and social issues.

Meeting the high demand for coal

Coal production has increased nearly six-fold since the sector was nationalized between 1971 and 1973, with an annual production of 431 MT (raw coal) and 30 MT (lignite) in 2006-07 (MOSPI, 2006). The production has been mostly from the state-owned collieries of Coal India Limited (CIL) and Singareni Collieries Company Limited (SCCL) – CIL and SCCL account for about 95% of current coal production.[1] Non-coking coal has dominated coal production, as coking coal reserves in the country are quite limited; the increased production of non-coking coal was mainly due to increasing demand from the power sector. In addition, most of the growth of India's coal production is based on opencast mining technology, as underground mining has essentially stagnated.

The demand for coal in the country is expected to continue to increase, especially driven by the power generation sector (see Figure 1). Other energy resources are uneconomic (as in the case of naphtha or LNG), have insecure supplies (diesel and imported natural gas), or simply too complex and expensive to build (nuclear and hydroelectricity) to make a dominant contribution to the near-to-mid term growth (Chikkatur and Sagar, 2007).

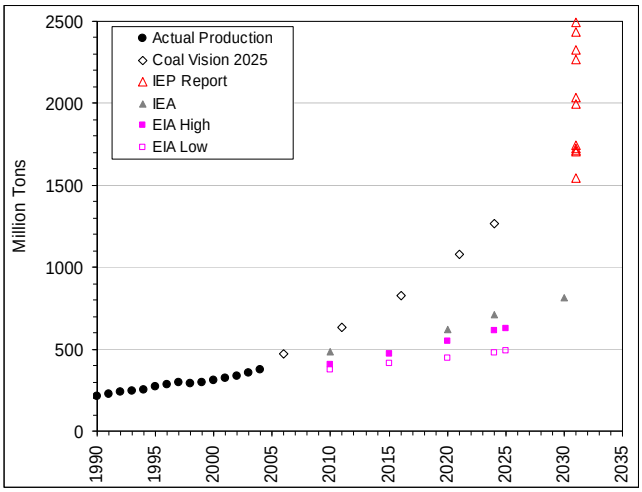

Figure 1: Projected future demand for coal in India. Coal demand based on various scenario projections from the Integrated Energy Policy (IEP) report are shown above (open triangles) along with projections from other sources, assuming coal calorific value of 4000 kcal/kg. Note that projections from international energy agencies (IEA and EIA) are lower than Indian agencies as the Indian agencies assume high GDP growth (8%). Source: (Planning Commission, 2006).

Recent scenario-based projections of coal demand indicate that coal consumption in the power sector could be in the range of 380-500 MT by 2012 (CEA, 2004). Longer term scenarios from the Planning Commission (2006) have indicated that annual coal consumption by the power sector might range between 1 to 2 billion tons (BT) by 2031-32, with the total coal demand

[1] Currently, lignite is being mined in Tamil Nadu, Gujarat, and Rajasthan, and it is primarily used for power generation at pithead plants.

varying anywhere between 1.5 and 2.5 BT.[2] Coal demand projections by various other agencies are also indicated in Figure 1. It is the considered opinion of the Integrated Energy Policy Committee that the annual coal and lignite demand will be about 2 BT by 2030—of which the power sector alone would demand 1.4 BT of coal and lignite (Ministry of Coal, 2006).

The increasing demand for coal (particularly for power generation) requires an expansion and speeding up of coal exploration, production, and processing in the country. Although the Indian coal sector does have significant exploration and resource assessment capacity, this capacity is increasingly under strain.[3] The key limiting factors for increasing exploration capacity at present are the limited domestic technological capacity and low availability of suitable human resources. Virtually no new geologists and geophysicists have been hired for coal exploration since 1990. Further, there has been very little investment for upgrading drilling machines and associated technologies, adapting and deploying new exploration technologies, and carrying out more indigenous exploration R&D.[4]

Expanding production from existing and new mines has been constrained by a lack of investment in underground mining and inability to resolve appropriately socio-environmental problems associated with opencast mining. Environmental damage from open cast mining (see below) is a key constraint for future open cast mining projects, and so many analysts have called for more investments and planning in underground coal production in the country (Chand, 2005; Ministry of Coal, 2006). However, increase of underground mining requires significant new investment in manufacturing and human resources.

Coal demand is already outstripping domestic supply—demand for coal has increased at an average annual rate of 5.7%, while production has only increased at 5.1% (Planning Commission, 2002)—leading to increased imports. The Planning Commission (2006) expects the domestic production of coal and lignite to be only about 1.4 BT by 2031-32, in contrast to a demand of 2 BT. Thus, coal imports will likely to increase significantly over the next 20-25 years in order to meet the projected demand. About 11% to 45% of total coal demand, i.e., coal imports of 70 to 450 Mtoe (Planning Commission, 2006), will likely be met by coal imports. This is a significant deviation from the current situation, where imported coal is only about 6% of consumption. Current imports are primarily for coking coal that is used in the steel industry, although the power sector has recently been importing more coal to mitigate coal shortages.

Finally, not only is there a high demand for coal, but it is increasingly for consistent, high quality of coal. The quality of coal in India has been worsening over the decades because of increased opencast mining combined with disincentives inherent in the grading structure used to characterize quality of coal. Therefore, improving coal quality is an important issue, as better and consistent coal quality improves the performance of coal power plants. Increased use of beneficiated coals is, however, limited by institutional and financial constraints. The current grading (with its wide bandwidths) is a strong disincentive for better coal quality. Moreover, coal

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[2] Coal demand of 2.5 BT occurs in a scenario where coal is the dominant fuel of choice; a demand of 1.5 BT occurs in a scenario where nuclear, hydroelectricity, gas, and renewables resources are promoted aggressively and demand side management, coal use efficiency, transport efficiency are all increased (Planning Commission, 2006).

[3] The Geological Survey of India (GSI) and the Central Mine Planning and Design Institute limited (CMPDI)—a subsidiary of CIL—are the main exploration agencies in India. See Chikkatur and Sagar (2007) for more information about coal exploration agencies.

[4] Author interviews with personnel in CIL, CMPDI, GSI, Planning Commission, and various NGOs; May-August 2007.

washeries are not considered legitimate coal end-users and hence they are not part of the transportation linkage process. The lack of contractual agreements between suppliers and consumers is a problem, as coal supply is not guaranteed at any particular quality and there is no penalty for non-compliance.

Current and past social and environmental issues

Coal mining in the country is associated with significant social and environmental impacts, mainly as a result of the large scale of mining activities and the significant expansion and dominance of open-cast mining. The human and social impacts resulting from coal mining in India have been significant. Most of the tenancy land acquired for mining in the country has been through the application of the Land Acquisition Act of 1894 or the Coal Bearing Areas (Acquisition and Development) Act of 1957, which has led to a large pool of involuntarily displaced persons (Banerjee, 2004). Overall, displacement from all development projects between 1951 and 1991 is estimated to be about 21 million people (Fernandes (1995) as cited in Bala (2006)), and this number probably had gone up to 30 million by 2006 (Sethi, 2006).[5] Mining of all minerals has been the second-largest cause of displacement – an estimated 2.55 million people have been displaced by mining, of whom 55 percent are members of scheduled tribes (Sethi, 2006; Bhushan, 2007).[6]

Even with resettlement and rehabilitation, there are multiple dimensions of human, social and economic impacts on displaced people,: breakdown of family and community structures, greater class and caste conflicts, women, elderly, and children particularly vulnerable; loss of livelihoods, and worsening of economic situation due to disruption (Verma, 2004). Local communities surrounding the projects, even if not displaced, can suffer from local environmental impacts of the mining activities, including water scarcity and pollution, air pollution with human health and agricultural impacts, and deforestation with concomitant loss of livelihoods.

The environmental impacts of coal mining are also considerable: (a) release of total suspended particulates (TSPs) and PM_{10} from the fugitive dust during open-cast mining and transportation operations (Chaulya, 2004; Singh, 2006a), b) impact on water resources from coal mining, washing and associated activities through use of water, runoff, acid mine drainage, and damage to aquifers from opencast mines (Singh, 2006a), c) land degradation and deforestation, especially because of the large areas required for the extractive process[7] as well as for the overburden in opencast mining, d) direct result of deforestation, with concomitant effect on biodiversity and wildlife corridors.[8]

Institutional and governance issues:

A number of institutional and governance issues are critical to sustainable development of the coal-power sector.

First, government and public sector institutions dominate the coal sector. The Ministry of Coal determines policies and provides guidelines for all matters regarding exploration,

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[5] Only 29% of these displaced people are estimated to have been rehabilitated, leaving almost 13.2 million uprooted people (Roy (1994) as cited in Saxena (2006)). In fact, scheduled tribes bear a disproportionate brunt of displacement—while they constitute only about 8% of the country's population, they comprised almost 40% of the displaced people until 1990 and nearly 50% by 1995 (Guha, 2005).

[6] Note that dams for irrigation and hydropower account for nearly 77% of total development-related displaced population, and mining (for all minerals) accounts for about 12% (Sethi, 2006).

[7] More than 0.8 million of hectares of land is under mining in the country (Jain 2003)

[8] See: "Alarm for wildlife habitat" The Telegraph, October 15, 2005.

production, supply, distribution and sale-price of coal and lignite. The Ministry is in administrative control of major coal producing companies including CIL, SCCL, and NLC. The Ministry also is in administrative control of the Coal Controller's Organization, which grants permission for opening new seams/mines, collects and publishes data on the coal sector, collects excise duties, and monitors progress in captive mining. In addition, various other ministries play key roles in the coal sector, including the Ministries of Power, Mines, Environment and Forests, Labor, and Finance. The Planning Commission, which sets the long-term vision and priorities for the government, provides overall policy guidance and specific growth targets for CIL.

Given the government dominance in the coal sector, the actions and policies of any single government agency can affect the trajectory of the entire sector; conversely, any significant changes require bringing on-board a number of key organizations. Institutional reforms in the coal sector that could greatly advance the sector's sustainable development are difficult because the government bureaucracy has resisted these changes (as have many other groups). The coal sector is also politically powerful and the heavy presence of labor unions makes legislative changes (such as amendments to existing laws) difficult to enact. Therefore, institutional reforms often have been placed within the confines of existing legislation—leading to convoluted policies.

Second, problems with governance and corruption constrain the growth and liberalization of the sector. It is well accepted, although not always publicly, that illegal mining is a problem; yet the extent of the problem is not fully known. Issues such as lack of accurate data collection on depleted reserves (not just cumulative production) and the general lack of transparency and independent oversight in coal mining are problematic. Moreover, coal mining companies could be reluctant to reveal such information, because of the fear of retribution and the loss of private gains. The governance and corruption issue is generally uncomfortable for many individuals and groups, as there are potential (and real) conflicts of interests (at different levels).

Third, issues relating to displacement, especially rehabilitation and resettlement (R&R), have been a major and persistent problem for the Indian coal industry, in large part because of the lack of coherent public policy in this area and lack of unwavering commitment by the industry (although CIL has had a R&R policy in place since 1994). The government's R&R policies have been criticized both for their formulation processes, and because of the perception that they support industries over the concerns of the people, particularly for land acquisition. In addition, the land acquisition process has recently come under intense scrutiny with the promulgation of the new Special Economic Zone policies.

At the same time, the resettlement and rehabilitation activities of firms often leave much to be desired. Coal India Limited, for example, has had an ambitious R&R policy since 1994, but subsequent experience with a major World-Bank-funded project intended explicitly to assist in environmental and social mitigation during expansion of 25 coal mines revealed some serious shortcomings in implementation.[9] A wide gap between stated policies and the reality of implementation gives rise to an atmosphere of mistrust, which is difficult to overcome and hinders future rehabilitation efforts.

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[9] For example, Central Coalfield Limited (CCL, a CIL subsidiary) was found to have failed in meeting the goal of successful rehabilitation or even CIL's own policies, resulting in lack of adequate compensation for lost assets and loss of income (World Bank, 2002; Herbert and Lahiri-Dutt, 2004). On the environmental side, CCL did not plan for reclamation of the mined land, despite it being in the project plans (Herbert and Lahiri-Dutt, 2004). To make things worse, it seemed that many of the practices by CCL were quite at odds with what one would expect of good-faith efforts (Herbert and Lahiri-Dutt, 2004).

The lack of desire or ability to address and amicably resolve the past social and environmental record of the sector could become a key limiting factor for further growth. In fact, people who have observed the fate of project-affected-people over the past several decades no longer want to give their land for mining projects, as they do not see any benefit in doing so. Moreover, the public sector units cannot just blame all of the R&R problems on the private firms that held the mines prior to nationalization. Forcible expulsion and attempts to "cheat" the people out of a fair compensation will only make the situation worse. This issue is relevant not just for the coal sector, for all future industrial and infrastructure projects, as competition for different land-use activities will only increase over time. Thus, lack of appropriate policies and ineffective implementation of existing policies are major constraint to sustainable development of the coal sector.

Key Focus Areas

Having described the key challenges and constraints in the coal sector, we provide a quick summary of different policy options for addressing the issues raised above.

Systems level perspective: Managing coal demand

The role of coal in the Indian power sector (and visa-versa) – in both the present and the future – cannot be understated. The strong influence of the power sector on coal demand implies that better coal-power policies can help reduce the demand for more coal (especially in the short term), thereby providing the time and a breathing room for the coal-sector to devise and implement appropriate policies and institutional changes. In fact, the current overemphasis on coal production pushes the government into a "panic mode" that pushes for production at all cost—leading to many of the problems discussed above. Although a detailed assessment of technology policies for coal-power have been discussed elsewhere (Chikkatur and Sagar, 2007), a key policy element of a broader energy strategy—greater energy efficiency—is discussed briefly.

There is significant potential for improving the efficiency of all elements within the country's existing power system. On the generation side, the efficiency of existing sub-critical PC power plants have great potential for improvement. The average net efficiency of the overall sector is 29%, with best units (500 MW) being 33% (Chikkatur, 2005). Nearly all existing power plants can improve their efficiency by at least 1-2 percentage points, and improvement by one percentage-point will reduce coal use, and corresponding air pollution and CO_2 emissions, by 3% (Deo Sharma, 2004). Current losses in the Indian T&D system are very high and reducing these losses to a more manageable (though still high) 10% will release power equivalent to about 10,000-12,000 MW of capacity (CEA, 2007)—thereby reducing coal demand. Existing efforts to upgrade the T&D system by modernizing the existing infrastructure and introducing new technologies must be accelerated through steps such as expanding the high-voltage lines, improving integration among regional grids, and improved monitoring and metering of distribution networks.

Improving the efficiency of end-use applications is also very important. Each kW saved at the end-use side is equivalent to almost 1.8 kW of generation (once auxiliary consumption at the power plant and T&D losses are taken into account). There is great potential for end-use energy-efficiency gains in the country. For example, it is estimated that the deployment of energy-efficient lighting, more efficient refrigerators in households, and more efficient motors in industry could save as much as 10% of the power generation (Shrestha et al., 1998).

Better data collection and assessment

Robust data and data analysis are critical for devising appropriate policies. In the coal sector, although some data (such as production, number of operating mines, type of mining technology, manpower productivity, etc.) is readily available from the Coal Controller's organization, critical data (such as the total economically mineable resources, depleted reserves, number of displaced people, abandoned mines, etc.) is missing. A good understanding of domestic coal reserves, including information about economical and technical extractability of coal resources, is essential for better energy planning and policies, which is necessary to ensure that social and environmental conditions are fully considered. There are considerable problems with the methodologies used for assessing Indian coal resources (Chand, 2005; Chikkatur, 2005; Ministry of Coal, 2006).

Detailed data and analysis from mining operations, including depleted reserves, is important to assess mining efficiency, management, and whether available reserves are being utilized to the fullest extent. Collection, collation, and time trends of environmental and social data related to coal mining is critical for better R&R policies—and often, such data is missing or not available easily. Furthermore, there is very little information about abandoned mines, the reasons for abandonment, and the amount of remaining reserves in abandoned mines—therefore, we do not have an understanding of possible reclamation potential (or barriers for reclamation).

Technology roadmap for coal exploration and extraction

A systematic effort to develop a technology roadmap for coal exploration and extraction sector is necessary to incorporate the latest technology developments and consider options for mitigating the environmental and social impacts resulting from exploration and extraction, while enhancing the effectiveness of these activities. A particular effort is needed to increase underground mining, an area where India has lagged behind even as other countries (especially China) have made progress in recent decades.[10] Other associated options such as underground coal gasification and coal bed methane must also be part of a strategic roadmap, as these technologies have potentially significant environmental benefits (and costs) relative to more conventional options. The development of a roadmap will also support the overall planning in the coal sector by assisting in the timely introduction of technologies that could improve mine and worker safety while reducing impacts on the broader environment.

Participatory and responsive decision-making

There are a large number of stakeholders in the coal sector. Reconciling their interests and resolving their conflicts will require the development of a transparent, inclusive, and responsive process that is seen as fair by all involved. In effect, it is important to adopt a philosophy of 'planning with people' that empowers all stakeholders and allows them to participate in the decision-making, rather than 'planning of people' or 'planning for people' (Burton (1976) as cited in Sidaway (2005)).

Therefore, it would be useful to begin by developing a vision for the coal-production sector as part of a larger visioning exercise for the overall coal-power sector. This would require building consensus across various stakeholders on the need for coal production in the country and how the benefits could be shared appropriately while limiting the social and environmental costs borne by some of them. Agreement on a vision should then allow for the prioritization of the key issues that need to be addressed, filling in missing data and analysis gaps, and developing appropriate policies.

[10] A recent Expert Committee report has provided some key proposals for increasing underground mining (Ministry of Coal, 2007).

R&R Policy Formulation

The Land Acquisitions Act (1894), a holdover from colonial times, does not have any provision for rehabilitation (Guha, 2005). The 2003 National Policy for Resettlement and Rehabilitation (promulgated in 2004), developed after two decades of discussions within the government and with civil society (Sethi, 2006) was roundly criticized for having a number of critical weaknesses and omissions (Guha, 2005). The final version is perceived by many as being less progressive than earlier drafts—Saxena (2006) notes that the final draft has "none of the progressive clauses that were put in earlier drafts after consultation with civil society" and "disappoints" on a number of key issues. Some even suggest that this policy was meant to "ensure the large-scale transfer of land to companies and corporate bodies [...] and to strengthen the corporate control over land" (Palit, 2004). The government then came up with a new draft National Rehabilitation Policy (2006), which has again received criticism for both the process of its development as well as shortcomings in the policies, and for being far weaker than the earlier draft put together by the National Advisory Council (Sethi, 2006; Singh, 2006b). Very recently, the Union Cabinet has approved the "National Policy on Rehabilitation and Resettlement, 2007" and proposed amendments to the Land Acquisition Act, 1894;[11] however, it is too early to tell how effective this policy or its implementation will be.

As Cernea (2006) has noted that risks to environment and risks to investors are paid attention but social risks often are ignored: "some risks, to some stakeholders, are considered while other risks to other stakeholders—like the risk-set imposed on displaced populations—are 'beyond the horizon' in the mindsets, attitudes, and management discourse."

Environmental impact assessment policies

Environmental impact assessment (EIA) by the MoEF is a critical step of the project approval process. The EIA process is complex and the cost-benefit analysis is often laborious and difficult; yet, the EIA is a very important tool that provides relevant data and information for the public, project proponent and the regulatory authorities (MoEF). An EIA should be performed by reputed (and accredited) agencies with stakeholder input, especially input from local people.

There have been, however, plenty of documented problems with EIA preparation. For example, some faulty EIAs have been literally "cut-and-pasted" from other EIAs,[12] very little time is provided for accurate data collection (often rapid EIAs without full seasonal data are used for expedience),[13] and the project proponent directly funds the agency preparing EIAs (rather than providing funds to an independent authority who then chooses a preparation agency). Furthermore, EIAs are prepared after nearly all of the project-related activity is already done—thereby putting enormous pressure on regulatory authorities (particularly MoEF) to approve project; this pressure also creates potential for corruption. Therefore, the project-affected people and NGOs feel that the EIA process often is subverted and important issues are sidelined or ignored.[4]

On the other hand, many in the mining industry feel that the EIA process is too slow and impedes timely progress on exploration and mine development activities. Some of them view that the clearance decision-making process can be arbitrary and not transparent.[4] Moreover, since

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[11] See: http://pib.nic.in/release/release.asp?relid=31832.

[12] See, for example, Dutta (2007); http://esgindia.org/campaigns/dandeli/docs/docs.html; http://www.ibnlive.com/news/sit-cement-giant-rains-trouble-on-cherrapunjee/44796-3.html.

[13] Sunita Dubey, "EIA: Foundations of Failure" (2006), http://www.indiatogether.org/2006/mar/env-eiafail.htm.

coal mining has to take place in areas where coal is located, people can take undue advantage and create more trouble. These different perspectives lead to a contentious and unproductive situation where the focus is more on the shortcomings of the EIAs rather than on working together (and with the MoEF) on developing a process that takes into account these concerns while paying full attention to environmental issues. Thus, a streamlined and more transparent process which removes uncertainties from the approval process would be highly desirable for the mining industry; local communities and NGOs, on the other hand, would very much support a public-hearing process that is seen as more thorough and responsive.

In effect, the EIA and the public hearing processes can be a venue for consensus-building between government agencies, industry, and the citizenry to protect the local environment as well as the rights of project-affected people. In fact, assessing the environmental impacts could happen first, so that the viability of a project can be assessed on techno-economic grounds and on the environmental basis *at the same time*. The EIA process should be taken seriously by all stakeholders and subverting this process (through fraudulent EIAs and improper data collection) will only further hinder any reconciliation and stakeholder consensus.

Need for innovative approaches

Innovative approaches that promote environmental and social protection while allowing for the desired increases in coal extraction must be explored. In this context, it would be very useful to learn from the international experiences and policy experiments in these areas. In the United States, for example, the Surface Mining Law requires that a coal mining permit requires the posting a reclamation bond, which ensures that availability of funds to reclaim a mine site if the operator does not complete the reclamation plan presented in the permit. The Working Group for Coal and Lignite for the 11th Plan has proposed the notion of "green credits," which would allow coal-mining companies to take up afforestation in advance and be given "green credits" for acres of new forest created. The utility and feasibility of such ideas needs to be widely discussed and debated, and, if appropriate, considered for implementation. Other ideas include, for example, accreditation and benchmarking of EIA preparation agencies, involving NGOs and local people in the EIA preparation process, building up environmental data through satellite imagery, public dissemination of environmental information, leasing of land for mining, rather than acquisition, and providing a share of the revenues from mining directly to project affected people or panchayats.

Conclusions

As the coal sector stands poised for greater growth, the need for more comprehensive and humane planning and implementation of coal mining projects and a transition towards sustainable development of the sector cannot be overemphasized. While this will 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. In the end, a sustainable coal sector will not only require reducing the environmental and social impacts of coal mining but also more equitable sharing of the benefits of coal mining activities.

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References

Bala, M., 2006. "Indian National Policy on resettlement and rehabilitation and the marginalization of women." Social Science Research Network. Available from the Internet: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=942913

Banerjee, S.P., 2004. "Social dimensions of mining sector." *IE(I) Journal –MN* 85: 5-10.

Bhushan, C., 2007. "Making India's mining sector socially and environmentally viable." Down to Earth, April 23, 2007.

CEA, 2004. "Draft Report on National Electricity Plan (Volume -I)." Central Electricity Authority, Government of India.

Cernea, M.M., 2006. "Resettlement management: denying or confronting risks." In: *Managing resettlement in India: Approaches, Issues, and Experiences*. Mathur, H.M. (ed.). Oxford University Press, pp. 19-44.

Chand, S.K., 2005. "Can domestic coal continue to remain king?" TERI Newswire, 1-15 April 2005.

Chaulya, S.K., 2004. "Assessment and management of air quality for an opencast coal mining area." *J. Envtl. Management* 70: 1-14.

Chikkatur, A., 2005. "Making the Best Use of India's Coal Resources." *Economic and Political Weekly* 40: 5457-5461.

Chikkatur, A.P., Sagar, A.D., 2007. "Cleaner Power in India: Towards a Clean-Coal-Technology Roadmap." Kennedy School of Government, Harvard University, Cambridge, MA. (In review).

Deo Sharma, S.C., 2004. "Coal-fired Power Plant Heat Rate and Efficiency Improvement in India." Workshop on Near-Term Options to Reduce CO2 Emissions from the Electric Power Generation Sector in APEC Economies, February 2004, Asia Pacific Economic Cooperation (APEC), Queensland, Australia. Available from the Internet: http://www.iea.org/dbtw-wpd/Textbase/work/2004/zets/apec/presentations/sharma.pdf

Dutta, R., 2007. "First Report on National level environment impact assessment response centre." Available from the Internet: http://www.rufford.org/files/Rufford%20Final.doc

Fernandes, W., 1995. "Rehabilitation of displaced persons: a critique of the Draft National Policy." *People's Action* 3: 3-10.

Guha, A., 2005. "Resettlement and Rehabilitation: First National Policy." *Economic and Political Weekly* 40: 4978-4802.

IEA, 2007. "Energy Balances of Non-OECD Countries 2004-2005." International Energy Agency

Ministry of Coal, 2006. "Report (Part-I) of the Expert Committee on Road Map for Coal Sector Reforms." Ministry of Coal, Government of India. Available from the Internet: http://www.coal.nic.in/expertreport.pdf

Ministry of Coal, 2007. "Report (Part-II) of the Expert Committee on Road Map for Coal Sector Reforms." Ministry of Coal, Government of India.

Ministry of Power, 2006. "Annual Report 2005-06." Ministry of Power, Government of India.

MOSPI, 2006. "Energy Statistics 2006." Ministry of Statistics and Programme Implementation. Available from the Internet: http://mospi.nic.in/energy_stat.htm

Palit, C., 2004. "Short-changing the displaced: National Rehabilitation Policy." *Economic and Political Weekly* 39: 2961-2963.

Planning Commission, 2002. "Tenth Five-Year Plan." Planning Commission, Government of India.

Planning Commission, 2006. "Integrated Energy Policy: Report of the Expert Committee." Planning Commission, Government of India. Available from the Internet: http://planningcommission.nic.in/reports/genrep/rep_intengy.pdf

Roy, D., 1994. "Large projects for whose benefit?" *Economic and Political Weekly* 29: 3129.

Saxena, N.C., 2006. "The resettlement and rehabilitation policy of India." In: *Managing resettlement in India: Approaches, Issues, and Experiences*. Mathur, H.M. (ed.). Oxford University Press, pp. 99-123.

Sethi, N., 2006. "India's rehabilitation policy under scanner again." Down to Earth, June 20, 2006.

Singh, G., 2006a. "Environmental issues with best management practice of coal mining in India." Responsible mining – a multi-stakeholder perspective, February 2006, TERI, New Delhi.

Singh, S., 2006b. "Displacement and rehabilitation: a comparison of two policy drafts." *Economic and Political Weekly* 41: 5307-5309.

Verma, M.K., 2004. "Development-induced displacement: A socio-economic study of thermal power projects." *Man in India* 84: 209-245.