DISCUSSION PAPER

JUNE 2015

The Energy and Resources Institute

Moving Forward with a World-class Mineral Policy for National Mineral Security

CONTENTS

Authors

S Vijay Kumar, Distinguished Fellow, TERI
Swati Ganeshan, Associate Fellow, TERI

With contributions from
Nidhi Srivastava, Fellow, TERI

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

Summary

The National Policy 2008 was a significant step in the evolution of India's Mineral Policy based on the experience of the Policy of 1993. The policymakers were fortunate in having at hand the recommendations of the High-level Committee (popularly called the Hoda Committee) which not only analysed the situation in the Indian context, but also looked at the international context and global best practices. The NMP 2008 comprehensively outlines the policy solutions that need to be established to address the challenges that are being faced by the minerals sector in India. These not only include the issue of allocation of mineral resources for exploitation, but also scientific mining, environmental management, community engagement, and sustainable development frameworks for the sector, linkages with Research and Development (R&D) and industry, and issues of resource security in the geopolitical and technological contexts. With natural resources being viewed in the changing global scenario as the key for overall progress of a nation, this paper examines the methods through which the Policy can be leveraged in India's interest for economic growth and sustainable development within the framework of resource security.

Introduction

The Ministry of Mines (MOM) strategy paper '*Unlocking the Potential of the Indian Minerals Sector*', published in 2011, highlights India's relatively low position in the global mining sector. India's share in world production of minerals stands at around 5.6 per cent (see Table 1).

The paper, rather bluntly, states:

"With global demand for minerals consistently outpacing supply, recent years have seen an unprecedented rise in commodity prices. In response, companies worldwide have explored all possibilities to boost supply, including increased mining activity in new geographies such as Africa. As the relevance of the mining sector grows globally, the Indian mining sector is lagging behind, with just 1.2 per cent contribution to Gross Domestic Product (GDP) over the last decade (as opposed to 5 to 6 per cent in major mining economies and very low exploration spend per square kilometre (USD 9 (₹400) compared to USD 124 (₹5,580) for Australia and USD 118 (₹5,310) for Canada)" (p 5, MoM, 2011).

Though the picture relates to the period before the NMP 2008 could have taken effect, it is a clear indication as to the issues that need to be monitored in relation to the health of the mineral sector. More importantly it points to the need to identify the systemic and institutional bottlenecks that require to be addressed if the situation is to change on the ground with the application of the new Policy. These include the concession management system, the survey and data management system, the regulatory systems at central and state level, and the strength of the linkages of the mining sector with other portions of the economy, particularly industry and manufacturing (not least in the context of the 'Make in India' goal). The Ministry of Mines clearly recognizes this, in view of the reference in their Strategy Paper as follows:

"India has initiated several progressive policy measures, putting itself in a good starting position to undertake the transformation of the mining sector. Unlocking the potential of the mining sector in India could add around USD 210 billion to USD 250 billion (₹945 to 1,125 thousand crore or 6 to 7 per cent) to the GDP and create 13 to 15 million jobs through direct and indirect contribution by 2025.

To achieve this, action is required on six key priorities, including enhancing resource and reserve base through exploration and international acquisition; reducing permit delays; putting in place core enablers (infrastructure, human capital, technology); ensuring sustainable mining and sustainable development around mining; creating an information, education, and communication strategy; and undertaking measures to ensure implementation." (p 5, MoM, 2011).

The minerals sector is a vital factor in the economic growth of the country and growth rates in this sector would have a cascading effect on the industrial sector and at the macroeconomic level as well. The Federation of Indian Chambers of Commerce and Industry (FICCI) Report of 2013, 'Development of Indian Mining Industry—The Way Forward, Non-fuel Minerals' highlights that the mining industry has had negative growth from 2011–13 and that has been a major impediment to the growth of the economy.

Box 1. Minerals and Mining in India

India produces 87 minerals both metallic and non-metallic in nature comprising of 4 fuel minerals, 10 metallic, 47 non-metallic, 3 atomic minerals, and 23 minor minerals. The minor minerals include building and other materials. Base Metals such as copper and noble metals like gold as well as gemstones are in short supply and are being imported, even though the geological potential for their presence in India is high. At the mining level, small size mines dominate the industry. Indian mining is a combination of open cast and underground mining practices. In 2011–12, there were 2,076 mines operating in the country, lower from the previous year that recorded 2,355 mines. According to the Ministry of Mines website, 11 states accounted for 93.64 per cent of total number of mines in the country in 2011–12, Andhra Pradesh–354 mines, Gujarat–308, Rajasthan–241, Madhya Pradesh–225, Karnataka–180, Tamil Nadu–156, Odisha–119, Jharkhand–106, Chhattisgarh–99, Maharashtra–86, and Goa–70. Mining in India is largely public sector driven with Public Sector Undertaking (PSU's) accounting for around 66 per cent of the value of mineral production; the rest emanates from medium and small mines that are largely privately operated. Mining accounts for around 2 per cent of the GDP and India is major exporter of minerals such as iron ore.

Source: Ministry of Mines and FICCI Report 2013 'Development of Indian Mining Industry—The Way Forward, Non-fuel Minerals Sector.'

According to the FICCI report, every one percent increase in the growth rate of mining and quarrying leads to an increase of 1.2 to 1.4 per cent in the growth rate of industrial production, leading to an increment of 0.3 per cent growth rate in India's GDP.

India has significant potential for discovery of minerals as the Indian continental landmass and its offshore consist of several crustal elements going back to the oldest periods. India is blessed with ample resources of a number of minerals and has the geological environment for many others (See Box 1). The National Mineral Policy 2008 spells out in detail the direction that the mineral development of this country should take in order to discover and exploit these resources. It is based on a review of the successes and failures of the earlier National Mineral Policy 1993 (announced soon after economic liberalization in 1991) analysed in the report of the High Level Committee (popularly known as the Hoda Committee), constituted for the purpose.

Table 1. Share of countries in world production of minerals (2010)

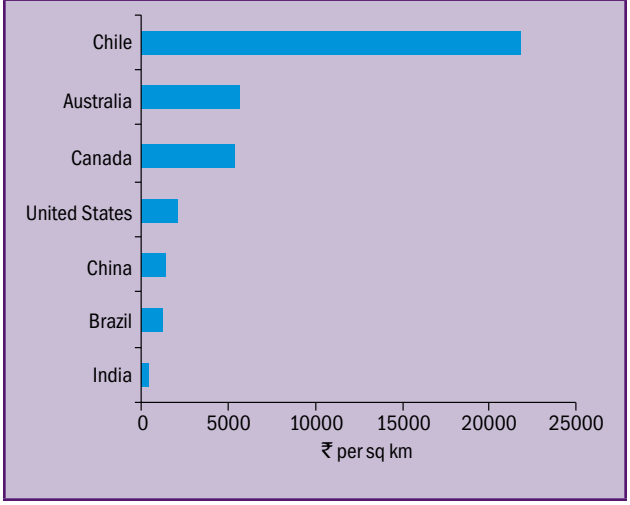
Rank	Country	Total production (USD million)	Share in world production
1	Australia	71,955	15.6%
2	China	69,281	15.0%
3	Brazil	47,027	10.2%
4	Chile	31,275	6.8%
5	Russian Federation	28,680	6.2%
6	South Africa	27,116	5.9%
7	India	26,042	5.6%
8	United States	22,957	5.0%
9	Peru	18,832	4.1%
10	Canada	13,984	3.0%
11	Indonesia	12,225	2.6%
12	Ukraine	9,283	2.0%
13	Mexico	8,361	1.8%
14	Kazakhstan	7,248	1.6%
15	Iran, Islamic rep.	4,387	0.9%

Source: ICMM 2012 Mining's Contribution to Sustainable Development.

One of the main thrusts of the Policy, based on the Hoda Committee recommendations, is that to exploit the country's geological potential for the sustainable development of the country, it is important to carry out scientific and detailed prospecting in search of its mineral resources. In particular, it needs to be ensured that regional and detailed exploration is carried out systematically in the entire geologically conducive mineral bearing area of the country, using state-of-the-art techniques in a time bound manner.

As a major resource for development, the extraction and management of minerals has to be integrated into the overall strategy of the country's economic development. In this context, there is a need to invest significantly in detailed prospecting. As detailed in the Ministry of Mines strategy paper 'Unlocking the Potential of the Indian Minerals Sector', investment for exploration needs to be heavily boosted as India's past investments have been almost negligible (See Figure 1). The exploitation of minerals has to be guided by long-term national goals and perspectives. Just as these goals and perspectives are dynamic and responsive to the changing global economic scenario, the application of the national mineral policy and consequent strategies have to be equally robust taking into consideration the changing needs of industry, in the context of the domestic and global economic environment.

Fig 1. Investment in exploration by select countries

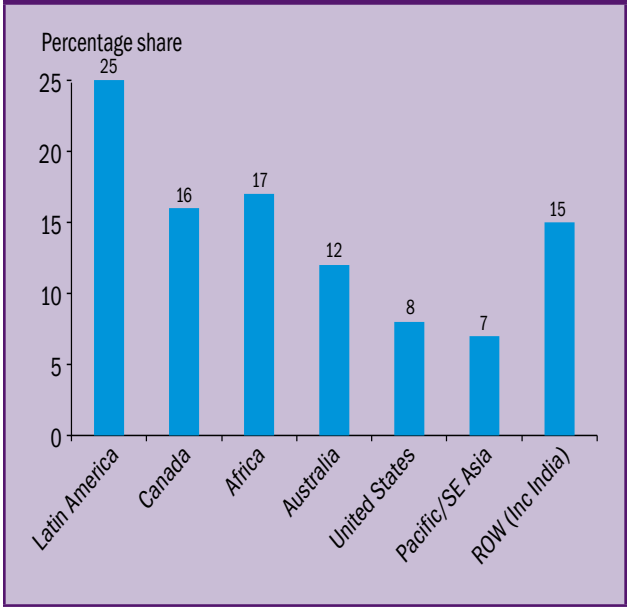


Source: Ministry of Mines. 2011. 'Unlocking the Potential of the Indian Minerals Sector', strategy paper for Ministry of Mines.

Survey and Exploration

With vast resources lying unexplored, survey and exploration is the first step to developing domestically available minerals for internal utilization in infrastructure, capital goods, and basic industries. Globally, economies with a large mining base or potential resources have set aside significant budget for exploration; however Indian exploration budgets are still limited in comparison to the global figures (Figure 2). It also needs to be noted that while the global investments in exploration has been rising, a similar trend is not visible in the Indian subcontinent. A study on the Corporate Exploration Strategies (CES) of global companies by the Metals Economic Group (MEG) conducted in 2014 highlights that around 39 global companies accounted for 40 per cent of the global exploration budget. The MEG CES study focused on the allocations for exploration for gold, base metals, PGM, diamonds, uranium, silver, rare earths, potash/phosphate, and many hard rock metals. The study excluded industrial minerals, aluminium, oil & gas, coal, and iron ore (Table 2).

Fig 2. Planned global exploration budgets for non-fuel minerals by region (2012)



Source: Wilburn D R, and Stanley, K A (USGS). May 2013. 'Exploration Review', Annual Review 2012, Mining Engineering.

Table 2. Large players exploration budgets by country (2014)

Country	Percentage share
Canada	10
United States	8
Mexico	9
Colombia	2
Peru	6
Brazil	4
Chile	12
Argentina	2
Russia	9
Finland	0.9
Kazakhstan	0.7
Mongolia	0.8
China	2
Serbia	0.6
Philippines	2
Indonesia	2
Australia	8
Papua New Guinea	0.8
Saudi Arabia	1.3
Burkina Faso	0.7
Guinea	0.6
Ghana	1
DRC	4
Tanzania	1
Angola	0.9
Zambia	2
Botswana	0.6
South Africa	2
ROW*	6.1

*ROW (Rest of the World) includes 32 countries including India and other regional allocations.

Source: SNL Metals & Mining. 'Large players account for 40 per cent of global exploration budgets' 2014.

The announcement of NMP 2008 led to a large number of legislative as well as non-legislative actions for sector reform to attract investments. Of these,

the restructuring of the Geological Survey of India (GSI) in 2009 in the form of 5 Missions is perhaps the most significant action completed. The GSI is the principal agency for geological mapping and regional mineral resource assessment of the country. The GSI needs to ensure that its regional surveys for baseline data collection cover all major geo-scientific datasets, including geology, magnetics, electromagnetics, spectral, gravity, geochemistry (for 68 elements), etc., and is in line with best international practices. It also needs to undertake measures to publish all pre-competitive data, including spatial data, in the Geographic Information System (GIS) environment to facilitate entrepreneurs to take investment decisions for exploration and when making applications for mineral concessions. Many of these data sets, though requiring high investment of funds and manpower, give very high returns through discovery of new mineral deposits. The GSI also needs to look at capacity issues in terms of experienced geoscientists and state-of-the-art equipment, both crucial constraints that need to be overcome in order to ensure availability of geochemical and geophysical regional baseline maps as per current best practice, i.e, on 1:50,000 scale. It is well known that the upsurge of exploration and mining in China was a consequence of their systematic geochemical mapping in the previous decade and there is no reason why such an upsurge should not also happen in India.

The National Mineral Policy advocates both auction of 'fully prospected' mineral deposits and encouragement of exploration under a risk-reward system incentivizing the use of high technology for locating deeper mineral occurrences. The recently enacted Minerals and Mines Development and Regulation Act MMDR (Amendment) Act, 2015 provides that mineral concessions will be granted on the basis of bidding wherever the data is adequate for the purpose of the Prospecting stage or Mining stage, as the case may be. The earlier process of granting Reconnaissance Permits has been replaced with a system of non-exclusive licences with no rights to proceed to prospecting or mining in case of evidence of mineralization. The intention seems to be that the preliminary work will be done by public agencies so that the data gathered can be used to auction any mineral occurrences.

In order to ensure that there is a well-established process of data gathering and continuous discovery of mineral occurrences, it will be necessary to equip and position public agencies such as the Geological Survey of India, as well as the Mineral Exploration Corporation Limited (MECL), Directorates of Mining and Geology of the State Governments, and various Central and State Public Sector Organizations to conduct detailed exploration at public expense so as to enable the State governments to identify mineral occurrences with potential and adopt the bidding route for their exploitation as provided by law. Currently, the capacity of these public agencies is severely limited in terms of geoscientific and technical resources. Substantial investments including financial equity will have to be made in these institutions to build up capacity to conduct detailed exploration and efficiently use modern technology to locate concealed mineral deposits. The National Mineral Exploration Trust set up through the MMDR (Amendment) Act, 2015 may be able to pay for only some of the huge expenditure that is entailed in this venture, and may

not be able to adequately capture the spirit of the high-risk high-reward paradigm. The Trust is funded by a 2 per cent cess on the royalty and assuming an annual royalty flow of ₹20,000 crore (including coal royalty), the funds accruing to the Trust will be of the order of ₹400 crore per annum (or $75 million per annum).While this is much higher than the current spending level in India of $5 million a year (mostly on coal exploration), this is clearly miniscule compared to exploration spends in countries like Australia to the tune of USD 500 Million p.a. and Latin America USD 700 Million p.a in 2005 (Hoda Committee report 2006). International exploration budgets are allocated based on attractiveness of destinations, and India must make its exploration sector much more attractive to FDI flows. The fact that FDI is now 100 per cent on the automatic route has pushed the level of flows below the radar, thus precluding proper monitoring.

There is also a real danger that the pressure to use the Trust funds may take GSI away from its primary work of baseline surveys of geology, geophysics, and geochemistry into regional and detailed exploration for minerals. GSI post restructuring is inducting expert manpower; however it may not be able to muster the scientific personnel to conduct detailed exploration on a mass scale with the requisite experience, particularly for deeper deposits of base metals, noble metals, and gemstones. The entire strategy for exploration may actually need to be analysed further from the point of view of ensuring that GSI's work of baseline data collection is not disrupted on the one hand, and funds and expert resources for exploration flow are unhindered on the other.

To expedite completion of reconnaissance work for the entire country as early as possible, as mentioned earlier, an open sky policy of non-exclusivity for reconnaissance work has been adopted through the MMDR (Amendment) Act, 2015. This is broadly in keeping with the recommendations of NMP 2008. However in the absence of adequate incentives including the right to obtain mineral concessions at prospecting and mining stages on this basis, large investments from the private sector in this area may

not be likely (and certainly this is an area to be closely monitored for the health of the sector). It is necessary to attract investments attached with high technology, so that base metal, noble metal, and other deeper mineral occurrences can be detected and assessed for commercial exploitation. These are issues not merely of mineral exploration but of resource security, particularly in respect of so-called Technology Metals and Energy Critical Metals [Technology Metals such as Molybdenum (Mo), and Tellurium (Te), and Energy Critical Elements (ECEs) such as Gallium (Ga), and Germanium (Ge)]. The Hoda Committee analysis of the key role of venture-capital based specialized exploration companies including the 'Juniors' has many lessons, which can only be ignored at the cost of undiscovered mineral wealth.

Fundamentally, it is exploration, generally on the strength of baseline regional geoscientific surveys, that generates data to locate mineral resources. As recommended by the National Mineral Policy, and as is the practice in other mineral jurisdictions, the national inventory of mineral resources will need to be based on a comprehensive and up-to-date review of exploration data which requires efficient IT applications to continuously integrate the interpreted exploration data with the existing data sets, and also add freshly generated data on a continuing basis.

Internationally accepted systems for categorization of mineral explorations such as Australasian Joint Ores Reserve Committee (JORC) (and its Canadian equivalent known as 43.101) will need to be accorded legal backing to bring in the standardization required to be able to attract FDI or even to credibly conduct auctions of explored prospects. The latter also requires the development of expert third party valuation mechanisms.

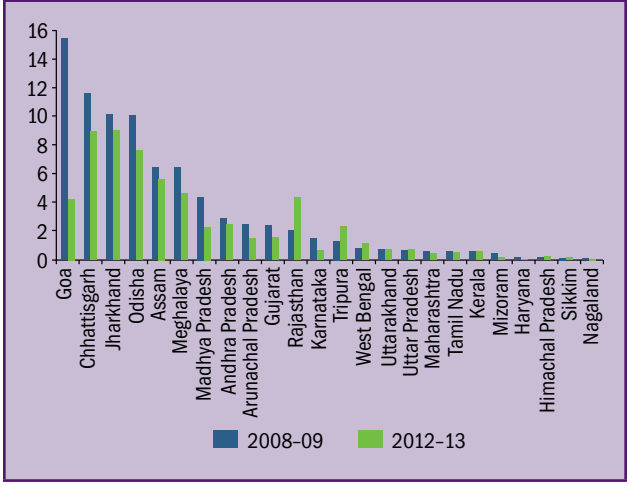
Sector regulation at mining stage, in particular, has to be made more robust so that data generated from detailed exploration at mining stage, including deeper drilling is adequately and reliably reflected in the data of reserves and resources. In line with best international practices, a National Geophysical Data Repository and a National Drill Core Library must be statutorily created, preferably under or in close collaboration with GSI.

Regulation

One of the major areas that needs a revision is the regulatory aspects of mining in India. The Indian Bureau of Mines (IBM) and the State Directorates need to be strengthened in order to be able to discharge their regulatory responsibilities. Along with manpower, equipment, and skill sets requiring upgradation to being state of the art, they also need to ensure that mining takes place within a sustainable development framework. In particular, the regulatory systems need to be provided with the necessary teeth through the legislative framework to make the sector more conducive to investment and technology flows. The MMDR (Amendment) Act has increased the range and scope of work of the Indian Bureau of Mines and the State Directorates (by making auctions as the only mode of granting mineral concessions), particularly with regard to mineral resource estimations and mineral reserve valuations, which are specialized activities requiring the development of credible and multi-disciplinary expertise. Capacity building for the purpose has to be a high priority if the intention behind adopting the auction route is to be realized.

It needs no reiteration that the inadequate regulation at the ground level has acted as an impediment for the growth of the mining sector in the past. The rampant illegal mining in the previous decade is largely a result of regulatory failure, caused mainly due to the inability of the appropriate agencies to anticipate and provide for the increase in volumes of mining that occurred due to the boom in Chinese demand for steel. It is also clear that from now on State governments have to take on the primary responsibility for regulation and have to be capacitated for the purpose. State governments are largely responsible for the proper functioning of the mining sector in the respective States. Failure to reform the regulatory mechanism has serious negative consequences going forward, such as environmental damage, social opposition, and discouragement of investment flows including FDI and, in the last analysis, to the revenues accruing to the State (Figure 3).

Fig 3. Share of mining and quarrying in SDP in states (per cent) at factor cost (at current prices) 2004 – 2005 base year.



Source: RBI Handbook of Statistics on Indian Economy (2013-14)

The National Mineral Policy actually takes a wide-angle view of regulation and speaks of an arms-length between State agencies that mine and agencies that regulate. Given the complex and widespread nature of the regulatory failure, perhaps the time has come to create independent Mining Regulatory Authorities for oversight at the Central and State level to restore investor confidence and ensure that the primary regulatory mechanisms for mining plans and closure plans operate transparently and reliably

to internationally recognized technical standards. As has been pointed out in The Energy and Resources Institute's (TERI) Policy Brief, Governance of mining in India: Responding to policy deficits (June 2012), 'It is important to ensure independence of the regulator from government as well as industry. This would be an important factor leading to faith in governance and acceptance of mining.'

Strategy of Mineral Development

As has been laid out in the National Mineral Policy, the strategy for development of any mineral should naturally keep in view its ultimate end usage in terms of demand and supply in the short, medium, and long term. Considerations of 'inter-generational equity' should be addressed 'positively', through exploration, to further enhance the current potential resources rather than through abstinence from consumption or preservation for use in the distant future. The fact that India is highly prospective for minerals given its geological evolution must be leveraged for discovery of new mineral resources on a continuing basis through latest technologies. Historical evidence in advanced mining jurisdictions shows that in the case of common minerals of widespread use such as iron ore and limestone, exploration more than replaces the resources consumed through mining. A case in point is Australia whose iron ore resources increased hundred fold in 40 years through increased exploration and beneficiation, as cited in the Hoda Committee Report, 2006.

As the National Mineral Policy rightly says, conservation of minerals cannot be construed in the restrictive sense but as a positive concept leading to augmentation of the reserve base through improvement in mining methods, beneficiation, and utilization of low grade ore and rejects and the recovery of associated minerals. Over time, the grades may go down, and extraction costs may rise as accessibility becomes more expensive, but since the process occurs in a globally networked context, preserving high grades for the future and denying oneself access to resources critical for current growth may be counter-productive, particularly at moments

when the growth momentum needs to be built up to a level where it can become self-sustaining.

Correspondingly, there has to be recognition of zero-waste mining as the ultimate goal and a commitment to prevent sub-optimal and unscientific mining (TERI 2015). Global best practices in efficient mining should be adopted to increase output and optimize available mineral resources. Sustainable and efficient mining would reduce production costs as well as environmental costs.

The unnaturally small size of mines in India is perhaps the single biggest problem besetting the sector, as it promotes non-scientific and inefficient mining and poor environmental management practices. Around 56 per cent of major mineral mines are below 10 hectares, and in most cases are not based adequately on scientific detailed exploration. Clearly, the legislative framework must allow, facilitate, and strongly incentivize amalgamation and transfers so as to enable consolidation of small mines on geoscientific principles. The regulatory framework must also firmly disincentivize some of the suboptimal and unscientific practices generally inherent to the operation of small mines. As the National Mineral Policy states, Mining Plans must ensure this, and non-adherence to the Mining Plan based on these parameters must carry repercussions, for which regulatory agencies will need

to be adequately equipped. The MMDR (Amendment) Act, 2015, takes a step forward by enabling the State to determine the mine size for the auction process in future and by allowing transfers of auctioned mines, but that does not address the current concern where most of the small mines are non-auctioned. It needs no reiteration that as pointed out by Supreme Court in the Natural Resources Allocation Reference (Cited in WP (Crl.) No. 120 of 2012), the ownership and control of natural resources should be so distributed as to subserve the common good (Extract from WP Crl. No. 120 of 2012 is in Appendix 1).

In order to make mining world-class, sectoral value addition in minerals through latest techniques of beneficiation, calibration, blending, sizing, concentration, pelletization, purification, and general customization of product will also need to be encouraged. The general experience is that much of this is better done when mining companies are able to freely trade in mineral ore and ore products. Historically, major mineral mining in India was an adjunct to metal making by the public sector, and the National Mineral Policy's general direction is both in favour of a level playing field for the private sector, and creation of a free market for ore to enable value addition. This is particularly important in iron ore mining as about 60 per cent or more of the iron ore produced in the country is in the form of fines and to promote pelletization, fiscal and non-fiscal incentives need to be provided. These incentives are necessary as pelletization enables transportation of the fines to distant locations. Clearly the MMDR (Amendment) Act, 2015, which provides for allocation of mines to public sector and auction to private sector, needs to be analysed further in this context, since it has implications in terms of widely divergent input costs (of the fines, and perhaps also coal) for pelletization.

Mining as an Industry with Linkages

Mining contributes to the generation of wealth and creation of employment and should therefore be treated as an economic activity in its own right and not merely as an ancillary activity of the manufacturing industry. The Hoda Committee Report reiterates that globally the current functioning of the government in the mining industry is limited primarily to three functions: information collection and dissemination; regulation; and tax collection. It further notes that globally the minerals market provides varied sources for minerals ranging from direct purchase to auctions. This diversity enables the dependent industries to opt for the appropriate market option to fulfill their mineral demand at competitive prices. Additionally, globally, the role of private sector in mining has risen with many governments relying on them for exploration decisions.

In the above context, the domestic and metal processing industry needs to receive supplies of mineral resources produced by the mining industry at market prices prevailing from time to time through a well-developed free market for mineral products, including different grades of ores, pellets, and concentrates. In the long run, this will drive efficiency and make the industry robust, innovative, and competitive. In order to be assured of uninterrupted supply of the mineral raw material from domestic sources, the user industry needs to be encouraged to develop long-term linkages with the mineral-product producing units whether at home or abroad. The mineral processing unit should not only get an assured supply of the mineral raw material but should also have close links with the production and marketing agencies of the mineral-based end products. Mining as a backward linkage and value addition as a forward linkage, therefore, needs to be encouraged. This can be done in a variety of ways, by allowing free transfer of concessions, including mining leases, and by giving a slight preference to value addition and end use when calling bids for mineral deposits as now required under the MMDR Act.

As the country develops and industry and manufacturing grows, impelled by the 'Make in India' policy, assured availability and lower prices of mineral resources will play an important role in giving a competitive edge to Indian industry in general and manufacturing in particular. The multiplier effect of minerals processed into metals on downstream industrialization cannot be overemphasized. Value

addition must, therefore, be actively encouraged to the extent appropriate for the long term development of the mineral sector. In particular, emphasis needs to be given to co-production of by-product metals from base metal ores through process R&D so that the country's needs of so-called Technology Metals and Energy Critical Metals are effectively met, and to provide raw material security on the one hand and competitive edge for the country's manufacturing sector on the other. Bidding systems under the MMDR (Amendment) Act, 2015, will need to address this squarely by ensuring that they are factored into resource estimations and valuations (and also into the Mining Plan).

Building Skills and Manpower

The quality and volume of our scientific human resources, including knowledge and expertise at the frontiers of geoscience has already emerged as a bottleneck for the growth of the sector. As the mining sector takes off, the country will need more and more mining engineers, geologists, geophysicists, geo-chemists, and geo-informatists. A comprehensive review of the sector's manpower was undertaken through a study by the Confederation of Indian Industry (CII) in 2011 in the form of *The Skill Mapping Report* commissioned for the Ministry of Mines. Based on that, the Strategy Paper for the Ministry of Mines, titled 'Unlocking the Potential of the Indian Minerals Sector', November 2011, has estimated that in the period up to 2025, there will be a need to produce some 3,000 geoscientists and 40,000 mining engineers over and above the normal supply. The MMDR (Amendment) Act's current emphasis on exploration, predominantly by government agencies, adds to the urgency of ensuring availability of appropriate human resources in a sector where experience is as important as expertise.

Infrastructure for Mining

While increasing mineral exploration is the need of the hour, improvement in support infrastructure is also a major issue that needs to be addressed. Roads, railways and ports play a vital role in the minerals

sector and access to and from mines to major business centres, export and import hubs, from mines to end user needs to be increased through modernization and capacity augmentation to create a robust network. The FICCI 2013 Report highlights that railway connectivity in mining States is poor and with most mining sites located in remote regions, access by road and rail is an urgent necessity.

Emphasizing on the significance of port facilities for the minerals network, the FICCI 2013 Report highlights the fact that there are various challenges such as lack of connectivity by rail or roads to ports, with existing ports being unable to provide for the expected growth in the traffic due to delays and significant time lags in the movement of cargo because of constraints of manpower, capacity, and lack of technology.

Sustainable Development Framework for Mining

Mining has been always considered as an industry that significantly, and usually adversely, impacts environment and communities. While there is no debate on the issue that mining is a significant part of nearly every economy, clearly there is a need to emphasize on more responsible mining. Public dissatisfaction and

resentment against infrastructure projects including mining has been rising. Implementation of current laws and effective regulation is a prerequisite so as to continue mining, atleast for the essential minerals. The National Mineral Policy 2008 and the Sustainable Development Framework of Mining, published in 2008, focus on the optimum and efficient utilization of resources and stress on minimizing external and negative impacts that are social and environmental in nature.

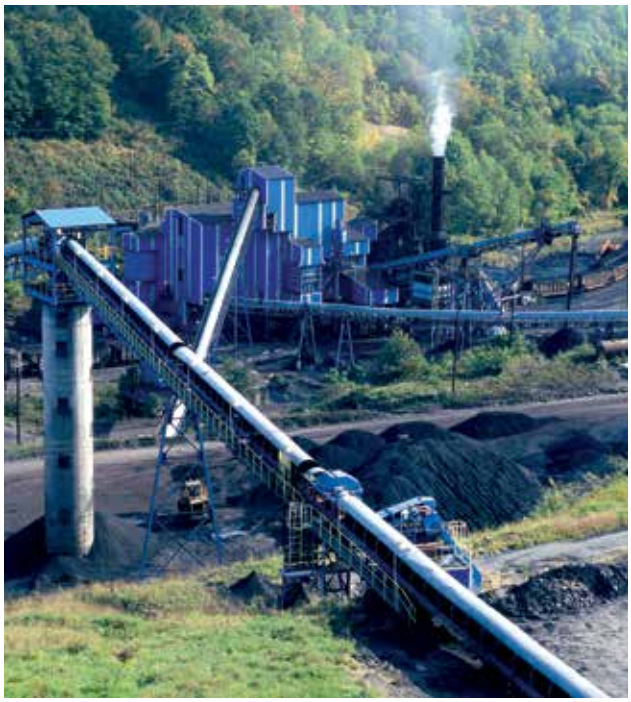
The National Mineral Policy well recognizes that extraction of minerals closely impacts other natural resources like land, water, air, and forests. The areas in which minerals occur often have other resources, presenting a choice of utilization of the resources. Some such areas are ecologically fragile and some are biologically rich. It is necessary to take a comprehensive view to facilitate the choice or order of land use, keeping in view the needs of development as well as the need of protecting the forests, environment, and ecology. Prevention and mitigation of adverse environmental effects due to mining of minerals and repairing and re-vegetation of the affected forest area and land covered by trees in accordance with the latest internationally acceptable norms and modern afforestation practices needs to form an integral part of mine development strategy in every case.

As advocated by NMP 2008, all mining must be undertaken within the parameters of a comprehensive Sustainable Development Framework that is devised in a form that takes all these aspects into consideration. The ideal scenario must be that a miner shall leave the mining area in better ecological shape than he found it. No mining lease should be granted to any party, private or public, without an environmentally sound mining plan. Environmental Impact Assessments (EIA) and Environmental Management Plans (EMP) will therefore need to be organically linked with the Mining Plan and Mine Closure Plan. Since environmental studies related to mining activities require deep and extensive knowledge of the mining domain, the regulatory agencies from the mining side such as the IBM and the State Directorates need to be suitably equipped and made part of a seamless statutory process.

The National Mineral Policy advocates the development of a Sustainable Development Framework (SDF) for the mining sector, with appropriate compensation to those affected by mining related operations forming an important aspect of the Framework. The SDF is intended to be the instrument that will fill gaps in addressing concerns for the well-being and socio-economic development of affected populations and also ensure that there is adequate and effective community engagement at all stages. In particular, insofar as indigenous (tribal) populations are concerned, the Framework will need to incorporate a model for the inclusion of stakeholder interests in mining operations. The SDF's first level documentation has already been prepared by the Ministry of Mines in November 2011, and is structured around the following seven principles:

- Incorporate environmental and social sensitivities in decisions on leases
- Undertake strategic assessment of key mining regions at periodic intervals
- Manage impacts at the mine level through sound management systems
- Address land, Relief & Resettlement (R&R), and other social impacts upfront
- Promote community engagement, benefit sharing, and contribution to socio-economic development
- Ensure orderly mine closure planning and implementation and post-closure activities
- Put in place systems for assurance and credible reporting

The MMDR (Amendment) Act, 2015, provides for the creation of a District Mineral Foundation (DMF) in every District affected by mining related operations to work for the benefit of persons and areas affected by such operations. The MMDR (Amendment) Act, 2015 also empowers the Central government to



issue directions to State governments *inter-alia* on minimizing and mitigating adverse environmental impacts and ecological disturbances, promoting restoration and rehabilitation work on mined out lands, and implementation of sustainable development frameworks. The MMDR Act, as amended, makes a small mention of the Framework. Ideally, this can be best taken forward by bringing out a second-level documentation under the Ministry's existing Framework document for use at the State level and getting the States to create a third-level document, as an operational manual for use at mine/lease level, perhaps based on a Model document. The second-level document which should address the issue of regional level and cumulative impacts is particularly important as these issues go to the heart of the matter arising from the Bellary and Goa cases presently before the Supreme Court. Additionally, the second and third level of documentation under the SDF also need to be applied to so-called 'minor minerals' which are often minor in economic importance but major in environmental impacts.

The role of communities and the environment is also central in the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act 2013 ('Land Acquisition Act' in short) and the environmental laws, namely The Water (Prevention and Control of Pollution) Act, 1974, The Air (Prevention and Control of Pollution) Act, 1981, and the Environment (Protection) Act, 1980. While the NMP 2008 and the SDF thereunder envisages the broader contours of the sustainability aspects that should be considered in every mining project, the Land Acquisition Act squarely addresses the issues relating to managing the social impacts of the acquisition and the environmental laws require the conduct of structured environmental impact assessments and preparation of management plans. The second and third level of documentation under the SDF is essential to ensure that these laws and procedures thereunder work in harmony and balance the social and environmental issues with those relating to the exploitation of mineral resources for economic growth and poverty reduction.

Research and Development (R&D)

Research and development in the mineral sector has to cover the entire gamut of activities from geoscientific survey, and exploration and mining to beneficiation and coproduction of low-concentration strategic metals (particularly as by-products from base metal processing). Efforts will need to be directed towards the development of new technologies for improving the feasibility of conversion of existing mineral resources into viable economic resources. In many cases, the technology needs to be sourced from advanced mineral jurisdictions (and locally customized), perhaps as part of FDI, and mechanisms will need to be developed for the purpose. The MMDR (Amendment) Act, 2015 does not currently incentivize FDI for exploration. It can however significantly influence inflow of FDI into mining by ensuring that the mine size put to auction is attractive for FDI, so that the successful bidder can enter into ownership transfer or sharing arrangements which bring in FDI.

As advocated by the NMP 2008, attention needs be given to beneficiation and agglomeration techniques to bring lower grades and finer particle size material into use. Research organizations, including the Mineral

Processing Laboratories of the Indian Bureau of Mines will need to be strengthened for development of regional level processes for beneficiation and mineral and elemental analysis of ores and ore dressing products. The issue of promoting process R&D (including beneficiation) needs to be considered in depth. While at one level, the Council of Scientific and Industrial Research (CSIR) Labs and IBM can do 'public good', process R&D based on regional samples, deposit-specific process R&D needs to be done by the concessionaire on a commercial basis (though CSIR Labs and IBM can do such work for the concessionaire on a job basis).

In the intermediate R&D space, where the feasibility of the deposit is the question, process R&D to conduct feasibility studies constitutes a high-risk, high-reward situation. IBM or CSIR Labs cannot and should not take up this work and creation of a venture-capital funded process R&D setup is clearly required if the concept of zero-waste mining is to be taken to its logical conclusion. Fiscal as well as non-fiscal incentives need to be structured after a detailed study of how the system works in other countries such as Australia and Canada especially Australia's Cooperative Research Centre (CRC) mechanism which supports end-user driven research collaboration. In this connection, the likely impact of granting concessions only through bidding processes, as provided in the MMDR (Amendment) Act, 2015, has to be analysed with reference to the potential for facilitation of both beneficiation of low grades, and (as mentioned earlier) co-production of minor metals as by-products.

For the proper growth of the mineral and metal industry in the service of the nation, research also needs to be directed towards raw materials required for production of materials of high purity for use in advanced technology applications, such as semiconductors, electrical storage devices, magnets, photovoltaics, lasers, special sensors, high temperature new ceramics, hard and high temperature materials, superconductors, insulators, very thin films, glasses and liquid crystals, and metal and mineral fibres. The Non-Ferrous Technology Development Centre (NFTDC), Hyderabad, a non-grant R&D institution under the Ministry of Mines has done significant lab scale work on many materials including base metals. Similarly, Jawaharlal Nehru Aluminium Research Development and Design Centre (JNARDDC) has done R&D on high purity aluminium suitable for defence and aerospace applications. There are other agencies under Department of Science and Technology and Defence Research and Development Organization (DRDO) that are conducting similar work on development of high purity material and special alloys. There is clearly a need for an institutional mechanism that comprises of stakeholders interested in tangible outcomes, to help direct lab scale research and then upscale it to pilot project level and enable commercialization.

Conclusion

The world is becoming more closely interconnected through transportation, communication, and interlinking technologies. This process of globalization has many implications for the national economy, some of which are related to demand and supply and pricing of resources. As pointed out in TERI's Policy Brief, 'Critical non-fuel minerals security: Why India urgently needs to have a policy in place' (December 2010), "There is an increased tendency of the producing nations to control the prices and the quantities made available in the world market". Growth in population and consumption will inevitably place greater stress on natural resources and the environment, forcing science and society to seek more sustainable responses, and the nation's mineral development policy must be able to rise to the challenge.

The Hoda Committee report elaborately envisioned the contours of an enlightened National Mineral Policy pointing out the need for technological impetus, adoption of best practices in tax regimes, mining regulation, community engagement, and research and development. The National Mineral Policy 2008 attempts to address all the major issues relating to securing the mineral resources we need as well as ensuring that the process of exploiting

the resources for development is environmentally sustainable and socially acceptable. The policy has been crucial for the formulation of the Sustainable Development Framework of Mining that sets the tone for responsible mining. However, the Policy has to be given effect through legislative and administrative measures, and much depends on how well the spirit and intention of the Policy can be incorporated in these measures. The sectoral setting also needs to be made conducive for the further evolution of the Policy with changing needs and global circumstances, through the establishment of an institutional mechanism that enables incorporation of scientific, economic, and geopolitical inputs.

With the changing global scenario, the Mineral Policy must be leveraged in India's interest for poverty reduction, economic growth, and sustainable development within the framework of resource security. A strong, vibrant, and evolving Mineral Development strategy that works to incentivize global best practices, supported with a legal framework, that has its roots in resource security, sustainable development and intergenerational equity, is the need of the hour. Specifically, the following strategic steps need to be taken urgently to give effect to the forward looking provisions of the National Mineral Policy 2008:

- The GSI needs to ensure that its regional surveys cover all major geo-scientific datasets, including geology, magnetics, electromagnetics, spectral, gravity, geochemistry (for 68 elements), etc., and that are in line with the best international practices. All pre-competitive data, including spatial data in GIS environment, also needs to be put out to facilitate entrepreneurs to take investment decisions for exploration and aid them in making applications for mineral concessions.
- A National Geophysical Data Repository and a National Drill Core Library must be statutorily created, preferably under or in close collaboration with GSI to systematically use the data generated during exploration.
- The National Mineral Exploration Trust set up through the MMDR (Amendment) Act, 2015, may be able to pay for only some of the huge expenditure that is entailed in this venture, and may not be able to adequately capture the spirit of the high-risk high-reward paradigm. The Trust is funded by a 2 per cent cess on the royalty and the funds accruing to the Trust will be of the order of ₹400 crore per annum (or $75 million per annum). This is miniscule compared to exploration spends in countries like Australia, Canada, South Africa, and Latin America, in each of which annual exploration spends are in the range of USD 500 million to USD 1,200 million per year.
- International exploration budgets are allocated based on attractiveness of destinations, and India must make its exploration sector much more attractive to FDI flows.
- The entire strategy for exploration may actually need to be analysed further from the point of view of ensuring that GSI's work of baseline data collection is not disrupted on the one hand, and funds and expert resources for exploration flow unhindered on the other hand.
- Internationally accepted systems for categorization of mineral finds such as JORC (and its Canadian equivalent known as 43.101) will need to be given legal backing to bring in the standardization needed to be able to attract FDI or even to credibly conduct auctions of explored prospects. The latter also requires the development of expert third party valuation mechanisms.
- The MMDR (Amendment) Act, by making auctions as the only mode of granting mineral concessions, has increased the range and scope of work of the Indian Bureau of Mines and the State Directorates particularly with regard to mineral resource estimations and mineral reserve valuations. Capacity building for the purpose has to be a high priority if the intention behind adopting the auction route is to be realized. Failure to reform the regulatory mechanism may have serious negative consequences in the future,

such as environmental damage, social opposition, and discouragement of investment flows including FDI, and last but not the least to the revenues being accrued by the State governments.

- The time has come to create independent Mining Regulatory Authorities for oversight at the Central and State level to restore investor confidence and ensure that the primary regulatory mechanisms for mining plans and closure plans operate transparently and reliably in accordance with globally well-recognized technical standards .
- Nearly 56 per cent of major mineral mines are below 10 hectares, and in most cases are not based adequately on scientific exploration. Clearly the legislative framework must allow, in fact, facilitate and strongly incentivize, amalgamation and transfers so as to enable consolidation on geoscientific principles. The MMDR (Amendment) Act, 2015, takes a step forward by enabling the State to determine the mine size for the auction process in future and by allowing transfers of auctioned mines, but that does not address the current problems where most of the small mines are non-auctioned. It needs no reiteration that as pointed out by the Supreme Court in the Natural Resource Allocation Reference (cited in WP (Crl) No. 120 of 2012, the ownership and control of natural resources should be so distributed as to subserve the common good (extract from WP (Crl) No. 120 of 2012 in Appendix I).
- Emphasis needs to be placed towards co-production of by-product metals from base metal ores through process R&D so that the country's needs of so-called Technology Metals and Energy Critical Metals are effectively met, and provide raw material security on the one hand and competitive edge on other, for the country's manufacturing sector. Bidding systems under the MMDR (Amendment) Act, 2015, will need to address this squarely by ensuring that they are factored into resource estimations and valuations.
- In the period up to 2025, there will be a need to produce some 3,000 geoscientists and 40,000 mining engineers over and above the normal supply. The MMDR (Amendment) Act, 2015, emphasizes on exploration predominantly by Government agencies, adding to the urgency of ensuring availability of appropriate human resources in a sector where experience is as important as expertise.
- Improvement in support infrastructure is a major issue that needs to be addressed. Roads, railways, and ports play a vital role in the minerals sector and access to and from mines to major processing and handling centres, and export and import hubs and the capacity of roads and railways from mines to end user needs to be increased to create a robust network. Currently many of these facilities are overstressed and in dire need of modernization and capacity improvement.
- The Sustainable Development Framework (SDF) for the mining sector with appropriate compensation to those affected by mining related operations is an important feature of the Mineral Policy which finds a small mention in the MMDR Act after its amendment. The first level SDF Document, already published, is intended to be the guiding instrument that will fill gaps in addressing concerns for the well-being and socio-economic development of affected populations and also ensure that there is adequate and effective community engagement at all stages. The second and third level of documentation, at the State and district level, respectively, under the SDF, is essential:
  - to ensure that laws relating to the environment and other natural resources like forest and land work in harmony with mining laws; and
  - to balance the social and environmental issues with those relating to the exploitation of mineral resources for economic growth and poverty reduction.
- Where the feasibility of a mineral deposit is the question, process R&D to conduct feasibility

studies often constitutes a high-risk high-reward situation. Creation of a venture-capital funded process R&D setup is clearly required if the concept of zero-waste mining is to be taken to its logical conclusion. Incentives, fiscal as well as non-fiscal, need to be structured based on a detailed study of how the system works in countries, such as Australia and Canada, in particular Australia's Cooperative Research Centre (CRC) mechanism which supports end-user driven research collaboration.

References

- Development of Indian Mining Industry-The way forward, Non-fuel minerals 2013, FICCI Mines and Metals Division, Federation of Indian Chambers of Commerce and Industry, available at http://www.ficci.com/spdocument/20317/Mining-Industry.pdf, last accessed on June 2, 2015.
- Minerals and Mines(Development and Regulation) Act 1957, Government of India, available at http://mines.nic.in/writereaddata/Filelinks/e342d686_MMDR%20Act%201957.pdf, last accessed on May 15, 2015.
- Minerals and Mines (Development and Regulation) (Amendment) Act 2015, Government of India, available at http://mines.nic.in/writereaddata/Contentlinks/f4e1c21aedc74ff8ad0d58788f9a01b3.pdf, last accessed on June 2, 2015.
- National Mineral Policy 2008, Ministry of Mines, Government of India, available at http://ibm.nic.in/writereaddata/files/12162014104115NMP2008.pdf, last accessed on June 5, 2015.
- Report of the High Level Committee to review the National Mineral Policy (Hoda Committee Report), 2006, Planning Commission, Government of India, available at http://mines.nic.in/writereaddata/Filelinks/46ff58f0_rep_nmp.pdf, last accessed on May 20, 2015.
- Report of the Working Group on Mineral Exploration and Development for the 12th Five Year Plan (2012–17), available at http://planningcommission.gov.in/aboutus/committee/wrkgrp12/wg_rep_min.pdf, last accessed on June 2, 2015.
- Sustainable Development Framework for Indian Mining Sector 2011, Ministry of Mines, Government of India, available at http://mines.nic.in/writereaddata/filelinks/2155afeb_FINAL%20REPORT%20SDF%2029Nov11.pdf, last accessed on May 28, 2015.
- The Energy and Resources Institute (TERI) 2015, Discussion Paper: The Mineral Development and Regulation Framework in India, http://www.teriin.org/policybrief/index.php?a=17, last accessed on May 28, 2015.
- Unlocking the Potential of the Indian Minerals Sector, Strategy Paper for the Ministry of Mines 2011, Government of India, available at http://mines.nic.in/writereaddata/Contentlinks/9eeb6e3b613423586029ee88e1f4b36.pdf, last accessed on June 5, 2015.

Appendix 1: Excerpt from Supreme Court Judgment dated August 25, 2014 in Writ Petition (Crl.) No. 120 of 2012

98. In *Natural Resources Allocation Reference*, the Constitution Bench said that reading auction as a constitutional mandate would be impermissible because such an approach may distort another constitutional principle embodied in Article 39(b). In the main judgment, with reference to Article 39(b), the Court stated as follows:

> 113 "…The disposal of natural resources is a facet of the use and distribution of such resources. Article 39(b) mandates that the ownership and control of natural resources should be so distributed so as to best subserve the common good. Article 37 provides that the provisions of Part IV shall not be enforceable by any court, but the principles laid down therein are nevertheless fundamental in the governance of the country and it shall be the duty of the State to apply these principles in making laws. Therefore, this Article, in a sense, is a restriction on "distribution" built into the Constitution. But the restriction is imposed on the object and not the means. The overarching and underlying principle governing "distribution" is furtherance of common good. But for the achievement of that objective, the Constitution uses the generic word "distribution". Distribution has broad contours and cannot be limited to meaning only one method ,i.e., auction. It envisages all such methods available for distribution/allocation of natural resources which ultimately subserve the "common good."
>
> 115. It can thus be seen from the aforequoted paragraphs that the term "distribute" undoubtedly, has wide amplitude and encompasses all manners and methods of distribution, which would include classes, industries, regions, private and public sections, etc. Having regard to the basic nature of Article 39(b), a narrower concept of equality under Article 14 than that discussed above, may frustrate the broader concept of distribution, as conceived in Article 39(b). There cannot, therefore, be a cavil that "common good" and "larger public interests" have to be regarded as constitutional reality deserving actualisation.
>
> 119. The norm of "common good" has to be understood and appreciated in a holistic manner. It is obvious that the manner in which the common good is best subserved is not a matter that can be measured by any constitutional yardstick—it would depend on the economic and political philosophy of the Government. Revenue maximization is not the only way in which the common good can be subserved. Where revenue maximization is the object of a policy, being considered qua that resource at that point of time to be the best way to subserve the common good, auction would be one of the preferable methods, though not the only method. Where revenue maximization is not the object of a policy of distribution, the question of auction would not arise. Revenue considerations may assume secondary consideration to developmental considerations.
>
> 120. Therefore, in conclusion, the submission that the mandate of Article 14 is that any disposal of a natural resource for commercial use must be for revenue maximization, and thus by auction, is based neither on law nor on logic. There is no constitutional imperative in the matter of economic policies—Article 14 does not predefine any economic policy as a constitutional mandate. Even the mandate of Article 39(b) imposes no restrictions on the means adopted to subserve the public good and uses the broad term "distribution", suggesting that the methodology of distribution is not fixed. Economic logic establishes that alienation/allocation of

natural resources to the highest bidder may not necessarily be the only way to subserve the common good, and at times, may run counter to public good. Hence, it needs little emphasis that disposal of all natural resources through auctions is clearly not a constitutional mandate.

99. In light of the above legal position, the argument that auction is a best way to select private parties as per Article 39(b) does not merit acceptance. The emphasis on the word "best" in Article 39(b) by the learned senior counsel for the intervener does not deserve further discussion in light of the legal position exposited by the Constitution Bench in *Natural Resources Allocation Reference* [*Natural Resources Allocation, In re*, Special Reference No.1 of 2012; {(2012) 10 SCC 1}] with reference to Article 39(b). We are fortified in our view by a recent decision of this Court (3-Judge Bench) in *Goa Foundation* {*Goa Foundation v. Union of India and Others*; [(2014) 6 SCC 590}] wherein following *Natural Resources Allocation Reference*, it is stated, "*…it is for the State Government to decide as a matter of policy in what manner the leases of these mineral resources would be granted, but this decision has to be taken in accordance with the provisions of the MMDR Act and the Rules made thereunder and in consonance with the constitutional provisions*…".

Appendix 2: Glossary of Terms

Beneficiation: Beneficiation is the processing of minerals or ores for the purpose of—(i) regulating the size of a desired mineral produce; (ii) removing unwanted constituents; and (iii) improving quality, purity, or assay grade of the desired mineral produce. (MCDR)

Exploration:

- **General Exploration** involves the initial delineation of an identified mineral deposit. Methods used include surface mapping, widely spaced sampling, trenching, and drilling for preliminary evaluation of mineral quantity and quality (including mineralogical tests on laboratory scale if required), and limited interpolation based on indirect methods of investigation. The objective is to establish the main geological features of a deposit, giving a reasonable indication of continuity and providing an initial estimate of size, shape, structure, and grade. The degree of accuracy should be sufficient for deciding whether a Prefeasibility Study and Detailed Exploration are warranted. (UNFC)
- **Detailed Exploration** involves the detailed three-dimensional delineation of a known mineral deposit through sampling, such as from outcrops, trenches, boreholes, shafts, and tunnels. Sampling grids for drilling are closely spaced such that size, shape, structure, grade, and other relevant characteristics of the deposit are established with a high degree of accuracy. Processing tests involving bulk sampling may be required. (UNFC)

Mineral: A mineral is a naturally occurring substance that is solid and inorganic and representable by a chemical formula, and has an ordered atomic structure. It is different from a rock, which can be an aggregate of minerals or non-minerals and does not have a specific chemical composition. Most but not all minerals are crystalline. Most but not all minerals have one or more metals as part of the substance.

Mineral Resource: A mineral resource is a concentration or occurrence of solid material of economic interest in or on the earth's crust in such form, grade, or quality and quantity that there are reasonable prospects for eventual economic extraction (International Council on Mining and Metals, i.e., ICMM).

Mineral Reserve (or Ore Reserve): A mineral reserve or an ore reserve is the economically mineable part of a mineral resource (ICMM).

Mineral Ore: An ore is a type of rock or rocky material that contains sufficient minerals with important elements including metals that can be economically extracted from the rock through mining operations. An ore body is the assemblage of such rocky material.

Mineralization: Mineralization is the process of formation of a mineral out of unmineralized material

or concentration of the mineral above its normal abundance due to geological processes involving heat, pressure, chemical action, sedimentation, etc.

Mineral Occurrence: An indication of mineralization, that is worthy of further investigation. The term mineral occurrence only indicates presence of one or more minerals but does not imply any measure of volume or tonnage, grade or quality and is thus not yet part of a mineral resource (UNFC).

Mineral Deposit: A mineral occurrence of relatively higher concentration.

Mining Operation: A mining operation is any operation undertaken for the purpose of winning (i.e., recovering) any mineral. It generally includes extracting the ore and then processing it to recover the minerals in the ore (MMDR Act, 1957).

Mining Lease: A lease granted for the purpose of undertaking mining operations, and includes a sub-lease (MMDR Act, 1957).

Prospecting: It means any operation undertaken for the purpose of exploring, locating, or proving mineral deposit, including geochemical and geophysical surveys, and drilling (MMDR Act, 1957).

Prospecting is the systematic process of searching for a mineral deposit by narrowing down areas of promising enhanced mineral potential. The methods utilized are outcrop identification, geological mapping, and indirect methods such as geophysical and geochemical studies. Limited trenching, drilling, and sampling may be carried out. The objective is to identify a deposit which will be the target for further exploration. Estimates of quantities are inferred, based on interpretation of geological, geophysical, and geochemical results (UNFC).

Note: A prospecting licence granted under the MMDR Act permits general exploration as well as detailed exploration.

Reconnaissance: Any operations undertaken for preliminary prospecting of a mineral through regional, aerial, geophysical, or geochemical surveys and geological mapping, but does not include pitting, trenching, drilling, or sub-surface excavation (MMDR Act, 1957).

A reconnaissance study identifies areas of enhanced mineralization on a regional scale based primarily on results of regional geological studies, regional geological mapping, airborne and indirect methods, preliminary field inspection, as well as geological inference and extrapolation. The objective is to identify mineralized areas worthy of further investigation towards mineral deposit identification. Estimates of quantities should only be made if sufficient data are available (UNFC).

This is part of a series of policy briefs by TERI based on its research work in specific areas. These briefs are made available to Members of Parliament, policy-makers, regulators, sectoral experts, civil society, and the media. The briefs are also accessible at http://www.teriin.org/policybrief/. The purpose is to focus on key issues and list our policy recommendations to encourage wider discussion and debate. We would very much value your comments and suggestions.

Policy Briefs and Discussion Papers of TERI

	Title	Date
1.	Towards a Policy for Climate Resilient Infrastructure and Services in Coastal Cities	June 2015
2.	Biofuel Promotion in India for Transport: Exploring the Grey Areas	February 2015
3.	Crisis in India's Electricity Distribution Sector: Time to Reboot for a Viable Future	January 2015
4.	The Mineral Development and Regulation Framework in India	January 2015
5.	What would India need for moving to a 100% renewable energy scenario by 2050?	December 2014
6.	Perspectives on a Water Resource Policy for India	October 2014
7.	Advancement of Fuel Quality and Vehicle Emissions Norms to Improve Urban Air Quality in India	September 2014
8.	Tax Regime for Improved Cookstoves and Its Implications	September 2014
9.	Proliferation of Cars in Indian Cities: Let Us Not Ape the West	June 2014
10.	Climate Proofing Indian Cities: A Policy Perspective	March 2014
11.	India and Sustainable Development Goals	December 2013
12.	Engagement with Sustainability Concerns in Public Procurement in India: Why and How	August 2013
13.	Shale Gas in India: Look Before You Leap	June 2013
14.	Petroleum Product Pricing Reforms in India: Are We on the Right Track?	March 2013
15.	Enhancing Water use Efficiency of Thermal Power Plants in India: Need for Mandatory Water Audits	December 2012
16.	Governance of Mining in India: Responding to Policy Deficits	June 2012
17.	Don't Tinker with the Clock to Save Energy	August 2011
18.	India's Coal Reserves are Vastly Overstated: Is Anyone Listening?	March 2011
19.	Critical Non-fuel Minerals Security: Why India Urgently Needs to have a Policy in Place	December 2010
20.	Strengthening Agricultural Biotechnology Regulation in India	September 2010

For more information contact:

Swati Ganeshan, Associate Fellow

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
E-mail: swati.ganeshan@teri.res.in

The Energy and Resources Institute

UKaid
from the British people