Mineral Resource Security for a Low-Carbon Indian Economy

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Summary

This policy brief highlights the significance of 'mineral resource security' for India in delivering its ambitious plans for development and economic growth. It emphasizes the linkage between a secure supply of minerals (as a raw material inputs) and domestic manufacturing with a purview of recent policies and programs announced by the current government of India. The findings are based on CEEW's on-going research work on "*Development of a framework to assess the criticality of non-fuel mineral resources essential for sustainable growth of Indian economy*," This work was supported by the Department of Science, and Technology (CHORD division), Government of India. The detailed report is under review and is expected to be published in June 2016.

Background

The current government has signalled a wide range of developmental policies and programs to woo global business community to come and 'Make in India'. To promote domestic manufacturing, India has liberalised foreign direct investment (FDI) in many sectors, which were earlier restricted or closed. Similarly, concerted action have been taken to ease the process of obtaining clearances (environment, social, etc.) and ease operational bottlenecks (such as labour inspections) by increasing the transparency of these processes. This has reflected in improved perception of India among various global institutions. The World Economic Forum's Global Competitiveness Index placed India 16 positions higher last year and an equally impressive improvement was seen in the 'ease of doing business' index released by the World Bank.

The stakes are high for 'Make in India', which aims to revive domestic manufacturing and create the millions of jobs that will result in a more uniform development of the country. While the operating environment is more conducive for new enterprises in the manufacturing sector, little attention has been paid to one of the important aspects of sector, i.e. assured supplies of raw material to feed the shop-floors and furnaces across these units.

What is the issue?

Raw materials, especially non-fuel minerals form the core of manufacturing process. There have been many instances where an industry setup or a country (as a whole) has faced impediments in promoting local manufacturing on account of a squeeze on the supply of

minerals. The example of restrictions placed on Japan's consumer electronics industry in light of the restrictions on the supply of rarer-earths by China is a case from recent memory.

An assured supply of raw materials is quintessential to the transformation of the country into a global manufacturing hub. National policies and actions do little to address (or even identify) the linkage between manufacturing sector needs and availability of mineral resources. There is an urgent need to address this possible roadblock and lessons from actions (to this effect) other parts of the world will be of immense value

Role of minerals in India's developmental plans

This issue brief evaluates some of the key policy announcements made by the current government in improving upon energy efficiency across multiple sectors, and, setting up a low carbon development pathway. The effort is to showcase what kind of technology solutions/products can deliver for those development goals and how minerals are associated with the manufacturing of them.

The important question is how India is planning to deliver upon its target policies? Whether, it will be largely met through imports of infrastructural components, or can we upgrade our domestic manufacturing setup by inviting global players in India? The current manufacturing structure of India is primarily dominated by the typical set of manufacturing streams such as 'food and beverages', 'chemicals', and 'metal processing (dominated by iron and steel), etc. Whereas, the role of technology intensive manufacturing streams, such as electronics and machinery, which can cater to the requirements of envisaged low carbon policies is limited to the low value add component manufacturing.

As it can be seen from the Table 1, to take an example – India has an aggressive target of 175 GW of renewable (100 GW solar, and 75 GW wind) based power installation by 2022. So far we have achieved less than 30 GW of installed capacity, where most of the components (polycrystalline modules, thin films panels, permanent magnets) are imported. India is a big consumer market for the global manufacturers. Moving forward, India would do well to increase the share of domestic content in the manufacturing of such 'consumer products'. Assured supplies of essential mineral resources, such as, Silicon, cadmium, tellurium, and neodymium (rare earth material) is imperative for manufacturers, before setting up the necessary facilities to manufacture. However, a big constraint at present in India is lack of production for any of these wanted minerals. The reasons extend from lack of exploration efforts to declare any mineable resource to the availability of appropriate technologies to make mineral extraction competitive with global suppliers.

Table 1: Mineral resources critical for key policy announcements on low carbon intensive and energy efficient development plans

Key Programmes/schemes/announcements made by the current Govt. of India	Key Initiatives	Component/Equipment required to support the initiative	Minerals required as raw material	Supply Risk	Estimated reserve depletion time by 2030 (in years)
National Domestic Efficient Lighting Program (DELP) & Street Light National Program (SLNP)	Replacing traditional bulbs with 200 million incandescant light bulbs & 35 million street lights	LED light	**Indium**	0.44	No primary production
			Gallium	0.37	No primary production
			LREEs (Ce, Yt)	0.81	No primary production
			HREEs (Eu, Gd)	1.00	No declared reserves
100 GW solar energy generation target	Installation of roof top solar, big solar projects etc.	Polycrystalline modules	**Silicon**	0.64	No primary production
		Thin film panels	**Cadmium**	0.00	No declared reserves
			Tellurium	0.47	No declared reserves
75 GW wind energy generation target	Setting up of Off Shore & On shore Stations	High performance rare earth permanent magnets	**LREE (Nd)**	0.81	No declared reserves
			HREE (Dy)	1.00	No declared reserves
FAME India - Faster adoption and manufacturing of HEVs/BHEVs	6 million (4 million 4Ws and 2 million 2Ws) hybrid and electric vehicles	Technology 1: Lithium-ion Batteries	**Titanium**	0.06	9.69
			Lithium	0.66	No declared reserves
			Nickel	0.33	No declared reserves
			Graphite	0.64	34.91
			Cobalt	0.57	No declared reserves
			Aluminium	0.34	27.04
			Iron	0.37	29.51
			Manganese	0.48	41.43
		High performance rare earth permanent magnets	**LREE (Nd)**	0.81	No declared reserves
			HREE (Dy)	1.00	No declared reserves
Capacity addition by 175GW of thermal power	Thermal Power plants using super-critical and ultra-super critical technologies	High pressure and temperature resistive structural applications	**Molybdenum**	0.62	No declared reserves
			Vanadium	0.54	No primary production
			Iron	0.37	29.51
Environmental management by improving air quality by setting stringent emission standards	Meeting new BS VI / Euro VI emission standards for automobile industry and also new emission standards for thermal power plants	Selective Catalytic Convertor (SCR) tehnologies	**Titanium**	0.06	9.69
			Molybdenum	0.62	No declared reserves
			Vanadium	0.54	No primary production
			PGM	0.54	No declared reserves

Source: CEEW analysis

India is reliant on imports for most (if not all) of the key raw material for such clean energy products. To add to it, our vulnerability to supply disruption is also high, as most of these minerals are geographically constrained in specific pockets and supplies are dominated by handful of countries in many cases. For example, 97% of the rare earth supplies are controlled by China globally, and in the past it has enjoyed to use the liberty of export restriction to provide for its growing domestic industrial base.

A similar scene plays out for a range of other manufacturing areas which could be competitive but for the unclear status of supply of the necessary raw materials. Table 1 illustrates vulnerability of Indian industry to the supply bottlenecks of Lithium, Nickel and Cobalt in the manufacture of Li-ion batteries, which are essential in promoting a large scale shift to electric vehicles in Indian cities. India has no reserve for lithium and hence setting up of domestic manufacturing of these components looks like a non-starter.

In most cases, there are limited or no substitutes available for these specialized minerals, and recovery from the end-of-life products is not economical due to low yield rate and high locking period.

Where we have failed?

While most almanacs paint a picture of India as a mineral-rich country (as per the IBM records, India is endowed with diverse resources of approximately 85 minerals), in reality though, there's only a hazy view of the potential mineral wealth that India is blessed with (or not).

A good quality baseline data on mineral resource potential is a precursor for investments and discovery of new mineral finds. The contribution form the mining sector is stagnant (< 2%) and is likely to remain that way unless a larger fraction of the landmass is surveyed scientifically for the occurrence and viable extraction of a range of minerals. As per official records, data for various types of primary surveys is available for very limited parts of the country. Till 2011, Indian agencies have managed to cover only 4% of the country's total land mass for detailed geochemical surveys, as compared to 91% coverage that is seen in a mineral rich country such as Australia. Whereas only 30%-40% of India's total landmass is covered under the geophysical surveys, every part of Australia has seen detailed geophysical surveys.

Due to lack of exploration, India has low or no clarity on the availability of a majority of minerals enlisted in the table 1. The ones that we are producing are dwindling in supply; or are under inefficiently produced due to several reasons, such as (a) inability to handle is low grade ores, (b) price factor, (c) significantly higher demand than what can be domestically produced (thereby resulting in total import dependence)

Even at the current rate of development, import dependency will see a rise for most of the minerals consumed in India (over the next decade). Certainly, this will expose our domestic manufacturers to vagaries of the global markets and where the reach of the Indian regulator is minimal.

Recommendations

As a first step an acknowledgment of minerals associated with India's manufacturing policy is necessitated. The list of required mineral resource could be unending, but an astute prioritization of minerals as per the needs of emerging technologies and domestic plans will assist policy planners in a big way. This study by CEEW has developed a framework for linking developmental plans and mineral needs. The study provides a priority list of target minerals on the basis of level of supply risk associated with each mineral and economic importance associated with the end use sectors. The action points extend from (a) domestic exploration, (b) economic diplomacy with specific global suppliers, (c) institutional reforms to undertake real time assessment of manufacturing and associated raw materials, and (d) augmenting our research and development towards targeted areas in order to find better substitutes for priority minerals, and simultaneously supporting the formal recycling sector in the country.