

( For discussions only)

# Long Term Perspectives for Indian Steel Industry

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## 1.0 INTRODUCTION

1.1 Steel is one of the most important products of the modern world and is of strategic importance for any industrial nation. Historically, all nations during their industrialization phase have been supported by a strong steel industry of their own. From construction, industrial machinery to consumer products, steel finds a wide variety of applications. It is also an industry with diverse technologies based on the nature and extent of use of raw materials.

1.2 The steel industry is characterized by high capital intensity, high dependence on bulk raw materials, cyclical growth trends, perpetual over-capacity and relatively low profitability. This is the reason why the problems associated with the steel industry are generally complex requiring larger governmental and social interventions for its sustainable growth. Also, given their criticality to nation building, almost all nations with strong steel industry today had started their journey with steel industry in the state sector. Today, the industry is largely privatized and public owned with the government holding significantly reduced equity.

1.3 India is the 4<sup>th</sup> largest producer of steel in the world accounting for production of 81.54 million tonnes of crude steel in 2013-14. It also holds the third position in consumption of steel. **(Annexure-1)** The industry exists in different sizes and with varying degree of vertical and horizontal integration. After the liberalization of the economic policies in the 1990s coupled with deregulation of the steel industry, the structure of the industry has changed significantly. In The role of the government is no longer that of a regulator, rather of a facilitator to industrial development of the development of the industry in removing bottlenecks and making the sector globally competitive.

1.4. The National Steel Policy 2005 (NSP 2005) sought to indicate ways and means of consolidating the gains flowing out of the new economic order and to chart out a road map for sustained and efficient growth of the Indian steel industry.

1.5. However, since 2008, the global economies, including India, have experienced a significant turbulence and uncertainty. Despite some stability coming back from actions taken in response to the emerging challenges worldwide, the global economic recovery remains fragile. This has affected the growth path of the Indian steel industry in more than one ways. The world witnessed volatility in commodity prices, more particularly in the case of those related to the steel industry such as iron ore, coking coal, nickel, manganese ores, and non-coking coal. This left a profound impact on the steel industry globally since 2008 and running into 2014. Also, during this period, global steel production and consumption growth have slowed down and the world is faced with an excess capacity in crude steel making to the tune of over 550 million tonnes by now. While the Indian steel demand and production have grown steadily till 2011-12, the same also has lost pace in the past two years.

1.6. The unfolding developments mentioned above, both on the demand and supply sides have warranted a re-look at the different elements of the NSP 2005. In the new environment new investments in the industry have to be steered with appropriate policy support to ensure that production of steel matches the pace of growth in consumption every year in the decades ahead. Fresh policy initiatives are needed to ensure that the industry follows a path that is sustainable when it comes to capacity addition, environment, raw materials sourcing, quality of steel products and the use of technology in steel making. Special attention is also required to be paid to the indigenous R and D efforts and induction of most modern technologies ensure that over time, the country's industry can reach and preferably surpass global efficiency benchmarks. Most importantly, it is incumbent on the part of the government to ensure that the industry is freed from negative externalities so that the growth of the industry is based on its absolute competitive strength and its actual performance matches its potential.

1.7. Any long term action plan for the industry in the context of developing infrastructure, provisioning for raw materials and supporting the industry with adequate policy tools to strengthen its competitive strength and face up to any external conditions will crucially depend, inter alia, on the projected growth of its market and the size of the industry. Given also the fact that the steel and its related raw materials markets are globally integrated today, the growth opportunities will also depend on how the industry shapes up in the rest of the world. Given the capital intensive and cyclical nature of the industry, there is an inherent danger of either under-investing or over-investing in it. Unrealistic optimism may lead to excessive planning and allocation of resources such land, capital, raw materials and labour which may be counterproductive both to the industry and the economy. Given the fact that all the resources will be in shortage, a larger than realistic plan will be tantamount to spreading the butter too thinly with no one really benefiting or the best options not getting the adequate support. At the same time, on the contrary, inadequate planning derived from an excessively conservative viewpoint may lead to suboptimal investment in the related areas and inappropriate planning. Therefore, the growth potential will have to be seen in a longer term perspective considering multiple scenarios of growth and choosing an optimal path.

1.8 Further, the domestic growth prospects cannot be isolated from the developments in the rest of the world. In a globally integrated economy and the steel industry in particular, the contours and direction of development of the industry will depend in a significant way on the supply position of raw materials in the world market, their cost, technology development, national policies of the governments in respect of trade and investment in raw materials, infrastructure and logistics, and, importantly, on the competitive growth of the steel industry itself elsewhere.

1.9. This document discusses the issues in the context of developing a long term plan for the steel industry in India. The timeframe considered is about 25 years from now, that is, up to 2035. Mainly, the paper is focused on the following subjects.

**(a) Global steel industry outlook: trends in production, consumption and investment and related strategic issues.**

- (b) Forecast of demand for steel and required production in India up to 2032-33.
- (c) Estimation of the requirement of raw material and domestic issues in respect of development of the raw materials industries.
- (d) Perspectives on infrastructure and specific requirement for the steel industry
- (e) Perspectives on technology, R andD and competitiveness of Indian steel industry

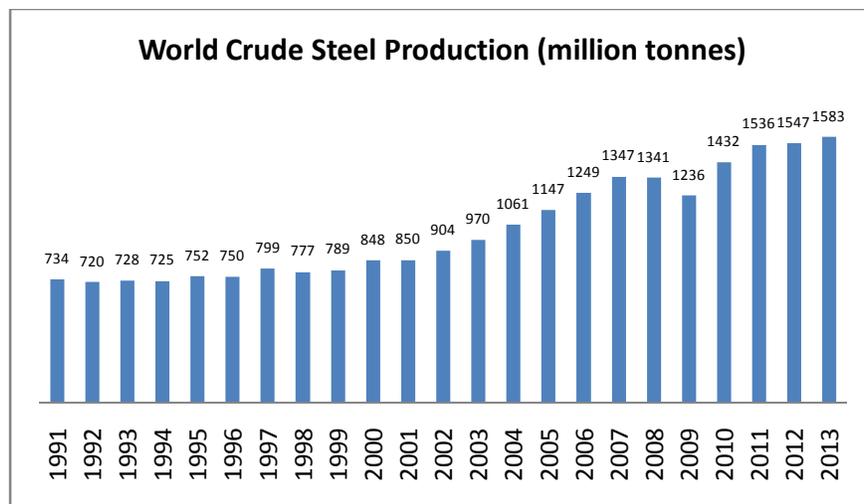
## Chapter -1

### World Steel Industry Outlook

#### 2.0 Trends in Global Steel production, Consumption and Trade

2.1 Global crude steel production reached an all time high of 1583 million tonnes in 2013. Nearly 67 per cent of the same was accounted for by Asia. China's share was at 49.2 per cent.

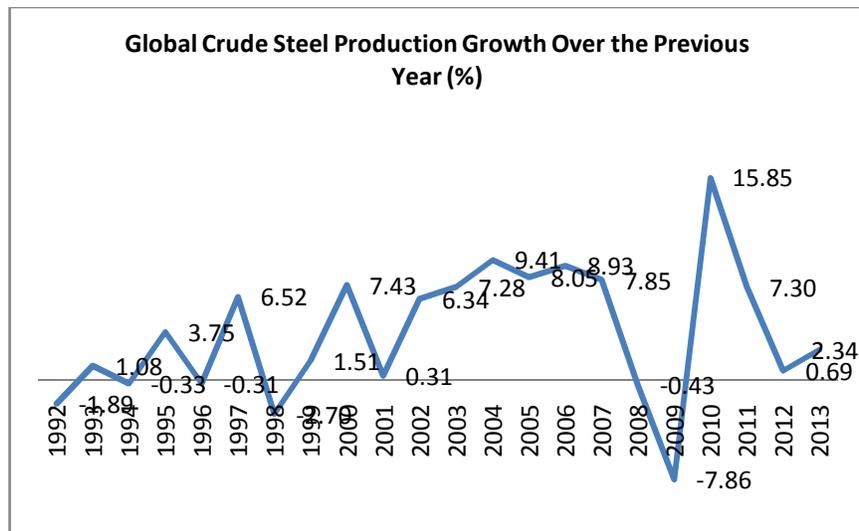
Chart-1



Source: WSA

2.2 The steel industry worldwide maintained a CAGR of 3.65 per cent during 2008-2012. This is fairly respectable compared to the corresponding figure of 1.6 per cent during 1973-2008 and 2.86 per cent during 1991-2008, despite the fact that the global economies have been under tremendous stress following the financial crisis and economic meltdown beginning 2008. However, despite a reasonable stability in production growth, barring the financial, crisis years, annual production growth rates over the period have exhibited significant volatility with wide swings observed over the past years.

Chart-2

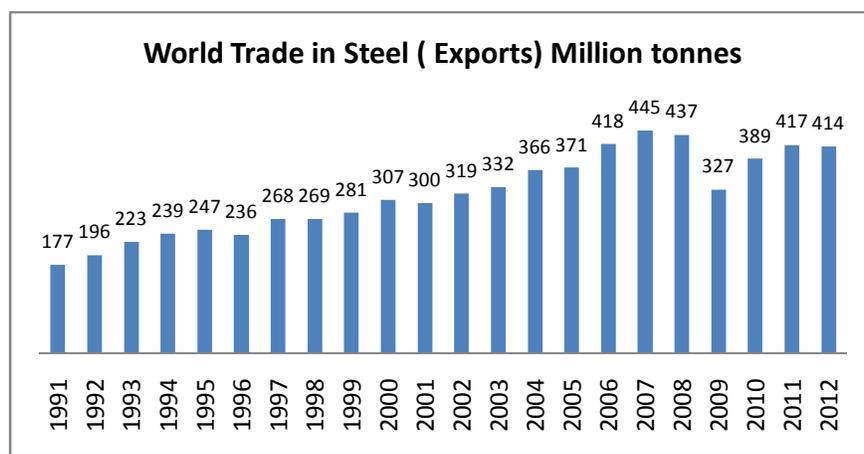


Source: WSA

2.3 Global steel production scenario has largely been shaped by the huge growth in both consumption and production of steel during this period.

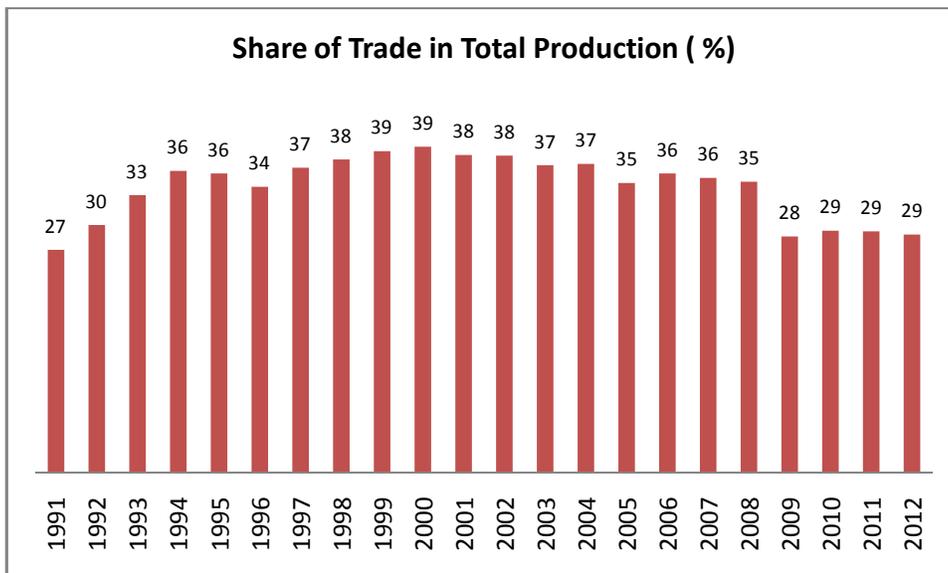
2.4 With globalization of the business of the steel industry, global trade in steel also grew rapidly till recently acquiring increasing share in the total production. Although this trend has flattened in the past few years with 2012 showing in fact a reduction in volume of steel traded in the international market, the total volume of trade in steel is likely to increase in the years to come considering the stronger initiatives taken by nations across the world to raise global trade.

Chart-3



Source: WSA

Chart-4



Source: WSA

2.5 The developments in the world steel market are important in the context of growth of the Indian steel industry. It is so also in view of the fact that unless globally cost competitive in a relatively open global market, the industry will not only have to fight for its space in the domestic market but also fail to grab shares in the world market. Competitiveness will depend on many factors including efficiency in production, labour productivity, costs of raw materials and infrastructure to move raw materials and finished products at low costs.

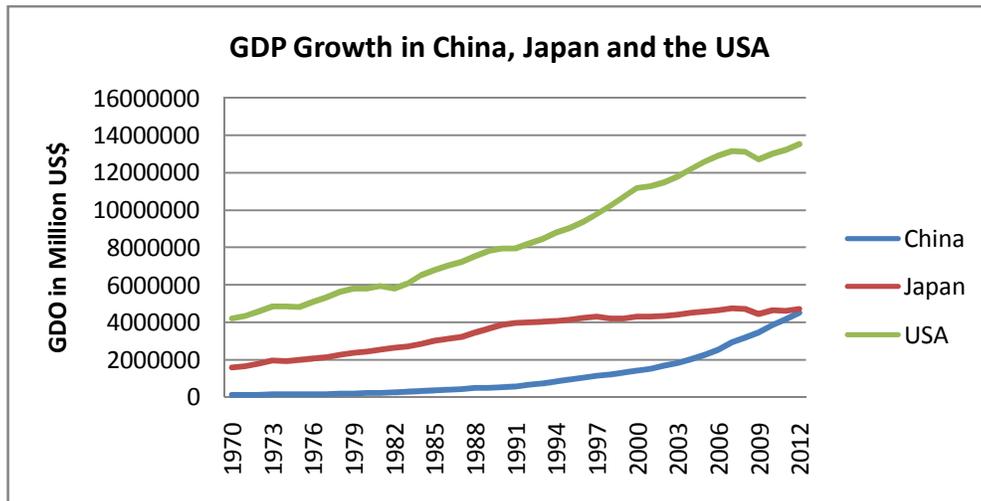
2.6 Also, despite the barriers to trade falling in the last few decades, the industry cannot be assured that the international trade in steel or any other product will go this way forever. The industry will have to take into account the non-tariff barriers which are coming up strongly across the world including the developed nations. Further, with more and more regional trade blocks coming with free and preferential trade, the global trading system will continue to face significant trade uncertainty and market disturbance. The industry will, therefore, require to take a broader view on the long term trade opportunities in the event it has to remain significantly dependent on the world market for business expansion.

2.7 Further, while it is not difficult to understand the factors related to domestic capabilities in absolute terms, the industry will have to be judged relatively in the context of global developments in capacity building, competitiveness, technological developments and future raw materials scenario.

## The World Economy

2.8 It is fairly clear that while there has been a continuous strong growth, year on year, in China. However, the trends in Japan and USA have not been so. The European Union has not been out of the financial mess and the emerging economies do not hold any strong promise to the global investor community in the short run as their macro management has been far below expectation. The latest report of IMF also point to gloomy prospects of the emerging economies while at the same time, they have in fact seen some stability creeping into the economies of the developed world.

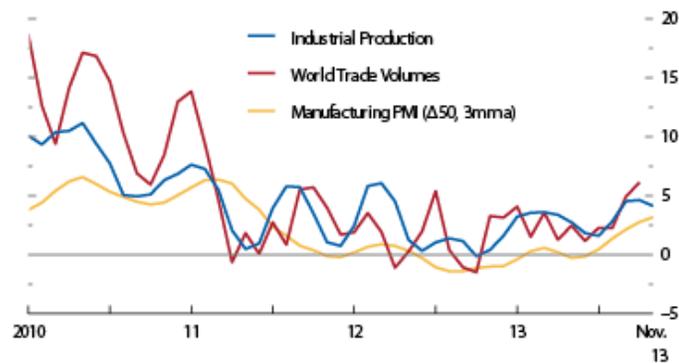
Chart-5



Source: International Monetary Fund

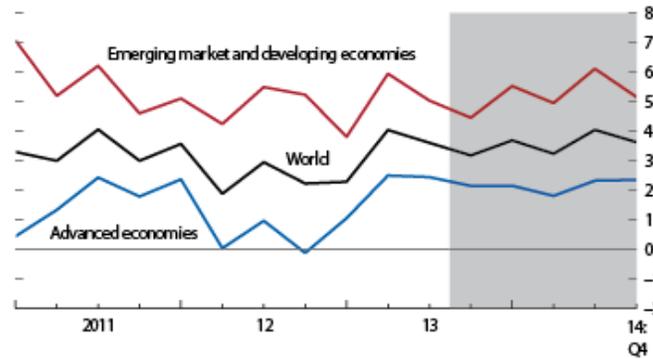
Chart-6

Figure 1. World Trade Volumes, Industrial Production and Manufacturing PMI  
(Three-month moving average, annualized percent change)



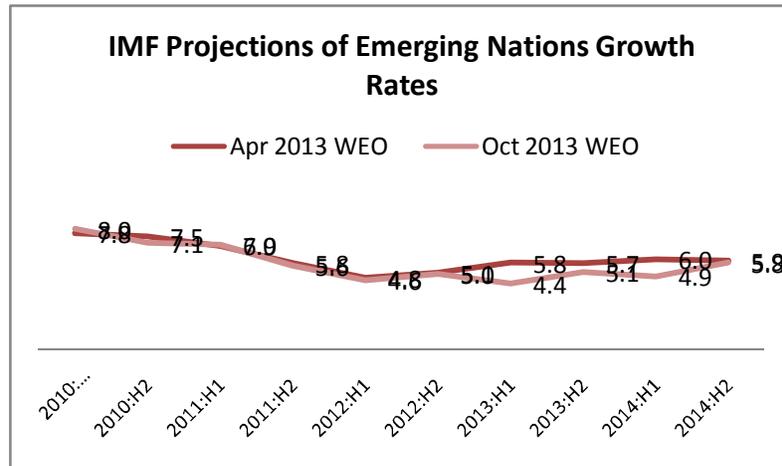
Sources: Market Economics, Haver Analytics and CPB World Trade Monitor.

Figure 2. Global GDP Growth  
(Percent; quarter over quarter, annualized)



Source: IMF staff estimates.

Chart-7



Source: IMF

2.9 While examining the prospects of the global economies for another 20 years or so, the current developments may not mean much. What is clear, however, is the fact that there is likely to be a change in the content and the nature of development of the global economy. This will be discussed in some more detail later.

### World Economy Forecasts

2.10 In the current states of the global economy with strong uncertainty around industrial development and especially in the context that both product and financial markets have been subject to high degree of volatility, it may not be possible to forecast global conditions of the market for many years into the future from the current position. It is, however, felt that in order to have wider perspective in regards to investment and growth of the steel industry in

India, there should be a projected future scenario in hand covering a much longer time horizon. This is mainly due to the fact that steel is a capital, infrastructure and raw materials intensive and dependent industry.

2.11 In a broad development perspective, we may assume that demographic changes, geopolitics, energy and minerals sourcing, security, technology development, capital and trade flows and human resource availability will drive the global economy in the decades ahead.

2.12 While one of the most important views holds that global population will stabilize and peak by 2050, in another, it is forecast that the same will happen by as early as 2030. There seems to be a higher degree of convergence of views towards the latter perception. This means that much of the global economic growth that results from pure consumption of an expanding population will not be available and the growth will depend more on quality of living and technology change. This will also put an end to the growth in demand for materials and possibly energy. Even if there is an increase in the same due to lifestyle changes, availability of energy and natural resources are unlikely to be major concerns by then.

2.13 It is also expected that the global economic system and trade flows will stabilize by 2030 as global economies will be more open to trade. It is difficult to foresee whether the national economies will turn more protectionist if not directly at least indirectly. China, a country that has been in the forefront of global industrial growth and industrialization in the last two decades or more will not be able to exploit its low labour cost advantage any more as the economy matures and the typical off-shoring manufacturing prospects reduces in the country. The Chinese government has already announced that in the coming years, China's economic growth will be driven more by consumption. This will lead to new opportunities for other developing and emerging nations, wherever labour costs are low and peaceful industrial development is possible. Given a valuable experience so far in industrial development, a supportive policy framework may provide strong opportunities for Indian industries to grow.

2.14 The global average investment rate in physical capital has increased considerably over the last decade to reach about 28 per cent of GDP, whereas it was only 21-22 per cent of GDP during the early 2000s. But investment rates have diverged across major regions, increasing considerably in the emerging economies and stagnating or even falling in the advanced countries. The investment rate in emerging countries now stands at about 33 per cent of GDP, while the great financial crisis has led to a sharp fall in investment in advanced economies, reinforcing its longer-term trend. The result is that investment in the EU and the US is substantially below 20 per cent of GDP, heading towards 15 per cent. It is viewed by most that investment in advanced countries should recover to a level somewhat below that observed before the crisis, but then resume its decline. Much larger falls in investment rates (as a share of GDP) are expected in China and the same may happen in the short term in India marginally.

2.15 As far as the developing or emerging nations are concerned, despite the significant prospects of industrial development in these economies, the ground reality has been that manufacturing got concentrated only in a few countries such as China, Korea, Taiwan, etc..

Contrary to the common expectations, the industrialization experiences in the developing world have not been very encouraging across these economies. Therefore, even if the global economies and particularly the developing nations do well in the years ahead, what can be expected is that only a few among them will be able to develop world class manufacturing base as late entry barriers coupled with resource constraints will prove hard to overcome.

2.16 The current developments do not really support a fact that more and more investments will be heading towards the emerging economies. But then the question will arise where will the investments go? According to the World Bank (2013), in a few years, total investment in developing countries should exceed that of (today's) high-income countries and that by 2030 the share of developing countries in the global total should go above 60 per cent. This should be compared to the situation until about 2000, when developing countries accounted for little over 20 per cent of the global investment total.

**2.17 Trade and investment links** may become dominant economic policy for developed nations with respect to developing nations.

2.18 Climate change and response of national governments to it will be critical when it comes to opportunities for industrial development and global competitiveness of the industry there as many of the developing nations with significant growth potential may find the burden of liabilities to maintain environment friendly production excessively heavy.

- Despite the current concerns, the growth in the world economy will be driven by the **well managed developing and emerging economies.**
- European growth will be flat but stable.
- The USA will gain out of shell gas/oil benefits and manufacturing in the country has the potential of a strong turn around.
- Japan's economic growth prospects remain fragile mainly due to high costs, strong growth of manufacturing in China, Korea and other Asian countries close by.

2.19 Growth prospects of the steel industry worldwide will have to be seen in the above context of opportunities and uncertainties. Given the fact that steel demand emanates both from new as well as replacement needs, the developed nations will mostly be catering to the replacement needs for themselves while the developing nations will see most of their steel consumption taking place in new areas, whether construction or industrial products.

### **Global Steel Industry Forecasts**

2.20 The steel industry globally has faced a number of unsettling global events that have reduced long-term viability of the current trends in the industry. There are a number of crosscurrents due to exogenous factors that are making charting a steady course difficult.

2.21 Although there are many research organizations devoted to the study of the steel industry worldwide and there are as many forecasts, it may be worthwhile to focus on those of an authoritative agency such as the World Steel Dynamics (WSD), an US based research organization of global reputation. Their forecasts are based on a few very important strategic perspectives on the future of the industry. (Table-1)

**Table-1 World Steel Dynamics' Crude Steel Forecasts**

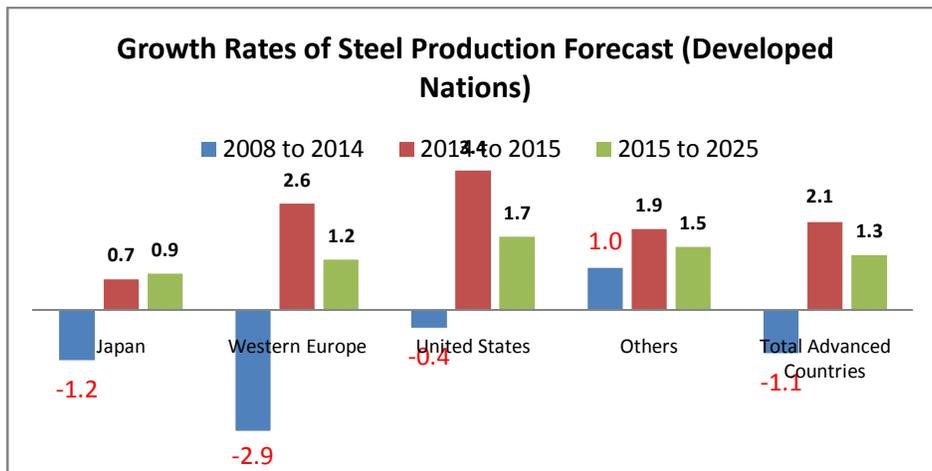
Country / Region	Crude Steel Production (in million tonnes)				
	2008	2013e	2014e	2015e	2025 e
Japan	118.7	108.8	110.2	111.0	121.0
Western Europe	163.7	132.9	136.9	140.4	158.1
United States	91.9	87.0	89.5	92.5	110.0
Others	117.0	120.0	124.2	126.6	147.0
<b>Total Advanced Countries</b>	<b>491.3</b>	<b>448.7</b>	<b>460.8</b>	<b>470.5</b>	<b>536.1</b>
<b>China</b>	<b>500.0</b>	<b>770.0</b>	<b>790.0</b>	<b>802.0</b>	<b>850.0</b>
<b>India</b>	<b>55.1</b>	<b>78.5</b>	<b>78.0</b>	<b>82.0</b>	<b>113.0</b>
MENA	25.3	33.0	35.1	36.2	62.0
Other developing countries	255.0	243.8	249.4	257.7	311.4
<b>Developing world ex. China</b>	<b>335.4</b>	<b>355.3</b>	<b>362.5</b>	<b>375.9</b>	<b>486.4</b>
<b>World total</b>	<b>1326.7</b>	<b>1574.0</b>	<b>1613.3</b>	<b>1648.4</b>	<b>1872.5</b>
<b>World Total ex. China</b>	<b>826.7</b>	<b>804.0</b>	<b>823.3</b>	<b>846.4</b>	<b>1022.5</b>

Country / Region	Compound Annual Growth Rate (%)		
	2008 to 2014	2014 to 2015	2015 to 2025
Japan	-1.23	0.73	0.87
Western Europe	-2.94	2.56	1.19
United States	-0.44	3.35	1.75
Others	1.00	1.93	1.51
<b>Total Advanced Countries</b>	<b>-1.06</b>	<b>2.11</b>	<b>1.31</b>

<b>China</b>	<b>7.92</b>	<b>1.52</b>	<b>0.58</b>
<b>India</b>	<b>5.96</b>	<b>5.13</b>	<b>3.26</b>
MENA	5.61	3.13	5.53
Other developing countries	-0.37	3.33	1.91
<b>Developing world ex. China</b>	<b>1.30</b>	<b>3.70</b>	<b>2.61</b>
<b>World total</b>	<b>3.31</b>	<b>2.18</b>	<b>1.28</b>
<b>World Total ex. China</b>	<b>-0.07</b>	<b>2.81</b>	<b>1.91</b>

Source: WSD

Chart-8



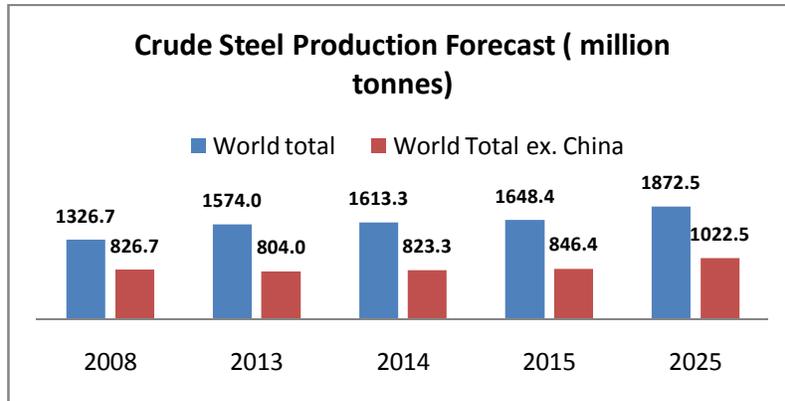
Source: WSD

2.22 Till now, the forecasts made by various agencies on future steel demand have not been universally found to be reliable, especially if they are for a period covering till 2030 or so . This is mainly due to extreme difficulties involved in predicting economic growth patterns across so many countries at different stages of development. In addition, wide variations are seen in national economic policy, political systems, quality of governance and specific performance levels in managing the economies. The economic growth trends exhibited so far by major economies can be seen from the chart below. While by pure size of it, the USA is the largest single national economy in the world, rapid growth in China has contributed significantly to the global incremental GDP.

2.23 The forecasts of global steel demand/production made by the World Steel Dynamics (WSD) are reasonably pessimistic, partly due to the reasons cited above. According to the organization, global steel production (as also demand for it or consumption) will grow at an annual average compounded rate of growth of 1.28 per cent during 2015-2025 to reach only 1873 million tonnes by 2025. In most of the other well known forecasts, this figure was to be

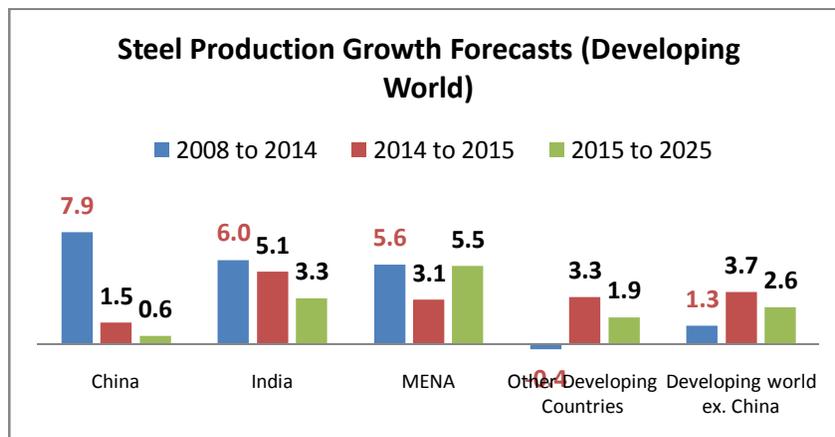
achieved by 2020. Interestingly, the organization has projected Chinese steel production to rise only by 0.58 per cent annually during this period.

Chart-9



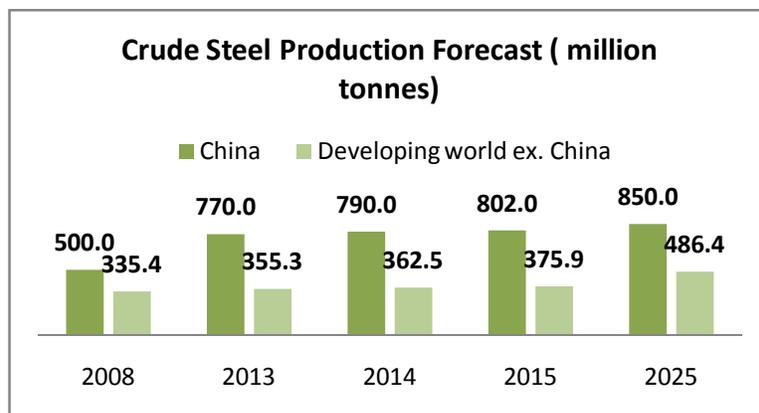
Source: WSD

Chart-10



Source: WSD

Chart-11



Source: WSA

2.24 While there may be questions on the validity of the assumptions made to arrive at these precise numbers, the outlook is based on wide research on the industry and, therefore, the results cannot be written off. India's steel production has been projected to reach only 113 million tonnes by 2025. While the organization may not have ruled out demand growth or capacity additions beyond that, the production level has been pegged at such a low level may be due to (i) inability to add capacity sufficiently and (ii) inability to use the capacity created despite domestic market demand due to factors such as raw materials constraint, infrastructure bottlenecks and high levels of imports coming at competitive prices. This scenario looks unrealistic from the experiences on the ground.

2.25 The WSD forecasts have also noted that investments in the steel industry will remain flat as a result capacity to produce steel will increase only marginally. The focus in major steel producing countries will be to make maximum use of the existing capacities. While low capacity additions in the rest of the world can be a positive for the steel industry's profitability point of view, the current assessment of the global market will cast a shadow over financing steel projects worldwide. ( Table-2,3 and 4)

**Table-2 Global Effective Steelmaking Capacity and Capital Spending Outlook**

(million tonnes, except capital outlays)							
Year	Global Gross Capacity (mmillion tonnes)	Global Effective Capacity (mmillion tonnes)	Ratio Effective Capacity/ Gross	Global Capital Outlays (\$ billion)	Global Steel Production (mmillion tonnes)	Global Capital Outlays per tonne produced	Operating Rate per cent
2000	1107	947	0.856	24	850	\$28	89.7per cent
2001	1130	977	0.864	24	852	\$28	87.2per cent
2002	1175	1011	0.861	24	905	\$27	89.4per cent
2003	1250	1067	0.853	32	971	\$33	91.0per cent
2004	1329	1152	0.867	39	1072	\$36	93.0per cent
2005	1428	1262	0.884	62	1144	\$54	90.6per cent
2006	1524	1369	0.898	86	1247	\$69	91.1per cent
2007	1619	1463	0.904	109	1346	\$81	92.0per cent
2008	1696	1535	0.905	128	1327	\$96	86.4per cent
2009	1801	1634	0.907	111	1236	\$89	75.6per cent
2010	1907	1734	0.909	119	1421	\$84	81.9per cent
2011	1982	1820	0.918	132	1538	\$86	84.5per cent
2012	2056	1889	0.919	149	1562	\$96	82.7per cent
2013	2132	1960	0.919	144	1600	\$90	81.6per cent
2014	2190	2002	0.91	130	1640	\$79	81.9per cent
2015	2215	2014	0.909	110	1676	\$66	83.2per cent
2016	2200	1990	0.904	85	1696	\$50	85.2per cent

<b>2017</b>	2200	1988	0.903	90	1717	\$52	86.4per cent
<b>2018</b>	2230	2014	0.903	100	1739	\$58	86.4per cent
<b>2019</b>	2215	1999	0.902	105	1766	\$59	88.4per cent
<b>2020</b>	2225	2008	0.902	110	1789	\$61	89.1per cent

Source : WSD - Truth 7 Consequences #72

**Table-3 Effective Steelmaking Capacity and Capital Spending Outlook - China**

(million tonnes, except capital outlays)

<b>Year</b>	<b>China Gross Capacity (mmillion tonnes)</b>	<b>China Effective Capacity (mmillion tonnes)</b>	<b>Ratio Effective Capacity/ Gross</b>	<b>China Capital Outlays (\$ billion)</b>	<b>China Steel Production (mmillion tonnes)</b>	<b>Chinese Capital Outlays per tonne produced</b>	<b>Operating Rate</b>
<b>2000</b>	164	154	0.94	5	129	\$37	83.5 per cent
<b>2001</b>	185	176	0.95	6	152	\$40	86.1per cent
<b>2002</b>	240	204	0.85	8	182	\$47	89.3per cent
<b>2003</b>	304	234	0.77	14	222	\$65	94.8per cent
<b>2004</b>	368	302	0.82	20	283	\$71	93.8per cent
<b>2005</b>	435	379	0.87	28	353	\$80	93.3per cent
<b>2006</b>	515	469	0.91	29	419	\$69	89.4per cent
<b>2007</b>	590	537	0.91	34	489	\$69	91.1per cent
<b>2008</b>	648	590	0.91	47	500	\$93	84.8per cent
<b>2009</b>	738	672	0.91	47	576	\$81	85.7per cent
<b>2010</b>	817	743	0.91	51	630	\$81	84.7per cent
<b>2011</b>	872	811	0.93	60	702	\$86	86.6per cent
<b>2012</b>	940	874	0.93	80	731	\$109	83.6per cent
<b>2013</b>	1000	930	0.93	82	780	\$105	83.9per cent
<b>2014</b>	1040	967	0.93	70	800	\$88	82.7per cent
<b>2015</b>	1065	990	0.93	60	812	\$74	82.0per cent
<b>2016</b>	1075	1000	0.93	40	817	\$49	81.7per cent
<b>2017</b>	1050	987	0.94	40	821	\$49	83.2per cent
<b>2018</b>	1050	987	0.94	40	826	\$48	83.7per cent
<b>2019</b>	1025	964	0.94	40	836	\$48	86.8per cent
<b>2020</b>	1025	964	0.94	40	841	\$48	87.3per cent

Source : WSD - Truth 7 Consequences #72

**Table-4 Effective Steelmaking Capacity and Capital Spending Outlook - World ex-China**

(million tonnes, except capital outlays)

Year	Rest of World ex-China gross capacity	Rest of World ex-China effective capacity	Ratio Effective Capacity/ Gross	Rest of World ex-China Capital Outlays (\$ billion)	Rest of World ex-China Steel Production	Non-Chinese Capital Outlays per tonne produced	Operating Rate
2000	943	793	0.84	19	721	\$27	90.9per cent
2001	945	801	0.85	18	700	\$26	87.4per cent
2002	934	807	0.86	16	722	\$22	89.5per cent
2003	946	832	0.88	18	748	\$24	89.9per cent
2004	961	851	0.89	19	789	\$24	92.7per cent
2005	992	884	0.89	34	791	\$43	89.5per cent
2006	1009	900	0.89	57	828	\$69	92.0per cent
2007	1029	927	0.90	75	857	\$87	92.5per cent
2008	1047	945	0.90	81	827	\$98	87.5per cent
2009	1063	962	0.91	64	660	\$96	68.6per cent
2010	1090	990	0.91	67	791	\$85	79.9per cent
2011	1110	1009	0.91	72	836	\$86	82.8per cent
2012	1116	1015	0.91	69	831	\$84	81.9per cent
2013	1132	1030	0.91	62	829	\$75	80.5per cent
2014	1150	1035	0.90	60	849	\$71	82.0per cent
2015	1150	1024	0.89	50	873	\$57	85.3per cent
2016	1125	990	0.88	45	889	\$51	89.8per cent
2017	1150	1001	0.87	50	905	\$55	90.5per cent
2018	1180	1027	0.87	60	922	\$65	89.8per cent
2019	1190	1035	0.87	65	939	\$60	90.7per cent
2020	1200	1044	0.87	70	957	\$73	91.7per cent

Source : WSD - Truth 7 Consequences #72

2.26 This means that in the context of expansion of Indian steel industry, the global market may not play an adequately supportive role and the industry will have to remain cautious when it comes to capacity additions beyond the domestic demand. This will perhaps be true only in the context of prices. **Otherwise, in a global market of over 1500 million tonnes of steel consumption, the Indian industry should not find it hard to make space for 50-60 million tonnes of steel to sell in that market provided the industry is competitive.**

2.27 As far as the global steel industry developments are concerned, the following factors are most likely to influence the steel industry through the period till 2025.

**(a) The Developing World's share of GDP on a purchasing power parity basis in 2025 could rise to 63 per cent versus about 52 per cent in 2011** granted that the Developing World grows 4.5 per cent per year compounded and Advanced Economies expand 1.5 per cent per year compounded. The higher the share of global GDP that exists in the Developing World, the faster that the global economy grows and, probably, the less cyclical it is, in the normal conditions of the business. This will also be a positive for the steel industry as stronger growth in the developing nations will provide conditions for higher demand for steel.

**(b) The steel industry's high capital intensity (investment per tonne of capacity) will cause marginal steelmaking and related facilities to be abandoned at a fairly high rate.** The steel industry globally is likely to face shortages of funds due to the violence of the steel cycle (i.e., huge swings in steel prices), sizable currency swings profoundly affecting the international competitive position of steel producers, threats to established plants from steel's ongoing technological revolution, uncertain raw material costs, poorly located plants turning out to be burden on the investors and unacceptably high costs of setting up steel plants due to added emphasis on environmental issues. **Global steel industry is increasingly focused on being good environmental citizens. It is believed that steel plants worldwide** are ready to make investments required to be good environmental citizens and that there is good evidence that developing nations are increasingly demanding higher pollution control standards from companies located in their countries. The Chinese policy makers, for example, abhor pollution and have increasingly added stringent restrictions that have been effective in shutting down severely polluting and inefficient high raw material consuming facilities.

**© A rising and sizable surplus of steel scrap in China will turn the global metallic balance situation upside-down.** Obsolete steel scrap availability will significantly increase by 2025 and over the next 50 years, the world will see more steel coming out of recycled scrap than from virgin iron ore. The important point is that as China's steel consumption and consequent production slows down, there will more and more scrap coming into the system. The Chinese steel industry may continue with the blast furnace route and export the scrap out or idle the blast furnaces and set up adequate electric

steel making capacities to use the domestically generated scrap. In such an event there will be surplus of iron ore and coking coal at a global level.

**(d) Iron ore prices are likely to remain under pressure in the world market due to abundant supplies and reduced demand. The boom in the industry in the last decade led to massive investments in iron ore mining and by the estimates available as on date, over 1.5 billion tonnes of iron ore mining capacities are getting added in the coming years before 2020. The consequences of this development can be either in the financial bankruptcy of the iron ore players, especially the new ones, who invested at higher valuation of iron ore prices, or, that they continue to produce as per the market demand and continue to sell at marginal costs. While this is good for the steel makers, those in the industry who have either captive mines or have recently invested on them will see their economics weakening. However, a counter argument is that the iron ore resources in China, and even in India to an extent, may be sufficiently depleted by then due to high steel production and therefore, one would expect high prices of iron ore on the international market in the years ahead to continue.**

**(e) The Chinese steel industry will not be cost competitive because of a strong currency,** likelihood of wages rising rapidly from the levels at present and higher raw materials prices. According to WSD, Chinese steel demand growth after 2013 may be in the order of 2 per cent per annum at the best. If they are not competitive, the industry will have to curtail their production to reduce their exposure at least in the global market.

**(f) Global research on technology is expected to bring in a technology revolution in the steel industry especially in view of the increasing stringency in maintaining environmental standards. Technological developments are more likely to be seen in mining of both iron ore, use of coal and production of iron. The steel industry will have to cater to the requirement of the technology changes in the end use areas. Demand for lighter and stronger steel will require technology change in steel making and rolling. Technology change in product areas will require high investment and not all the steel producers will be able to respond to it quickly.**

**(g) Changing energy price relationships will have a major impact on the steel industry.** If natural gas prices remain reasonably priced in a number of regions such as the USA and the Middle East, blast furnace construction will be diminished and steel-scrap-substitute production will be enhanced.

**(h) Coking coal in desired quality may be in continued tight supply because of the depletion of reserves in many mines that make this product.** The new mines which have been opened in many parts of the world including Australia are not delivering products in quality the steel industry will be happy with. Further, supply bottlenecks in Australia are mounting with floods and freak weather conditions which make delivery

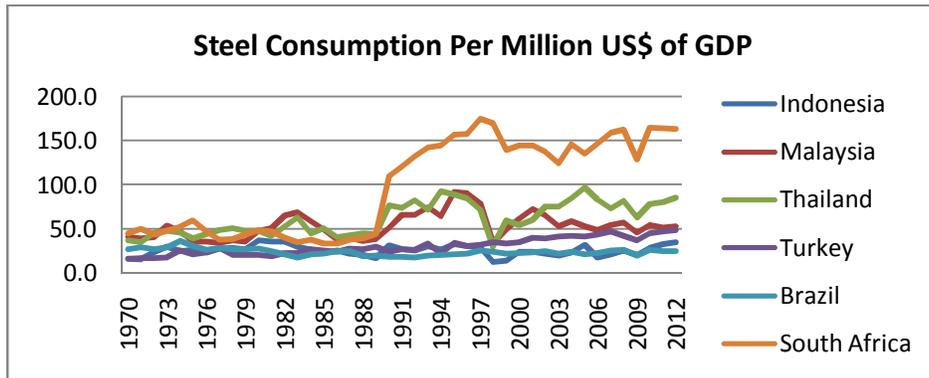
difficult even at current levels. The ability of raising deliveries to significant level on assured basis remains questionable. Further, several steel mills in China, Japan and Korea already having invested in Australian coal mines, the steel mills in countries such as India which did not make any significant acquisition of mining assets will have significant disadvantage in coking coal compared to other countries mentioned.

**(i) Pig iron production may lag behind demand.** Most steel mills in the past were designed also to produce certain quantities of pig iron for merchant sales. However, pig iron production turning out to be an unprofitable business, it has been abandoned now by design. This is happening in China as also in India. This may result in shortages of pig iron globally as also in industrial countries, including India. Closure of independently operated blast furnaces or their subsequent downstream integration to produce steel will have a major impact on the supply of pig iron.

**(j) The steel industry will see banks in support hard to find as bankruptcies and poor financial conditions continue. This may trigger consolidation within the industry with mergers and acquisitions across geographies. The typical family run and regional businesses will be the worst hit and the space for consolidation will be limited.**

2.21 There is a commonly accepted hypothesis that steel consumption will continue to increase globally and especially in the emerging nations. The basis of this argument lies in the fact that the developing and underdeveloped nations, including the emerging nations, will move to a more steel intensive development model as was witnessed in the history of the developed world. This hypothesis assumes that there will not be any financial, materials and manpower constraints in the development of these nations. This view is generally contradicted by the theory of vicious circle holding back development of the already underdeveloped nations. There is, therefore, a need to take a realistic view on it. The past trends of steel consumption per unit GDP for a few developing nations are as below. Despite growth in steel consumption on an annual basis, the steel intensity in GDP has not shown any perceptible change in the case of most of the economies considered.

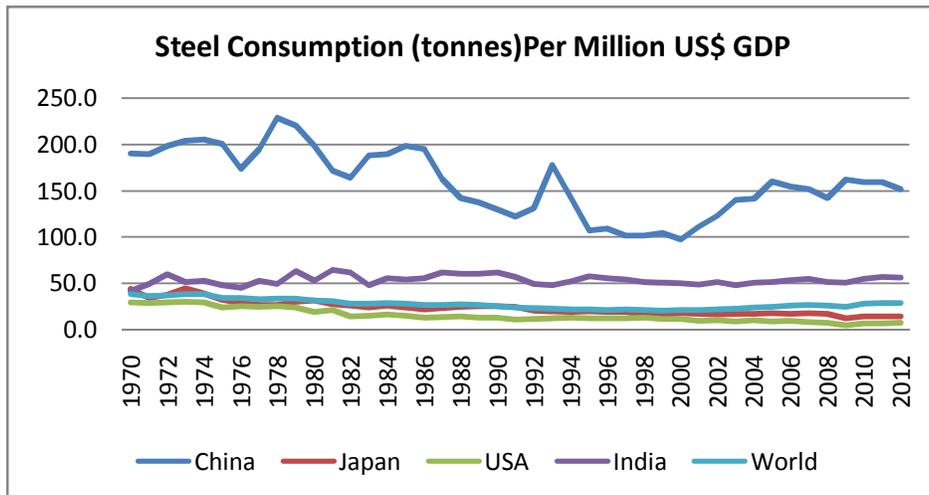
Chart-12



Source: ERU

2.28 In the case of the world as a whole and the developed world, there is an overall downward trend as can be seen from the Chart below.

Chart-13



Source: ERU

## Chapter -2

### Steel Demand and Production Outlook for Indian Steel

#### 3.0 Indian Economic Growth Prospects

3.1 Despite the current concerns over growth, there is a strong view within the industry and the government that due to the intrinsic potential of steel demand growth in India, the longer term opportunities for the sector continue to be strong.

3.2 Steel consumption significantly depends on the overall performance of the economy (GDP) and more specifically on investments made in fixed assets such as housing, infrastructure like railways, ports, roads, airports, etc.. While there is no absolutely reliable information on the share of steel consumption in these areas in India, most of the estimates put the figure at about 65 per cent. This is in line with global experiences. In addition, steel is consumed significantly in the production of capital goods, automobiles, etc..

3.3 The Indian economy maintained significant growth, especially from 2003-04. It is only recently that the economy has slowed down due a variety of factors including those externally derived. Despite this economic slowdown in the past two years, the overall expectations on the macro economic performance of the economy in the longer term are generally and widely seen to be strong. It is believed that the sub-optimal economic performance by India has mainly been due to factors which can be resolved rather easily. Therefore, there are no strong reasons to believe that the current low growth syndrome will continue forever. Although one does not expect a dramatic change within a short span of time for various reasons such as the existing shortages of investible capital due to low savings rates, inadequate development of quality infrastructure to support a strong manufacturing sector growth and a low domestic market base, etc., a 6.5-7 per cent annual GDP growth rate for the coming 20 years can still be a reasonable expectation assuming that the country leaves behind a status quoist position and gets into a more dynamic action mode to break the low growth syndrome. In the event of an extremely positive environment, it is also believed that the Indian economy can have a strong annual growth rate in the range of 8 -9 per cent for the period. Although there is no empirical basis to assume that such prospects exist, there are also no reasons to believe that such optimism lies in the realm of impossibility.

3.4 However, technological changes in the past decades, changing nature of international business with globalization, freer flow of capital across nations and easier dissemination of knowledge and technology have changed the conditions which are to determine the actual pattern of growth for the developing and the underdeveloped economies. Therefore, today, the growth path of any economy remains hard to predict especially if it has to take into account the potential or even unexpected structural breaks in the development path in between. The way the economies in South East Asia grew, the way China rose and why the Indian economy has not followed the path taken by any of them need to be examined in the context of assessing the growth prospects of the Indian economy and the steel industry in

particular. Further, why the South East Asian economies could not maintain pace they attained in the 1980s and 1990s and why China could do so will also provide a perspective on the development strategies for developing nations. In the same vein, many economists have taken positive view of the Indian economy which maintained decent to strong growth for a long period of time, provided financial stability all through including the days of global financial crisis and the overall transparency in policy the country's government provided. The point is made here that the complexities of economic development make it difficult to assert that India or any developing nation for that matter will follow the path the developed nations have walked through in the last 50-60 years.

### **Steel Demand Outlook**

3.5 Empirical studies have shown that steel consumption trends in the developed nations have exhibited three distinct phases in the level and intensity of steel consumption. Such nations have started with a low base in steel consumption and then seeing exponential growth for a period and then stabilizing at a similar or lower level as the economy attains a degree of maturity in industrial growth, development of infrastructure and saturation in housing construction. In the post peak period the bulk of the steel is consumed either in the consumer goods, automobiles or replenishment of the housing and infrastructure stocks, with not much significantly added in the form of new fixed capital assets. As one moves from one stage to another lifestyle changes and the increased requirement to support the manufacturing base raises the share of the services sector where steel consumption intensity is low.

3.6 As discussed above, since there are no reasons to believe that the Indian economic growth will follow the path traversed by the developed and emerging nations at higher stages of development, to believe that Indian steel consumption will follow exactly the same path is not borne out by logic or facts. In fact, what happened in the developed west or China is not of overriding relevance in the context of India. But, what is borne out by empirical evidence is the fact that steel consumption is strongly driven by the growth of the economy and the investments in fixed assets.

3.7 However, given the necessity to have a long term view from strategic considerations and planning for the future it may be worthwhile to see how the Indian economy will be placed on its own as also in relation with other nations in the world.

### **Steel Demand Forecasts**

**3.8 There are many studies projecting steel demand growth scenario over the next couple of decades.** In a recent study, the Boston Consulting Group (BCG) has made the following observations. :

- a) **On the present pattern of growth** - the real GDP of India grew from 2002 to 2013 was at 7.4per cent and the steel consumption grew by 8.2per cent in the said period. Over the next 12 years at a GDP growth of 6 – 6.5per cent, and a GDP elasticity of steel

demand at 1.1, the likely growth of steel consumption growth rate was estimated at 7.3per cent per year and **the finished steel consumption in 2025-26, on this basis, was estimated to grow to 155 – 170 million tonnes by that year.**

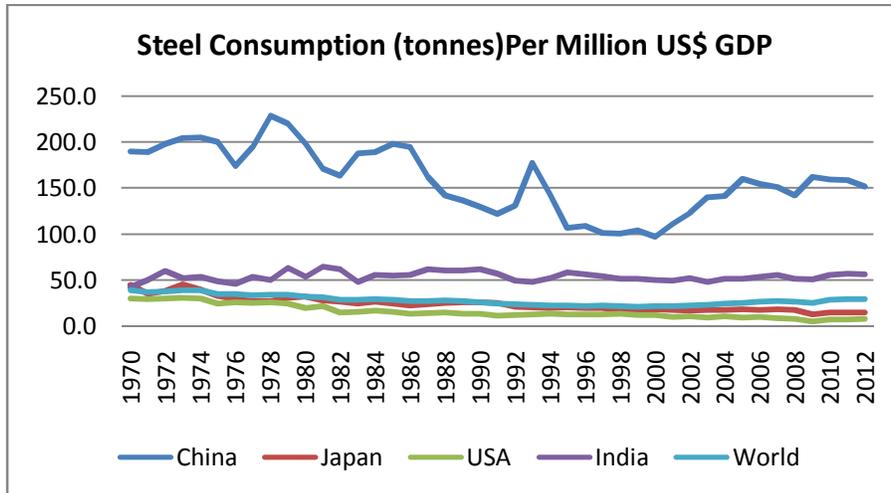
- b) **Bench marking India’s stage of economic growth with other countries** – On another model, following established trajectory of growth as seen in other countries, the per capita consumption of steel in India would move from the level of 59 kgs in 2011 to 175 kgs in 2025-26, and given the fact that the population of India is projected to grow to 1.43 billion that year, the **steel consumption in 2025-26 is likely to be around 250 million tonnes.**
- c) **The goal of India to increase share of manufacturing to 25per cent of GDP by 2025 –** The above target if achieved can propel the usage of finished steel from 16 kgs / \$ PPP in the year 2012 to 22 – 25 kgs / \$ PPP in the year 2025-25. This would mean a growth in steel consumption of 9 -10per cent and the **steel consumption in 2025-26 is likely to be around 230 – 255 million tonnes. ( Table-5)**

**Table- 5**

Particulars	Finished steel consumption	How to be achieved
Steel consumption under scenario (1)	170 million tonnes	
Addition in construction	30 – 35 million tonnes	Push growth from 9per cent to 11per cent
Addition in infrastructure	20 – 30 million tonnes	Push growth from 9per cent to 11per cent
Addition in steel intensive capital goods	10 – 15 million tonnes	Push growth from 11per cent to 14 /15 per cent
Additional direct steel exports	10 – 15 million tonnes	Boost export incentives
Additional indirect steel export	5 – 10 million tonnes	
Total consumption as per scenario (2) / (3)	245 – 250 million tonnes	

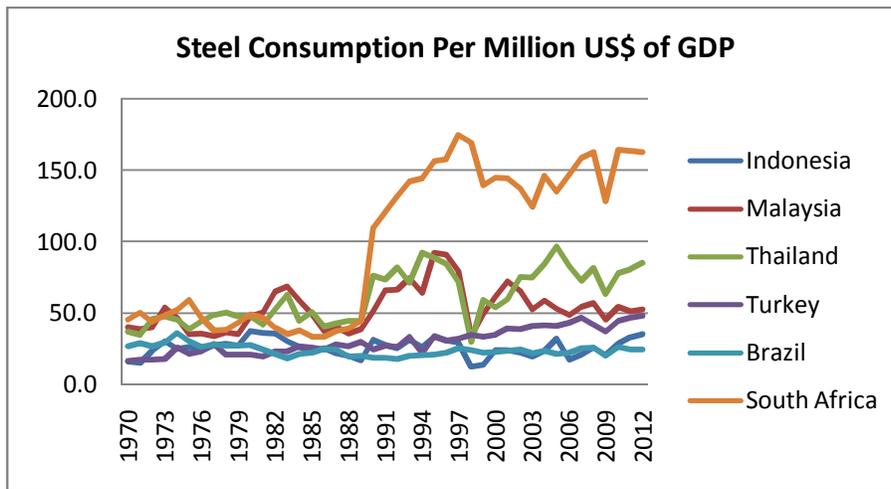
3.9 As discussed above, the above scenarios projected by BCG, excluding the “Business As Usual” scenario, are on the optimistic side considering current conditions and constraints. The underlying assumptions will also be required to be examined especially the point that low per capita consumption of steel in the country is a good reason to believe that there is significant growth potential. In the same context one needs to take note also of the fact that steel consumption in the country per unit GDP is not so low. Therefore, the steel intensity in the economy is not a major issue but the low GDP is. This means, the focus remains on economic growth.

Chart-13



Source: ERU

Chart-14



Source: ERU

3.10 Steel demand in India has been forecast mainly on the basis of past trends, taking into account the relationship between GDP and steel consumption, and then projecting specific assumed GDP growth rate for future years. The forecasts of steel demand for 2025-26 made by INSDAG as per standard methodology assuming 6 and 6.5 per cent annual compounded average growth rate of the GDP seems fairly realistic. As per this, demand for finished steel is likely to rise to 165-171 million tonnes respectively. To meet this demand only, the country will require about 190-205 million tonnes of crude steel capacity to be set up. The estimates made by the ERU also are in the same order and the requirement of crude steel production to meet this demand is as below. The ERU, however, considers different growth rate assumptions in respect of the GDP at 6.5 per cent and 7 per cent respectively. (Table-6,7) In order to see the

potential surge in the economy with the economy maintaining an annual average rate of growth of 8per cent, another scenario has been drawn up, which has also been included in the Tables mentioned.

**Table-6 Forecast of Finished Steel Demand ( million tonnes)**

	2013-14	2025-26	2032-33
Finished Steel Demand @ 6.5per cent GDP Growth Rate	74	176	273
Finished Steel Demand @ 7per cent GDP Growth Rate	74	186	298
Finished Steel Demand @ 8per cent GDP Growth Rate	74	208	339

**Table-7 Forecast of Crude Steel Production Derived from Forecast of Finished Steel Demand ( million tonnes)**

	2013-14	2025-26	2032-33
Crude Steel Production @ 6.5 per cent GDP Growth Rate	81	185	287
Crude Steel Production @ 7per cent GDP Growth Rate	81	196	314
Crude Steel Production @ 8per cent GDP Growth Rate	81	219	357

3.11 There are expert agencies, both within and outside the government, who have talked about either the need to achieve higher rates of GDP growth or have set such high targets. There are no specific studies which have empirically supported a view that the Indian economy will grow at a higher pace – say, in the range of 8-9 per cent every year for another 15-20 years. However, in the considered time frame, there will certainly be years when the country’s growth rates will hit high provided the policy support of the government and external environment remains substantial and positive. **It was, therefore, considered prudent to have a 7per cent growth rate scenario for long term planning.**

3.12 In the worst case scenario, the ongoing challenges in the form of difficulties in land acquisition, increased environmental concerns, rising population with stagnant agriculture productivity, inadequate power generation due to inability to exploit the coal resources sufficiently and lower than required generation of savings in the economy may in fact bring down the GDP growth rate even further to about 5-6 per cent a year over the coming decades. This is at this moment looks to be an unlikely scenario as the Indian economy has the strength and the resilience to overcome strong externalities. It also makes no sense to consider a low growth scenario from the objective of planning.

3.13 However, As against the modest scenarios projected above, the High Level Committee on Manufacturing (HLCM) under the Hon. Prime Minister has set a target of raising annual crude steel making capacity to 300 million tonnes by 2025-26. Since steel demand is strongly related

to the growth of the economy, if the capacity is to grow to 300 million tonnes, the growth rate of the GDP will have to be higher than 8 per cent for the entire period or else the industry will have to plan for significant exports. In our estimates such a level will be possible by around 2032-33 at an assumed GDP growth rate of 6.5 per cent annually. The same will be reached two years earlier if 7 per cent growth rate scenario is considered.

## Product Mix of Demand

3.14 In the context of steel capacity expansion, it is important to know the pattern of the emerging steel market by products as production of flat and long products take different equipment route and not necessarily substitutable beyond the steel making stage. Economies of scale and logistics of production of flat steel products are also different than those for long products. Forecasting steel demand by product categories involves far more complex analytical and statistical issues, especially for longer time horizon. It has been historically observed that as an economy matures and its steel consumption base expands, the share of flat products in total consumption of steel rises. It is mainly because in the earlier phase of development is normally based on investment and development of infrastructure, industrial capacity and housing. This phase is associated with high levels of consumption of long products. In the second phase, the economy is driven by rising incomes and consumption of the population and this leads to increased consumption of automobiles, appliances etc.. This leads to a rise in flat steel demand.

3.15 Also, it has been seen from the experiences of the developed nations, newer and more sophisticated products of steel tend to find larger space with the steel market. The steel industry will also have to take note of these developments and prepare technologically to face up to new challenges. Product mix has a strong bearing on the choice of technology and size of the plants. **(Table-8)**

**Table-8 Product-wise Shares of Steel Demand Forecast  
( as per centage of total consumption of finished carbon/mild steel )**

Year	2010-11	2016-17	2020-21	2025-26	2032-33
<b>Bars and Rods</b>	39.3	39.9	40.2	40.2	39.8
<b>Structurals</b>	9.0	7.6	6.8	5.8	4.2
<b>Rly. Materials</b>	1.8	1.3	1.0	0.8	0.4
<b>Total Long Products</b>	50.1	48.8	47.9	46.8	44.5
<b>Plates</b>	7.7	7.0	6.5	5.9	4.9
<b>HR Coils/Skelp/Sheet (excl. double counting)</b>	21.0	20.9	20.7	20.4	19.4
<b>CR coils/sheets (excl. double counting)</b>	9.7	11.4	12.7	14.5	18.6
<b>GP/GC</b>	7.6	7.8	7.9	7.9	7.9
<b>Electrical Sheets</b>	0.8	0.8	0.8	0.8	0.8
<b>Tin Plate/TFS</b>	0.6	0.7	0.7	0.7	0.8
<b>Pipes</b>	2.5	2.7	2.8	3.0	3.2
<b>Total Flat Products</b>	49.9	51.2	52.1	53.2	55.5

Total Carbon Steel	100	100.0	100.0	100.0	100.0
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3.16 Stainless steel accounts for only 2.4per cent of global crude steel production. In the case of India, the latest available estimate puts the corresponding figure at 3.6 per cent for the year 2012-13. Give the understanding that stainless steel consumption growth rates have been higher than those for carbon steel, it is expected that slowly the share of stainless steel in total consumption of steel will rise to take a share of 5per cent in total steel production. The forecast for other alloy steel is that their consumption will come to 7per cent of the total consumption of steel.( **Table-9,10,11 and 12**) **It may be noted that the entire demand and production of stainless and alloy steel are included in the overall estimates of demand and production of steel as mentioned above. Therefore, the figures shown separately are included in the above estimates.**

**Table-9: Forecast of Stainless Steel Demand ( million tonnes)**

	2025-26	2032-33
Finished Steel Demand @ 6.5per cent GDP Growth Rate	6.4	11
Finished Steel Demand @ 7per cent GDP Growth Rate	7.44	11.9
Finished Steel Demand @ 8per cent GDP Growth Rate	10.4	17

**Table-10: Forecast of Stainless Steel Production ( million tonnes)**

	2025-26	2032-33
Crude Steel Production @ 6.5per cent GDP Growth Rate	7.04	12.1
Crude Steel Production @ 7per cent GDP Growth Rate	8.2	13.1
Crude Steel Production @ 8per cent GDP Growth Rate	11	18

**Table-11: Forecast of Alloy Steel Demand ( million tonnes)**

	2025-26	2032-33
Finished Steel Demand @ 6.5per cent GDP Growth Rate	11.2	19.2
Finished Steel Demand @ 7per cent GDP Growth Rate	13	20.86
Finished Steel Demand @ 8per cent GDP Growth Rate	14.6	24

**Table-12 Forecast of Alloy Steel Production ( million tonnes)**

	2025-26	2032-33
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<b>Crude Steel Production @ 6.5per cent GDP Growth Rate</b>	12.32	21.12
<b>Crude Steel Production @ 7per cent GDP Growth Rate</b>	14.3	22.95
<b>Crude Steel Production @ 8per cent GDP Growth Rate</b>	15.3	25

3.17 In addition to steel, there will be continuous increases in demand for pig iron and sponge iron ( DRI/HBI). Pig iron demand is more complex to forecast given its sensitivities to technologies in its use. For example, the move towards aluminium motor engine blocks, substitution of cast pipes by synthetic materials etc.. will have a deep impact on the demand for pig iron. Assuming that pig iron demand can grow at 6 and 6.5 per cent annual growth rates, the forecast demand for is as shown below.

3.18 Forecasting demand for sponge iron (DRI/HBI) depends on the technology adopted. In turn, this will depend on the availability and economics of raw materials in use such as coal, natural gas, iron ore, scrap etc.. In addition, one will have to consider the space of environmental laws to come which will have a deep impact on the choice of technology. However, assuming the mix of technology in steel production expected by 2016-17 to continue over the entire forecasting years, the following results have been obtained. **(Table-13)**

**Table-13 Forecast of Sponge Iron ( HBI/DRI) and Pig Iron for Sale**

Figures in million tonnes

	2025-26	2032-33
Pig Iron Production for Sale	14.5	21.8
DRI Production ( Coal+Gas Based )	50	78

### **Issues Related to market Growth Potential**

3.19 Given clear competitive advantage and ability to sustain business without support, steel production in the country need not depend exclusively on the home market. The industry has the option to expand capacity beyond the requirement of the home market and export to the rest of the world.

3.20 The longer term steel consumption growth forecasts for India will be also based on the trends in population growth, urbanization, mobility and energy costs, including fuels for the transport sector. Further, steel has a strong relationship with manufacturing and so long the country's long term growth pattern is not supported by adequate local manufacturing base, steel demand growth will remain limited. A rapid change in the structure of the economy in terms of changing shares of different major sectors in the economy, viz., agriculture, industry and services will involve a large transformation of the economy and the structure and size of the same will need to be ascertained first and then the economic opportunities for steel

demand growth will have to be identified. It is possible that any economic transformation with rapid growth in manufacturing will trigger steel demand growth much more than estimated so far. If that does not happen and the economy moves along the well trod path so far with for well known reasons including inadequate resources to overcome current challenges, the outlook for steel will be remain passive. The fear is that as the process of transformation is delayed, in the global context, the prospects of industrial development in the country will reduce in a relative sense. This will not only lead to loss of opportunities in the world market but also expose the domestic market to stronger and wider foreign competition. With continuous drop in the share of manufacturing in the overall economy over the years, the reversal of the trend will be an increasingly stronger challenge and the resources required to bring in the change will also be significant. Whether the steel industry can see that happen quickly is a matter to be analysed.

**3.21** In forecasting steel demand for a longer period such as for about 20-25 years, several other factors will have to be taken into account besides the prospects of economic and industrial growth.

3.22 For example, the steel industry will increasingly come under threats of competition from substitute materials such as aluminium (in specific areas with long product life such as buildings, infrastructure, automobiles, etc.) and plastics (construction, pipes, consumer durables, appliances, etc.. irrespective of product life ). Not only that the existing areas where steel is in use are being replaced, future products are being developed considering the low cost alternatives and energy considerations. Therefore, steel intensity in the economy will see a decline rather than an increase, much in line with the global trends. To what extent and how quickly this transformation will take place is difficult to predict. But, one has to consider the downward pressure on steel demand on account of this.

3.23 Miniaturisation of products and use of thinner steel will reduce steel intensity significantly. It is evident in the use of steel in passenger cars, refrigerators, air conditioners, etc..(thinner but stronger steel sheets).

3.24 However, the positive in this respect is the fact that shortages of electric power have so far created a low level of use of appliances and steel intensive products. Given the fact that once the power shortages are taken care of the country's population will move to a new lifestyle with steel intensive products, the latent demand for steel seems to be fairly high.

## Chapter-3

### Raw Materials for the Steel Industry in India

#### 4.0 Iron Ore

4.1 Till now India has been largely dependent on domestic sourcing for iron ore, with imports being marginal and exceptional cases. However, in the current scenario of overall reserves position, environmental constraints, mining caps imposed by the Hon. Supreme Court on states, inadequate infrastructure move iron ore and extremist disturbances in iron ore mining areas may not even support mining to its full potential. The estimation made by Mecon Ltd. has pointed out that at the projected demand for iron ore if the country has to reach 300 million tonnes of steel production by 2025-26, the haematite reserves will be exhausted by 2032-33. If our estimates of steel consumption at 7 per cent GDP growth are considered, the steel industry at the projected levels of steel production will require 7.3 billion tonnes of iron ore by 2035-36.

4.2 If crude steel production has to be maintained at the levels to meet fully the domestic demand with zero external trade balance, the requirement of major raw materials is as below.

**Table-14** Raw Materials Demand at 6.5 per cent GDP growth Scenario

	2013-14	2025-26	2032-33
<b>Crude Steel Production</b>	81	185	287
<b>Iron Ore Demand</b>	132	295	454
<b>Coking Coal Demand</b>	50	133	206
<b>PCI Demand</b>	2.3	6.7	10.6
<b>Non-coking coal demand for Steel industry</b>	30	47	80
<b>Steel Melting Scrap</b>	9.4	21.4	33

**Table-15** Raw Materials Demand at 7 per cent GDP growth Scenario

	2013-14	2025-26	2032-33
<b>Crude Steel Production</b>	81	196	314
<b>Iron Ore Demand</b>	132	311	494
<b>Coking Coal Demand</b>	53.6	130	206
<b>Non-coking coal demand for Steel industry</b>	23	73	124
<b>Steel Melting Scrap demand</b>	9.4	23	36

**Table-16** Raw Materials Demand at 8 per cent GDP growth Scenario

	2013-14	2025-26	2032-33
<b>Crude Steel Production</b>	81	219	375
<b>Iron Ore Demand</b>	132	346	584
<b>Coking Coal Demand</b>	54	144	244
<b>Non-coking coal demand for Steel industry</b>	23	83	150
<b>Steel Melting Scrap demand</b>	9.4	25	43.4

4.3 Going by the available known resources, the country's effective iron ore reserves of high and medium grades of haematite will be over by then. As on date the magnetite reserves are small. The remaining resources ( Total Resources-Reserves) cannot be included for any planning purpose at this stage.

**Table-17** Reserves/Resources of Iron ore (Haematite) As on 1.4.2010 (P)  
(By State)

State	Reserves	Remaining	Total Resources ( '000 tonnes)
<b>All India (Total)</b>	8,093,546	9,788,551	17,882,098
<b>AP</b>	152,217	229,261	381,478
<b>Assam</b>	0	12,600	12,600
<b>Bihar</b>	0	55	55
<b>Chhattisgarh</b>	<b>900,110</b>	2,391,714	3,291,824
<b>Goa</b>	469,844	457,328	927,172
<b>Jharkhand</b>	2,304,142	2,292,478	4,596,620
<b>Karnataka</b>	876,866	1,281,811	2,158,678
<b>MP</b>	56,814	174,632	231,446
<b>Maharashtra</b>	13,414	269,795	283,209
<b>Meghalaya</b>	0	225	225
<b>Odisha</b>	3,313,000	2,617,232	5,930,232
<b>Rajasthan</b>	7,139	23,420	30,560
<b>UP</b>	0	38,000	38,000

Source: IBM

**Table- 18 :Major Reserves/Resources of Iron ore (Magnetite) As on 1.4.2010 (P)**

State and Grade	Reserves	Remaining	Total Resources ('000 tonnes)
AP	0	1,463,541	1,463,541
Metallurgical	0	43,034	43,034
Unclassified	0	1,420,507	1,420,507
Karnataka	0	7,801,744	7,801,744
Metallurgical	0	1,456,437	1,456,437
Not Known	0	279,200	279,200
Unclassified	0	6,066,107	6,066,107
Rajasthan	4,240	522,590	526,831
Foundry	455	303	758
Metallurgical	0	522,000	522,000
Not Known	615	246	861
Unclassified	3,171	41	3,211
Tamil Nadu	0	507,037	507,037
Metallurgical	0	1,688	1,688
Unclassified	0	505,349	505,349

Source: IBM

4.4 The estimates above show that from the current levels, the demand for raw materials will rise significantly and given the currently known supply potential of the same, the country will have to work towards greater exploration, raising mining capacities, developing necessary infrastructure or else remain prepared for a significant imports.

4.5 Further, since much of the resources are held on a captive basis, the producers without captive mines will have to depend on the small merchant market where mining caps will further reduce supply to the market. In the absence of an export market and continued policy push for value addition, the merchant iron ore mining industry will go for value addition and consume much of the iron ore themselves. This will complicate the supply line further.

4.6 In the absence of inadequate development of domestic iron ore resources, if the steel industry in India has to grow to projected levels, it has to resort increasingly to the overseas market. This again has two major implications to the industry's growth plans. One, the industry will forfeit the domestic competitive advantage currently available to the industry. Second, if imports to become routine, the location of the future steel plants will have to be coast based. This is also due to the fact that a lot of coal, limestones and other materials will have to be imported. The policy space for iron ore will remain further complicated as the world prices of

iron ore remain depressed and the Indian steel makers have to pay more for domestic iron ore to rising mining, regulatory or infrastructure related costs. The pressure of costs will rise even for captive mined ores. This mean, the Indian steel producers, unless provided with low cost iron ore alternatives, will lose competitive edge in this specific advantage area.

4.7 Alternatively, taking a positive view, one may accept the view of the iron ore mining industry that iron ore is abundantly available and provided a support to grow, the existing mining industry can engage itself in more intensive scientific exploration and mining and make available more iron ore reserves to avoid any potential import dependence. The mining industry has claimed routinely that there is not really going to be shortage of iron ore in the foreseeable future and that a supportive policy framework is what is only required to make things happen.

4.8 Considering the above, assuming the world case situation in respect of supply of iron ore, the government may, apart from promoting exploration efforts significantly, may unlock the reserves held by the steel producers on captive basis, more than their future consumption potential by way of either re-allocating the surplus reserves to new steel players or merchant iron ore producers or allow the steel producers to sell in the domestic market within a reasonable policy framework.

4.9 The domestic iron ore industry is highly fragmented. Before the ban imposed by the Supreme Court in Karnataka, there were 336 operating mines reporting production to IBM in 2011-12 as per their latest report. A look at the size of the mining leases so far given by the government will show that the average size of the mining areas has dropped sharply and these are very small in global comparison. Operating very small mines involves high degree of material wastes. The government will have to ensure that productivity of the mines is improved with greater economies of scale. For that the government may bring in policies to consolidate mines which are significantly fragmented and also ensure that.

**4.10 In a favourable policy framework, the steel industry can fully capitalize on the domestic resources of iron ore to turn them into a competitive advantage for itself. The government has so far followed a policy to accord priority to allocation of iron ore mines on captive basis to the steel producers. Given the fact that exploration efforts so far have been limited due to various constraints, there are not enough mines to be allocated on captive basis to the new generation of steel producers. Further, with the state governments holding priority in allocating mines either to their own PSUs or the steel plants located in their own respective states, the aggregate benefits to be expected out of this policy framework itself will be limited.** Given the fact that proximity to the steel plants is not the only criterion for competitive production of steel, the locations with other advantages such as proximity to the market, developed infrastructure availability, etc. will not gain whatever little advantage one expects them to have from free movement of iron ore or allocation of captive mines located in different states. In the absence of a developed iron ore market, the steel investors in other favourable locations may have to drop the iron ore advantage factors from the viability estimation of their projects. This means, the iron ore

advantage at a national level will become of lesser or no consequence to them at all. **In conditions of global overcapacity in the iron ore market, dependence of import of iron ore may turn out to be one of the worst and economically undesirable options for the industry.**

4.11 The iron ore mining industry, including the steel producers holding iron ore on captive basis, will have to pay utmost attention to resource conservation of resources by making maximum use of low grade materials by engaging required beneficiation technologies and reducing wastes to the minimum. A lot of research is still required in this area, especially involving iron ore of Fe content less than 50 per cent in the eastern India where the iron ore contains high alumina.

4.12 India's magnetite resources have so far remained untapped due to environmental issues. The resources which are available for mining may be exploited to the full extent.

## Coal

4.13 India has a large reserve of both coking and non-coking coal. But, all these coals are inferior in quality in global comparison. Because of this there is a general dependence on imported coking coal. Although the problems associated with non-coking coal can be handled to some extent, the sheer shortages of the same have forced Indian power plants and many sponge iron plants to import of non-coking coal.

**Table-19: Type wise Coal Resources as on 1.4.2011**

Type of Coal	Category			Total (in Bt)
	Proved (in Bt)	Indicated (in Bt)	Inferred (in Bt)	
Prime Coking	4.62	0.70	0.00	5.31
Med. Coking	12.57	12.00	1.88	26.45
Semi Coking	0.48	1.00	0.22	1.71
Non- Coking	95.74	123.67	31.49	250.90
<i>Tertiary Coal</i>	0.59	0.10	0.80	1.49
Total	114.00	137.47	34.39	285.86

Source: IBM

4.14 If the steel production in the country has to grow in the projected line, demand for coking coal, non-coking coal for steel production and PCI will increase as shown in the Tables above. below.

4.15 In the case of coking coal, import dependence will rise significantly despite the best results from the domestic industry. The domestic capacity to supply coking coal is not likely to increase beyond 20-25 million tonnes even if best efforts are made from the current position.

This means, the industry will have to import about 180 million tonnes coking coal annually by 2032-33 in the 7 per cent GDP growth scenario and much more if the GDP growth rate is higher. While non-coking coal imports for the industry may be minimized, the PCI imports will rise as sharply due to domestic non-availability and rising trends in their use. Apart from sourcing imports and costs of the same, the industry will have to attend to issues such as security of supplies, potential export restrictions coming from source countries, stricter environmental issues related to shipping, infrastructure needed in both the source countries and in Indian ports to handle such volumes, etc.. **The industry will also have to take a balanced approach to the quantum of use of PCI as the future supplies of the same will remain critical and their prices significantly pegged to coking coal prices.** All these issues again bring into the context the point related to location of the plants. If the plants are to be located in the hinterland closer to the iron ore mining areas, infrastructure will have to be ready connecting the ports to the plants too. The potential locations of the plants, at this moment, in most cases, are in the hinterland.

4.16 **However, in a long term strategic perspective, the steel industry will be able to derive remarkable competitive strength using both coking and non-coking coal available within the country, despite the quality concerns.** There is also an alternative view in this regard. This takes into account the long term domestic resource security and conservationist standpoint arguing that it is more prudent, if possible, to continue to depend on foreign energy resources and keep the country's resources for future use. The difficulty in this argument is that it assumes that imported resources such as coal will always be available at reasonable prices and the steel industry will be able to grow unhindered depending on them. This may not happen as demonstrated dependence on a fixed source provides a pricing power to the suppliers and the long term cost of paying more today may turn out to be extremely high tomorrow.

4.17 At present, as per New Coal Distribution Policy, linkage of 75 per cent of the normative requirement of non coking coal by sponge iron companies is being provided by Ministry of Coal at the notified price. However, it is represented by sponge iron companies that the coal companies, while entering into Fuel Supply Agreement (FSA) with sponge iron producers, have been insisting on signing MOUs alongside FSAs which provide for supply of only 50 per cent of Annual Contracted Quantity (ACQ) putting the sponge iron /steel companies at a risk of operating at under-capacity. It is noticed that CIL is selling a substantial quantity of coal through e-auction. To ensure availability of coal for sponge iron sector, it is required that the coal companies should first meet the FSA quantity in full for the full linkage quantity of coal before selling coal through e-auction.

4.18 More than 60 per cent of Indian coal reserves can be extracted only by underground mining. Over the last few decades, the share of coal from underground mines has gradually fallen and now stands at about 10 per cent only. Underground mining is usually viable through deployment of mass production technologies which ensure high productivity thereby drastically reducing costs. To develop underground coal mining will require substantial investment funds and the government will have to create policy atmosphere supporting and encouraging the same. The government may also deploy substantial financial resources to create a research

base development of appropriate technologies locally and to that purpose either set of new institutions or equip the existing organizations to this effect.

**4.19 It is worth noting that Jharia Action Plan initiatives were taken about 15 years ago to develop the coking coal mines in the region which are either getting burnt away or wasted due to inability of the government to rehabilitate and resettle a large population settled in the mining areas. Apart from the fact that these precious resources are not getting available to use and are getting burnt away in fires, the lives of those nearby are in constant risk. While the problem out there is easy to appreciate, the solutions to them have been difficult to identify due to multiple conflicting interests. The non-availability of land has come as a huge setback to the Jharia rehabilitation and development plan. Jharia Rehabilitation and Development Authority (JRDA), which has been made the nodal agency for shifting the families of underground fire zone, admit that they didn't have any land at their disposal to rehabilitate the affected families. JRDA needs 2700 acres of land for resettling the 55,000 families from 595 sites. The process needs to be expedited by quickly identifying land nearby where the displaced people can be settled.**

4.20 Due to limited availability of quality coking coal assets in the country and the oligopolistic control over global coking coal market by a few companies, acquisition of suitable coking coal assets abroad becomes imperative for the domestic steel industry. Though a number of companies from the private sector as well as the public sector (including ICVL, a Joint Venture of public sector companies, viz. SAIL, RINL, NMDC and CIL) are in process of identifying and acquiring coking coal assets abroad, the efforts need to be more focused and required to be supported by the government through diplomatic dialogues. The government may also consider holding diplomatic discussions with coal rich countries to sign MoUs to get rights to assets which they can then offer to the Indian private and public sector companies on a PPP model. These mines can then be developed to export coal back to India on long-term basis. One of the major issues related to such investments is that the resource nation holds that exports of the mineral takes place at market price so that the financials of the subsidiary company in that country can show good profit and thereby the government can get more revenue out of the corporate incomes taxes etc.. In contrast the interest of the Indian company and the Indian government would be to see that exports take place at costs and the parent company shows the profits in their balance sheets. **In any greenfield investment, the Indian company and the government should insist that exports are allowed to take place duty free and at cost.**

4.21 In the context of securing mineral assets such as coal, the potential buyer has to assess the risks in all respects carefully. These include mining risk, information risk, political risk, policy risk and the overall economic risk. There should be proper due diligence of the assets and the countries where they are located. In the recent times, a lot of investments made by the global investing community on mineral assets have come under severe concern due to emergence of adverse socio-political and economic policy related factors. Further, acquisition of assets during the economic boom period is also not a desirable proposition due to the risk of excessive financial valuation. Therefore, what is recommended is that even if there is a need for securing

mineral assets, the process of going about it needs to be carefully studied in all respects and not get driven by popular perceptions.

4.22 Government can also encourage Indian companies in acquisition process by providing guarantees and counter guarantees from a specially created Sovereign Fund, which will help growth in investment by Indian companies in acquiring assets. The concessional loans could be a certain percentage of the total proposed investment.

4.23 Besides, the government can also consider providing grants to develop local infrastructure in emerging countries (like Africa, Mongolia, Vietnam, etc) that are endowed with mineral wealth, as a quid pro quo for the host country offering leases/concessions on a transparent basis to Indian companies for developing mines and for carting the coal to India on long term basis. While moving into such ventures, the Indian entrepreneurs may be advised to assess the current geo-politics and there risks therein in consultations with experts and Indian mission in these countries. It is important also to take note at this point that due to high costs of operation and low prices of coking coal almost half of the coking coal mines in Queensland, Australia are reportedly incurring cash losses in exporting coking coal. This would significantly reduce the immediate future valuation of the mining assets in the region. The Indian steel producers may find this a good opportunity to acquire such mines in financial trouble.

#### **Limestone:**

4.24 The production of limestone in 2011-12 was at about 256.7 million tonnes which was higher by 4 per cent than in the previous year.

4.25 There were 659 reporting mines in 2011-12 as against 592 during the previous year. Twenty two mines, each producing more than three million tonnes per annum contributed about 40 per cent of the total production of limestone in 2011-12. The share of 9 mines, each in the production range of 2 to 3 million tonnes was 8 per cent of the total production. About 27 per cent of the total production was contributed by 51 mines, each producing 1 to 2 million tonnes annually. The remaining 25 per cent of the total production was reported by 577 limestone mines and 3 associated mines. Twenty four principal producers contributed about 79 per cent of the total production. About 6 per cent of the production was reported by the public sector mines as in the previous year.

4.26 Andhra Pradesh was the leading producing state accounting for (21 per cent) of the total production of limestone, followed by Rajasthan (19 per cent), Madhya Pradesh (13 per cent), Gujarat (9 per cent), Tamil Nadu, Karnataka and Chhatisgarh (8 per cent each), Maharashtra and Himachal Pradesh (4 per cent each) and the remaining 6 per cent was contributed by Meghalaya, Uttar Pradesh, Odisha, Jharkhand, Kerala, Bihar, Assam and Jammu and Kashmir.

**4.27 About 94 per cent of the total production of limestone during 2011-12 was of cement grade, 5 per cent of iron and steel grade and the rest 1 per cent consisted of chemical and other grades.**

4.28 In the iron and steel industry, limestone is used both in blast furnaces and steel melting shops as a flux after calcining. It is also added as flux in self-fluxing iron ore sinters. It has two basic functions in steel making, first to lower the temperature of melting and second to form calcium silicate which comes out as a slag, as it combines with silica in iron ore.

4.29 For use in the blast furnace, the calcium carbonate (CaCO<sub>3</sub>) content in limestone should not be usually less than 90 percent. The combined SiO<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> should not exceed 6 per cent though up to 11.5 per cent is allowed; MgO should be within 4 per cent and sulphur and phosphorus as low as possible. In Steel Melting Shop (SMS), insolubles in limestone should not exceed 4 per cent. Good fluxing limestone should naturally be low in acid constituents like silica, alumina, sulphur and phosphorus. Limestone should be dense, massive, preferably fine-grained, compact and non-fritting on burning. The BIS has prescribed specifications for flux grade limestone for use in steel plants as per IS : 10345 - 2004 (Second Revision; Reaffirmed 2009).

**4.30 On account of constraints faced in moving limestones from places such as Jaisalmer and Himachal Pradesh, the steel producers, especially those in coastal areas are turning to imports. It is desirable that the domestic limestones are used first in the larger national interest.**

4.31 Following measures are required to improve availability of limestone for the Indian iron and steel industry:

- i. Detailed exploration for new deposits.
- ii. Restrictions on supply of steel grade limestones to the cement industry.
- iii. Investment in infrastructure in and around limestone deposits to ensure economical movement of limestones to steel plants.
- iv. Support to steel and other producers to acquire limestone assets overseas, in countries such as UAE, Oman, Thailand and other countries rich in limestone deposits. **But, such investments, in the first place, will have to be economically viable. In order to make such investments viable, the government may consider waiving of all customs duties on the imports from such acquired mines.**

## **Manganese**

4.32 Indian manganese ore deposits occur mainly as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archeans) of Madhya Pradesh (Balaghat, Chhindwara and Jhabua districts), Maharashtra (Bhandara and Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundergarh district) and with Kodurite Series (Archeans) of Odisha (Ganjam and Koraput districts) and Andhra Pradesh (Srikakulam and Visakhapatnam districts).

**Table- 20 Reserves/Resources of Manganese ore (By States)  
As on 1.4.2005 and 1.4.2010**

(In '000 tonnes)

State	1.4.2005
	378569
<b>All India (All India)</b>	
Andhra Pradesh	15583
Goa	19057
Gujarat	2954
Jharkhand	7458
Karnataka	82736
Madhya Pradesh	62422
Maharashtra	30353
Odisha	152964
Rajasthan	4821
West Bengal	200

Figures rounded off.

(P) : Provisional

*Note : Updation of National Mineral Inventory as on 1.4.2010 is in under Progress.*

*(Source : National Mineral Inventory)*

4.33 The total resources of manganese ore in the country as per UNFC system as on 1.4.2005 are placed at 378.57 million tonnes. Out of these, 138.15 million tonnes are categorized as reserves and the balance 240.42 million tonnes are in the remaining resources category. Grade wise, ferro-manganese grade accounts for only 7per cent, medium grade 8per cent, BF grade 34per cent and the remaining 51per cent are of mixed, low, others, unclassified, and not known grades including 0.5 million tonnes of battery/chemical grade.

4.34 State-wise, Odisha tops the total resources with 40 per cent share followed by Karnataka (22per cent), Madhya Pradesh (16per cent), Maharashtra (8per cent), Goa (5per cent) and Andhra Pradesh (4per cent). Rajasthan, Gujarat, Jharkhand and West Bengal together shared about 5per cent of the total resources. However, as per the latest reports Maharashtra and Madhya Pradesh account for higher production.

**Table-21 :Production of Manganese Ore 2009-10 to 2011-12(p)**

State / District	(Quantity in tonnes)		
	2009-10	2010-11	2011-12 (P)

	Quantity	Quantity	Quantity
India	2491950	3056385	2349300
<b>Andhra Pradesh</b>	260628	290785	322087
<b>Goa</b>	770	440	1550
<b>Gujarat</b>	55090	245240	-
<b>Jharkhand</b>	39875	44898	18265
<b>Karnataka</b>	301163	413287	136072
<b>Madhya Pradesh</b>	607148	716285	648283
<b>Maharashtra</b>	613520	672828	649898
<b>Odisha</b>	605313	655984	565662
<b>Rajasthan</b>	8443	16638	7483

Source: IBM

4.35 Present domestic consumption of manganese ore is around 4.2 million tonnes. During 2011-12 only, India imported about 1.2 million tonne of manganese ore, particularly of high grade, from different countries.

4.36 Based on the projections for production of steel in future years, projections for the requirement of manganese ore by the domestic industry up to 2032-33 were made and the same are as in the table below. In the event, the overall quality of manganese ores in terms of Mn content falls, the specific requirement of the same will rise.

**Table-22 Demand for Manganese Ores in the Iron and Steel Industry as per Growth Projections of Crude Steel Production**

(In million tonnes)

GDP Growth Rate of GDP( per cent)	2025-26	2032-33
6.5	9.6	14.9
7.0	10.2	16.3
8.0	11.4	19.5

### **Key Policy Issues Pertaining to Manganese Ore Exploration**

4.37 Inadequate exploration is a major bottleneck for a realistic assessment of the manganese ore reserves in the country. During the last fifteen years, no significant exploration has been made by the agencies of Central Government (GSI and MECL) as well as State Governments to convert the resources in the reserve categories.

4.38 The exploration efforts by the government agencies need to be expedited to improve the reserves of Manganese Ore in the country. Besides, the existing mine owners are also required to undertake further exploration in their existing mines to establish/ enhance Manganese Ore reserve base of individual mines, which will not only increase the reserve/ resources of the mine but will also promote capacity augmentation. The explorations of deep-sea nodule could also be made, as that can be potent source of manganese in the future.

### **Beneficiation of Manganese Ore**

4.39 Out of the total available reserves of manganese ore in the country, only about 15 per cent of it is of high grade and the rest is coming under medium and low grades. To optimally utilize the manganese ore resources of the country and to cater to the increasing requirement of ore by the domestic steel industry, it becomes absolutely necessary to fully exploit and utilize even the lower grades of these ores. The industry needs to set up beneficiation facilities for upgrading and utilizing all grades of manganese ore, particularly of lower grades. Greater R and D efforts are also required for developing economically and technically viable beneficiation techniques in the country. The manganese ore producers are a fragmented lot with only MOIL, a public sector undertaking, as a significant player with some good resources under its command. Therefore, it may not be possible for each mining company to set up individual R and D projects which require substantial financial resources. Therefore, such efforts will have to be either an industry co-operative with the steel and ferro-alloy makers included or a fully government backed effort with the industry marginally contributing to it in whichever form that may be possible.

### **Agglomeration of Manganese Ore**

4.40 Due to increasing demand of manganese ore in ferro-manganese and silico-manganese industry, it is required to set up more facilities for sintering, briquetting and pelletizing of manganese ore fines, which will also help in optimal utilization of manganese ore resources of the country.

### **Overseas acquisition of assets of manganese ore**

4.41 Keeping in view the projections of steel demand in coming years and the consequent demand of manganese ore by the steel industry, it is anticipated that there is likely to be a continued demand supply gap in the country for manganese ores, necessitating import of the same. It is, therefore, desirable that special efforts are made by domestic companies to explore possibilities of overseas acquisition of manganese ore mines, particularly for high grade manganese ore, in various manganese ore rich countries like South Africa, Australia and others.

### **Method of Mining**

4.42 Keeping in view the future requirement of manganese ore in line with projected steel production, mechanization of manganese mines becomes crucial and needs to be given a priority. The industry has reported that proper selection of machinery for open cast mining is the very important. In case of underground mining activities, a lot of R and D activities are required to deal with soft and friable ores along with soft host rock. At present, these types of deposits are dealt with through cable bolting with timber square set support in hydraulic cut and fill mining. This is not only a slow process but the same also results in increased cost of mining and lower productivity and recovery. Alternative methods have to be explored for exaction of ore of similar nature to improve productivity, recovery and safety.

### Chromite

4.43 Chromite is used mainly in metallurgical industry in the production of ferro-alloys; e.g., ferro-chrome, charge-chrome and silico-chrome which are used as additives in making stainless steel and special alloy steel. Chromite resources in the country are not abundant. As per UNFC system, total resources of chromite in the country as on 1.4.2010 (Provisional) are estimated as 203.3 million tonnes, comprising 53.9 million tonnes “reserves” (26.5 per cent) and 149.4 million tonnes “remaining resources” (73.5 per cent).

**Table-23: Reserves/Resources of Chromite  
As on 1.4.2010 (P)  
(By State)**

State	Reserves	Remaining resources	(in '000 Tonnes) Total Resources
All India (Total)	53,970	149,376	203,346
Andhra Pradesh	0	187	187
Jharkhand	0	736	736
Karnataka	745	887	1632
Maharashtra	76	556	632
Manipur	76	6581	6657
Nagaland	0	3200	3200
Odisha	53073	136948	190021
Tamil Nadu	0	282	282

(P) : Provisional

Figure rounded off

(Source: National Mineral Inventory as on 1.4.2010)

4.44 More than 95 per cent resources of chromites are in Odisha. Grade wise, charge-chrome grade accounts for 26 per cent resources followed by ferro-chrome grade and beneficiable

grade (20per cent each) and refractory grade 2per cent. Low, others, unclassified and not known grades together account for 32per cent. Grade wise resources of chromite and state wise resource of chromite as on 1.4.2010 are given in Table-26 below.

**Table-24 : Reserves/Resources of Chromite  
As on 1.4.2010 (P)  
(By Grade)**

Grade	Reserves	Remaining resources	(in '000 Tonnes)
			Total Resources
All India (All Grade) : Total	53,970	149,376	203,346
Refractory	5,701	4,064	9,765
Beneficiable	13824	21154	34978
Charge-chrome	21418	50961	72379
Ferro-chrome	9346	29061	38407
Low	52	3713	3765
Others	921	183	1104
Unclassified	2707	40062	42769
Not know	0	179	179

(P) : Provisional

Figure rounded off

(Source: National Mineral Inventory as on 1.4.2010)

4.45 India produced 3.76 million tonnes of chromite in 2011-12 and consumed 2.38 million tonnes. Based on the projections for production of steel in future years, demand for the same within the country is likely to grow as shown below. This projection was made by the Task Force set up to formulate steel policy. The forecast seems to assume that over time, chromium content in steel ( alloy or stainless) will drop as at the assumed rate of growth of the alloy and stainless steel in the country, the chromite demand should have gone by to about 6.9 million tonnes by 2025-26 and 11,8 million tonnes by 2032-33 on the basis of an extrapolated calculation assuming a 7 per cent GDP growth rate scenario.

**Table-25: Demand for Ferrochrome and Chrome Ore**

Particulars	2025-26	2032-33
TOTAL FERRO	2165.24	5000
CHROME		
IN '000 Kgs.		

Total Chrome Ore	5.41	12.5
Requirement in million tonnes		

## **Key Policy Issues Pertaining to Chromite:**

### **Export of Chromite**

4.46 Although the reserves of chromite ore in the country are not encouraging, India has been a net exporter of it and export volumes are fairly high compared to the reserves available. The country accounts for only about 1.8 per cent of the total chromite ore reserves of the world but maintains 30-35 per cent share in world trade. Exports of chromite increased to 0.23 million tonnes in 2011-12 from 0.17 million tonnes in the previous year. Out of total chromite exported in 2011-12, a bulk of about 48 per cent share was of chromite concentrate while chromite lumps and other chromite together accounted for the balance 52 per cent. Exports were mainly to China (97 per cent) and Japan (2 per cent). In 2011-12, about 10 tonnes of chromium and alloys and scrap was exported mainly to Indonesia and USA .

4.47 The projections of requirement of chromite by domestic steel and alloy industry in the coming years clearly indicate that with the present trends in exports continuing, the resources of chrome ore in the country may not last very long leaving the domestic end use industry to rely on imports. Therefore, there is an urgent need to conserve this critical input for survival of domestic stainless and alloy steel industry and bring in effective fiscal/ other restrictive measures to curb exports of chromite.

### **Exploration**

4.48 It is necessary that extensive exploratory drilling through national agencies i.e GSI/ MECL and state agencies are carried out to convert the remaining resources of chrome ore into the reserves category and to explore new areas for addition of mine reserves.

### **Methods of Mining**

4.49 The ore deposits of Sukinda Valley of Odisha are generally of friable nature and all of them are open pit mines, which have reached the optimum pit limit. The stripping ratio in some cases has reached 1:20. Many open pit mines are required to be made underground and appropriate method of mining should be adopted for exploitation of medium as well as for friable ore. R and D efforts need to be intensified for using low grade ore, with or without blending, in the ferro alloys industry for overall increase in the resource base.

### **Nickel**

4.50 Nickel is used in the production of certain grades of stainless steel as well as special alloy

steel. The production of nickel in the country is negligible and almost the whole of the demand of the domestic end use industry is being met from imports. Domestic stainless and alloy steel industry has to face the vagaries of the widely fluctuating prices of nickel in international market. In view of this, there is a need for development of nickel resources in the country for exploring possibilities of nickel production from available resources of associated minerals.

4.51 There is a good potential of nickel in chromite overburden dumps of Sukinda Valley in Odisha and therefore, extraction of nickel from these chromite overburden dumps of Sukinda Valley need to be given a priority. Extraction of nickel is an energy intensive process and also involves environmental hazards associated with it. More intensive R and D efforts are required for finding economically and technically viable methods for the exploitation of nickel for chromite overburden dumps of Sukinda Valley.

4.52 Besides, domestic companies also need to explore possibility of acquisition of some suitable nickel reserves in a nickel rich country, considering overdependence on imports for this mineral.

### **Ferro- Alloys**

4.53 Ferro alloys are consumed in the production of all grades of steel, but, significantly and specifically in alloy and stainless steel. As steel production increases, demand for ferro-alloys will also rise in nearly the same proportion. Ferro-alloys are a set of diverse products and lack of adequate information in respect of consumption and production of ferro-alloys in each grade, a reliable forecast of their growth could not be made. However, it is fairly well established that, globally, the industry exhibits significant excess capacity and the Indian industry is faced with stiff competition from overseas. Although the industry has remained a net exporter of bulk ferro-alloys with the advantage of domestic resources and current value of the rupee, in the longer term perspectives several measures are required to make the industry competitive on a long term basis. Some of the recommendations are as below.

- i. Ferro-alloys are a power intensive industry and there is a strong need to ensure steady power supplies to the industry at a stable price. In the absence of competitively priced electrical power, the domestic industry will face stiff competition from imports leading to possible closure or under utilization of the capacity in the industry. Concessional power tariff or some other policy measures to encourage captive power plants like higher depreciation for captive power plants, duty free imports of used power equipment, exemption from payment of electricity duty, etc. need to be explored for the survival of this industry.
- ii. Simultaneously, ferro-alloy industry needs to focus on captive power generation and use non-conventional sources of energy.
- iii. Government may also consider allocation of coal blocks on captive basis to power plants attached to ferro-alloys producing units.
- iv. There is scope to implement the scheme of utilizing more and more agglomerated feed in the production of chrome and manganese ferro alloys. Since pellets have an

- advantage over briquettes, pelletization process has to be eventually followed by the Indian plants to reduce their costs by bringing down the specific power consumption.
- v. There is a need for government sponsored research in collaboration with industry in the area of beneficiation of low grade manganese ore for utilization by domestic ferro-alloy industry.

## **Refractories**

4.54 Refractories are crucial for iron and steel production and the productivity of the steel industry depends a lot on the quality of the refractories used. As the blast furnace or steel making shops have undergone significant design and technology changes, the quality of refractories have gained further importance.

4.55 Following are the key issues pertaining to refractories in the context of the steel industry.

- i. There is a need for close coordination between the refractory makers and operational units as 30 per cent of the performance parameters are refractory based and 70 per cent operation based. Close interaction between operational establishments within the end using plants and refractory makers is required for optimization of operational parameters and standardization of the same.
- ii. The R andD efforts for refractory are inadequate and need to be expanded. The stringent specifications of input raw materials for refractory restrict the use of indigenous raw materials. R andD is required for enhancing the use of indigenous inputs by developing suitable technical specifications. However, again, given the small size and fragmented nature of the refractory industry, it is very unlikely that industry wide R andD programme can be initiated by the industry alone. The government will have to play a very important role in funding and leading such efforts.
- iii. There is a need for standardization of shapes and size of refractory bricks to ensure smooth production and inter-changeability in the industry.
- iv. There is an overdependence on imports, mainly from China to meet the domestic demand. The Chinese manufacturers of refractories have overwhelming pricing power given their strong dominance in the world market. There is an urgent need to improve the domestic production capabilities and in development of raw materials for refractories by adequate exploration and research.

## **Natural Gas**

4.56 Natural gas is being mainly used in iron and steel sector by Gas Based Sponge Iron Units (DRI) like Essar Steel (Hazira), JSW Ispat (Dolvi) and Welspun Maxsteel Limited (Salav/ Alibaug) as a feedstock for reduction process. The 2012 estimated requirement for Natural Gas (NG) for

gas based DRI plants was around 7.64 MMSCMD while the availability of natural gas to these plants is presently only 3.45 MMSCMD. The detailed break-up is shown in **Table-21** below.

**Table-26 : Demand and supply of Natural Gas to Gas-based Sponge Iron Plants**

SI No	Name of Plant	Natural Gas Requirement	GLC Gas Supply	RLNG Supply	RIL KG D6 Supply	Total Supplies	Shortfall
1	Essar Steel	5.50	0.70	1.60	0	2.30	3.20
2	JSW Ispat	1.34	0.75		0	0.75	0.59
3	Welspun Maxsteel	0.80	0.40		0	0.40	0.40
	<b>Total</b>	<b>7.64</b>	<b>1.85</b>	<b>1.60</b>	<b>0</b>	<b>3.45</b>	<b>4.19</b>

4.57 The Ministry of Petroleum and Natural Gas had allocated 4.19 mmscmd of gas from RIL's KG D6 field to these three gas based sponge iron units. However, MoPNG vide an order dated 30.3.2011 directed that supply from KG D6 to core sectors (Fertilizer, LPG, power and city gas Distribution) should meet their firm allocations before supplying to other sectors, including steel, irrespective of production levels and if, there is any shortfall in meeting the firm demand of remaining sectors due to fall in production, pro-rata cuts be made on non-core sector customers. Based on this order dated 30.3.2011 of MoPNG, whole of the supply of KG D6 Gas to these three gas based sponge iron units has been stopped due to falling production of LG D6 gas. This has led to a shortfall of about 4.19 mmscmd of natural gas for these plants. In the absence of KG D6 gas, they may have to rely on imported RLNG, which, given its high price, may not work out for these units. This will consequently have an adverse impact on investment in downstream steel industry.

4.58 Further, these sponge iron as well as some other steel plants have made additional fresh demand for natural gas. However, since the sectors prioritized for natural gas appear to have demands substantially higher than the incremental supplies from KG D6 or other gas fields, it is doubtful how far these requirements of domestic gas may be met for the steel plants.

#### **Key Issues pertaining to Natural Gas:**

4.59 Supply of natural gas is critical to the survival of the gas based sponge iron units. All of these units are on the Western Coast, far away from the sources of other raw materials like iron ore. These were set up on the assurance of adequate gas and iron ore supplies. Iron ore is required to be hauled a long distance which make them expensive. Natural gas cannot be replaced by any other material in these plants, as technologically, these plants are designed to use gas only as a reductant. In the absence of KG D6 gas, they may have to rely on costlier imported RLNG, which may adversely affect financial viability of these units. This may result in lower production of sponge iron/ steel and may also have an adverse impact on investment in downstream steel industry. It is required that full supply of natural gas be made to these

existing gas based sponge iron units as per allocation already made, to facilitate continuance of production to the capacity by these units.

4.60 The steel industry has being assigned a lower priority vis-a-vis the other end using industries in the matters of gas allocation at administered price. This may result in non-availability or less availability of natural gas to upcoming sponge iron and steel plants, which require natural gas in their production. The production of natural gas needs to be augmented through urgent policy measures in the interest of domestic end use industry, including iron and steel companies.

## **ALTERNATE ENERGY OPTIONS**

### **Shale gas exploration in Indian context and its use in iron making**

4.61 Shale gas, an unconventional source of hydro-carbon, is a natural gas composed primarily of methane (CH<sub>4</sub>) just like from any other source. Unlike other unconventional gas such as CBM which occurs closer to the surface, shale rock is sometimes found 3,000 metres below the surface. Therefore, special drilling techniques are applied to extract the gas.

### **Global developments in Shale Gas**

4.62 The success of shale gas discovery in the USA, has made all such places in the world where there is a sedimentary basin and contains coal, oil or gas, as a potential target. The governing factors for its development are environmentally benign effects and huge economic benefits. Further, because of the huge reserves widely dispersed all over the world, it will provide much needed energy security as traditional oil and gas sources are not going to last longer than 15-20 years.

4.63 Further shale gas development in other countries are also affected by the level of technologies, lack of infrastructure and regulatory framework, political decision whether to go for drilling or not, through hydraulic fracturing of reservoir rock. Countries like France, Bulgaria, Netherland, Luxembourg and the Czech Republic, have not allowed the fracking. Out of 23 other nations that contain sedimentary basins and are believed to hold gas, most of them have permitted drilling and fracking, however, there have been instances wherein some countries, certain areas do not allow due to heavy population.

4.64 Costs are also playing a major role in planning. In Poland, initial drilling projects have proven to be 2 to 5 times expensive than similar projects in USA. This is primarily due to lack of infrastructure and adequate drilling rigs. It is expected that as the infrastructure develops, the cost will come down to respectable levels. Effect of the developing shale gas industry will not only be purely economic, but also geo-political as its large scale availability, will affect

transportation and pricing. The entire energy value chain will require re-examination and re-assessment.

4.65 Amongst the Asian countries, China's early success with shale gas has given them leverage in their negotiations with companies and governments hoping to sell them energy. China is taking a big lead by spending heavily i.e. ~ US \$ 15 billion /year, almost equal to US spending, to explore and develop tight formations containing oil and gas. China is expected to produce 200 billion cubic feet in 2015 and in the next 5 years, this figure is supposed to see a 10-fold increase to 2 trillion cubic feet per year. As per US Energy Agency's current estimates, China has 1.23 Quadrillion Cubic feet of shale gas available, enough to sustain 2 trillion cubic feet consumption rate for 650 years.

### **Scenario of Shale Gas Exploration in India**

4.66 India's current estimate of shale gas reserves is in the range of 63 trillion cubic feet, one and half times of natural gas reserves. This augurs good for the country's future energy needs.

#### ***Work initiated/carried out***

4.67 The Government has initiated steps for development of shale oil/gas in Indian onland sedimentary basins.

4.68 Following actions have been taken up :

- MoU has been signed between MoPNG and DOS, USA on December 06, 2010 for co-operation in resource assessment, regulatory framework, training, etc.
- A multi-organisational team (MOT) has been constituted among DGH, ONGC, OIL and GAIL for collection of required G andG, geochemical and petro-physical data for assessment of shale oil/gas prospects in Indian onland sedimentary basin.
- Studies have been initiated to identify prospective basin/area for offer
- Formulation of policy for shale oil/gas development with regard to legislative changes

### **Strategies for development of shale oil/gas in India**

4.69 The following strategies have been made with respect to above:

- a) Identification of basins : DGH/MOT has made a critical study towards shale oil/gas prospects and the following six (6) onland sedimentary basins have been shortlisted for study (2011-12)
  - Cambay
  - Krishna-Godavari on land
  - Cauveri On land
  - Assam
  - Indo-Gangetic

- Damodar Valley
- b) Identification of areas within basins  
The detailed analysis of G andG (Geological and Geo-physical), geochemical and petro-physical data of source rocks is in progress to identify the prospective areas within the 6 identified basins. This will be done by DGH in conjunction with MOT, CMPDI. Independent third party analysis would also be carried out.
- c) Resource assessment  
The task of making resource assessment of shale oil/gas for basins would be completed by DGH. In this exercise, USGG (US Government Grants) would provide technical support.
- d) Formulation of shale gas policy  
Currently policies applicable in other countries are being examined in the context of Indian conditions. There are issues related to environment, especially in respect of water use in shale gas production, which need to be addressed. In line with MoU signed between MoPNG and DOS, USA, discussions have been initiated with different US agencies in the area of regulatory and fiscal regimes related to shale gas.

#### **4.70 Shale Gas and its impact on Indian Iron and Steel Industry – A Futuristic Scenario**

- i. Shale gas will have far reaching impact on the Indian industry like power, fertilizer, refineries, petro-chemicals and steel industry.
- ii. In steel sector, particularly in iron making, natural gas along with shale gas can promote the green technologies and lower the CO<sub>2</sub> emission.
- iii. Shale gas application can be found specifically in two areas, viz., a) as injectant through tuyeres in place of/alongwith pulverised coal in blast furnace. This will reduce the coke rate, increase furnace productivity and lower CO<sub>2</sub> emissions due to presence of H<sub>2</sub> in the gas. b) as fuel/reductant for gas based direct reduction for production of sponge iron. In both the cases, besides thermal energy, the chemical energy of the gas is also effectively utilised, thereby maximising benefits over such application areas where gas is used purely as fuel.
- iv. Large shale gas discovery will invariably impact the natural gas pricing and affordability in the country. Substantial reduction in CO<sub>2</sub> emissions can be foreseen if more of iron is produced through DR-EAF route using the natural gas/shale gas instead of following the BF-BOF route. Thus to promote green iron making technology and to meet country's commitment in bringing down CO<sub>2</sub> levels, it is important that Govt. of India adopts a favourable allocation policy for the natural/shale gas to iron and steel sector in the coming future. This will also reduce substantially the pollution load of the plant as sinter plant, coke ovens etc. are getting eliminated.
- v. Undoubtedly, the shale gas 'revolution' is expected to spread around the planet. And with this expansion, DRI will become much more common than it is today.

The majority of DR modules would be built as iron making plants to supply EAF's with sponge iron, just like most DRI modules today. They will produce most of their iron product as hot DRI for direct charging to the steelmaking furnaces so that maximum advantage of energy conservation can be taken.

### **Coal Gasification**

4.71 India's vast non-coking coal reserves and that too, of low rank i.e. high ash > 40 %, can be effectively utilised in environmentally friendly manner, through gasification of coal and production of synthesis gas. This synthetic gas can be used for iron production through DRI route and then steel through the EAFs. Also, it can find its use as an effective injectant in blast furnaces through tuyeres with/without pulverised coal injection and achieve the benefits of lower coke rate, high productivity and low CO<sub>2</sub> emissions. Use of high ash non-coking coal in iron and steel industries after gasification will also conserve the limited resources of coking coal in the country. In this respect, there is vast potential for underground coal gasification (UCG) which has found to have many advantages over surface gasification. The idea is that country should make full utilization of a basket of alternate fuels available viz. coal gasification, UCG, CBM, CMM and shale gas resources in iron and steel sector for the intended benefits by way of promoting greener technologies using indigenous resources. The experience so far in the use of gasified coal has not been overwhelmingly encouraging due to high costs. The industry will have to see that this remains competitive vis-a vis other fuels.

## Chapter-4 Infrastructure for Steel Industry

### Projected Location of Steel Capacities based on Current Investment Intentions

5.1 As per a study conducted in 2010, expressed investment intentions and progress of the various on-going steel projects indicate concentration of steel capacity close to the sources of raw material i.e., in the iron ore rich states of Odisha (25per cent), Chhattisgarh (13per cent), Jharkhand (14per cent), Karnataka (9per cent) and the adjoining areas of Andhra Pradesh. This position may not have changed much in the overall in the more recent period. With the projected dominance of the blast furnace as the key iron making technology to be adopted by the steel industry, it is expected that this geographical distribution of steel-making capacity may remain unchanged unless coast based locations are explored. There will be scattered growth of smaller DRI/scrap based steel units, much of that will depend on the actual capacity additions in integrated plants. As the large integrated plants come up, the smaller units will most likely to be for special, alloy and stainless steel production only. It is possible that some such units will be coastal based taking advantage of imported scrap supplies, especially in the South and the West of the country. What is required from the point of view of the steel industry is that the infrastructure development should support competitive locations for the industry setting up excellent transport network connecting mines, plants, ports and steel markets.

### CURRENT STATUS VIS-À-VIS FUTURE VISION FOR INFRASTRUCTURE

#### Railway Sector

5.2 Railway share in freight handling in steel sector in 2012-13 is as follows, as per estimates of Mecon Ltd.

**Table- 27**

Items	Rail (%)		Road (%)	
	Raw Material	Finished Steel	Raw Material	Finished Steel
<b>Mega projects</b>	90	70	10	30
<b>Small and medium projects</b>	25	25	75	75
<b>Iron ore export</b>	60	-	40	-

5.3 In the steel sector, freight distribution of various modes of transportation is as follows, as per Mecon.

**Table-28**

Steel Freight Distribution (%)	Rail	Road	Slurry Pipeline
<b>2013 : 400 Million tonnes freight turnover</b>	66	28	6
<b>2025 : 1200 Million tonnes freight turnover</b>	66	25	9

5.4 As such, growth in rail traffic will be about 800 million tonnes to achieve production level of 300 million as compared to 264 Million tonnes in the year 2013 as shown in table below.

**Table-29**

Railway's freight year	Total freight handling capacity (Million tonnes)	Steel sector related freight (Million tonnes)
<b>2013</b>	1052	264
<b>2025</b>	3490	800

5.5 Since growth will be almost three times the current rail traffic of steel plants, rail infrastructure needs augmentation along with addition of new lines connecting ports, mines and steel plants to cope up with the steel production level of 300 million tonnes.

5.6 State-wise identified routes where existing rail network are to be strengthened or new routes are to be taken up are highlighted below:

**Table-30**Odisha

- **Doubling – 874 Km**
- **Third Line – 101 Km**
- **Connectivity of future iron ore mines in Odisha to East Coast Railway - 90 Km**

Jharkhand

- **Doubling – 316 Km**
- **Third Line – 21 Km**
- **New line – 40 Km**
- **Connectivity of future iron ore mines in Jharkhand to South Eastern Railway - 50 Km**

Chhattisgarh

- **Single line - 93 Km**
- **Doubling - 445 Km**

Karnataka

- **Single line - 657 Km**
- **Doubling - 435 Km**

Gujarat

- **Conversion of meter gauge to broad gauge -102Km**
- **Doubling - 40Km**

Maharashtra

- **Doubling -75 Km**

5.7 The list of few projects mentioned above is not exhaustive. There will be many more mines, ports where rail connectivity is to be further studied. Strengthening requirement of existing rail

network, requirement of increasing section capacity, planning of new freight corridors etc need discussion with Indian Railways.

5.8 The necessity of creating exclusive iron ore freight corridors may be examined keeping in view the large quantum of iron ore traffic from mines located across the country. Some of the identified routes which may be planned in PPP/FDI are suggested below:

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Exclusive Iron Ore Freight Corridor Requirement and Connectivity to DFC

- **Chiria to Manoharpur – (~40 Km) and connectivity to the proposed East-West DFC for feeding Iron Ore to proposed plants at Chhattisgarh, Jharkhand and West Bengal.**
- **Dalli Rajhara to Rowghat – (~93 Km) single line with future provision of doubling for feeding Iron ore to existing and proposed plants at Chhattisgarh.**
- **Rail connectivity from new mines in Odisha (Maliparbat, Makarnacha and Malangtoli) to proposed East Coast DFC for feeding Iron ore to proposed plants at Odisha and Andhra Pradesh.**

5.9 In addition to the above the proposals of Indian Railways for creation of 4 new DFC's may also be examined under PPP/FDI keeping in view the iron ore export in future and despatches of finished steel across the country.

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FDI/PPP

- **East – West (Kolkata-Mumbai) – (~2000 Km)**
- **North – South (Delhi – Chennai) – (~2137 Km)**
- **East Coast (Kharagpur–Vijaywada) – (~1100 Km)**
- **Southern (Chennai-Goa) – (~890 Km)**

5.10 Apart from the general drawbacks of the Indian Railway system (e.g., very slow expansion of route length and fixed line capacity, congestion in main trunk routes, low capacity of rolling stock etc.), the specific areas of concern for the Indian steel industry where immediate action is needed include, inter alia,

a) Strengthening and augmenting railway links between ports and steel plants as Indian steel is expected to become increasingly dependent on imported coking coal, coke, limestones, manganese ores and iron ore (may be after 25 years or so)

b) Capacity planning, mobilization of funds and timely execution of railway projects in the iron ore mining areas; and

c) Most importantly, augmentation of rail infrastructure in the Eastern and Southern States where large steel capacities are being planned in close proximity to major sources of iron ore in the country.

5.11 Importantly, it is not just a question of connectivity, the railway infrastructure to be built up should be world class so that the plants can gain competitive strength from it. Indian

Railways have many plans for modernization of the existing railway infrastructure with the state of the art rolling stocks and equally good tracks and control systems. These projects need to be implemented early.

## Roads

5.12 India's road network carries almost 65 per cent of freight and 80 per cent of passenger traffic. National Highways (NH) constitute for almost 2 per cent of the network but carry about 40 per cent of the total road traffic. Thus, India relies heavily on roads to move freight in the most cost-efficient and effective manner.

5.13 The Government of India formulated seven-phase programme known as 'National Highway Development Project (NHDP)', vested with NHAI, for the development of national highways has resulted in a significant improvement in the quality of road infrastructure in India. However, as compared to rest of India, the road connectivity in the eastern region of India in terms of quality and last mile connectivity is still lagging behind. The road density of Jharkhand is 0.33 Km/ Sq.Km and Chhattisgarh is 0.56 Km/ Sq.Km which is far less than the national average of 1.48 Km/ Sq.Km. As such the road infrastructure in Jharkhand and Chhattisgarh needs augmentation. Keeping in view the proposed industrial development, the roads in the eastern sector needs focus in the form of maintenance and upgradation to four lane carriageway depending on the traffic projections.

5.14 Based on the existing and probable steel plant locations the following important routes have been identified which are all located in the eastern region of India and are to be taken up on priority.

- Rajamunda to Roxy to Keonjhar to Chandikhol (NH-215) – Strengthening and Widening to be implemented
- Angul to Cuttack (NH-42) – Strengthening and Widening to be implemented
- Talcher to Chandikhol (NH-200) – Strengthening and Widening to be implemented
- Dhamra Port to NH-5 – new road to be developed
- Gopalpur Port to NH-5 - new road to be developed
- NH-6 – Stretches which have not been widened to 4 lane from Chhattisgarh border to West Bengal border to be 4 laned
- NH-75 – Stretches of 2 lane to be widened to 4 lane
- NH-200 - Stretches of 2 lane to be widened to 4 lane

5.15 The modal switch of steel related transportation away from railways to the road sector after deregulation has been caused primarily by the dispersed geographical spread of the proliferating small/medium scale units apart from the inadequacies in the railway transportation system in handling the bulk transportation needs of the expanding Indian steel

industry. The reason for increasing importance of road transportation has also emerged in the context of the need for efficient last mile distribution of finished steel to end-users located in distant areas. Lastly, road transportation has become an important element in a multi-modal transportation matrix, especially, as part of the port related transportation network for import of raw materials and export of finished steel.

5.16 Specific concerns for the steel industry in road transportation include low road density and poor quality of roads in the three iron-ore rich states resulting in high transaction costs due to delay and loss of materials in transit. A second source of problem is the inadequate network of state and district level roads connecting mines and plants to the National Highways, especially in the mining areas in the eastern sectors. In view of the rising importance of road network in steel related transportation, efforts will be made to:

5.17 The government will promote and encourage PPP mode of funding of road projects as a vital link in multi-modal transportation system, especially in relation to port and mine connectivity and distribution of steel in remote areas.

## **Ports**

5.18 Port sector especially in eastern region of India needs to be developed at a rapid pace to synchronize with the growth rate of steel and other industrial sectors. West Bengal, Odisha, Andhra Pradesh and Tamil Nadu in the east coast and Kerala, Karnataka, Goa, Maharashtra and Gujarat on the west coast are having ports of various capacities installed/planned.

5.19 Kolkata Port Trust, Paradip Port Trust, Dhamra Port Company Limited, Visakhapatnam Port Trust, Gangavaram Port Limited, Krishnapatnam Port, Ennore Port, Chennai Port, V O Chidambaranar Port Trust are the operational ports on the eastern coast of India. Apart from these ports there are other upcoming ports viz. Subarnarekha, Chudamani, Astaranga in the state of Odisha which are in various stages of planning/development. Out of above listed ten ports in the eastern sector, Kolkata Port, Paradip Port and Visakhapatnam Port come under the category of major ports. Balance seven ports are categorized as non-major ports.

5.20 Kandla Port Trust, Mumbai Port Trust, Jawaharlal Nehru Port Trust, Mormugao Port Trust, New Mangalore Port Trust, Cochin Port Trust, Ports at Dahej, Mundra, Hazira, Pipavav, Jaigarh are the operational ports on the western coast of India. Out of above listed ports in the western sector, Kandla Port, Mumbai Port, Jawaharlal Nehru Port, Mormugao Port, New Mangalore Port and Cochin Port come under the category of major ports. Balance ports are categorized as non-major ports.

5.21 With the opening up of economy and formulation of new policy guidelines, there has been significant and notable contribution of non-major ports in recent years. However there is still a lot of untapped potential and efforts have to be made by all concerned agencies to ensure that the ports are ready with the planned capacity in time.

5.22 The table below shows the requirement of port handling to meet the increased capacity of steel plants, power plants and other industrial units by 2025.

**Table-31**

Inputs (2025)	Steel Sector	Power Sector	Total (Million tonnes)
<b>Iron ore</b>	21		21
<b>Coking coal</b>	104		104
<b>Imported Coal</b>	51	240	291
<b>Steel scrap</b>	10		10
<b>Limestone and Dolomite</b>	20		20
<b>Grand Total</b>			446

5.23 Port wise current capacity and planned capacity for the year 2020 for all the major and non major ports is given below.

**Table-32**

State	Annual Total capacity (MILLION TONNESPA)	
	Current - 2014	Planned - 2020
<b>West Bengal</b>	67	254
<b>Odisha</b>	104	352
<b>Andhra Pradesh</b>	142	463
<b>Tamil Nadu</b>	155	333
Total – Eastern Region	<b>468</b>	<b>1402</b>
<b>Gujarat</b>	341	1058
<b>Maharastra</b>	150	456
<b>Goa</b>	57	88
<b>Karnataka</b>	65	166
<b>Kerala</b>	50.2	108
Total – Western Region	<b>663</b>	<b>1876</b>
<b>Grand Total – India</b>	<b>1131</b>	<b>3278</b>

(Source: Maritime Agenda 2010-2020, Ministry of Shipping and Web site/Port Departments of the respective ports)

5.24 The present installed port capacity is 1131 million tonnes per annum of which about 277 million tonnes are accounted for by bulk cargoes. The port capacity is estimated to rise by 2020 to 3278 million tonnes of which about 793 million tonnes will be bulk cargoes. As such there will be adequate margin in capacity of ports to take care of increased bulk material requirement in future. The ports, however, have to ensure that the estimated capacity augmentation/project executions are implemented as per schedule to match with the increase in traffic.

5.25 Assuming imports of 85 per cent of coking coal, 20 per cent of non-coking coal and 30 per cent of scrap and imports and exports of steel at 10 per cent of consumption and production by 2025-26, total steel-related port traffic is projected to increase two-folds from the current levels of around 60 million tonnes, if the economy has to grow at about 6.5 per cent annually.

5.26 As far as the ports are concerned, the major problem is not inadequacy of capacity but of low productivity of operations attributed mainly to slow evacuation of cargoes leading to increased transaction costs and loss of competitiveness of the Indian steel industry. The port authorities will have to work towards acceleration in the rate of evacuation through seamless connectivity of ports with a multimodal system of land transportation i.e., railways and roads, under the PPP route with active collaboration amongst steel investors, the state governments and other related agencies providing transport-related services. They will also have to develop deep draft ports so that larger vessels can be berthed and economies of scale are achieved.

5.27 Much of the concerns should actually be addressed if the Ministry of Shipping manages to implement the projects already included in their published long term plans.

### **Slurry Transportation**

5.28 At present the iron ore and coal to iron making units of the country are being transported through railways and roads from their respective linked sources and port. The proposed projected growth of steel industry would impart tremendous pressure on railways with respect to inward and outward traffic, loading and evacuation of raw materials and finished products. As such slurry transportation will play a major role for transportation of raw materials mainly iron ore fines.

5.29 The slurry transportation of iron ore concentrate through pipe line will have following broad advantages.

- A. Bulk and distant transportation of iron ore concentrate in slurry form is environment friendly. These eliminate the dependency on the railways and reduce the cost on transportation of ore.
- B. The long distance transportation of these ultra fine concentrate will require special wagons, which can be avoided by slurry transportation.
- C. The environmental degradation due to vehicular movement in congested road network of mining areas can also be eliminated through slurry transportation.
- D. The upgradation and utilization of the unused low grade iron ore available at different mine sites across the country will enhance the resource base and support mineral conservation.
- E. This will also fulfill the statutory requirements of IBM for utilisation of low grade iron ore by way of beneficiation.

- F. Slurry transportation has minimum social impact, shorter route, easier river crossings (without bridging) and minimum en-route losses.
- G. Easier access for construction, operation and maintenance.
- H. Availability of indigenous equipment for major part of the project except few critical items such as pump and engineering capability.

5.30 The existing/on-going/possible slurry pipeline routes are given in the table below.

**Table-33**

Sl. No.	Existing / On-going / Possible pipeline routes	Iron ore concentrate (Million tonnes/yr)
1	Existing project	8
2	On-going projects	37
3	Possible Pipe line projects	55
	<b>Total</b>	<b>100</b>

5.31 Alternative modes of transporting raw materials e.g., through slurry pipelines will go a long way in reducing the problems of congested transportation network in the mining areas. This mode of transport is environment friendly, hassle-free and such facilities can be set up quickly. However, since these pipelines remain a part of the individual business and are not open to the public, the capital intensity remains high and the industry has sought infrastructure status for it so that several supportive investment related benefits can be availed to lower capital costs. The government may ensure that this status is provided and this mode of transportation is encouraged.

### **Transportation Infrastructure - Rail, Road, Port and Slurry Pipeline**

5.32 In the Base Case Scenario of demand and supply, total transportation needs of the steel sector (i.e., major raw materials, finished steel and pig iron) is slated to more than double from around 325 million tonnes in 2011-12 to about 815 million tonnes in 2025-26. Rising share of large producers in total steel production indicates that around 70-75 per cent of this will be transported by rail and the remaining by road. Concentration of steel plants in specific areas can reduce the overall burden on the infrastructure network and provide optimal economics in aggregate for both the producers and the infrastructure provider.

### **Coastal Waterways and Shipping**

5.33 Given the sources of raw materials and increased dependence on imported raw materials such as coal, it is likely that more and more steel plants will be located in the coastal areas. This means, there will be strong potential for coastal movement of raw materials and finished products from one place to another in the country itself. Coastal transportation can also take place partially in a multi modal system if the plants are located in the hinterland. The government will actively encourage this mode of transportation to reduce pressure on the existing railways and roadways system and create the necessary infrastructure for the same.

## **Power**

5.34 In the Base Case scenario, power required by the steel industry is estimated to increase to 16,000 MW in 2025-26 from around 8200MW in 2016-17 projected by the Working Group on 12<sup>th</sup> Five Year Plan. The top four steel producing states of Odisha, Jharkhand, Chhattisgarh and Karnataka are power surplus as far as generation is concerned. However, deficits in peak power and energy levels occur and are likely to continue as these states are under obligation to transfer power to other regions. For steel projects, especially the large with captive power plants, the problems will be less severe. However, dependence on the grid will continue to be high for small and medium steel units. As power generating capacities rise in the country with mega projects under construction, the government will ensure adequate assured supply of power to the domestic industry through the national grid. The government, at the same time, may constantly encourage use of energy saving technologies in the production of steel.

## **Water**

5.35 Consumption of water by the steel industry is estimated to go up to around 650 million cu. Meter in 2025-26 from about 290 million Cu M today. The total requirement of water by steel is a minute fraction of the total consumption in the country i.e., steel's share was only 0.04per cent in 2006-07 at 215 Million Cu. M. out of a total of 62900 Million Cu. M. Total industrial usage in that year accounted for 5 per cent.

5.36 The three largest iron-ore bearing states of Odisha, Jharkhand and Chhattisgarh have large surface water sources (i.e., river basins) and also account for 10per cent of all ground water reserves in the country. Despite this, steel projects may face problems on account of low priority accorded to the industry in allocation of water. Moreover, the need for steel producers to build external infrastructure for accessing water as a result of inadequate public storage infrastructure and low public water supply also pose serious problems for the steel industry. Very often such efforts result in excessive dependence on ground water resources

5.37 To minimize the deleterious inter-generational environmental and social impacts of depletion in ground water resources and contamination of water sources by industrial effluents, efforts will be made to:

- a) Involve all stake-holders i.e., local community, the steel plants, the state agencies, in chalking out an optimum water sharing agreement and monitoring of the quality of water in the various water sources in the vicinity of steel units.
- b) The government may initiate water footprint mapping and rainwater harvesting in steel industry and related mining areas.
- c) Fix a system of penalty and rewards aimed at bridging the gap between international best practice norms of water use or recycling in steel plants and the Indian standard practices.

## Land

5.38 One of the major impediments to growth for the Indian steel industry in the past decade has come in the form of delays in acquisition of adequate 'Land' at the preferred locations.

5.39 Steel plants of capacities with adequate economies of scale require vast stretches of contiguous land. Land acquisition in the country has been a strenuous process. The new law in the country has sought to ensure adequate compensation to the landowners and also that no land is acquired forcefully against the will of the owners. This is going to making land acquisition a difficult and expensive task for the private sector in particular. More than this, the government has not been able to acquire land even for the private sector in various states such as Jharkhand because of absence of land records which in turn has brought in multiple claimants. Unless the land records are straightened, land acquisition for steel plants will remain difficult. Also, since there is no realistic market price for land to be acquired, it is up to the land owners collectively decide whether they will accept any price. This decision will depend on many market or non-market factors and in the process the buyer of the land is likely to be left in a state of uncertainty despite being willing to pay an asking price. The process of generating consent as per law is a long drawn and tedious process and most of the delays and failures have been on account of this rather than on inability to reach a price agreement.

5.40 It is expected that the benefits of speedy transfer of land will far outweigh the extra private costs incurred on account of added social responsibility and land costs. It is also expected that as land becomes more expensive, the plants will use this resource more efficiently and that there will be some substitution of land by capital at the margin. In a deregulated steel economy such a process will be triggered by forces of competition.

5.41 There have been delays in acquiring environmental and forest clearances. The delays in such clearances can be seen in two areas: one, procedural and bureaucratic delays and two, the non compliance of the applicant to the existing law while making a proposal, that is, the applicant fails to meet the necessities as per law. This problem is not going to go away even if there is a strong government intent to cut procedural delays as the laws are themselves getting increasingly difficult in line with rising domestic consciousness and popular demand and compulsions to remain aligned to remain aligned with the norms set by the developed world and various commitments made by the country in international forums.

5.42 The investment intents in building infrastructure such as roads, railways etc.. have also been marred by inability to acquire land, extremist violence in places and lack of environmental clearances. There has not been an apparent shortages of funds for these projects. One will have to wait for infrastructure to develop adequately for the industry to be competitive. However, even if the government manages to create streams of infrastructure, the question will remain whether the same will really support the steel industry at all. Therefore, unless the infrastructure development takes place in the mining and steel industry areas, the steel industry will not gain effectively.

5.43 Similarly, formation of steel clusters, especially for small and medium sized units/ service/steel processing centres and creation of related common infrastructure on a consortium basis may be encouraged and supported for optimizing land use through scale economies. Efforts should also be made to provide fiscal/financial/administrative help for such shared infrastructure in steel clusters.

5.44 The government may also strongly pursue the concept of creation of SPVs to facilitate quicker acquisition of land, site development and getting necessary government clearances within the overall framework of the government policy in respect of land acquisition.

### **Issues in Alternative/ Ideal Location of Steel Plant**

5.45 Choice of locating a steel plant is a business decision of the individual producers on considerations of specific business interest. Currently, an overwhelmingly large proportion of the new capacities are concentrated in and around the iron-ore bearing states. Transportation network in the iron ore-rich states, which also happen to be rich in other essential minerals, is already highly congested giving rise to a number of negative externalities. Moreover, many of the chosen locations are situated in ecologically and sociologically fragile areas where acquisition of land for building adequate transportation network poses significant problems. Connecting the steel plant locations to mines, ports and the market is crucial without which no investment can even start to flow in.

5.46 Taking into account the considerable social and environmental costs of concentration of extractive production units within a limited geographical area along with the growing import dependence of Indian steel plants for coking coal, efforts will be made to support diversified location of steel plants away from the current hotspots to shore-based facilities. This will reinforce the private choices already evident in a few of the new project proposals.

### **RELATED ISSUES AND SUGGESTIONS**

5.47 LARR Act, 2013 may be reviewed to relax relevant issues which may lead to difficulty in land acquisition along with higher incidence on cost of its acquisition such as :

- a. Govt. to frame detailed rules based on the Act
- b. Project affected persons / criteria for loss of primary source of livelihood to be clearly defined.
- c. Land covered under Schedule-5 / CNT Act in Jharkhand need to be reviewed and relaxed for acquisition for steel project development.
- d. Land records to be updated and digitized at National level.
- e. The mandatory procedure for seeking consent of Gram Sabha for land acquisition need to be relaxed (from a consent level of 70-80 % of project affected families to 51 % of PAFs).
- f. Higher price mechanism under the new Act for acquiring land to be relaxed (Limited to max. 2 times instead of 4 times the market price). Additionally equity partnership may be offered.

5.48 Unified and integrated statutory clearance for mining and steel related infrastructure for the growth of the region would need to be accorded. Delay in statutory clearances / multiplicity of clearances to be eliminated through creation of single authority which shall facilitate fast track statutory clearances of projects including environmental and forestry clearance and linkage for water.

5.49 The government may constitute an authority for creation of updated data base on water resources and its use / allocation at the national level. Possibility of inter-basin connectivity for ensuring water availability in the deficit areas may be explored. All idle / non-moving MoUs for water allocation need to be unlocked for re-assessment of water availability and its re-allocation to industries.

5.50 **Special Mining Zones** to be established through amendment in MMDR Act / Bill / other relevant legal provisions for fast track clearance for exploration and exploitation. The basic characteristics of this will be as under.

- All areas having iron ore resources may be notified except those having extreme biodiversity sensitivity.
- The notified areas may be excluded from the requirement of prior clearance under various laws.
- These notified areas could be handed over to the jurisdiction of a special environmental authority.
- The authority should lay down a detailed mining plan supported by a comprehensive environment management plan.
- Once the plan is laid down, the area should be allocated through a transparent process of auction.
- The environment authority will strictly monitor the adoption of EMP by the miner.
- International best practice should be adopted for mining / environment measurement.
- The notified area should be subjected to independent audit periodically.

## Chapter -5

### Issues in Human Resource Development , Technology, R andD, Ownership and Competitiveness of Indian Steel Industry

#### Human Resource Development

6.1 Steel is not just a capital intensive industry. It requires a huge pool of exceptionally talented and skillful workers at all levels of management and operation. The manpower and skill requirement go beyond the steel industry as similar demand will come from the allied and ancillary industries, development and management of infrastructures related to the steel plants and services sector the support the industrial activities and civic and social life. Currently, the steel producers are facing shortage of skilled manpower. Shortages seem to be more on the side of quality than quantity.

6.2 The steel industry has reported that it has found it difficult to attract talents and retain them due to the fact that there are alternative areas such as finance, marketing and corporate management which are more attractive to an engineer working at a plant which usually is located in a remote area. In many such cases, the initial earnings for such disciplines are much higher than for the stable businesses such as steel making. There is also a preference among the young to live in metropolitan cities with better amenities and quality of life.

6.3 While the steel industry will have to overcome such challenges with offering higher and competitive compensation and work hard to improve upon the quality of life in the plants, the issues pertaining to the overall shortages of employable manpower will have to be resolved at a national level in a mission mode. It may be worth noting that the other industries in the country too faces the same problem. In many ways, the industries, in fact, are competing among themselves to attract talents and retain them.

6.4 While it will not be possible to forecast the exact number of workers that will be required to meet the requirement of each specific skill group, Mecon has estimated that to produce 300 million tonnes of crude steel, there will be requirement of 315,000 people for direct employment and 12,62,000 for indirect employment.

6.5 Given the current status of the educational and training institutes and their capacities, the government or the private sector will have to make massive efforts to create this pool of skilled workers for the steel and allied industries alone.

6.6 For the success of huge human resource development programme, it will be necessary to carry out integrated planning at macro and micro levels in detail through large scale and in

depth socio-economic study, planning and arrangement of resources, formulation of strategies, creation of necessary infrastructure, before going ahead with implementation in a planned and phased manner.

### **Training in Technical Disciplines**

6.7 For employment in steel and allied industries, specialised technical skills are required in different areas. Therefore, the first step would be to assess the skill levels of the local community with the help of trained/institutional experts. Thereafter, appropriate technical training modules can be designed on the basis of skill-sets, trainability parameters and academic background to make optimum use of employment opportunities. The manpower, to be employed for the operation and maintenance of the steel plant, right from the managerial level to the semi-skilled category of workforce, needs to be adequately oriented and trained to the needs of steel plant technology and its various spheres of activities. Such an orientation is a pre-requisite for the plant's human resources development (HRD) so that the personnel are available at the time of construction and commissioning of the various plant units and for subsequent operation and maintenance.

6.8 To get the skilled manpower and also to develop skills amongst the local populace, following facilities are required to be set-up in and around the upcoming steel plants.

***Skill development centres:*** To impart specialised skills amongst the local populace, state-of-the art skill development centres need to be set up. Training modules are to be developed in various skills required to operate and maintain the steel plant. Skill development centres comprises of class rooms and workshops to provide technical skill training to local population. This will help in generating skilled manpower that can be suitably deployed in the steel plant.

***Faculty development centres:*** Experts from particular technological area, from any integrated iron and steel plant/ from consultancy organisation should teach about the latest trends in iron and steel sector to the faculties of premier institutes.

***Training in existing steel plants:*** The managerial and skilled personnel in various categories may be trained in existing steel plants of India in their respective trades.

***Training at the premises of equipment supplier:*** Plant personnel can also be trained at the works of equipment suppliers depending on the type of equipment.

### **Training in the non-technical areas**

***Creation of employment opportunities in non-farm based, small and micro enterprises following training/skill upgradation :*** It is important to provide alternative and

sustainable livelihood to project affected families who have been farmers for generation. For such relocated families, income generating programmes need to be conducted to help them get an exposure to all available opportunities.

***Employment opportunities in greenery development*** : Initiation of a nursery to cater to the green belt development of the plant for which elderly women and widows can be engaged for raising saplings.

***Self-employment opportunities and nurturing entrepreneurial potential following skill upgradation and exposure*** : Women and men beyond employable age, can be encouraged to utilise and avail self employment opportunities by raising poultry farm or dairy farm through co-operative. Young girls/boys can also be imparted training on machinery repair, mobile repair, electronics equipment repair, watch repair etc. to make them become self employed.

***Harnessing and training of young*** : Young girls and boys, by setting up coaching and with the help of expert selectors, will be picked-up for nurturing their innate talent in various sports activities and prepare them to blossom at various national/international levels. Nursing centres, for training the young girls in the areas of health and nursing, may be opened.

Through above efforts, a better quality of life can be made available to the local community so that they reap the fruits of industrialization along with all other stake holders and in the end, nation benefits by way of development which is sustainable.

Apart from the human resource development programmes for employability of project affected families and local people, few more steps are required to be taken to make available adequate managerial and skilled level human resources commensurate with the growth aspiration of 300 MILLION TONNES of steel.

### **Improvements Needed at the Academic Front**

6.9 The academic institutes frequently are understaffed in the area of Ferrous Metallurgy; this is particularly disturbing as the number of students in the area of Materials and Metallurgical Engineering has more than tripled in the last 5 – 7 years.

#### **A University for Higher Learning in Iron and Steel**

6.10 Clearly a need exists to have a higher school of learning in Ferrous Metallurgy: a Graduate Institute of Ferrous Technology is recommended. The objective of this institute would

be to help those working in the area of iron and steelmaking to take up courses in ferrous alloy fundamentals, innovation in steel products and industry-related technologies. These would be specialized courses and their course contents would be directly drawn from the requirements of the industry.

6.11 The location of this institute would be near one of the steel industry with satellite campuses at other steel industry towns. Managers from the steel industry are expected to participate actively at the institute and take courses.

### **Engagement of Leading Academic Institutes bodies with Steel Industries**

6.12 It is suggested that as a first step, the leading academic institutes revisit their Ferrous Metallurgy syllabus and research programme with the active involvement of the steel industry. Presence of (steel) industry representative on the (relevant) Council of the Institutes would also be beneficial to both the parties.

### **Improvements Needed at the Industrial Front**

6.13 Since it is the industry that is going to be the beneficiary of the human resource that emerges out of the institutes, it has to build a long term plan to have a continuous flow of skilled manpower at all levels. The company HR policy should not merely be routine affairs of manpower management. The companies have to devise specific policies and make efforts to retain skilled manpower and take serious note of the reasons for attrition.

6.14 Shortage of professional/ experts due to perceptible decline of interest in pursuing career in metallurgical industries amongst B Techs, M Techs and PhDs is an area of concern. Education systems and corporate policies are to be tuned to facilitate and generate domain experts in every walk of steel plants to achieve higher efficiency and productivity.

6.15 Human resource requirement will be based on the technology engaged in steel production, the size of the plants and the economies of scale derived out of them, location of the plants and the extent of peripheral development required to sustain economic production, etc.. At this stage, it will be premature to project any specific figure how many engineers, non technical managers, industrial workers both in technical and non-technical areas, etc.. unless a detailed study is undertaken. A study to this effect has already been commissioned by the Ministry of Steel.

6.16 The more important point in this regard is the creation of educational institutions which will maintain a continuous flow of qualified people for absorption in the steel industry. At this moment, there is already a shortage and the same will rise unless there are special efforts.

## Technology Perspective

6.17 The technology profile of Indian Steel Industry has undergone a sea change in the post liberalization era with the setting up of new green field steel plants adopting latest technologies. Some of the older plants have been modernized and capacity expanded. However, a lot need to be done to improve the performance of all older plants which require extensive modernization including phasing out of obsolete facilities by modern and state-of-the-art technologies.

6.18 BOF steel making process accounts for about 43 per cent followed by induction furnace route with 34 per cent and electric arc furnaces 22 per cent in the total crude steel production in the country. The induction furnace route has grown haphazardly in the post liberalization era with the growth in the coal based DRI production. This route of iron and steel production may not be sustainable in years to come because of very high energy consumption and associated green house gas emission, besides quality related issues. Growth in electric arc furnace route remains constrained due to limited availability and high cost of scrap.

6.19 Going by the current and likely level of development in the country, it is unlikely that scrap availability from domestic sources will increase in the near future substantially. The growth prospect of sponge iron production in India also does not seem to have a strong prospect because of perennial shortage of natural gas, high cost of imported LNG, shortages and high price of hard lumpy iron ore and lack of quality non coking coal. Under these perspectives, it is projected that the BOF route is going to have a quantum jump to a level of around 70% by 2025. The balance is expected to be met through DRI and scrap based electric arc furnace and electric induction furnace units with a total overall in this sector towards large energy efficient, environment friendly manufacturing facilities. However, this will be subjected to several considerations namely;

- (a) Availability and quality of coking coal at competitive price and cost effectiveness for production of high quality coke with minimum environmental emission.
- (b) Competitiveness of using coal gas and shale gas for production of sponge iron through gas based route or new and emerging non coking coal based route namely – jumbo rotary kilns (1000 tpd), FAST MET and ITmk3 technology.
- (c) The extent of penetration of alternative liquid iron making processes like Corex / Finex, High –Smelt / HISARNA.
- (d) Development in oxygen based blast furnace and technological advances in favor of adoption of BOF processes.
- (e) In view of increasing demand of steel by the consumers, the steel industry needs to pay much greater attention to secondary refining and continuous casting to improve quality of steel. Thin slab casting is already well established and the agenda for the next decade should consider development and adoption of near- net-shape casting viz. strip casting and long product casting.

(f) Due to phenomenal growth in automotive industry and strict emission norms in automotives have already led to reduction in overall weight which has necessitated development in steel products both in galvanized and cold rolled annealed category.

6.20 Choice of technology is a subject matter of the investor which is driven by specific conditions of raw materials supply, locations, product mix, etc.. The government, however, has a major role to play indirectly by formulating policies in respect of raw materials, environment management and pollution control and land allocation. A strategic view will also have to be taken on the likely change in steel making technologies, especially in the iron making areas, in the context of the future scenarios of supplies of raw materials in India and worldwide. While several new iron making technologies have been successfully tried and some of them implemented, the core of the steel industry technology has not changed much in decades. The industry will have to pay increased attention to steel scrap recycling as scrap availability will rise gradually over the coming decades.

6.21 In a longer term perspective, say for about 30-40 years, or even beyond, many changes are expected from the current position, especially in the areas of raw materials supply and technology change. Increased availability of steel scrap in the coming decades will substitute iron ore and the demand for iron ore and coking coal will then fall. The steel making technology space will thus change in accordance. Also, in the last ten years, a huge quantum of investment has gone into adding iron ore and coking coal mining capacity globally and more such are in the pipeline. The rise of iron ore and coking coal prices in the past decade was mainly due to the fact that such investments were minimal and both coking coal and iron ore industries could not easily respond to the unexpected demand coming from China. The world may not really run into a resource crisis as happened in the past decade.

6.22 The global trends observed in rising emphasis on sustainable environment management will cast their shadows on India as well. The steel industry will have to take a strategic view on it, especially when it comes to technology choice, mining and energy use. The increased association of environmental standards and adherence to them with external trade is already visible in global trade with scores of non-tariff barriers in place. Whether the industry will remain competitive bearing all the costs to meet the full requirement of the environmental standards in the global context is important as the industry at the projected level of steel production may have to be deeply engaged in exports.

6.23 There is a need for instituting a professional body on the lines of World Steel Association, Japanese Iron and Steel Federation etc for knowledge sharing, information dissemination and evolving nation wide strategies.

6.24 1 National Mission for Enhanced Energy Efficiency (NMEEE) aims at reducing the emission intensity of India's GDP by 20-25 percent by 2020 from the 2005 level. The potential of the initiatives devised by NMEEE should be fully exploited by steel companies, especially the small and medium enterprises, if they are to survive in a stricter regulatory environment aimed at

compliance with the stated goals. Ministry of steel may facilitate the Industry in the process of utilizing opportunities available under the NMEEE.

6.25 It is now being increasingly appreciated that competitiveness of Indian Steel Industry cannot be sustained in the long run purely on the basis of low labor costs and cheaper raw materials. Technological excellence, innovation and adoption environment-friendly techniques in all stages of production from extraction of minerals to treatment of wastes - are the key to sustained growth in this sector.

6.26 Some of the important issues in this context are as below.

i) The government in partnership with the steel companies needs to frame specific strategies towards reduction of pollution level (PM) below 0.5 kg per tonne of crude steel, zero effluent (water) discharge and drastically reduce water consumption.

ii) Absence of a common methodology in reporting environment performance with respect to the status on resource consumption, emissions, effluent and waste recycling makes comparison of relative performance of the steel plants difficult. This calls for development of an internet based tool, which adopts a common and verifiable procedure for reporting of environment data by the steel plants.

iii) Documents on best available technologies (BAT) for energy efficiency and environment protection shall be made available to the Industry, especially small and medium enterprises, to ensure faster progress towards the goal of sustainable development. In accordance with the world wide trend in adoption of such technologies, the government shall encourage/mandate Indian industry to make use of the available technologies.

iv) Strict enforcement of existing environmental laws and a phased movement towards the international best practice norms will be followed to regulate the growth of environmentally damaging steel units. Stricter enforcement of tax laws to ensure that growth of the industry is not at the cost of environment and loss of public revenue.

v) Steel plants will have to be encouraged to achieve the goals of zero waste generation through 100 per cent recycling of wastes generated. A nation-wide policy in line with fly ash utilization will be required to be formulated to make better use of LD/EAF slag.

vi) Currently, expenditure on Research and Development has been quite low varying in the range of 0.15 to 0.3 per cent of the turnover. The extremely low level of expenditure on R & D in the steel sector poses a grave challenge to the prospects of long term growth of this industry. The industry will have to make more efforts in R&D in their own interest as continued dependence on foreign technology and knowhow even for small matters may lead to significantly rising costs in their efforts to improve productivity and adapt to new conditions of operation. The steel producers, with or without government

support, should earmark about 1.5 – 2 per cent of their total steel business turnover to R&D.

6.27 In the absence of good design, engineering and manufacturing facilities in the country, the steel producers have to depend on import of modern plants and facilities at very high costs. It is desirable that proactive policy initiatives are taken to develop indigenous capabilities in equipment design and manufacturing and thereby reduce dependency of high cost imported machinery. But, such a transition is not likely in a short period of time and concerted and sustained efforts are needed to develop such manufacturing capabilities. The government at one level can privatise some of the large capital goods manufacturers such as HEC and get them to have foreign technical collaboration with adequate foreign equity holding in order to bring them into a world class equipment manufacturing hub for the iron and steel industry. In addition, the government will have to create a business environment sufficiently healthy and promising so that the global equipment manufacturers are encouraged to come and set up such units in India.

6.28 Steel producers may also associate themselves with known equipment suppliers individually or as a group to promote new process development activities. Generation of key knowledge and IPRs from such collaborations will make the process easily adoptable during the commercialization stage. Government may think of suitable incentives for such activities

### **Environmental Issues**

6.29 Environment and GHG emission would be measure criteria for selection and adoption of new technologies in future under the backdrop of environmental regulations both internationally as well as in the domestic front. Going by this perspective, and the fact that energy and carbon intensity of steel production is highest in conventional coal DRI-Electric Furnace route, growth in this sector is expected to be restricted and would also call for innovative approach.

6.30 Conventional integrated steel plants in India are 50% more energy & emission intensive than the global average. The industry therefore, has to chalk out a time bound action plan to reduce energy consumption and CO<sub>2</sub> emission by fixing benchmarks and striving hard to achieve these benchmarks explained here under:

- |  |  |
|--|--|
| <b>a)</b> BF Productivity:                   | 2.5 T/M <sup>3</sup> /D (Min) for old BFs<br>3.0 T/M <sup>3</sup> /D (Min) for new BFs |
| <b>b)</b> BF Fuel Rate:                      | 500 kg/thm (Max) (Old BFs)<br>480 kg/thm ( Max) (New BFs)                              |
| <b>c)</b> BF CDI rate:                       | 100 kg/thm (Min) (Old BFs)<br>150 kg/thm (Min) (New BFs)                               |
| <b>d)</b> Specific Energy Consumption:       | 5 G cal/tcs (Max)  |
| <b>e)</b> Specific CO <sub>2</sub> emission: | 2 T/tcs(Max) (old plants)<br>1.8T/tcs (Max) (New)                                      |

6.31 The specific emissions of air pollutants like dust, oxides of sulphur (SO<sub>x</sub>) and nitrogen (NO<sub>x</sub>) in most of the Indian steel plants are still beyond 1.0 kg per ton of steel as compared to less than 0.5 kg per tonne of steel in developed countries. Sustained action plans need to be developed to reduce the pollution level below 0.5 kg/tonne of steel. Similarly, the issue of high dust emission from coal based sponge iron sector needs to be addressed failing which suitable strategies for forced closure of non-complying units have to be mandated.

6.32 Reduction of fresh water for steel industry is yet another challenge for Indian steel sector in view of growing water scarcity. The industry should pursue plans and strategy to reduce water consumption to below 2 m<sup>3</sup>/tcs for long products and 3 m<sup>3</sup>/tcs for flat products.

6.33 The volume of solid waste (slag, sludge and dust) generated in Indian steel plants is almost 1.5 times the global average while taking steps to reduce the solid waste generation, the Indian steel industry needs to establish innovative ways for utilization of solid waste generated.

6.34 Utilization of BF slag in cement making is well established and this is to be adopted in all Blast Furnaces. However, recycling /reuse of steel slag is low (less than 30%), with growing iron and steel production the problems are expected to grow many fold in years to come which would call for establishing alternate uses for BF slag as well as SMS slag viz. use of air cooled/granulated slag in place of natural aggregates for construction roads, buildings etc.. Innovative ways are also called for complete reuse/recycle of dust and sludge collected from air and water pollution control equipments.

6.35 The priority areas to be considered for incentivizing the industry as well as for public funding of research projects can be environment management, energy efficiency and reduction in GHG emissions, optimum utilization of indigenously available natural resources – beneficiation, agglomeration and adoption of SR technologies, product development for strategic areas such as defence, space research and nuclear energy and optimum utilization of land, especially in green-field steel plants by vertical space management, irrespective of process routes.

6.36 Indian Iron and Steel industry to become partner in development of newer and greener technologies, waste utilization, enhancing use of steel in various areas through innovative design, improving quality of steel with better and improved properties etc., by closely associating with World steel Association and other International collaborations in this direction.

### **Competitiveness Indian Steel Industry**

6.37 If one examines the competitive scenario drawn by World Steel Dynamics of two major Indian companies, SAIL and Tata Steel, relative to four other competitive steel producers in the

world, it will be clear that the Indian steel producers considered stand way behind in most of the technical and financial parameters considered as shown in Annexure-2. However, when it comes to the overall strength of the company from the point of view of their intrinsic strength, performance, management’s vision, etc., JSW Steel stands fairly high in comparison. These are not exhaustive and definitive comparison, but, point to the fact that there is still some distance to cover for the best Indian mills to reach the top.

**Table- 34 : WSD's World-Class Steelmaker Ranking as of January 2013**  
(Weighted Average score out of 10)

Name of the Company	Weighted Average
Bao-Steel	7.03
Essar	6.97
JFE	6.98
Jindal (JSPL)	6.97
JSW Steel	7.23
Nippon Steel	7.15
Nucor	7.09
POSCO	7.76
SAIL	6.99
Severstal	7.32
Vizag	6.23
Source : WSD- Core Report V Feb., 2013	

6.38 In the context of steel industry’s future development, the following issues may also be taken into account reflecting the relative strength and weakness of the industry.

6.39 India has a history of steel making and the industry has reached sufficient levels of maturity in terms of technology absorption, product development and productivity gains. However, capacity additions to the industry and the market growth both have been fairly slow, especially when compared to countries such as China.

6.40 India’s market is growing but the domestic producers are yet to be fully competitive and there is a strong demand routinely coming from the industry to raise tariff protection. It is a

different matter that much of the inefficiency is derived from external surroundings such as poor infrastructure, etc.. While most other industries are also similarly placed, steel being a high capital intensive and infrastructure dependent industry, it faces a greater degree of disadvantage on account of this.

6.41 The wage rates in India are still low compared to not only those in the developed world but also in the comparable emerging economies. While the older plants continue to be burdened with large workforce resulting in low labour productivity, the new generation plants are known to be highly efficient. Over time, as the manpower is restructured in line with future needs the steel industry as a whole will gain in labour productivity. However, due to inadequate development of technical skills, the steel industry continues to suffer from shortages of skilled manpower.

6.42 While large producers are partially or fully dependent on the electricity they generate themselves in their captive power plants using purchased fuels such as coal or capturing waste energy. The smaller plants or stand alone rolling mills are largely dependent on purchased power. Apart from pure shortages, what seems to have hurt the small and medium plants especially is the rising costs of the same. While one can realistically expect the power situation to improve with the currently idle coal based capacities due to coal shortages and the power projects which are either under construction or in advanced stages of planning with the hope that coal shortages will be overcome, the costs of delivery of power remains a big concern for the steel plants dependent on purchased power.

6.43 The costs of capital in India are much higher than those for the producers in the developed or in some of the developing nations. Further, with the depreciating rupee and high domestic inflation, the costs of setting up steel plants have also gone up substantially and if the current trends persist, the same will increase further. The actual capital costs incurred at the end of the day also gets jacked up due to time overruns which in turn leads to cost overruns. In fact, weakness in implementing large projects in India has been experienced widely and the steel industry has seen more of this. Whether it is a managerial inefficiency due to lack of planning or externality, the fact remains that the project costs rise due to poor handling of the same.

6.44 In a longer term perspective, say for about 20-25 years, or even beyond, many changes are expected from the current position, especially in the areas of raw materials supply and technology change. Increased availability of steel scrap in coming decades will substitute iron ore and the demand for iron ore and coking coal will then fall. The steel making technology space will thus change in accordance. Also, in the last ten years, a huge quantum of investment has gone into adding iron ore and coking coal mining capacity globally and more such are in the pipeline. The rise of iron ore and coking coal prices in the past decade was mainly due to the fact that such investments were minimal and both coking coal and iron ore industries could not easily respond to the unexpected demand coming from China. The world may not really run into a resource crisis as happened in the past decade. There is a need to study in detail the iron ore and coal ( coking and non-coking ) supply scenario globally based on specific projects in countries such as Australia, Canada, Indonesia, China, South Africa, Mozambique, etc..

6.45 Another major area which will define the contours of the future steel industry is the reorganization of the markets for steel as a result of saturation in steel consumption in many developing nations, most notably China. Most research on China and the south east Asian nations indicate that steel consumption in these economies have more or less peaked. China's annual consumption levels will gradually fall.

6.46 A strategic view will also have to be taken on the likely change in steel making technologies, especially in the iron making areas. While several new iron making technologies have been successfully tried and some of them implemented, the core of the steel industry technology has not changed much in decades.

6.47 It will be also necessary to study the implications of stronger and lighter steel and miniaturization on the demand side of the market. The gradual movement towards high value steel will reduce consumption of steel by weight in a relative sense.

6.48 In order to ensure that global competitive ranking of the Indian steel industry improves and the industry is able to stand on its own feet without any sustained government support, the government will have to manage the external environment adequately by taking specific and proactive actions to ensure that the steel industry gains fully from the inherent advantages such as availability of high cost iron ore. Given the uncertainty over the future supply of iron ore, the government must ensure quickly that the domestic iron ore is available largely to the industry within the country. Exports may be considered only as exceptional cases. This may be done by policy changes to prioritise supplies to the local industry, discourage exports by fiscal tools and strengthen exploration and mining by direct investment by the government and encourage private agencies to do so with necessary supportive mechanism.

6.49 The government may also consider restructuring the PSUs both in terms of ownership pattern and management so that all the resources currently lying with the PSUs can be properly used to make them global behemoths. The government must also ensure that the gas based sponge iron plants which are unviable at the current global prices of natural gas and can only run if natural gas is allocated at the current or the proposed administered price of the same get adequate gas supplies. The government may have to review the allocation model currently in place.

### **Development Strategy**

6.50 Given the overall scenario presented above in terms of steel demand growth prospects, raw materials availability and the policy concerns therein, infrastructure shortages and the required actions, manpower development needs and industry actions needed in respect of technology induction and enhancement of overall productivity and efficiency, the government actions and policies will have to strategized appropriately so that the development of the industry takes a smooth course.

6.51 It is important to note that currently several major, or even medium and small, projects are in the final stages of completion. The government priority will have to be first to see that these projects are completed quickly if these are held up due to regulatory constraints or lack of appropriate action of the government.

6.52 In the next priority, the government actions may be focused on getting all those projects which are in the advanced stages of planning and some significant investments may have already gone into areas such as partial or full land acquisition, placement of orders for plant and machinery, completing financial closures and acquiring partly other regulatory clearances.

6.53 With the above, the annual steel capacity can be raised to about 180 million tonnes.

6.54 The government then can focus on policy issues related to further development of the steel industry in the Greenfield route to raise the capacity to 300 million tonnes or above.

### **Ownership and Management**

6.55 Steel industry's history worldwide is closely associated with state ownership and the state playing a pivotal role in the industry's development. It has been observed as the steel industry and the market matured most of the state owned steel companies were corporatized with ownership and management being transferred to the private entities. In India too, major steel producer SAIL and mining company NMDC were corporatized. However, government disinvestments in both the cases were small not amounting to any loss of management control in the companies. The government, however, in all such cases transferred management control to the Board where the government is also represented.

6.56 In the context of long term perspectives for the steel industry, there is a need to examine whether the government should continue holding majority stakes in the public sector undertakings and control their management or a process of devolution of control be initiated so that ultimately the concerned steel companies are privatized with the government holding a minority by significant stake, say 26 per cent or so. So far, the disinvestments in the PSUs have been mostly to raise government revenue. These are not being totally guided by any strategic considerations. It is important to note the capability of the Indian steel producers in the private sector to set up and profitably manage their businesses in the most adverse conditions of the market and amidst negative externalities. Considering also significant foreign investment interest in the country's steel sector, the government may consider a process of disinvestment in the existing PSUs.

6.57 The government in the longer term perspective may review the ownership pattern in some of the PSUs under the administrative control of the Ministry of Steel which are not in the business of making steel but in the areas allied services such as engineering consulting, trade and by-products management. The government may initiate a process of disinvestment in these PSUs with a aim to completely privatise them.

## Conclusions

7.1 While there may be debates on whether it makes sense for the government to have such a long term perspective plan for the industry in this huge world of uncertainty, it is certain that without a longer term outlook and strategic plan, the industry's development at the national level will not be strongly footed. It is worth noting that the new action of plan adopted by the European Commission has taken a perspective up to 2050. Much of the policy action has emanated from a study carried out by an expert group on all relevant subjects.

7.2 The objective of this study was to understand the long term and strategic issues which the steel industry is likely to confront in its growth in the future. What were seen mainly as major constraints include concerns over the prospects of growth of the economy itself in the first place. Supportive external environment for a sustained long term average 8 per cent plus GDP growth rate seems elusive at this moment but cannot be entirely ruled out as confidence building and investment measures are already underway. Taking an optimistic yet reasonable view of the growth of the economy, the steel demand in the country can be expected to grow sufficiently to support the production of 300 million tonnes of crude steel by around 2030-2033. If the production capacity is built earlier, the industry will then have to depend on the world market which will remain challenging if the competitive strength of the industry is not enhanced remarkably and to its full potential. To maintain production at 300 million tonnes plus levels will require extensive efforts in the areas of mining of iron ore, coal, manganese ores, etc.. to boost their production and ensure that the steel industry finds these raw materials at competitive prices. It is fairly easily understandable that raw materials remain the basic advantage for the Indian steel industry and in the absence of their easy and low cost availability, the steel producers will face high costs of production and remain globally uncompetitive. With the natural advantages taken away, and given the fact that with increased globalization and lowered trade barriers, the steel industry faces strong competition from imports, the domestic market will no longer remain a comfortable place for the domestic industry. Similarly, there is a need to develop infrastructure to support steel industry's growth especially in the areas where steel plants are likely to be located. There should be a special focus on the steel and mining areas as in a generalized model of infrastructure development, the steel industry may end up seeing no significant benefit.

7.3 In addition to the issues highlighted in this paper above, the government will also have to look at the overall energy policy of the country, long term issues in respect of environment protection and global warming, trade policy, etc.. The country will surely have to take steps to cope up with a host of Non-Tariff Barriers which are expected from the rest of the world in steel or products with high steel intensity.

7.4 The steel industry is capital intensive and unless the industry is financially stable and prosperous, mobilization of resources from the capital market for investment will become extremely difficult. Therefore, industry has to grow competitively with own efforts as also supported by adequate government actions.

## Annexure-1

Annual Production of Crude Steel in Million Tonnes

Rank	Country	2012	2011	2010	2009	2008	CAGR 2008 to 2012
1	China	716.5	694.8	638.7	577.1	512.3	8.75
2	Japan	107.2	107.6	109.6	87.5	118.7	-2.52
3	United States	88.6	86.4	80.5	58.2	91.4	-0.77
4	India	76.7	73.6	69	63.5	57.8	7.33
5	Russia	70.6	68.9	66.9	60	68.5	0.76
6	South Korea	69.3	68.5	58.9	48.6	53.6	6.63
7	Germany	42.7	44.3	43.8	32.7	45.8	-1.74
8	Turkey	35.9	34.1	29.1	25.3	26.8	7.58
9	Brazil	34.7	35.2	32.9	26.5	33.7	0.73
10	Ukraine	32.9	35.3	33.4	29.9	37.3	-3.09
	World	1547.8	1529.2	1431.7	1235.1	1341.2	3.65

Source: WSA

## Annexure-2

Steel Sector Labor Cost Per Tonne Produced (Dollars)

Name of the Company	2007	2008	2009	2010	2011
Nippon Steel -Japan	39.3	52.7	55.5	51.4	58.2
Posco - S. Korea	50.1	48.6	34.1	42.5	43.1
TISCO (Tata Steel) -India	87.3	86.1	73.5	88.2	86.5
SAIL - India	148.4	143.4	90.8	120.7	123.9
Severstal - Russia	105.0	95.0	83.1	92.0	119.7
Bao Steel - China	8.9	10.1	9.3	8.7	8.6

Source : WSD- Core Report V Feb., 2013

**Steel Sector Material and Other Costs Per Tonne Produced (Dollars)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	486.6	776.0	635.4	715.6	843.3
Posco - S. Korea	499.1	584.5	531.9	602.9	762.4
TISCO (Tata Steel) -India	463.8	481.0	427.0	468.4	549.3
SAIL - India	469.1	511.7	449.1	515.5	578.5
Severstal - Russia	538.7	509.5	388.4	502.9	659.4
Bao Steel - China	567.2	758.4	561.6	711.8	870.5
Source : WSD- Core Report V Feb., 2013					

**Steel Sector Interest Cost Per Tonne Shipped (Dollars)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	4.2	6.3	7.2	6.7	7.7
Posco - S. Korea	3.8	4.2	8.0	8.8	11.0
TISCO (Tata Steel) -India	44.3	46.5	50.0	57.6	58.8
SAIL - India	4.9	4.7	6.8	8.6	11.6
Severstal - Russia	6.3	26.0	34.3	25.6	26.8
Bao Steel - China	4.6	10.6	10.3	3.2	-0.8
Source : WSD- Core Report V Feb., 2013					

**Operating Rate (Percent)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	103.0	89.0	85.6	101.0	94.0
Posco - S. Korea	96.2	97.3	86.7	95.1	99.4
TISCO (Tata Steel) -India	77.1	86.9	93.8	97.9	73.5
SAIL - India	84.3	81.2	81.5	83.0	80.0
Severstal - Russia	90.5	84.7	71.0	79.3	93.3
Bao Steel - China	99.1	92.5	89.0	94.8	92.5
Source : WSD- Core Report V Feb., 2013					

**Gross Margin (Sales- Employment Cost-Material Costs) (Million Dollars)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	4390.9	3776.7	1116.5	2777.8	2236.9
Posco - S. Korea	6836.7	6826.0	4407.4	6418.7	5278.6
TISCO (Tata Steel) -India	2042.6	1985.9	1886.9	2521.0	2407.4
SAIL - India	2625.7	1704.6	1913.8	1504.3	1121.3
Severstal - Russia	3618.2	4051.4	1474.8	3107.0	3500.7
Bao Steel - China	3505.6	2955.7	2686.7	3719.8	2381.0
Source : WSD- Core Report V Feb., 2013					

**Debt to Shareholders' Equity (Percent)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	84.9	115.5	119.2	102.4	131.8
Posco - S. Korea	10.9	17.2	18.4	23.0	26.2
TISCO (Tata Steel) -India	20.5	26.3	22.9	11.7	47.7
SAIL - India	19.7	22.1	44.0	51.4	40.4
Severstal - Russia	32.6	86.5	86.3	83.6	84.6
Bao Steel - China	26.9	22.6	8.9	11.5	21.5
Source : WSD- Core Report V Feb., 2013					

**Interest Expense to total Debt (Percent)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	1.7	1.6	1.5	1.7	1.4
Posco - S. Korea	3.9	3	5.1	3.9	4.3
TISCO (Tata Steel) -India	15.8	14.8	17.8	30.7	7.4
SAIL - India	5.5	4.1	2.7	2.5	4.2
Severstal - Russia	3.4	6.4	8.2	7.6	7.1
Bao Steel - China	3.6	8.9	20.7	4.7	-0.7
Source : WSD- Core Report V Feb., 2013					

**Average Age of Plant (Years)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	32.0	27.9	24.4	23.2	23.1
Posco - S. Korea	14.3	11.3	11.0	13.8	9.7
TISCO (Tata Steel) -India	11.1	9.4	10.0	10.5	9.6
SAIL - India	18.0	14.5	16.4	18.1	15.7

Severstal - Russia	5.4	5.8	6.5	5.8	5.8
Bao Steel - China	10.0	10.1	9.4	11.8	13.7
Source : WSD- Core Report V Feb., 2013					

#### Value added per Employee (thousand dollar)

Name of the Company	2007	2008	2009	2010	2011
Nippon Steel -Japan	427.2	388.3	209.1	355.5	326.2
Posco - S. Korea	493.5	511.4	339.3	487.1	419.2
TISCO (Tata Steel) -India	70.5	42.2	74.3	94.5	91.3
SAIL - India	40.5	34.6	31.3	32.2	30.0
Severstal - Russia	53.1	65.2	30.6	53.2	77.4
Bao Steel - China	142.1	123.7	108.9	146.0	97.8
Source : WSD- Core Report V Feb., 2013					

#### Steel Sector Labor Cost Per Tone produced (Deflated by WPI) (2000=100)(dollars)

Name of the Company	2007	2008	2009	2010	2011
Nippon Steel -Japan	38.3	49.9	55.3	50.9	56.7
Posco - S. Korea	44.6	39.8	28.0	33.6	32.1
TISCO (Tata Steel) -India	62	56.5	46.5	51	45.9
SAIL - India	105.5	94.1	57.4	69.8	65.7
Severstal - Russia	35.9	26.8	25.3	24.9	27.5
Bao Steel - China	7.8	8.4	7.8	7.1	6.6
Source : WSD- Core Report V Feb., 2013					

#### Steel Sector Total Assets Per Tonne Capacity (Dollars)

Name of the Company	2007	2008	2009	2010	2011
Nippon Steel -Japan	870.2	940.3	1082.2	1163.9	1239.5
Posco - S. Korea	1015.9	986.9	920.5	1175.8	1267.0
TISCO (Tata Steel) -India	1990.1	2178.6	2138.9	2724.5	2007.3
SAIL - India	607.9	702.7	863.1	1000.2	953.8
Severstal - Russia	848.9	972.0	815.7	884.7	1070.2
Bao Steel - China	804.1	938.8	907.8	914.50	966.9
Source : WSD- Core Report V Feb., 2013					

**Steel Sector Total Assets Per Tonne Produced (Dollars)**

<b>Name of the Company</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>
Nippon Steel -Japan	844.6	1056.2	1264.7	1152.0	1319.0
Posco - S. Korea	1056.3	1014.1	1061.4	1236.2	1274.6
TISCO (Tata Steel) -India	2579.8	2508.1	2281.0	2782.1	2730.8
SAIL - India	721.5	865.9	1059.4	1204.4	1192.2
Severstal - Russia	938.1	1148.1	1149.4	1116.2	1147.7
Bao Steel - China	811.6	1015.0	1019.8	964.5	1045.3
Source : WSD- Core Report V Feb., 2013					

# Appendix: Mecon's Note

## Import Requirement of Raw Materials

**Coking coal:** 80% of requirement for all the states except Jharkhand is expected to be met through import. In Jharkhand, only 35 % import has been envisaged considering availability of indigenous coking coal from BCCL and CCL and proposed new washeries.

**Iron ore:** 5% of requirement for all the states will be met through import as a number of global acquisitions are in the process.

**Non-coking coal (PCI):** 100% of requirement for all the states will be met through import due to non-availability of low ash coal in the country. However, Syngas /CBM/CMM/Shale gas/SNG from UCG, likely to be available from indigenous resources of the country through technology interventions/development, can partly/fully replace the PCI as injectant into the blast furnaces.

**Non-coking coal (DRI):** 20% of requirement for all the states will be met through import mainly for the plants located near port.

**Non-coking coal (CPP):** 30% of requirement for all the states will be met through import.

**Low Silica Limestone:** As per the requirement of the steel industry.

## CURRENT STATUS VIS-À-VIS FUTURE VISION FOR INFRASTRUCTURE

### Railway Sector

Railway share in freight handling in steel sector in 2012-13 is as follows:

Items	Rail (%)		Road (%)	
	Raw Material	Finished Steel	Raw Material	Finished Steel
Mega projects	90	70	10	30
Small and medium projects	25	25	75	75
Iron ore export	60	-	40	-

In steel sector, freight distribution of various modes of transportation is as follows:

Steel Freight Distribution (%) 	Rail	Road	Slurry Pipeline
2013 : 400 Million tonnes freight turnover	66	28	6

2025 : 1200 Million tonnes freight turnover	66	25	9
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As such, growth in rail traffic will be about 800 Million tonnes to achieve production level of 300 Million tonnes in the year 2025 as compared to 264 Million tonnes in the year 2013 as shown in table below

Railway's freight year	Total freight handling capacity (Million tonnes)	Steel sector related freight (Million tonnes)
2013	1052	264
2025	3490	800

Since growth will be almost 3 times of the current rail traffic of steel plants, rail infrastructure needs augmentation along with addition of new lines connecting ports, mines and steel plants to cope up with the steel production level of 300 Million tonnes.

State-wise identified routes where existing rail network are to be strengthened or new routes are to be taken up are highlighted below:

<b><u>Odisha</u></b>
<ul style="list-style-type: none"> <li>▪ Doubling – 874 Km</li> <li>▪ Third Line – 101 Km</li> <li>▪ Connectivity of future iron ore mines in Odisha to East Coast Railway - 90 Km</li> </ul>
<b><u>Jharkhand</u></b>
<ul style="list-style-type: none"> <li>▪ Doubling – 316 Km</li> <li>▪ Third Line – 21 Km</li> <li>▪ New line – 40 Km</li> <li>▪ Connectivity of future iron ore mines in Jharkhand to South Eastern Railway - 50 Km</li> </ul>
<b><u>Chhattisgarh</u></b>
<ul style="list-style-type: none"> <li>▪ Single line - 93 Km</li> <li>▪ Doubling - 445 Km</li> </ul>
<b><u>Karnataka</u></b>
<ul style="list-style-type: none"> <li>▪ Single line - 657 Km</li> <li>▪ Doubling - 435 Km</li> </ul>
<b><u>Gujarat</u></b>
<ul style="list-style-type: none"> <li>▪ Conversion of meter gauge to broad gauge -102Km</li> <li>▪ Doubling - 40Km</li> </ul>
<b><u>Maharashtra</u></b>
<ul style="list-style-type: none"> <li>▪ Doubling -75 Km</li> </ul>

The list of few projects mentioned above is not exhaustive. There will be many more mines, ports area where rail connectivity is to be further studied. Strengthening requirement of existing rail network,

requirement of increasing section capacity, planning of new freight corridors etc need discussion with Indian Railways under facilitation/ guidance from MoS.

The necessity of creating exclusive iron ore freight corridors may be examined keeping in view the large quantum of iron ore traffic from mines located across the country. Some of the identified routes which may be planned in PPP/FDI are suggested below:

<b>Exclusive Iron Ore Freight Corridor Requirement and Connectivity to DFC</b>
<ul style="list-style-type: none"> <li>▪ Chiria to Manoharpur – (~40 Km) and connectivity to the proposed East-West DFC for feeding Iron Ore to proposed plants at Chhattisgarh, Jharkhand and West Bengal.</li> <li>▪ Dalli Rajhara to Rowghat – (~93 Km) single line with future provision of doubling for feeding Iron ore to existing and proposed plants at Chhattisgarh.</li> <li>▪ Rail connectivity from new mines in Odisha (Maliparbat, Makarnacha and Malangtoli) to proposed East Coast DFC for feeding Iron ore to proposed plants at Odisha and Andhra Pradesh.</li> </ul>

In addition to the above the proposals of Indian Railway for creation of 4 new DFC's may also be examined under PPP/FDI keeping in view the iron ore export in future and despatches of finished steel across the country.

<b>FDI/PPP</b>
<ul style="list-style-type: none"> <li>▪ East – West (Kolkata-Mumbai) – (~2000 Km)</li> <li>▪ North – South (Delhi – Chennai) – (~2137 Km)</li> <li>▪ East Coast (Kharagpur-Vijaywada) – (~1100 Km)</li> <li>▪ Southern (Chennai-Goa) – (~890 Km)</li> </ul>

## Road Sector

India's road network carries almost 65 per cent of freight and 80 per cent of passenger traffic. National Highways (NH) constitute for almost 2 per cent of the network but carry about 40 per cent of the total road traffic. Thus, India relies heavily on roads to move freight in the most cost-efficient and effective manner.

The Government of India formulated seven-phase programme known as 'National Highway Development Project (NHDP)', vested with NHAI, for the development of national highways has resulted in a significant improvement in the quality of road infrastructure in India. However, as compared to rest of India, the road connectivity in the eastern region of India in terms of quality and last mile connectivity is still lagging behind. The road density of Jharkhand is 0.33 Km/ Sq.Km and Chhattisgarh is 0.56 Km/ Sq.Km which is far less than the national average of 1.48 Km/ Sq.Km. As such the road infrastructure in Jharkhand and Chhattisgarh needs augmentation. Keeping in view the proposed industrial development, the roads in the eastern sector need focus in the form of maintenance and upgradation to four lane carriageway depending on the traffic projections.

Based on the existing and probable steel plant locations the following important routes have been identified which are all located in the eastern region of India and are to be taken up on priority.

- Rajamunda to Roxy to Keonjhar to Chandikhol (NH-215) – Strengthening and Widening to be implemented
- Angul to Cuttack (NH-42) – Strengthening and Widening to be implemented
- Talcher to Chandikhol (NH-200) – Strengthening and Widening to be implemented
- Dhamra Port to NH-5 – new road to be developed
- Gopalpur Port to NH-5 - new road to be developed
- NH-6 – Stretches which have not been widened to 4 lane from Chhattisgarh border to West Bengal border to be 4 laned
- NH-75 – Stretches of 2 lane to be widened to 4 lane
- NH-200 - Stretches of 2 lane to be widened to 4 lane

## Port Sector

Port sector especially in eastern region of India needs to be developed at a rapid pace to synchronize with the growth rate of steel and other industrial sectors. West Bengal, Odisha, Andhra Pradesh and Tamil Nadu in the east coast and Kerala, Karnataka, Goa, Maharashtra and Gujarat on the west coast are having ports of various capacities installed/planned.

Kolkata Port Trust, Paradip Port Trust, Dhamra Port Company Limited, Visakhapatnam Port Trust, Gangavaram Port Limited, Krishnapatnam Port, Ennore Port, Chennai Port, V O Chidambaranar Port Trust are the operational ports on the eastern coast of India. Apart from these ports there are other upcoming ports viz. Subarnarekha, Chudamani, Astaranga in the state of Odisha which are in various stages of planning/development. Out of above listed ten ports in the eastern sector, Kolkata Port, Paradip Port and Visakhapatnam Port come under the category of major ports. Balance seven ports are categorized as non-major ports.

Kandla Port Trust, Mumbai Port Trust, Jawaharlal Nehru Port Trust, Mormugao Port Trust, New Mangalore Port Trust, Cochin Port Trust, Ports at Dahej, Mundra, Hazira, Pipavav, Jaigarh are the operational ports on the western coast of India. Out of above listed ports in the western sector, Kandla Port, Mumbai Port, Jawaharlal Nehru Port, Mormugao Port, New Mangalore Port and Cochin Port come under the category of major ports. Balance ports are categorized as non-major ports.

With the opening up of economy and formulation of new policy guidelines, there has been significant and notable contribution of non-major ports in recent years. However there is still a lot of untapped potential and efforts have to be made by all concerned agencies to ensure that the ports are ready with the planned capacity in time.

The table below shows the requirement of port handling to meet the increased capacity of steel plants, power plants and other industrial units by 2025.

Inputs (2025)	Steel Sector	Power Sector	Total (Million)
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			tonnes)
Iron ore	21		21
Coking coal	104		104
Imported Coal	51	240	291
Steel scrap	10		10
Limestone and Dolomite	20		20
<b>Grand Total</b>			<b>446</b>

Port wise current capacity and planned capacity for the year 2020 for all the major and non major ports is given below.

State	Annual Total capacity (MILLION TONNESPA)	
	Current - 2014	Planned - 2020
West Bengal	67	254
Odisha	104	352
Andhra Pradesh	142	463
Tamil Nadu	155	333
<b>Total – Eastern Region</b>	<b>468</b>	<b>1402</b>
Gujarat	341	1058
Maharashtra	150	456
Goa	57	88
Karnataka	65	166
Kerala	50.2	108
<b>Total – Western Region</b>	<b>663</b>	<b>1876</b>
<b>Grand Total – India</b>	<b>1131</b>	<b>3278</b>

(Source: Maritime Agenda 2010-2020, Ministry of Shipping and Web site/Port Departments of the respective ports)

The present installed port capacity is 1131 MILLION TONNESPA of which about 277 MILLION TONNESPA is bulk cargo. The estimated port capacity (Year 2020) is 3278 MILLION TONNESPA of which about 793 MILLION TONNESPA will be bulk cargo. As such there will be adequate margin in capacity of ports to take care of increased bulk material requirement in future. The ports however have to ensure that the estimated capacity augmentation/project executions are implemented as per schedule to match with the increase in traffic.

### Slurry Transportation

At present the iron ore and coal to iron making units of the country are being transported through railways and roads from their respective linked sources and port. The proposed projected growth of steel industry would impart tremendous pressure on railways with respect to inward and outward traffic, loading and evacuation of raw materials and finished products. As such slurry transportation will play a major role for transportation of raw materials mainly iron ore fines.

The slurry transportation of iron ore concentrate through pipe line will have following broad advantages.

- I. Bulk and distant transportation of iron ore concentrate in slurry form is environment friendly. These eliminate the dependency on the railways and reduce the cost on transportation of ore.
- J. The long distance transportation of these ultra fine concentrate will require special wagons, which can be avoided by slurry transportation.
- K. The environmental degradation due to vehicular movement in congested road network of mining areas can also be eliminated through slurry transportation.
- L. The upgradation and utilization of the unused low grade iron ore available at different mine sites across the country will enhance the resource base and support mineral conservation.
- M. This will also fulfill the statutory requirements of IBM for utilisation of low grade iron ore by way of beneficiation.
- N. Slurry transportation has minimum social impact, shorter route, easier river crossings (without bridging) and minimum en-route losses.
- O. Easier access for construction, operation and maintenance.
- P. Availability of indigenous equipment for major part of the project except few critical items such as pump and engineering capability.

The existing/on-going/possible slurry pipeline routes are given in the table below.

Sl. No.	Existing / On-going / Possible pipeline routes	Iron ore concentrate (Million tonnes/yr)
1	Existing project	8
2	On-going projects	37
3	Possible Pipe line projects	55
	<b>Total</b>	<b>100</b>

## 1. RAW MATERIAL REQUIREMENT

The production of steel in an integrated steel plant involves consumption of various raw materials. The major raw materials required for steel plants are:

- Iron ore
- Coal
- Limestone and dolomite,
- Ferro- alloys

Accordingly the estimated annual raw materials requirement by 2025-26 to cater the steel industry for production of 300 Million tonnes steel in the country is presented below.

### Raw Material Requirement by 2025-26

Raw Materials (Million tonnes/yr)							
Iron Ore	Limestone and	Coking Coal	Non-Coking	Non-Coking	Ferro alloy		
					Manganese	Chromite	Quartzite

	<b>Dolomite</b>		<b>Coal CPP</b>	<b>Coal PCI/DRI</b>			
<b>490</b>	<b>95</b>	<b>150</b>	<b>80</b>	<b>168</b>	<b>13.5</b>	<b>5.7</b>	<b>2</b>

Additional tentative raw material requirement for foundry grade pig iron production is presented below.

<b>Raw materials</b>	<b>Gross Quantity (Million tonnes/yr)</b>	
	<b>14.5 Million tonnes/yr Pig Iron Stage</b>	<b>21.5 Million tonnes/yr Pig Iron Stage</b>
Iron ore lump	26	39
Coking coal	19	29
Limestone (BF Grade)	2.9	4.3
Dolomite (BF Grade)	2.3	3.4
Quartzite	0.8	1.2
Manganese Ore	0.5	0.7

### Import Requirement of Raw Materials

**Coking coal:** 80% of requirement for all the states except Jharkhand will be met through import. In Jharkhand, only 35 % import has been envisaged considering availability of indigenous coking coal from BCCL and CCL and proposed new washeries.

**Iron ore:** 5% of requirement for all the states will be met through import as a no. of global acquisition is underway.

**Non-coking coal (PCI):** 100% of requirement for all the states will be met through import due to non-availability of low ash coal in the country. However, Syngas /CBM/CMM/Shale gas/SNG from UCG, likely to be available from indigenous resources of the country through technology interventions/development, can partly/fully replace the PCI as injectant into the blast furnaces.

**Non-coking coal (DRI):** 20% of requirement for all the states will be met through import mainly for the plants located near port.

**Non-coking coal (CPP):** 30% of requirement for all the states will be met through import.

**Low Silica Limestone:** As per the requirement of the steel industry.

### Major Raw Material Availability in the Country

<b>Raw Material</b>	<b>Reserve (Million)</b>	<b>Remaining Resource</b>	<b>Total Resource</b>
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	tonnes)	(Million tonnes)	(Million tonnes)
Hematite	8093	9788	17,881
Magnetite	22	10,623	10,644
Coal	1,18,145	1,75,352	2,93,497
Limestone	14,926	1,70,008	1,84,935
Dolomite	738	6992	7730
Chromite	54	149	203
Karnataka	877	1282	2159

(Source: Indian Mineral Yearbook 2012)

## 2. ALTERNATE ENERGY OPTIONS

### Shale gas exploration in Indian context and its use in iron making

Shale gas, an unconventional source of hydro-carbon, is a natural gas composed primarily of methane (CH<sub>4</sub>) just like from any other source. It only receives the name “shale gas” because it originates out of rocks that are mostly shale rather than coming out of sandstone as is the case with most natural gas.

Unlike other unconventional gas such as CBM which occurs closer to the surface, shale rock is sometimes found 3,000 metres below the surface. Therefore, special drilling techniques are applied to extract the gas.

#### **Global development in Shale Gas**

The success of shale gas discovery in USA, has made all such places in the world where there is a sedimentary basin and contains coal, oil or gas, as a potential target. The governing factors for its development are environmentally benign effects and huge economic benefits. Further because of the huge reserves widely dispersed all over the world, it will provide much needed energy security as traditional oil and gas sources are not going to last longer than 15-20 years.

Further shale gas development in other countries are also affected by the level of technologies, lack of infrastructure and regulatory framework, political decision whether to go for drilling or not, through hydraulic fracturing of reservoir rock. Countries like France, Bulgaria, Netherland, Luxembourg and the Czech Republic, have not allowed the fracking. Out of 23 other nations that contain sedimentary basins and are believed to hold gas, most of them have permitted drilling and fracking, however, there have been instances wherein some countries, certain areas do not allow due to heavy population.

Costs are also playing a major role in planning. In Poland, initial drilling projects have proven to be 2 to 5 times expensive than similar projects in USA. This is primarily due to lack of infrastructure and adequate drilling rigs. It is expected that as the infrastructure develops, the cost will come down to respectable levels. Effect of the developing shale gas industry will not only be purely economic, but also geo-political as its large scale availability, will affect transportation and pricing. The entire energy value chain will require re-examination and re-assessment.

Amongst the Asian countries, China's early success with shale gas has given them leverage in their negotiations with companies and governments hoping to sell them energy. China is taking a big lead by spending heavily i.e. ~ US \$ 15 billion /year, almost equal to US spending, to explore and develop tight formations containing oil and gas. China is expected to produce 200 billion cubic feet in 2015 and in the next 5 years, this figure is supposed to see a 10-fold increase to 2 trillion cubic feet per year. As per US Energy Agency's current estimates, China has 1.23 Quadrillion Cubic feet of shale gas available, enough to sustain 2 trillion cubic feet consumption rate for 650 years.

### **Scenario of Shale Gas Exploration in India**

India's current estimate of shale gas reserves is in the range of 63 trillion cubic feet, one and half times of natural gas reserves. This augurs good for the country's future energy needs.

#### ***Work initiated/carried out***

The Government has initiated steps for development of shale oil/gas in Indian onland sedimentary basins.

Following actions have been taken up :

- MoU has been signed between MoPNG and DOS, USA on December 06, 2010 for co-operation in resource assessment, regulatory framework, training, etc.
- A multi-organisational team (MOT) has been constituted among DGH, ONGC, OIL and GAIL for collection of required G andG, geochemical and petro-physical data for assessment of shale oil/gas prospects in Indian onland sedimentary basin.
- Studies have been initiated to identify prospective basin/area for offer
- Formulation of policy for shale oil/gas development with regard to legislative changes

### **Strategies for development of shale oil/gas in India**

The following strategies have been made with respect to above:

- e) Identification of basins : DGH/MOT has made a critical study towards shale oil/gas prospects and the following six (6) onland sedimentary basins have been shortlisted for study (2011-12)
  - Cambay
  - Krishna-Godavari onland
  - CauveriOnland
  - Assam
  - Indo-Gangetic
  - Damodar Valley
- f) Identification of areas within basins  
The detailed analysis of G andG (Geological and Geo-physical), geochemical and petro-physical data of source rocks is in progress to identify the prospective areas within the 6 identified basins. This will be done by DGH in conjunction with MOT, CMPDI. Independent third party analysis would also be carried out.
- g) Resource assessment

The task of making resource assessment of shale oil/gas for basins would be completed by DGH. In this exercise, USGG (US Government Grants) would provide technical support.

h) Formulation of shale gas policy

Currently policies applicable in other countries are being examined in the context of Indian conditions. There are issues related to environment, which needs to be addressed. In line with MoU signed between MoPNG and DOS, USA, discussions have been initiated with different US agencies in the area of regulatory and fiscal regimes related to shale gas.

### **Shale Gas and its impact on Indian Iron and Steel Industry – A Futuristic Scenario**

- vi. Shale gas will have far reaching impact on the Indian industry like power, fertilizer, refineries, petro-chemicals and steel industry.
- vii. In steel sector, particularly in iron making, natural gas along with shale gas can promote the green technologies and lower the CO<sub>2</sub> emission.
- viii. Shale gas application can be found specifically in two areas, viz., a) as injectant through tuyeres in place of/alongwith pulverised coal in blast furnace. This will reduce the coke rate, increase furnace productivity and lower CO<sub>2</sub> emissions due to presence of H<sub>2</sub> in the gas. b) as fuel/reductant for gas based direct reduction for production of sponge iron. In both the cases, besides thermal energy, the chemical energy of the gas is also effectively utilised, thereby maximising benefits over such application areas where gas is used purely as fuel.
- ix. Large shale gas discovery will invariably impact the natural gas pricing and affordability in the country. Substantial reduction in CO<sub>2</sub> emissions can be foreseen if more of iron is produced through DR-EAF route using the natural gas/shale gas instead of following the BF-BOF route. Thus to promote green iron making technology and to meet country's commitment in bringing down CO<sub>2</sub> levels, it is important that Govt. of India adopts a favourable allocation policy for the natural/shale gas to iron and steel sector in the coming future. This will also reduce substantially the pollution load of the plant as sinter plant, coke ovens etc. are getting eliminated.
- x. Undoubtedly, the shale gas 'revolution' is expected to spread around the planet. And with this expansion, DRI will become much more common than it is today. The majority of DR modules would be built as iron making plants to supply EAF's with sponge iron, just like most DRI modules today. They will produce most of their iron product as hot DRI for direct charging to the steelmaking furnaces so that maximum advantage of energy conservation can be taken.

### **Coal Gasification**

India's vast non-coking coal reserves and that too, of low rank i.e. high ash > 40 %, can be effectively utilised in environmentally friendly manner, through gasification of coal and production of synthesis gas. This synthesis gas can be used for iron production through DRI route and then steel through EAF. Also it can find its use as an effective injectant in blast furnaces through tuyeres with/without pulverised coal injection and achieve the benefits of lower coke rate, high productivity and low CO<sub>2</sub> emissions. Use of high ash non-coking coal in Iron and Steel industries after gasification will also conserve the limited resources of coking coal in the country. In this respect, there is vast potential for underground coal gasification (UCG) which has found to have many

advantages over surface gasification. The idea is that country should make full utilization of a basket of alternate fuels available viz. coal gasification, UCG, CBM, CMM and shale gas resources in iron and steel sector for the intended benefits by way of promoting greener technologies using indigenous resources.

### **3. HUMAN RESOURCE DEVELOPMENT FOR LONG TERM PERSPECTIVE PLAN**

Setting-up of mega steel projects in a place give Phillip to the all round development of the area by way of infrastructural development, development of allied/ancillary industries in the surroundings and building up of strong social and educational infrastructure in the region. The overall business and industrial climate of the region is raised by the growth of ancillary units both in manufacturing sector like power generation and distribution, slag cement, refractories, spares, foundry and forge, safety appliances, furniture, paint, etc. and service sectors such as consultancy, transport, hospitality, education, health and sanitation, retail chain etc. The resulting effect is that it raises the income, employment opportunities and economic growth of the people and reduces regional disparities in economic development.

For realizing the national mission of having steel capacity of 300 Million tonnes by 2025-26, an additional steel production capacity of ~ 176 Million tonnespa in Eastern Sector (Jharkhand, Chhattisgarh, Odisha, Part of West Bengal and part of Andhra Pradesh) and about 26 Million tonnespa in rest of India is required to be created. Such huge steel capacity addition shall bring about a cataclysmic change in the region. It is expected that Large steel complexes along with associated social infrastructure facilities and development of surrounding allied/ancillary industries, will bring about huge direct and indirect employment opportunities to the tune of approx. 315,000 and 1,262,000 respectively. For ensuring employability of project affected families and local people, massive human resource development efforts need to be made in a planned manner by imparting specialized skills in both technical as well as non-technical areas, keeping in view the socio-cultural tradition of the population, their age and gender profile.

For the success of huge human resource development programme, it will be necessary to carry out integrated planning at macro and micro levels in detail through large scale and in depth socio-economic study, planning and arrangement of resources, formulation of strategies, creation of necessary infrastructure, before going ahead with implementation in a planned and phased manner.

#### **Training in technical disciplines**

For employment in steel industry and allied industries, specialised technical skills are required in different areas. Therefore, the first step would be the skill assessment of local community with the help of trained/institutional experts. Thereafter, appropriate technical training modules are to be designed on the basis of skill-sets, trainability parameters and academic background to make optimum use of employment opportunities.

The local populace need to be imparted with requisite training and skills to make them employable. The manpower, to be employed for the operation and maintenance of the steel plant, right from the managerial level to the semi-skilled category of workforce, needs to be adequately oriented and trained to the needs of steel plant technology and its various spheres of activities. Such an orientation is a pre-requisite for the plant's human resources development (HRD) so that the personnel are available at the time of construction and commissioning of the various plant units and for subsequent operation and maintenance.

To get the skilled manpower and also to develop skills amongst the local populace, following facilities are required to be set-up in and around the upcoming steel plants.

**Skill development centres:** To impart specialised skills amongst the local populace, state-of-the-art skill development centres need to be set up. Training modules are to be developed in various skills required to operate and maintain the steel plant. Skill development centres comprises of class rooms and workshops to provide technical skill training to local population. This will help in generating skilled manpower that can be suitably deployed in the steel plant.

**Faculty development centres:** Experts from particular technological area, from any integrated iron and steel plant/ from consultancy organisation should teach about the latest trends in iron and steel sector to the faculties of premier institutes.

**Training in existing steel plants:** The managerial and skilled personnel in various categories may be trained in existing steel plants of India in their respective trades.

**Training at the premises of equipment supplier:** Plant personnel can also be trained at the works of equipment suppliers depending on the type of equipment.

### Training in the non-technical areas

**Creation of employment opportunities in non-farm based, small and micro enterprises following training/skill upgradation :** It is important to provide alternative and sustainable livelihood to project affected families who have been farmers for generation. For such relocated families, income generating programmes need to be conducted to help them get an exposure to all available opportunities.

**Employment opportunities in greenery development :** Initiation of a nursery to cater to the green belt development of the plant for which elderly women and widows can be engaged for raising saplings.

**Self-employment opportunities and nurturing entrepreneurial potential following skill upgradation and exposure :** Women and men beyond employable age, can be encouraged to utilise and avail self employment opportunities by raising poultry farm or dairy farm through co-operative. Young girls/boys can also be imparted training on machinery repair, mobile repair, electronics equipment repair, watch repair etc. to make them become self employed.

**Harnessing and training of young :** Young girls and boys, by setting up coaching and with the help of expert selectors, will be picked-up for nurturing their innate talent in various sports activities and prepare them to blossom at various national/international levels. Nursing centres, for training the young girls in the areas of health and nursing, may be opened.

Through above efforts, a better quality of life can be made available to the local community so that they reap the fruits of industrialization along with all other stake holders and in the end, nation benefits by way of development which is sustainable.

Apart from the human resource development programmes for employability of project affected families and local people, few more steps are required to be taken to make available adequate managerial and skilled level human resources commensurate with the growth aspiration of 300 MILLION TONNES of steel.

### **Improvements Needed at the Academic Front**

The academic institutes frequently are understaffed in the area of Ferrous Metallurgy; this is particularly disturbing as the number of students in the area of Materials and Metallurgical Engineering has more than tripled in the last 5 – 7 years.

### **A University for Higher Learning in Iron and Steel**

Clearly a need exists to have a higher school of learning in Ferrous Metallurgy: a Graduate Institute of Ferrous Technology is recommended. The objective of this institute would be to help those working in the area of iron and steelmaking to take up courses in ferrous alloy fundamentals, innovation in steel products and industry-related technologies. These would be specialized courses and their course contents would be directly drawn from the requirements of the industry.

The location of this institute would be near one of the steel industry with satellite campuses at other steel industry towns. Managers from the steel industry are expected to participate actively at the institute and take courses.

### **Engagement of Leading Academic Institutes bodies with Steel Industries**

It is suggested that as a first step, the leading academic institutes revisit their Ferrous Metallurgy syllabus and research programme with the active involvement of the steel industry. Presence of (steel) industry representative on the (relevant) Council of the Institutes would also be beneficial to both the parties.

### **Improvements Needed at the Industrial Front**

Since it is the industry that is going to be the beneficiary of the human resource that emerges out of the institutes, it would be prudent for them to build into their HR policy, practices that actively encourage engagement of their personnel with the Institutes in different capacities. Since the number of students in the Metallurgical branch has increased considerably, the Steel industry would need to put in place a system that is able to handle industrial tours and internship in larger numbers. Specialized lectures are to be conducted for the ferrous students to make them more familiar with what to expect in an industrial environment.

## **4. WAY AHEAD**

1. There is need for SDF (sustainable development framework) based regional planning for development of infrastructure, mining, steel and other industries.
2. A two tier framework should be instituted i.e. i) formation of JV for long term supply linkage of iron ore to prospective steel producers; ii) Setting up of large capacity steel projects in SPV (special purpose vehicle) mode through competitive bidding route. This will help in fast track

- development of steel and mining sector in India through speedy land acquisition / R and R, statutory clearances and securing ore and water linkages.
3. LARR Act, 2013 to be reviewed to relax relevant issues which may lead to difficulty in land acquisition along with higher incidence on cost of its acquisition such as :
    - g. Govt. to frame detailed rules based on the Act
    - h. Project affected persons / criteria for loss of primary source of livelihood to be clearly defined.
    - i. Land covered under Schedule-5 / CNT Act in Jharkhand need to be reviewed and relaxed for acquisition for steel project development.
    - j. Land records to be updated and digitized at National level.
    - k. The mandatory procedure for seeking consent of Gram Sabha for land acquisition need to be relaxed (from a consent level of 70-80 % of project affected families to 51 % of PAFs).
    - l. Higher price mechanism under the new Act for acquiring land to be relaxed (Limited to max. 2 times instead of 4 times the market price). Additionally equity partnership may be offered.
  4. Unified and integrated statutory clearance for mining and steel related infrastructure for the growth of the region would need to be accorded. Delay in statutory clearances / multiplicity of clearances to be eliminated through creation of single authority which shall facilitate fast track statutory clearances of projects including environmental and forestry clearance and linkage for water.
  5. Govt. to constitute authority for creation of updated data base on water resources and its use / allocation on National level basis. Possibility of inter-basin connectivity for ensuring water availability in the deficit areas may be explored. All idle / non-moving MoUs for water allocation need to be unlocked for re-assessment of water availability and its re-allocation to industries.
  6. Special mining zones to be established through amendment in MMDR Act / Bill / other relevant legal provisions for fast track clearance for exploration and exploitation.
  7. Transparent policy need to be formulated for grant of iron ore lease for inter-state transportation and use for value addition within the country. However, first preference should rest with the state in which the deposits are located. Draft recommendations of MMDR Bill, 2011 on these aspects need to be adopted. Further action would need to be initiated as follows :
    - a. Intensive and deeper exploration (>60 m depth and Fe cut-off<50%)
    - b. Beneficiation / agglomeration / pelletization of low grade fines and slimes (<55 %)
    - c. Grant of mining lease against credible mining plans with preference for value addition
    - d. Tapping magnetite ore in eco-fragile western ghat through suitable underground mining technique
    - e. Phased reduction in iron ore export to moderate levels keeping long term security of raw material and sustainable growth of iron and steel industry in the country.
    - f. Attracting investment in development of mine related infrastructure
    - g. Strategic initiative for acquisition of overseas iron ore deposits
  8. Indigenous metallurgical coal reserves in the country to be reserved exclusively for steel sector only and there should be no diversion of such coal to any other sector. Further there should be :
    - a. Intensive exploration on prime coking coal beyond 300 m.
    - b. Speedy implementation of Jharia Action Plan for prime coking coal exploitation (Co-ordination with concerned Ministries/Govt. Deptt.)

- c. Strategic overseas acquisition.
  - d. Long term FSA between Coal Companies and DR Units / ISPs for non-coking coal
9. Coal blocks to be allocated to steel sector on priority for promoting coal gasification / underground coal gasification based technology etc. for use in Iron and Steel sector to promote energy efficiency and lower carbon footprint.
  10. Alternate energy sources such as shale/natural gas in Indo-Gangetic and Damodar Valley basins to be accorded priority allocation to Iron and Steel sector to promote energy efficiency and reduce GHG emission.
  11. Railway Vision 2020 and subsequent projection up to 2025 envisages up-gradation of axle load of tracks, development of wagons with higher payload to tare weight ratio, thrust on improving rail connectivity with ports, investment by users in efficiency improvement in terminal handling system and sharing the efficiency gain accruing from reduced wagon turnaround time as well as mobilisation of financial resources through internal surpluses / borrowings, PPP route / creation of Accelerated Rail Development Fund (ARDF). Other strategic measures should include :
    - a. Timely execution of railway projects in iron ore mining areas
    - b. Augment rail infrastructure (eastern/southern states-large steel capacities planned)
    - c. Dedicated rail link between mines and plants (PPP mode)
    - d. Prioritize funding of DFC projects in Eastern area for transportation of raw materials and finished products
    - e. Mineral development fund for social infrastructure development in mining belt.
  12. There is low road density and poor road quality in three iron ore rich states of Jharkhand, Odisha and Chhattisgarh resulting in high transaction costs / delay and transit loss of material. Further there is inadequate network of state and district roads connecting mines and plants to NHs in mining areas in Eastern Sector. Thus there is need for PPP mode of funding to :
    - a. Strengthen road network in remote/distant rural areas for steel distribution
    - b. Improve road connectivity with ports and mines
  13. Maritime Agenda on port sector aims to :
    - a. Bring Indian ports at par with best global ports wrt efficiency/transaction cost
    - b. Develop two new major ports (one each on east and west coast)
    - c. Full mechanization of cargo handling/movement / deepening of port channels
    - d. Identification/implementation of rail/road/inland waterway connectivity to port
 Suggested strategies in the port sector should focus on :
    - a. Construction of deep draft berths (berthing of large vessels, economy of scale, enhanced handling capacity at major ports)
    - b. Faster evacuation through seamless port connectivity with multi-modal land transportation (railways and roads) under PPP route collaborating amongst investors, State Govt. and transport related service providing agencies.
  14. Govt. may consider creation of slurry transportation highways in the country and attract investment by incentivizing in line with infrastructure sector.
  15. PPP / FDI to be made more attractive through conducive legal / contractual mechanism for attracting fund for road / rail and port infrastructure.
  16. Review of policy / regulatory framework for successful creation and management of social infrastructure through PPP mode.
  17. Institutional capability would need to be enhanced through PPP mechanism to meet demand for skilled manpower and faculty development needs.

18. There should be creation of hubs for mining, steel industry and manufacturing through National Mission mode.
19. Steel industry and slurry transportation to be accorded the status of infrastructure.

## 20. Environmental Issues

Areas	Indian Plants	Developed world
Emission of air pollutants (dust, SO <sub>x</sub> , NO <sub>x</sub> )	> 1 kg/tcs	< 0.5 kg/tcs
Solid waste generation	600-800 kg/tcs	400-500 kg/tcs
GHG Emissions	2.5	2.0

Thrust areas for implementation in 12<sup>th</sup> FYP include :

- a. 100% utilization of BOF and EAF slag
  - b. Reduction in fresh water use(<4m<sup>3</sup>/tcs) in ISP and aim for zero water discharge
  - c. Incentivizing Zero waste generation through 100% waste recycling
  - d. Reduction in process dust emissions to < 1 kg/tcs
  - e. Staged combustion in burners to reduce NO<sub>x</sub> emissions
  - f. Online monitoring of stacks in all plants
  - g. Introduction of EMS (ISO-14001) in all sectors of steel making
  - h. Explore carbon capture and sequestration (CCS) and new routes to carbon free steel technologies by leveraging soft loan from developed economies.
  - i. New technologies with higher capacities (improved energy and env. Efficiency)
  - j. Specialized training / R andD for capability building
  - k. Thrust on renewable energy generation
  - l. Internet based tool for verifiable reporting of environmental data.
21. Indian Iron and Steel industry to become partner in development of newer and greener technologies, waste utilization, enhancing use of steel in various areas through innovative design, improving quality of steel with better and improved properties etc., by closely associating with World steel Association and other International collaborations in this direction.
  22. R and D related issues :
 

On R and D front, the following strategy would need to be taken up :

    - i. Leverage Govt grant for R andD through PPP to enhance R andD expenditure from 0.15-0.3% to 1.5-2% of turnover by 2025.
    - ii. Incentivizing industry / public funding in R andD in :
      - i. EMS, energy efficiency/GHG reduction
      - ii. Beneficiation/agglomeration/SR technology for ind resource utilization
      - iii. Product development for defence, space research and nuclear energy
      - iv. Optimum land use in greenfield projects.
      - v. Product development / import substitution for
        - Auto grade steel (Dual phase,TRIP, AHSS, Ultra Fine Grain Steel, Nano Steel)
        - CRGO/high grade CRNO,special gr boiler quality plate,API gr large dia pipe
        - Special grade environment friendly pre-fabricated steel structures for high rise buildings / urban infrastructure with faster execution.
    - iii. Centre of Excellence (PPP) for R andD and product development and HRD for creating talent pool for research in the steel industry.
    - iv. Market driven translational research customized for steel industry.

- v. Steel Companies to pool resource for creation of manufacturing facilities / revival of HEC into modern manufacturing centre to avoid long term dependence on imports.
  - vi. Steel Companies to associate with reputed equipment suppliers for development of new processes
  - vii. Govt. to encourage leading equipment manufacturer to put manufacturing base in India.
  - viii. Realigning education system and corporate policies to attract, facilitate and generate domain experts in the steel industry.
  - ix. Instituting a professional body for knowledge / information dissemination similar to World Steel Association/Japanese I andS Federation
  - x. Govt. should make it mandatory for industries to spend at least 1% of their turnover on R andD, which should gradually increase to 2% over a period of 10 years. National mission on R andD objectives for Iron and Steel sector should be clearly defined and implementation/result vigorously pursued through industry-research institutions collaborative effort under one national level Umbrella institution which may be separately created in line with American Iron and Steel Institute. This may be called as “Indian Iron and Steel Institute”. The progress made/results obtained need to be critically examined/reviewed by a team comprising of eminent personalities in the field, capable of placing their bold and critical analyses on the matter.
  - xi. R andD collaboration program with other countries may be taken up for development of new and innovative technologies.
23. Trade Policy Issues
- a. Fixation of import tariff levels should be based on :
    - i. Global oversupply/slow down in major steel nations
    - ii. Erosion in cost competitiveness due to raw material /energy price dynamics
    - iii. Cost of capital and infrastructure constraint.
  - b. Ensuring level playing field with trading partners with mature steel industry for bilateral / regional trade agreements.
  - c. FTAs/PTAs to factor global competitiveness / possible trade distortion.
  - d. Develop export market in Africa, Latin America and Asia incl. ASEAN members
  - e. Thrust on export of steel products to mitigate adverse impact on net Forex earning by steel sector due to rising import of coking coal and reduction in iron ore export.
24. Country/region specific Export promotion strategy need to be in place for export of finished steel products to various countries on sustained basis, to make the country a net exporter of steel, from a position of net importer of steel. In this respect, a target of 10 % of production as export should be aimed at as per the national steel policy.
25. To promote higher steel use in various applications, particularly in construction industry, a focussed strategy through collaborative efforts of various organisations, associations, industrial bodies, architects, designers, planners need to come together and frame objectives and implementable solutions with Govt. helping in terms of promotional benefits. This will have a positive impact on domestic steel demand.