REPORT OF THE WORKING GROUP ON STEEL INDUSTRY FOR THE TWELFTH FIVE YEAR PLAN (2012 – 2017)

Ministry of Steel

(November 2011)

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PREFACE

The decade following liberalisation was a period of robust economic growth, increased liquidity and low interest rates. As the resultant manufacturing boom was also maintained during the tenth plan, the steel industry prospects on the eve of eleventh plan (2007-12) were largely optimistic. These expectations were also justified by the initial plan performance but the unexpected global turmoil of 2008 triggered by the sub-prime debt crisis was to prove the spoilsport leading to substantial scaling down of operations and profit margins. However thanks to Indian economy's inherent resilience these reverses were only temporary and even the domestic steel sector managed to make a recovery helped by a resurgence in sectors like automotive appliances, capital goods and construction.

2. Today as the 11th plan draws to a close, the growth indicators for the industry remain positive but the performance levels are lower than what was achieved during the pre- crisis phase. As for future prospects - and this includes the 12th plan (2012-17) period, the outlook remains optimistic despite concerns regarding the existing domestic and global economic scenario. The optimism stems from the fact that as compared to other emerging economies the basic fundamentals of the economy remains strong which is crucial for an industry depended more on domestic than external demand trends. But the growing budgetary deficit sliding rupee and double digit inflation are worrying and from a business perspective there are fears of a slowing down as reflected in the volatile stock markets, lower investment on account of increasing cost of credit and rising input prices specially of imported fuel and raw materials. There are also fears about a likely shrinkage in global demand in the wake of the new global crisis triggered by unmanageable public debt in the US and many European countries.

3. However, as highlighted in the 12th plan Approach Paper the above challenges may only be temporary and given the strong fundamentals the economy is very well placed to achieve a growth rate of 9% over the next five years. The domestic growth prospects for the industry therefore remain positive. The sector already has certain inherent advantage like easy access to key raw materials, low cost of labour, requisite technical manpower, a high potential for technology absorption and most important a growing domestic market. As demand for steel is essentially a derived demand, any growth in the major consuming sectors may be expected to provide the requisite performance stimulus. In this context the proposed huge investment for infrastructure development and implementation of the new National Manufacturing Policy (NMP) during the 12th plan period are relevant.

4. Presently we are the fourth largest producer of crude steel and the largest producer of sponge iron in the world. However in terms of techno economic efficiency of operations our steel making units are nowhere near their global competitors. The industry in fact continues to be characterised by low labour productivity and high energy consumption levels, heavy dependence on imported technology, low priority for Research & Development initiatives and diversification. For improving the sectoral performance and competitiveness there is an urgent need to address its basic structural constraints irrespective of equity size and nature of operations. These efforts will also have to cover every phase of steel making as a manufacturing process i.e. from accessing of raw materials to its processing, finishing, quality control, transportation to

final retailing. Already significant changes on all these fronts are expected over the next three years on account of the new capacities coming up and the resultant competition.

5. Taking into account the above issues, the Working Group after mutual consultations with all the stakeholder groups concerned had identified three crucial structural issues for a detailed appraisal i.e. steel demand and supply trends, raw-material and Infrastructure issues and the issues linked to technology, R&D and sustainable development. Each of these issues were examined by a separate Subgroup and based on the inputs provided by them the report's recommendations have been finalised.

6. The recommendations broadly support not only initiatives for achieving competitiveness in terms of the right technology , quality and product-mix but also timely policy intervention and consensus building for resolving issues beyond the purview of the market mechanism. Amongst the critical issues highlighted in the recommendations are that of acquisition and conservation of critical raw materials for the industry, promoting the development of infrastructure linkages through coordinated efforts across sectors and encouragement for innovative R&D projects consistent with existing resource endowments through the ongoing Plan scheme for promotion of R&D in steel sector. Two new areas of focus proposed and with specific reference to environment sustainability by the sector, the provision of budgetary assistance for improving energy efficiency by the secondary steel sector and also for promoting increased investment in beneficiation and agglomeration of low grade iron ore and ore fines by the industry.

I would like to thank all members of the main group and of the subgroups for sparing time for active participation in the deliberations and for their valuable inputs.

A report like this required careful compilation of all sector specific information received including statistical projections and estimates and this was taken care of by the Budget Division and the Economic Research Unit (ERU). The involvement of the ERU project team was also crucial for the compilation and editing of the report.

I hope that the report will prove to be a useful referral document on understanding the problems and prospects of the Indian Iron and Steel Industry.

Yours sincerely

November, 2011

(Pradeep Kumar Misra)
Secretary (Steel) & Chairman
Working Group on Steel Sector

INTRODUCTION

The Planning Commission vide its letter No I&M 3(30)/2011 dated 29th April, 2011 constituted the Working Group on Steel sector for the Twelfth Five Year Plan (2012-17) under the Chairmanship of Secretary, Ministry of Steel. The Composition and Terms of Reference of the Working Group is given at **Annexure – I.**

The first meeting of the Working Group was held on 19th May, 2011 in which it was decided that there was need for an in-depth analysis of the issues relating to Steel Industry prior to framing a development strategy for 12th Plan. Accordingly, three Sub-Groups were set up the Sub-Group-I on 'Demand and Supply of Iron & Steel, under Shri S. Machendra Nathan, AS&FA, Ministry of Steel', Sub-Group-II on 'Raw Material and Infrastructure Issues, under Shri U.P. Singh, Joint Secretary, Ministry of Steel' and Sub-Group-III on 'R&D and Technology Issues', under Dr. Dalip Singh, Joint Secretary, Ministry of Steel. The Composition and Terms of Reference of the three Sub-Groups are given at **Annexure – II**.

Sub-Groups-I, II, & III submitted their reports on 12th September, 2011 and their recommendations were considered by the Working Group in its second Meeting held on 19th September, 2011. Based on the deliberations held on the recommendations, the report of the Working Group has been finalised.

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Working Group on Steel Industry for Twelfth Five Year Plan 20012 – 17 was constituted by the Planning Commission with the objective of making a critical assessment of the performance of the industry, examine major sectoral policy issues and concerns, estimate the potential demand and supply requirements during 12^{th} Plan and make policy recommendations for implementation.

The major findings and observations of the Working Group are summarised as follows;-

A. Overview of the Indian Steel industry Status, Performance and Emerging Trends

(i) The first four years of Eleventh Five Plan witnessed a marginal slowdown in growth when compared to the growth rates in the tenth five year plan mainly due to the global financial crisis in 2008-09. However, the counter cyclical policy measures taken to arrest the economic slowdown and the innate resilience of the economy ensured a quick turnaround that enabled the domestic steel industry to return to moderate growth.

(ii) Crude steel production grew at the rate of 8.2% per annum from 50 .817 million tonnes in 2006-07 to 78.001 million tonnes in 2010-11. While the share of additional production by main producers (SAIL, TATA & RINL) accounted for a mere 6%, (about 1.67 million tonnes), this growth was primarily driven by capacity expansion by major producers and other producers group. Production of finished steel grew at an annual rate of growth of 5.8% from 52.53 million tonnes in 2006-07 to 66.01 million tonnes in 2010-11.

(iii) Consumption of steel exceeded production and grew at an annual rate of 8.8% from 46.78 million tonnes in 2006-07 to 65.61 million tonnes in 2010-11. However, the growth in consumption was lesser than growth of 10.4% achieved in the tenth Five Year Plan. It may however be noted that if we ignore the crisis year of 2008-09 then the average growth rates during the 11^{th} plan in production and consumption do not actually show any significant shortfall.

(iv) A striking feature to be noted from the sectoral performance trends is the relatively higher growth in domestic demand for steel vis-a-vis that of availability. With demand overtaking supply, the country has become a net importer of steel, since 2007-08, i.e. from the 1^{st} year of the 11^{th} plan onwards.

(v) The Indian steel industry is experiencing a slowdown, in the terminal year of the Eleventh Plan and on the eve of launching 12^{th} Five Year Plan. Prospects of domestic demand for steel in the short-term appear grim and gloomy. Also all the macro-economic indicators point out the onset of overall economic slowdown of Indian economy which will have a profound impact on investment, growth of manufacturing and other sectors. Further, the uncertain global economic environment continues to pose serious challenges to the sustained growth of Indian economy.

(vi) Nevertheless, there exists enormous potential in the economy for higher growth of domestic steel demand in medium and long term. In terms of actual steel usage India lags behind other major steel producing countries. In 2010 our per capita consumption of steel was only 51.7 Kgs as against the world average of 202.7 kgs. A massive investment to the tune of $ 1 trillion dollars has been envisaged during the Twelfth five year plan in the infrastructure sector. Besides there is a greater emphasis on the growth of the Manufacturing Sector in the country. This augurs well for expansion of the base of steel consumption in the economy. A rough estimate of incremental demand for steel in the country works out approximately to 40 million tonnes in infrastructure alone. Hence, it is likely to raise intensity of steel consumption in the country measured in terms of steel consumption per unit of Gross Domestic Product (GDP).

(vii) The post deregulation era has seen significant changes in the structure of the Indian steel industry in terms of ownership. Capacity addition during the last two decades after deregulation has taken place entirely in the private sector. As a result, there has been marked shift towards the private sector both at the crude and finished steel stages. Private sector now accounts for 75% of total crude steel output compared to 37% in 1992-93 and 80% of total finished steel output compared to 67% in 1992-93.

(viii) The advent of new production technologies has brought about a significant change in the composition of the Indian steel industry. Capacities created in the aftermath of deregulation have been based on technologies as diverse as COREX (JSW Steel Ltd), large-scale hybrid technologies combining Electric Steel making with BF hot metal with downstream rolling of flat products (Ispat Industries Ltd.) and large-scale integrated 'DRI-EAF-Flat products Rolling; capacities (Essar Steel Ltd.) etc..

(ix) In the last four years the Indian Sponge Iron industry grew at an annual rate of 9.8%. India has become the largest producer of sponge iron in the world with a total production of 26.71 million tonnes in 2010-11 as against 5.4 million tonnes in 2001-02. This growth is the result of a remarkable expansion in the small-scale coal based units with short gestation period and low capital intensity concentrated largely in the iron-ore rich states of Jharkhand, Orissa and Chhattisgarh. On the other hand, production has remained stagnant in the large-scale technologically sophisticated gas based sponge iron units.

(x) During the first four years of 11^{th} plan, production of Pig iron reached a peak level of 6.21 million tonnes till 2008-09. However, pig iron production then started falling and remained at 5.58 million tonnes in 2010-11. The noticeable trend with respect to this sector has been the gradual decline in the supply of merchant pig iron from the integrated Main producers (i.e., SAIL and RINL) and the rise of the other producers' share from 82.7% in 2006-07 to 89.6% in 2010-11.This trend is expected to continue in future as the main producers diversify more and more into value added products.

(xi) The performance of the domestic Ferro Alloy sector has been in line with the Indian and global steel industry. Production increased at annual average rate of 9.5% from 2.00 million tonnes in 2006-07 to 2.88 million tonnes in 2010-11. The export performance of this sector also remained robust with export share in production going up steadily from 25.52% to 47.27% in the last four years despite uncompetitive power tariff. In the case of this industry, while chrome alloys dominated the export basket, imports have been mostly of Ferro silicon.

(xii) The Indian Refractory industry caters to a wide range of sectors such as steel, cement, non-ferrous metals, glass etc. Production in this sector has remained stagnant and resulted in low capacity utilization in this sector. Domestic consumption has also not grown much during 11th plan and has hovered around 1.17 million tonnes However, there still exists, substantial unutilized capacity in this segment (utilization rate being 55%). The industry is constrained by long term deceleration in volume growth in demand because of improved technology and operating practices leading to increased refractory life cycle in critical areas of steel making which accounts for about 75% of the total Refractory consumption in India.

(xiii) Liberalisation of the foreign trade regime has had a favourable effect on Indian exports. Export of steel reached a peak level of 5.24 million tonnes at the end of Tenth five year plan. In the Eleventh plan period, exports of steel started slowing down and recorded negative growth rate of 9% per annum, from 5.08 million tonnes in 2007-08 to 3.46 million tonnes in 2010-11. This period also coincided with a change in the country's export basket in favour of more value added and sophisticated products.

(xiv) On the other hand, imports followed a different growth path. Progressive reduction in customs duty levels after deregulation led to an imports surge. India became a net importer of steel even before the commencement of Eleventh plan period and net imports have fluctuated between a low of 1.40 million tonnes in 2008-09 to 4.13 million tonnes in 2009-10. It is important to note that there has been a change in the relative movements of exports and imports in the last 3-4 years.

(xv) These developments would imply that the rise in imports is, to a very large extent, the result of increased domestic demand and not of erosion in the competitiveness of Indian steel industry. The reduction in import duty rates was undertaken to provide domestic steel users easier access to global supplies and thereby stem the abnormal rise in domestic prices and also to avoid possibilities of a supply shortfall in the domestic market.

(xvi) Domestic prices are now being determined by international prices as expected in a free and open market situation. In fact, progressive reduction in custom duty rates has over the years reduced the margin between the landed cost of imports and the domestic market prices.

(xvii) Prospects of steel industry are primarily determined by market forces, domestic as well as external and these signals are reflected through the trends in prices of both raw materials and the finished products. Prices of steel were stable till the third quarter of 2007-08. The last quarter witnessed sharp increase in prices coupled with high volatility and this rising trend continued till July 2009 fuelling inflationary pressures marginally. Several measures like tariff reduction, withdrawal of export incentives and moral persuasion were initiated by the Government of India. These had a salutary effect and steel prices began to moderate from third quarter of fiscal 2008-09.

(xviii) Again with the onset of global financial crisis, domestic and international prices of steel collapsed in the last quarter in 2008-09. The prices of steel remained at comparatively subdued levels till middle of 2009-10 and the year ended with marginal increases which were maintained till the first quarter of fiscal 2010-11. From second quarter there was some moderation in prices of long products while the prices of flat products remained at high levels till June, 2011.

(xix) Due to volatility in steel prices, the differences between the contracted price and spot prices have also widened in the recent years. This is more apparent in the case of flat products, especially Hot Rolled flat products, as against the long products.

(xx) This volatility has been reflected in the Indian steel market as domestic prices in the de-regulated market tend to move in tandem with international prices. In reflection of the global situation, in the last four years, prices of both finished steel and those of its inputs such as iron ore and coal have also risen considerably.

Outlook for Steel Demand and Supply

(a) Domestic Demand

(i) The demand for steel has been worked out on the basis of observed relationship between steel consumption and selected macro economic variables under four scenarios of GDP growth (i.e. of 8%, 8.5%, 9% and 9.5%) by 2016-17. The Draft Approach paper of the Twelfth Five Year Plan envisages a GDP growth of 9% per annum. In the 'Most Likely' growth scenario i.e. 9% GDP growth, the demand for steel works out to be 113.3 million tonnes by 2016-17. Therefore, it is likely that in the next five years, demand will grow at a considerably higher annual average rate of 10.3% as compared to around 8.1% growth achieved during the last two decades.(1991-92 to 2010-11)

(b) Export Demand.

(i) India has enormous potential and necessary resources, capabilities to become a global supplier of quality steel. Also there exists ample market opportunities in the neighbouring regions of Asia, Africa and the Middle East. The policy framework while according top priority to meet domestic demand should also take into account the large export possibilities.

Estimated Demand and Capacity Creation

(Unit: Million Tonnes)

S.No.	Item	2010-11	2016-17
1.	Demand for Carbon Steel	62.14	108.3
2.	Demand for Alloy/Stainless Steel	3.47	5.0
3.	Total Domestic Demand for Steel	65.61	113.3
4.	Net Export	(-)3.34	2.0
5.	Production (net of double counting)	62.27	115.3
6.	Category-Wise Consumption (Carbon Steel)		
	Total Long	31.16	54.3
	Total Flat	30.99	54.0
	Total Carbon Steel	62.14	108.3
7.	Total Requirement of crude steel	-	142.3
8.	Likely Capacity of Crude Steel	78.0	149.0

(i) In a deregulated environment, it is difficult to forecast capacity creation, especially in the private sector. Further, capacity creation is sensitive to unfurling market conditions domestic as well as global. Based on information furnished by the existing and prospective investors, the estimated crude steel supply works out to more than 128.1 million tonnes in 2016-17. These estimates have been worked out based on historical trends as well as an objective assessment of the following factors.

- Actual extent of land already acquired for the new units;
- Availability of investible funds with the respective enterprises to support the planned increase in existing capacity;
- Availability of infrastructural network at the project site; and
- Availability of key raw material linkages.

(ii) The National Steel Policy had set a production target 110 million tonnes to be achieved by 2019-20. The Indian steel industry may achieve double digit growth in consumption and surpass this production target by 2016-17 well ahead of the target date.

(iii) In the last 20 years (i.e. 1991-92 to 2010-11) import of steel as a percentage of total consumption in India has varied between a high of over 13% in 2007-08 and a low of 4.8% in 1998-99 and 2001-02. Import of steel during Twelfth plan is expected to be around 5 million tonnes per annum.

(iv) A strong steel industry can emerge only if it can take on international competition and develop overseas markets. Keeping this in view, net exports of 2 million tonnes has been assumed in 12th plan. Accordingly assessment of finished steel of production has been worked out at 115.3 million tonnes in 2016-17.

(c) Requirement of Raw Materials, Infrastructure and Investments to Ensure Additional Production

i) Estimates of total and additional requirement of raw materials have been worked out Based on the projected production of crude steel according to process routes and average norms of consumption. However, in view of the fact that there exists large scope of improvement in operational efficiencies and also due to the fact that there are possibilities of changes in technology adopted, the estimates of input requirements are only indicative:

Estimated Requirement of Raw Materials and Other Inputs by 2016-17

Input Materials	Unit	Estimated Consumption 2011-12	Estimated Consumption 2016-17	Additional Requirement by 2016-17
Coking Coal	Million Tonnes	43.2	90.2	47.0
Non-coking Coal	Million Tonnes	35.3	28.4	-
Iron Ore	Million Tonnes	115.0	206.2	91.2
Natural Gas	MMSCMD	7.2	13.541	6.341
Ferro Alloys	IN ‘000 tonnes	2152	3673	1521
Refractories	Million Tonnes	1.29	1.97	0.69

Raw Materials:

India is endowed with abundant Iron ore resources, the basic input for steel making. Of late, large scale exports of iron ore have raised concerns about future availability of iron ore resources to meet the fast rising domestic steel demand. Large quantities of iron ore fines are exported due to mismatch between domestic production and consumption and also lack of adequate sintering and pelletisation facilities for steel making. Steel industry confronts the problem of depletion of high grade ore deposits and lack of domestic technological capabilities to process low grade iron ores. In the larger national interest of conservation of natural resources and environment, efforts are being made to preserve and utilize the precious Iron ore fines for domestic production of steel and at the same time the Ministry has taken measures to discourage export by imposing higher tariffs and special levies etc.

The domestic availability of Coking coal, a critical raw material required by steel industry is limited and therefore the Indian Steel industry has to depend heavily on imported coking coal to meet its needs. Currently, domestic steel makers meet 70% of their coking coal requirement through imports. The quantum of imports may go up significantly in the 12th plan as steel production in a large number of new projects is likely to be through the BF-BOF route. To ensure raw material security and minimize the impact of volatility in coal prices, it is desirable to acquire overseas coking coal assets. International Coal Ventures Limited (ICVL), a Joint Venture company promoted by SAIL in 2008-09 and consisting of RINL, NMDC, CIL and NTPC to achieve the above objective has not made much progress so far but it is imperative to make this venture more effective.

In view of the limited availability of coking coal in the global market and the fact that its supply is controlled by a few large companies, it will be extremely important to increase the domestic production of coking coal and upgrade its quality to meet the requirements of steel making. Technologies which require less of coking coal and lower grades of it will need to be encouraged.

Non-coking coal used for production of sponge iron is also increasingly becoming scarce in the country. With the demand for non-coking coal from priority sectors like power, Fertilizers etc going up further, its availability for steel making is likely to be limited during the 12th plan. While sponge iron producers may opt for import of coal, the economic viability of this sector may be under pressure due to higher prices of imported coal. Moreover, the gas based DRI units face restricted supply of CNG, largely due to priority allocation of gas to power and fertilizer sectors. Supply of CNG to this sector is a major concern for its growth and these units may have to depend more on imported source of fuel supply. Many existing and new producers propose to create additional capacity manifold under gas based route in Twelfth plan period.

Infrastructure:

Development and growth of Infrastructure sector is critical for rapid growth of domestic steel industry in the country. Steel industry is a major user of infrastructural facilities especially of Railways, roads, power, and ports. Besides, the competitiveness of domestic steel industry depends heavily on the expansion and provision of efficient infrastructural facilities. As per the working group projections, the steel production in the country will nearly double within the next five years. This requires rapid growth of railways, roads, ports and power facilities. The existing infrastructural facilities are not adequate. The domestic steel industry meets 70% of its coking coal requirement from imported sources and if the same trend is maintained, nearly 50 million tonnes of coking coal will have to be imported by 2016-17. There is urgent need for expansion of port capacity to handle the raw materials and finished goods of steel sector. The steel plants which are likely to come on stream in Twelfth plan period will need to transport 85 to 90 million tonnes of iron ore from the mines and also deliver 45 to 50 million tonnes of finished steel from steel plants to distribution centres. Therefore, there is immediate need for substantial up gradation of infrastructural facilities to meet the increasing steel requirements of the steel industry.

Investments to the tune of US $ 1 Trillion are proposed in the infrastructure sector in the 12th plan. An investment of this scale and size is likely to generate higher domestic demand for steel and at the same time help build necessary infrastructure required for the steel industry. Large investments of this nature suffer from gestation lags, constraints in mobilization of financial resources, land acquisition issues and hurdles in obtaining statutory clearances in case of mega infrastructural projects. These need to be sorted out since the development of infrastructure sector has strong forward and backward linkages and contributes significantly to overall growth and development of the economy.

Investment:

Requirement of financial resources to support an additional capacity creation of about 60 million will be approximately 2.5 lakh crores during the 12th Plan and securing such large investible funds at reasonable cost will be a challenging task. FDI in the steel sector has been lagging behind, despite massive investment intentions by some major global steel majors. In order to ensure sufficient availability of financial resources for the growth of Indian steel industry, it is imperative to review steel related sectoral caps of the banking sector. Government may also consider easing of norms connected with external borrowings (ECBs). Special purpose long term financing facility may be created to finance huge investment in new steel plants.

Technology and Research & Development

A cursory examination of the present status of Performance Indices shows that the technological performance of Indian Steel Plants in terms of specific consumption of raw material / consumables, specific energy / power consumption, environmental and pollution norms is significantly lower than those in the advanced countries. The poor performance standards of the domestic industry are primarily attributable to poor quality of raw materials / inputs, prevalence of obsolete technology and lack of R&D to overcome the technological gaps. Major areas where focus /attention of Industry and Government are required in the 12th Plan are as follows:

i) Iron ore quality in terms of high alumina content and high alumina to silica ratio is a serious concern.
ii) There is a need to reduce the coal ash substantially to make our coals suitable for coke making and iron making operations.
iii) It is suggested that the improvement in raw materials be achieved through selection of appropriate beneficiation process and improvement in operational practices of ore beneficiation / coal washing circuit.
iv) Above 20% of the ROM (run of mine) which is known as 'slime' has low percentage of iron (less than 55%). The size of slimes is lower than 150 micron and further beneficiation is difficult and not economical. There is an immediate need to find out solutions for the realization of iron value from slimes. Alternative iron making process such as FASTMELT or ITmk3 may be useful to realize the iron value efficiently.
v) Use of mine wastes such as Jhama coal in Iron and Steel production will be helpful to increase the mine life. Coal gasification of non coking coals and recovery & utilization of CBM are some of the steps to address issues such as coal / coke shortage and CO2 emissions.
vi) Large size Blast Furnaces with the state of the facilities have done well in terms of productivity, consumption norms and hot metal quality. With installation of such furnaces in future, the need for agglomerated burden (sinter + pellet) is likely to increase. The improvement in burden quality will facilitate higher injection of coal fines and thereby reduction in metallurgical coke requirement and overall fuel rate.
vii) The units that have adopted DRI – HM – EAF and DRI – IF routes for iron making are suffering due to non availability of hard iron ore lump, high cost of natural Gas, non availability of good quality coal, absence of good scrap and rising prices of raw material inputs for BF. To alleviate the shortages of iron ore lump, there is a need to put up pellet plants. Coal gasification is believed

to be a good option to replace natural gas for the production of synthesis gas (reducing gas in shaft kiln process).

viii) Large quantity of slag is produced in BOF / EAF. It is not easy to dispose of the steel making slag due to the presence of free lime and high percentage of iron oxide. Technologies have been developed (ORP, MURC) in Japan to reduce the generation of slag and reduce the 'Phosphorous' level below 0.010%. Some of the technologies for reuse in the form of 'brick for pavement / construction of dykes', 'flux / iron bearing material in cupola' and construction material after sufficient aging can be adopted to gainfully utilize the slag. There is also a possibility to recover the iron values through smelting reduction.

ix) DRI – EIF route suffers from lack of refining capacities. The steel melted by the process has higher percentages of Phosphorus and Nitrogen. Rotary kiln DRI-EIF route needs to improve its technology substantially to avoid obsolescence, market acceptability due to poor quality and to reduce its adverse impact on the environment. There is a dire need for Technology Up gradation in Secondary Steel Sector in general and the EIF sector in particular to make them competitive in terms of Productivity, Quality and Environment friendliness. .

x) Dynamic soft reduction and Near net shape casting will result in quality improvement and energy saving respectively and these emerging technologies are likely to be adopted in the coming years by the Steel Industry.

xi) Due to increasing demand for High Strength Steel, current BAF (Batch Annealing Furnace) technology may get replaced with Continuous Annealing Technology.

xii) Environmental concerns would be a major criterion for the selection / adoption of new technology in near future. Therefore the steel industry may have to carry out research in the areas of carbon foot print, CO2 absorption and sequestration.

xiii) There is a need to develop sound indigenous capacity to develop technologies to a) suit indigenous raw materials, b) improve energy input norms through energy-efficient technologies and c) meet national norms for emission per ton of products and comply with global responsibilities for carbon foot print.

xiv) The Research and Development systems should also match the composite structure of the steel industry in the country. While some large corporate houses which could afford in-house R&D and acquire plants overseas could adopt global approaches for developing and acquiring technologies, R&D and technology needs of several small units engaged in manufacturing remain unaddressed. Small enterprises are not able to leverage the benefits of improved technologies and this explains their poor performance standards when compared to national and international benchmarks.

xv) Pre-competitive research in steel related technologies for a) energy-efficiency, b) emission control, c) solid waste minimization, d) more efficient use of Indian coal resources and e) value addition to indigenous raw materials in public and private sector R&D would need to be promoted through a Challenge Award Scheme. International Science & Technology cooperation in the area of steel making technologies would be necessary considering that the number of Indian experts engaged in R&D in steel making is significantly low. Synergies within the country and through international cooperation may need to be developed for growing industry-relevant R&D activities.

Environmental Management and Pollution Control

i) The Indian steel industry currently is at a crucial stage with challenges of climate change. While the industry is expected to accelerate ramp up steel production to meet the needs of its population by infusion of additional capacity, global issues like Climate change necessitate guided growth through low carbon intensive routes for steel production. It is therefore imperative that all the steel makers across the country adopt energy efficient and environment friendly technologies in all areas of iron and steel making in line with SOACT and BAT guidelines.

ii) It is also necessary that all protection measures are adopted at the planning stage itself, as the cost of correction at a later date will be very high. Existing plants need to evolve short term and long term action plan to phase out the old and obsolete facilities by state-of-art clean and green technologies with an aim not only to achieve higher standards of productivity but also to harness all waste energy with minimized damage to the environment.

iii) Since the cost of measures for energy and environment management is expected to be high, it is imperative that Government evolve suitable measures in the form of capital subsidy or incentives to promote adoption of such measures.

Safety Measures

i) The safety policy adopted in the Iron and Steel Industry in India is comparable to the policy followed internationally. However, implementation and monitoring of these policy guidelines on the ground leave much to be desired. As a result, the number of accidents, casualties, disabilities, loss to plant and machinery and consequential loss of man-days and production is quite significant. It calls for an introspection and review of the whole situation.

ii) It has been observed that adherence to safety measures and policy is lacking due to many factors, viz. Indifference on the part of management and workers, financial problems, lack of awareness, complicated and slack legal machinery and lack of adequate statutory provisions.

iii) Use of many out-dated technologies still prevalent in India exacerbates the hazards and risks in the plant.

Role of Government

i) The Government has an important facilitating role in the development of the steel industry. As steel making is a highly capital intensive and complex process requiring large-scale investment, historically the industry has evolved with Government support. While direct Government involvement in steel making process may no longer be required, the State will have to provide the necessary policy support to the sector to achieve the object of the National Steel Policy to make India a global Steel producer. Some of the important areas, where Government support is required, are – providing essential infrastructure facilities; assuring easy availability of critical inputs such as iron ore, coal, gas and power; provision of training facilitity for manpower development and creation of a consolidated and reliable data base for informed decision making by all stakeholders.

CHAPTER - I

PERFORMANCE OF INDUSTRY

Present status of Indian Steel Industry and its performance during the 11th Five Year Plan (2007-12)

1.1 Global Status of Indian Steel Industry

1.1.1 Indian Iron and steel industry with its strong forward and backward linkages contributes significantly to overall growth and development of the economy. As per official estimates, the Industry today directly contributes 2 per cent of India's Gross Domestic Product (GDP) and its weightage in the official Index of Industrial Production (IIP) is 6.2 per cent. Globally also, over the last two decades, the industry has been able to carve out a niche for itself. From a country with a fledgling status of one million tonnes of capacity at the time of Independence, it has today become the world's 4th largest producer of crude steel preceded only by China, Japan and USA as shown below:-

Table-1.1

Top ten Crude Steel Producing Countries of the World

No.	Country	Production (in million metric tonnes)		Rank
		2010	**2011***	
1	China	626.7	350.54	1
2	Japan	109.6	54.07	2
3	U.S.A	80.5	42.65	3
4	**India**	**68.3**	**35.64**	**4**
5	Russia	66.9	34.58	5
6	South Korea	58.4	33.87	6
7	Germany	43.8	23.18	7
8	Ukraine	33.4	17.90	8
9	Brazil	32.9	17.72	9
10	Turkey	29.1	16.41	10
	World(total)	1414	757.7	
	India's Share (%)	4.8	4.7	

Source: World Steel Association (WSA); P=Provisional *January –June

1.1.2 In spite of being one of the largest producers of steel in the world, India has been lagging behind other major steel producing countries in terms of intensity of steel usage in overall economic activities (i.e., per unit of GDP) or per capita consumption of steel. In 2010 our per capita consumption of steel was only 51.7 kg as against the world average of 202.70 kgs. There is a tremendous potential for improvement in the domestic steel consumption given the economy's large untapped markets especially in rural areas. This is reflected in the steady rise in consumption levels over the last few years at a rate faster than the world average growth rate as seen in the following Table (**Table- 1.2).**

Table – 1.2

Per Capita Finished Steel Consumption in Selected Countries (in Kgs)

No.	Countries	2005	2006	2007	2008	2009	2010 (P)	CAGR (%) (2005-10)
1	China	266.0	287.4	319.6	326.9	409.4	427.4	12.4
2	S. Korea	981.6	1042.6	1144.1	1210.7	936.1	1077.2	1.5
3	Japan	601.6	619.5	637.0	612.1	415.6	502.9	(-) 3.0
4	USA	356.5	400.9	358.5	323.6	192.7	258.2	(-)7.1
5	Russia	204.9	245.8	285.6	251.7	178.1	256.2	5.7
6	Ukarine	118.4	142.5	173.9	149.5	86.6	121.0	(-) 0.1
7	Germany	427.7	475.6	518.4	514.3	342.7	440.8	0.03
8	India	36.6	41.2	45.8	45.1	47.8	51.7	7.8
	World (average)	173.9	188.0	199.4	194.4	181.0	202.7	3.7

Source: World Steel Association; P=Provisional

1.1.3 India also remains the world's largest producer of sponge iron since 2002. As per latest available information (**Table- 1.3**), during 2010 total global production of sponge iron was 71.3 million metric tonnes - of which India alone accounted for 26.3 million metric tonnes or 36.9% of the total.

Table – 1.3

India's share in World Production of Sponge Iron since 2003

(in million metric tonnes)

	2003	2004	2005	2006	2007	2008	2009	2010
India	7.1	9.1	12.1	15.0	20.1	20.9	23.4	26.3
World	47.8	54.1	56.7	56.4	66.8	66.1	64.5	71.3
Share of India	14.9%	16.8%	21.3%	26.6%	30.1%	31.6%	36.3%	36.9%

Source: World Steel Association & JPC

1.2.0 Evolution and Structure of the Indian Steel Industry

1.2.1 At the time of independence in 1947, the country had three integrated steel plants (TISCO, IISCO and VISL) and a few Electric Arc Furnace (EAF) based plants in the secondary sector. During the initial planning years i.e. from 1950 to the 1970's, large integrated steel plants were set up in the public sector at Bhilai, Durgapur, Rourkela and Bokaro. With the opening up of the economy and deregulation of the steel sector in the 1990's, many private companies (Essar, Ispat, Jindal etc.) set up large integrated steel plants. This post liberalization phase led to rapid growth in domestic steel making capacities with many new entrants joining the race and the established players undertaking modernization and expansion of capacities at the same time.

1.2.2 In the course of its evolution over the last several decades, the structure of Indian Iron and Steel Industry has become extremely diverse in terms of scale of operation/size, integration levels, process routes and levels of technological sophistication. In consonance with the stages of evolution of the industry and keeping in view the requirements of inter-temporal continuity in systems of data collection, the Joint Plant Committee (JPC) has classified the Indian steel producers into three broad groups for dissemination of official data. The scheme is as given below:

i) **The Main Producers**: This category includes public sector integrated plants of the Steel Authority of India Ltd. (SAIL) (with its various subsidiaries) and the Rashtriya Ispat Nigam Ltd. (RINL) along with the private sector producer Tata Steel Ltd. The Main Producers – all dating back to the pre-deregulation era - have a combined capacity of around 22.55 million tonnes per annum with current capacity utilization rates exceeding 100%.

ii) **Majors :** This category includes integrated steel plants (other than the Main Producers) with crude steel capacity of 0.5 million and above – irrespective of technology routes - like JSWL, ESSAR, JSW Ispat Steel Ltd (erstwhile Ispat Industries Ltd) and JSPL. Estimated total crude steel capacity of these producers is around 17.40 million tonnes. These are primary steel makers using diverse technology routes like DRI-EAF DRI/BF-EAF, COREX/BF- BOF etc.

iii) **Other Producers:** This category includes the mini steel plants - mainly the Electric Arc Furnace (EAF) and Induction Furnace (IF) units - with capacity below 0.5 million tonnes as also all EOF units. Besides it also covers the stand-alone processors without backward integration of steel making like the Re-rolling (RR) units, Cold Rolling (CR) units, GP/GC Sheets units, Pig Iron & Sponge Iron Plants, etc.

While category (i) above includes units in both public and private sectors, the other two categories i.e. (ii) & (iii) consist only of private sector producers. In fact, today domestic steel making is dominated by the private players. During 2010-11 (**Table- 1.4**) the private sector units accounted for 75% of the total crude steel production and 80% of finished steel production in the country:-

Table – 1.4

Percent share of private sector in domestic Crude and Finished steel production

Year	Share of Private sector in Total Production	
	Crude Steel	Finished Steel
1992-93	37%	67%
2000-01	49%	68%
2010-11 (P)	75%	80%

Source: JPC; P=Provisional

1.2.3 In terms of choice of technology, production through oxygen route remains the dominant steel making technology in the country with a share of 44%. However, the unique feature of our steel industry has been the emergence of the electric steel making route, especially the Induction Furnace (IF) units, whose share in total crude steel production is today as high as 32% with the remaining 24% accounted for by the EAF route as shown in **Table 1.5**.

Table- 1.5

Indian Crude Steel production by Process Route (Percentage Share)

Process Route	2005-06	2010-11 (P)
Basic Oxygen Furnace	53%	44%
Electric Arc Furnace (EAF)	18%	24%
Induction furnace (IF)	29%	32%
Total	100%	100%

Source: JPC; P=provisional

1.3.0 Trends in Production and Consumption of Steel during 11th Plan (2007-12)

1.3.1 For the domestic steel industry, the 10th five year Plan (2002-07) was a period of fast-paced growth with significant increases in both steel production and consumption. Therefore, business expectations at the time of formulation of the 11th plan (2007-12) were largely optimistic and this was justified in the performance of the industry in the initial years of the plan period. In fact, the first year of the Plan i.e. 2007-08 had been a year of high growth for the industry. However, with onset of the global economic downturn the same pace could not be maintained in the second year i.e. 2008-09. Like all other manufacturing industries, steel making is also largely market driven and therefore was affected directly by the adverse global market conditions. Fortunately, the sector was able to contain the rate of deceleration thanks to the timely policy interventions and counter-cyclical stimulus of fiscal and monetary packages announced by the government and more importantly by the inherent stability of the Indian economy itself. As a result, by the beginning of the third year i.e. 2009-10 there were signs of recovery with stable and strong growth rates in both steel production and consumption. The growth rates have, since then, remained steady and over the last two years i.e. since 2009-10, have matched the pre-crisis levels in both production and consumption with simultaneous acceleration in capacity additions

1.3.2 An analysis of sector level performance during the first four years of the 11th Plan, show that growth rate in both production and consumption of steel recorded during this period was lower than that achieved during the 10th Plan. While finished steel production for sale and real consumption (i.e. production + imports-exports adjusted for stock variation/double counting) increased by 5.8% and by 8.8%, respectively, the corresponding growth rates during the 10th Plan were much higher at 9.4% and 10.4%. However, despite the slowdown, performance of the Indian steel industry during the 11th Plan period has been better not only in comparison to the levels achieved in the 9th Plan but to that of the entire decade preceding liberalization. The relative periodic growth performance of the Indian steel industry is placed at **Table – 1.6**. In fact, if we ignore the crisis year of 2008-09 then the average growth rates during the 11th Plan in production and consumption do not actually show any significant deceleration compared to the earlier period.

Table – 1.6

Trends in Growth of Production & Consumption of Finished steel (Plan-wise)

No.	Five Year Plan	Production (Million Tonnes)	CAGR (%)	Consumption (Million Tonnes)	CAGR (%)
1	9th Plan (1997-98 to 2001-02)	27.42 -33.38	4.9	23.81 to 28.52	4.1
2	10th Plan (2002-03 to 2006-07)	37.17 -52.53	9.4	30.68 to 46.78	10.4
3	11th Plan (2007-08 to 2010-11)*	56.07-66.01	5.8	52.12 to 65.61	8.8
4	Decade preceding deregulation (1982-83 to 1991-92)	8.48 14.23	5.9	9.26 - 14.84	5.3
5	Post De-regulation Period (1992-93 to 2010-11)	16.89-66.01	8.4	15.81 to 65.61	8.1

Source: JPC for the basic data

Note: (1) *First four years

(2) For calculating growth rates (CAGR) for a five year plan, the terminal year of previous plan has been taken as the base year

1.3.3 One striking feature to be noted in sectoral performance is the relatively higher growth in domestic demand for steel vis-à-vis that of availability during this period. With growth in demand overtaking supply the country has in fact become a net importer of steel since 2007-08, i.e. beginning of the 11th Plan as shown in **Table-1.7** below:-

Table – 1.7

Trends in Production for Sale and Real Consumption of Total Finished Steel in India, during 11th Plan (up to 2010-11)*

Year	Production for Sale (MT)	Change over previous year (%)	Real Consumption (MT)	Change over previous year (%)	Net Imports (MT)
2006-07	52.529	12.8	46.783	12.9	-0.315
2007-08	56.075	6.8	52.125	11.4	1.952
2008-09	57.164	1.9	52.351	0.4	1.402
2009-10	60.624	4.4	59.34	13.3	4.131
2010-11 (P)	66.013	8.8	65.610	11.0	3.337
CAGR (2007-2011)	5.8%		8.8%%		

Source: JPC; P=provisional;

Note: (1) Figures include alloy steel

(2) *First four years

1.3.4 Capacity utilization rates achieved during the 11th plan (2006-07 to 2011-12) ranged between 88% and 90% (**Table-1.8**). Operation at such high capacity utilization levels is also a strong indicator of the need for going in for capacity additions for meeting potential future demand.

Table – 1.8

Overall Crude Steel Production, Capacity, Capacity Utilization, 2006-07 to 2010-11

Year	Capacity (Million Tonnes)	Production (Million Tonnes)	% Utilization
2006-07	56.843	50.817	89
2007-08	59.845	53.857	90
2008-09	66.343	58.437	88
2009-10	75.001	65.839	88
2010-11 (P)	78.001	69.575	89.2
CAGR	8.2%	8.17%	

Source: JPC; P=Provisional

1.3.5 The producer/group/company-wise performance during the Plan period, as presented in the **Table – 1.9** indicates that the rate of growth of 'Majors and Other Producers' was higher than that of the BF-BOF based Main producers (SAIL, RINL, Tata Steel). The combined share of this group has increased from 66.5% in 2006-07 (end of the 10th Plan) to 72.3% in 2010-11. However, the future scenario may be different with the implementation of substantial capacity expansion projects by the main producers.

Table – 1.9

Producer Group Wise Production of Crude Steel, 2006-07 to 2010-11

(Million Tonnes)

Producer/Group	**11th Plan (2007-12) Production of Crude Steel**				
1.**Main Producer**	2006-07	**2007-08**	**2008-09**	**2009-10**	**2010-11 (P)**
SAIL	13.51	13.96	13.41	13.51	13.76
RINL	3.50	3.13	2.96	3.21	3.24
TATA STEEL	5.17	5.01	5.65	6.56	6.86
TOTAL (1)	**22.18**	**22.10**	**22.02**	**23.28**	**23.85**
2. Major					
JSWL	2.64	3.15	3.22	5.26	5.85
ISPAT	2.76	2.83	2.20	2.69	2.38
ESSAR	3.01	3.56	3.34	3.47	3.37
JSPL	-	-	1.46	1.96	2.27
TOTAL(2)	8.41	9.54	10.22	13.38	13.87
3. Other Producer					
EAF Units/ COREX-BOF *	4.84	5.28	8.15	9.36	9.79
INDUCTION FURNACE*	15.39	16.93	18.05	19.82	22.07
TOTAL (3)	**20.23**	**22.21**	26.20	**29.18**	**31.86**
GRAND TOTAL(1+2+3)	**50.82**	**53.86**	**58.44**	**65.84**	**69.58**

Source: JPC, P=provisional, *Reclassified as others

1.4.0 Category-Wise Production and Consumption of Finished Steel During 11th Plan (the first four years i.e., up to 2010-11)

1.4.1 Category-wise analysis of production for sale and real consumption (i.e. apparent consumption adjusted for double counting in flat products) of finished steel during 11th Plan shows that certain categories such as large dia. pipes, CR coils/sheets and bars & rods registered significant growth while production of others like HR coils/sheets; railway materials & structurals etc. remained sluggish.

1.4.2 As for consumption of finished steel, while demand for certain steel products such as GP/GC, CR & large dia. Pipes etc. was quite robust during the period, that for others like Railway materials, structurals and plates were relatively much lower as shown in **Table -1.10**.

Table – 1.10

Category-Wise Production for Sale and Real Consumption of Finished Steel (Alloy & Non-Alloy) during 11th Plan period

	Production for Sale (Million Tonnes)						Real Consumption (Million Tonnes)					
	2006-07*	2007-08	2008-09	2009-10	2010-11	CAGR (2007-11) (%)	2006-07*	2007-08	2008-09	2009-10	2010-11 (P)	CAGR (2007-11) (%)
Bars & Rods	18.81	20.19	20.43	21.77	24.37	6.7	18.78	20.38	20.55	21.62	24.44	6.8
Structurals	4.88	5.04	5.37	4.14	5.54	3.2	4.91	4.99	5.33	4.20	5.62	3.4
Rly. Materials	1.04	1.09	1.18	1.04	1.09	1.2	1.05	1.08	1.19	0.99	1.1	1.2
Total Longs	**24.73**	**26.32**	**26.98**	**26.95**	**31.0**	**5.8**	**24.73**	**26.45**	**27.07**	**26.81**	**31.16**	**5.9**
Plates	3.34	4.06	4.00	3.98	4.25	6.2	4.35	5.40	4.66	4.77	4.76	2.3
HR Coil/Skelp/ Sheets	11.88	12.43	11.78	12.61	12.93	2.1	11.99	14.03	13.1	14.85	14.59	5.0
CR sheets/Coils/ TMBP	4.33	4.44	4.62	5.91	5.76	7.4	4.53	4.73	5.00	6.14	6.64	10.0
GP/GC	4.39	4.38	4.55	5.62	5.60	6.3	2.40	2.62	3.02	4.51	4.74	18.5
Elect. Sheets	0.14	0.16	0.15	0.15	0.18	6.5	0.39	0.38	0.36	0.42	0.49	5.9
Tin Plate (incl. w/w)/TFS	0.17	0.18	0.21	0.25	0.23	7.8	0.32	0.34	0.29	0.40	0.40	5.7
Pipes Large Diameter	1.20	1.34	1.87	1.64	1.85	11.4	1.06	1.22	1.38	1.17	1.54	9.8
Total Flat excluding Double counting	**25.45**	**26.99**	**27.18**	**30.16**	**30.80**	**4.9**	**19.59**	**22.97**	**21.83**	**29.27**	**30.99**	**12.1**
Non-Flat Alloy	1.48	1.74	2.03	2.21	2.47	13.7	1.43	1.56	2.10	2.23	2.40	13.8
Flat Alloy excl. dbl. count.	0.85	1.02	0.99	1.32	1.75	19.8	1.03	1.18	1.26	1.03	1.07	1.0
Total Alloy	**2.33**	**2.76**	**3.02**	**3.53**	**4.22**	**16.0**	**2.46**	**2.74**	**3.36**	**3.26**	**3.47**	**9.0**
Grand Total	**52.53**	**56.08**	**57.16**	**60.62**	**66.01**	**5.8**	**46.78**	**52.13**	**52.35**	**59.34**	**65.61**	**8.8**

Source: JPC; P=Provisional * End of 10th Plan

1.5 Trends in International Trade in Iron & Steel

1.5.1 Prior to deregulation, imports of steel were permitted under a rigorously defined Foreign Trade Policy designed to bridge the gap between domestic demand and domestic availability. Like most other industries the steel industry was also insulated from foreign competition by high import tariffs and quantity restrictions via canalization and import licensing. As for exports- it took place primarily to take care of surplus availability if any.

1.5.2 Deregulation brought about far-reaching changes in the international trading scene for the globally integrated Indian steel industry. Import duty rates were progressively reduced from above 150% to 5% with abolition of all quantitative controls. Protection from unfair import competition is currently being provided through the mechanism of Trade Actions (Anti-Dumping, Anti-Subsidy and Safeguard actions) as permitted under the WTO. Most importantly, during the 10th Five Year Plan (2002-07) there was substantial reduction in the peak duty rates i.e from then existing 25% to 5%. In the case of seconds and defective steel products, however, a higher import duty rate of 20 per cent continues to be maintained.

1.5.3 Liberalization of the foreign trade regime has had a favourable effect on Indian exports as it is no longer subject to availability of surplus. In fact between 1991-92 and 2002-03 our exports grew fast at a rate exceeding 25% per annum. Thereafter, till 2005-06 export levels stagnated at around 4-4.5 Million Tonnes per year. During this period, the country's export basket also changed in favour of more value added and sophisticated products. The export destinations also got widened with Indian steel reaching a very large number of countries across the world.

1.5.4 During the first four years of the 11th plan period (i.e. up to 2010-11), additions to existing capacities have not been adequate to meet the growing demand. Further, with the onset of global financial crisis, there was significant decline in global demand and International Steel Producers had to substantially scale down their operations. Under such conditions margins on export sales had also come under pressure and domestic producers had to opt for domestic sales to contain their losses. As a result finished steel exports declined from 5.24 million tonnes in 2006-07 to 3.46 million tonnes in 2010-11 (**Table – 1.11**). Exports of semis have also showed a similar declining trend during the period.

Table – 1.11

Import & Export of finished Steel & semis during 11th Plan (2007-12)

Year	Total Finished Steel		Semis	
	Import	Export	Import	Export
2006-07	4.927	5.242	0.435	0.665
2007-08	7.029	5.077	0.367	0.373
2008-09	5.839	4.437	0.598	0.746
2009-10	7.382	3.251	0.443	0.625
2010-11$ (P)	6.798	3.461	0.339	0.35

Source: JPC $ as estimated in September, 2011

1.5.5 As regards steel Imports –it remained static around the pre-liberalization level of 1- 2 million tonnes per annum till 2003-04 but thereafter almost doubled between 2003-04 and 2005-06 i.e., from 1.7 million tonnes to 4.1 million tonnes. This surge has continued during the 11th plan also - primarily to bridge the gap between domestic demand and availability as well as due to price considerations. From 4.93 million tonnes in 2006-07 steel imports peaked to 7.38 million tonnes in 2009-10 before declining marginally to 6.8 million tonnes in 2010-11. An important reason for the high level of imports during the 11th Plan has been the domestic non-availability or limited availability of sophisticated/specialized steel products like the following:

i. CR Sheets / Coils for Auto Sector
ii. CRGO and High Grades of CRNO
iii. Over Dimensional Plates, Quenched and Tempered Plates, Special grades of Boiler Quality Plates, etc.
iv. Organic coated, Vinyl coated sheets.
v. Prime quality Tinplate (OTSC Grade)
vi. API Grade large diameter pipes etc.

1.6 Performance of different segments of Iron and Steel Industry during 11th plan period

1.6.1 The performance trends in production and consumption of Pig Iron, Sponge Iron, Ferro Alloys and Refractories are given in **Annexures – 1.1 (a), (b), (c) & (d)** respectively.

1.7 Trend in prices of steel and raw materials during the 11th Plan

1.7.1 Today prospects of the steel industry are primarily determined by market forces- domestic as well as global, and these signals are transmitted through the movements in the prices of both raw materials and the finished products. During the first three quarters of 2007-08, the steel prices after remaining stable had witnessed sharp increase which was coupled with high volatility from the last quarter of 2007-08. The rising trend in steel prices continued till July 2009. Government and large scale integrated producers both in public and private sectors took following important initiatives to moderate the impact of rise in steel prices on the general inflation levels:

- Self-restraint by the producers on further hike in steel prices and reduction in export of steel as a result of mutual deliberations and advice by the Government
- Roll back of prices of steel products such as TMT, Galvanized sheets etc. used by common man for house hold construction
- Removal/reduction of fiscal barriers on imported steel-removal of customs duty, suspension of CVED on imported TMT bars
- Disincentivization of exports by withdrawal of DEPB benefits and imposition of export tax
- Facilitating access of steel producers to steel-making raw material/inputs at competitive prices by removal of customs duties on imports
- Increase in allocation of steel by Main producers (SAIL and RINL) to Small Scale Industries Corporations (SSICs) and National Small Industries Corporation (NSIC).

1.7.2 As a result of initiatives taken by the Government and Steel producers, the rising trend in steel prices was arrested and prices started to moderate from third quarter 2008-09. With the onset of global financial crisis, international and domestic prices of steel collapsed in the last quarter of the year i.e. end of 2008-09. The prices of steel remained at a comparatively subdued level till middle of 2009-10 and the year ended with marginal increases which were maintained till first quarter of next year i.e. 2010-11. From second quarter onwards there was some moderation in prices of long products while the prices of flat products remained at high levels till June 2011. During first quarter of current year i.e.Q1 2011-12, once again there was a modest increase in prices and especially that of long products. Presently steel prices are under pressure following the slowdown in Europe –specially the EU and USA with adverse implications for investment and manufacturing activities within the country. Another important factor that contributed to the pressure on prices during the year specially of core raw materials was the earthquake and floods in the world's major producer and exporter i.e. Australia with adverse impact on global availability. In fact the movement in the Quarterly Price Index (**Table – 1.12**) may also confirm that substantial part of increase in steel prices could be traced to the steep rise in prices of raw materials crucial for steel making i.e. coking coal, iron ore.

Table – 1.12

Movement in Price Index of Steel and its Inputs
(Base: 2007-08=100)

Year	T MT	H R Coil	Iron Ore	Coking Coal
Q1 (2007-08)	100	100	100	100
Q2 (2007-08	106	101	135	125
Q3 (2007-08)	100	98	184	154
Q4 (2007-08)	116	100	195	250
Q1 (2008-09)	158	140	187	359
Q2 (2008-09)	146	129	160	344
Q3 (2008-09)	140	127	77	199
Q4 (2008-09)	120	102	75	119
Q1 (2009-10)	112	98	70	108
Q2 (2009-10)	115	98	93	141
Q3 (2009-10)	110	102	101	148
Q4 (2009-10)	115	104	135	193
Q1 (2010-11)	135	129	166	211
Q2 (2010-11)	119	126	143	179
Q3 (2010-11)	122	125	164	198
Q4 (2010-11)	129	126	183	279
Q1 (2011-12)	143	128	181	283
Q2 (2011-12	145	128	181	272

Source: ERU/JPC for domestic steel prices, SBB for prices of inputs.
Specifications: TMT (10mm), HR Coil (2.5mm); Mumbai Market.
Iron Ore- Indian Iron Ore 63% Fe fines dry/ China Import CFR N China
Coking Coal-10.5-12.55 ash / China Export FOB Main ports

CHAPTER - II

Prospects of Domestic Demand for Steel – Review of Relevant Macro Economic Factors

2.1.0 Introduction

2.1.1 Growth in steel consumption in a country depends upon the rate of growth in its GDP and the estimated 'GDP-elasticity of steel demand'. While growth in GDP is a crucial determinant of growth in steel consumption, GDP elasticity of steel demand is the definitive parameter specific to an economy and determines the rate of growth in its steel demand over time. GDP-elasticity of steel demand at a given period of time, is a function of the development strategy adopted and is determined by the structure of the economy and the dynamics of its growth path – expressed in shifting shares of the Primary, Secondary and Tertiary sectors, household consumption patterns, rates of investment, levels of urbanization etc. The value of GDP elasticity of steel demand, therefore, varies widely amongst countries and over time as countries achieve economic growth with different combinations of these structural factors over the short and long run.

2.1.2 Inter-Country variations in structural factors lead to wide variations in steel intensity as measured by 'Apparent Steel Consumption' per unit of Gross Domestic Product (GDP) or per unit of Gross Fixed Capital Formation (GFCF). For example, in terms of steel intensity in GDP and steel intensity in Fixed capital Formation, China with a ratio of 95.1 and 195.4 respectively (**Refer Table – 2.1**) is ahead of other countries including India (ratio of 42.1 and 111.0).

2.1.3 It is therefore necessary to examine in detail the following to make a realistic assessment of future demand for steel in India:

- Review of past performance of the Indian economy and analyze the emerging trends especially in view of uncertain international economic scenario
- Review of changes in the structure of the economy and the likely scenarios
- Special factors relevant for the 12th Plan Period-such as increased outlays on infrastructure and thrust on manufacturing

Table 2.1

Steel Intensity Analysis for Selected Countries (2010)

	GDP	**Population**	**Gross Fixed Capital Formation (GFCF)**	**GFCF Share of GDP**	**Apparent Steel Consum. (ASC)**	**ASC/GDP**	**ASC per Capita**	**ASC/GFCF**
	Bil. USD ($)	Million	Bil. USD ($)	%	Mill. Metric tones	Mill.tones per trillion ($) GDP	Tones per person	Mill. tones per trillion ($) GFCF
Brazil	2090	193.3	402	19%	27.0	12.9	0.14	67.1
China	5915	1341.4	2877	49%	562.2	95.1	0.42	195.4
Germany	3316	81.6	580	17%	37.2	11.2	0.46	64.1
India	1538	1215.9	582	38%	64.7	42.1	0.05	111.0
Japan	5459	127.5	1103	20%	62.6	11.5	0.49	56.7
Korea	1007	48.9	289	29%	54.8	54.4	1.12	189.6
Mexico	1039	108.6	267	26%	17.2	16.6	0.16	64.6
Russia	1465	140.4	290	20%	37.4	25.6	0.27	129.0
Turkey	742	71.3	151	20%	21.7	29.3	0.30	143.8
Ukraine	136	45.5	27	20%	6.9	50.3	0.15	256.2
United States	14658	310.0	2332	16%	83.4	5.7	0.27	35.8

Source: World Steel Dynamics

2.2.0 Performance of Indian Economy during 11^{th} Plan period and Emerging Trends

2.2.1 The Eleventh Plan targeted an average GDP growth of 9% in 2007 - 2012. The economy achieved a robust GDP growth of 9.3% in the first year of the Eleventh Plan. The growth momentum was, however, interrupted by the onset of the global financial crisis. As a result, the Indian economy witnessed significant moderation in GDP growth to 6.8% in the 2^{nd} year of the 11^{th} Plan. The counter cyclical stimulus measures taken by the Government had a positive impact on the Indian economy and it recovered quickly to record 8% and 8.5% growth in GDP, respectively, in the third and fourth year of the 11^{th} Plan.

2.2.2 The Economic Advisory Council to the Prime Minister of India in its recent forecast (July 2011) has estimated GDP growth for the 5^{th} year of the 11^{th} Plan i.e. for 2011-12, at 8.2%. Over the last two decades, the growth rate of India economy has been higher than 8% only in 5 years. Since three of these years happen to fall in the last five years, there is justified cause of optimism in the performance of the economy.

2.2.3 As the Indian economy enters the 12th Plan period, uncertain global economic environment continues to pose serious challenges to the restoration of the high growth path seen in the recent past prior to the global economic downturn. According to projections made by various agencies, the Indian Economy is unlikely to attain high levels of GDP growth which were achieved during 2005-06, 2006-07 and 2007-08 in the short term.

GDP Growth rates (%) in India during 2005-06 to 2011-12

	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12
GDP (at constant prices 2004-05) (%)	9.5	9.6	9.3	6.8	8.0	8.5	8.2*

*Projected

2.2.4 Some of the international developments listed below may also adversely impact the growth prospects of the domestic economy during the 12th plan:

- Sovereign Debt Crisis of the Western economies, especially those in the Euro-Zone
- Recent Downgrade of the US Government Sovereign Credit Rating by S&P and proposed cut in Expenditures in the US
- High volatility in currency and equity markets

In the latest update of World Economic outlook of the IMF, growth in the advanced economies in 2011 and 2012, has been broadly projected at levels lower than those achieved in 2010.

Another important factor which needs to be constantly watched is the possibility of a slowdown in the Chinese economy. China has been an engine of global growth in steel production and consumption for the last decade as is evident from the **Table – 2.2**.

Table – 2.2

Share of different countries/regions in global Crude Steel Production

Country	2000	2010
China	15.1%	44.3%
Japan	12.5%	7.8%
India	3.2%	4.8%
Other Asia	11.6%	11.5%
EU (27)	22.8%	12.2%
Other Europe	2.0%	2.4%
CIS	11.6%	7.7%
NAFTA	15.8%	7.8%
Others		
Africa	1.6%	1.2%
Middle East	1.3%	1.4%
Central and South America	4.8%	3.2%
Australia and New Zealand	0.9%	0.6%
World Total	**849 million metric tones**	**1414 million metric tones**

2.2.5 The events of the last few years and future projections made by various agencies indicate that it is difficult for any economy including that of India to insulate itself from external shocks, irrespective of its degree of globalization. At the same time, it may be noted that India's growth is largely driven by domestic demand rather than being export led. Besides the adverse effects of global financial crisis, Indian economy exhibited a large degree of resilience and recorded a modest growth in GDP at a time when the rest of the World, especially the developed market economies, registered negative rates of growth. The relatively better performance of Indian Economy is expected to continue in the medium and long terms on the strength of strong domestic demand. The past & projected performance of Indian Economy vis-à-vis rest of World is placed at **Table – 2.3**.

Table – 2.3

Comparison of GDP Growth Rates of some select countries/groups (in per cent)

	2007	2008	2009	2010	2011*	2012*
World	5.4	2.90	-0.5	5.1	4.3	4.5
Advanced Economies	2.67	0.22	-3.38	3.0	2.2	2.6
USA	1.9	0.0	-2.6	2.9	2.5	2.7
Japan	2.4	-1.2	-6.3	4.0	-0.7	2.9
Germany	2.8	0.7	-4.7	3.50	3.2	2.0
Emerging & Developing Economies	8.8	6.1	2.7	7.4	6.6	6.4
India	9.9	6.2	6.8	10.4	8.2	7.8
China	14.2	9.6	9.2	10.3	9.6	9.5

Source: World Economic Outlook, IMF, June 2011 & WEO database April 2011, * projected

2.3.0 Trends in Structural Factors and Indian Steel Industry

2.3.1 As discussed earlier, weakening of the intensity of steel consumption in India can be traced back to the shifts in the structure of the economy measured by relative shares of agriculture, industry and services in GDP. The primary reasons for weakening of GDP elasticity of steel are:

a) Faster growth of the tertiary sector as compared to the material intensive commodity sector from 1970 onwards. The rates of growth of various sectors of the economy from 1970 till 2010 are shown in **Table – 2.4.**

Table – 2.4

Sectoral share (% share) in GDP

Decades	Primary Sector (Agriculture, Forestry and Fishing)	Secondary Sector (Mining, Manufacturing, Electricity, Gas, Water Supply and Construction)	Tertiary Sector (Trade Hotels, Transport, Storage & Communication, Financing, Insurance, Real Estate & Business Services, Community, Social & Personal Services	Real GDP growth rate (%)
1970 – 71	46.0	20.4 (12.6)	33.6	5.0
1980 – 81	39.7	23.7 (13.8)	36.6	7.6
1990-91	32.2	27.2 (14.8)	40.6	5.3
2000-01	23.9	25.8 (15.3)	50.3	4.4
2007-08	16.8	28.7 (16.2)	54.5	9.3
2008-09	15.7	28.1 (15.8)	56.2	6.8
2009-10	14.6	28.1 (15.9)	57.3	8.0
2010-11	14.4	27.9 (15.8)	57.7	8.5

( ) Share of manufacturing in GDP
Source :
1) Eco Survey, 2010
2) Data during 1970-71 to 2000-01 based on old National Accounts Series with 1999 – 2000 prices while the later period are based on the new series with 2004-05 prices.

It is apparent that the share of commodity sectors (Primary & Secondary) in GDP has been coming down progressively with higher growth observed in non-material intensive tertiary sector. This, therefore, explains that despite high rate of growth of GDP, the growth in steel consumption has been less than what was warranted by a more material intensive approach to economic growth in the country. As a comparison, in China the share of industry has been assessed at 48 percent and that of services at 40 percent of GDP in 2010.

2.3.2 Another important determinant of intensity of steel demand is investment in creation of fixed assets. A major area of concern during the 11th plan has been that Gross Domestic Fixed capital Formation (GDFCF) has clearly come off from its peak level 32.9% in 2007-08 to 30.8% in 2009-10. The initial estimate for 2010-11 is placed at 29.5%. FDI and FIIs would continue to feed the investment requirement of the Country. It is also feasible to assume a Current Account Deficit of around 3% and hence it should be possible to provide a fixed capital formation rate of around 33 - 35% of GDP, if not more, during the 12th Plan. This may be compared with more than 48% share of gross fixed capital formation in GDP in China.

2.3.3 Trends in other macro-economic indicators such as IIP, Gross Domestic Savings also point out weakening of growth momentum post global financial crisis (see **Table – 2.5**). At the same time inflationary pressures increased initially on account of rise in prices of primary products and commodities. Subsequently, inflation became more broad-based resulting in monetary tightening by the Reserve Bank of India (RBI). Reserve Bank of India has increased repo rates 11 times since March 2010 which is likely to enhance the cost of capital and adversely affect demand for steel in the short term.

Table – 2.5

Macro Economic Indicators, 2007-08 to 2010-11

(Percentage change over previous period)

Parameters	2007-08	2008-09	2009-10	2010-11
Gross Domestic Product at factor cost (at 2004-05 prices)	9.3	6.8	8.0	8.5
Index of Industrial production	15.5	2.5	5.3	8.2
Whole-sale price index	4.8	8.0	3.6	10.48
Imports at current prices (In US $ million)	25.16	30.36	28.83	N A
Exports at current prices (In US $ million)	16.31	18.53	17.87	N A
Money Supply (M_3)	21.2	18.6	16.8	16.5
Sectoral Real Growth Rate (at 2004-2005 prices) Agriculture & Allied Industry Services	5.8 9.7 10.3	-0.14 4.4 10.1	0.4 8.0 10.1	6.6 7.9 9.4
Gross Domestic Savings as percentage of GDP	36.9	32.2	33.7	33.8
Gross Domestic Investment as percentage of GDP	38.1	34.5	36.5	37.5
Gross Domestic Fixed Capital Formation (GDFCF)	32.9	32.0	30.8	29.5

Source: CSO

2.4.0 Special Factors Contributing to Steel Demand during 12th Plan period

2.4.1 While the recent trends in macro economic variables suggest likely moderation in steel demand, there are a large number of qualitative factors which may have the impact of increasing intensity of steel in the country.

a) The 12th Plan envisages massive investments to the tune of 1 trillion dollars (Refer **Table – 2.6**) in the infrastructure sector which augurs well for expansion of the base of steel consumption in the economy. On a rough estimate, it may lead to a demand of approximately 40 million tonnes per annum during 2012-13 to 2016-17. It is also likely to raise the intensity of steel consumption in the country measured in terms of steel consumption per unit of the GDP.

Table – 2.6

Projected Investment in Infrastructure during the Twelfth Five Year Plan

Year	Base Year (2011-12)	2012-13	2013-14	2014-15	2015-16	2016-17	Total 12th Plan
GDP at market prices (Rs. Crore)	63,14,265	68,82,549	75,01,978	81,77,156	89,13,100	97,15,280	4,11,90,064
Rate of Growth of GDP (%)	9.00	9.00	9.00	9.00	9.00	9.00	9.00
Infrastructure investment as % of GDP	8.37	9.00	9.50	9.90	10.30	10.70	9.95
Infrastructure investment (Rs. Crore)	5,28,316	6,19,429	7,12,688	8,09,538	9,18,049	10,39,535	40,99,240

(Rs. Crore at 2006-07 prices)

Source: Committee on Infrastructure/Planning Commission

b) The Approach Paper for the 12th Plan envisages increasing the growth rate of the manufacturing sector from the current 8 per cent to 11-12 per cent. The anticipated growth in the end using manufacturing industries will lead to significant increase in steel demand. The implementation of the National Manufacturing Policy is expected to further strengthen this trend.

c) The trend towards higher rates of urbanization will lead to increase in intensity of steel as per capita consumption of steel of urban India is many times more than in rural India. It is estimated that India's urban population will increase to 600 million by 2030 from the current level of 400 million.

d) The rising middle class population of India will generate additional demand for automobiles, white goods and other consumer non-durables leading to higher per capita steel consumption.

e) There has been a perceptible rise in steel consumption in the rural and retail sector. Projects like Bharat Nirman, Pradhan Mantri Gram Sadak Yojana, Rajiv Gandhi Awaas Yojana have led to increasing demand for constructional steel items like TMT Bars, Light and medium structurals, GP & GC sheets. Coupled with maximum thrust on rural penetration by all the steel producers, comparatively easy availability of steel is contributing to the higher use of steel in rural / semi urban and retail sector. As per capita rural consumption at around 10 kg (as per latest survey of IMRB sponsored by JPC) is significantly lower than its urban counterpart, there is a huge untapped potential of steel demand emanating from the rural sector.

CHAPTER - III

DEMAND & SUPPLY PROJECTIONS

Demand and Supply Projections for the Twelfth Five Year Plan Period

3.1.0 Estimation of GDP Elasticity of Demand – Methodology and Constraints

3.1.1 As noted in the preceding Chapter, demand for steel is closely linked with production activities in various sectors of the economy. Being the basic material for development of economic and social infrastructure, steel is used for producing capital goods as well as final consumption goods. **As a result one may establish a direct relationship between economic growth as measured by Gross Domestic Product (GDP) and demand for steel**. The same methodology based on the estimated relationship between GDP and steel demand was adopted while making the projections of steel demand for the 11th Plan period and it did give a fairly accurate assessment as may be seen in the **Table – 3.1** given below:-

Table – 3.1

Projected Demand and Actual Consumption of Carbon Steel during 11th Five Year Plan (2007-08 to 2010-11)

Unit: Million Tonnes

Year	2007-08	2008-09	2009-10	2010-11	2011-12
Projected Demand*	50.280	54.680	59.470	64.680	70.340
Actual Consumption**	49.420	48.988	56.084	62.137	33.101#

Report of the Working Group on Steel Industry for 11th Five Year Plan (2007-12)
***Source: JPC*
April-September, 2011

3.1.2 The lower growth in actual steel consumption vis-à-vis projected steel consumption may be partly attributed to the fact that while the projections for 11th Five Year Plan was based on an assumed 9% GDP growth rate, the actual GDP growth rate during first four years of 11th Plan touched 8.2% only.

3.1.3 It is, therefore, proposed that an econometric model with GDP as an explanatory variable may be adopted for projecting demand for 12th Plan period too. It needs to be noted, however, that for the same rate of GDP growth, the estimated relationship (as measured by the co-efficient of elasticity of steel demand with respect to GDP) will be stronger when that economic growth is driven by capital formation/investment and industrial growth rather than growth in other sectors of the economy. The implication is that at a more immediate level, steel consumption is also linked with sector-level macro-economic variables such as capital formation/investment and industrial production which in turn are directly linked to GDP growth. Analyzing the past behavior of these interrelated macro variables in a given general economic context, it is possible to estimate associated GFCF and IIP values required to attain the targeted GDP growth assumed for our projection. Placed within the overall analytical framework of forecasting based on GDP elasticity of steel demand, limits to growth in steel demand can, in fact, be laid down by estimating steel demand with respect to related growth in sector level macro-economic indicators such as GFCF and IIP. In other words, the structure of the economy and relative rates of growth in its different segments are as important in determining the associated growth in demand for steel as the adopted GDP growth rate.

3.1.4 For making the demand projections, a major constraint faced was the absence of the New Time Series Data (based on 2004-05 prices) for the period prior to 2004-05 especially for important macro-economic variables such as GFCF and IIP.

3.1.5 Even for GDP, the time-series data (1991-2011) received from CSO are provisional. Therefore while the projections based on GFCF and IIP utilize short term seven years' data series (i.e. from 2004-05 to 2010-11), the projections based on GDP are based both on short term (2004-05 to 2010-11) time series data as well as on longer time series data i.e. from 1991-92 to 2010-11.

3.1.6 While projections based on a shorter period may have statistical limitations, the shorter run elasticity (arc elasticity to approximate point elasticity) may help in capturing the latest trend in the correlation of selected variables. Accordingly, based on different projections of selected macro variables, a scenario based analysis for steel demand forecast during 12th Plan has been attempted as detailed below:-

3.2.0 Assumptions and Results

3.2.1 Assumptions:

3.2.1.1 The approach paper of the 12th Plan period has envisaged a GDP growth of 9% to 9.5%. However, due to reasons mentioned in Chapter-2, the Working Group felt that it will be appropriate to attempt a sensitivity analysis based on not only GDP growth of 9% and 9.5% but also for lower GDP growth rates of 8% and 8.5% respectively. Accordingly, demand projections have been made for four different Scenarios viz. Scenario – I i.e. with a GDP growth of 8.0%, Scenario – II i.e. with a GDP growth of 8.5% and Scenario – III i.e. with a GDP growth of 9.0%. and Scenario – IV i.e. with a GDP growth of 9.5%.

3.2.1.2 The movements in other macro indicators such as Gross Fixed Capital Formation (GFCF) and Index for Industrial Production (IIP) used for forecasting finished steel demand have been linked to the GDP growth rate for the four scenarios cited above. The associated growth rates of IIP and GFCF have been calculated on the basis of their respective coefficients of elasticity vis-à-vis real GDP estimated on the basis of regression equation of the double log type using a data base spanning the period from 2004-05 to 2010-11.

3.2.2 Results:

3.2.2.1 **Table – 3.2** below summarizes the elasticity of steel demand with respect to three main explanatory variables as well as the elasticity of the explanatory variables with respect to GDP.

Table – 3.2

Elasticity of Steel Demand with respect to major Macro Variables (Based on Time Series Data from 2004-05 to 2010-11)

	Estimates of Elasticity of	
Explanatory Variables	Steel Demand with respect to Explanatory Variables	Explanatory Variables with respect to GDP
GDP	1.14	-
GFCF	0.96	0.97
IIP	0.89	1.08

3.2.2.2 As mentioned earlier since the provisional longer time series data for GDP (2004-05 prices) was made available to Working Group by CSO, the regression exercise was run for longer series and the following results were obtained:
GDP Elasticity of Steel Demand = 1.14 (R^2 = 0.99, t = 24.18, S.E = 0.048)

The demand equations for finished steel (after due corrections for serial auto correlation) have been obtained on the basis of the time series and is used to forecast year-wise break-up (given the projected value of the explanatory variables) during the 12th Plan as given in **Table – 3.3** below:-

Table – 3.3

Year-wise Forecast of Domestic Demand for Carbon Steel for 12th Plan (2012-17)

(Million Tonne)

Sl. No	Year	Scenario I (GDP @ 8%) Explanatory Variables			Scenario II (GDP @ 8.5%) Explanatory Variables			Scenario III (GDP @ 9.0%) Explanatory Variables			Scenario IV (GDP @ 9.5%) Explanatory Variables		
		GDP	GFCF	IIP	GDP	GFCF	IIP	GDP	GFCF	IIP	GDP	GFCF	IIP
1	2012-13	72.6	71.4	71.6	72.9	71.7	71.9	73.3	72.1	72.2	73.7	72.4	72.6
2	2013-14	79.2	76.8	77.1	80.0	77.4	77.8	80.8	78.1	78.5	81.7	78.8	79.2
3	2014-15	86.4	82.5	83.0	87.7	83.6	84.2	89.1	84.6	85.3	90.5	85.7	86.4
4	2015-16	94.3	88.6	89.4	96.3	90.2	91.0	98.3	91.7	92.7	100.3	93.3	94.3
5	2016-17	102.9	95.2	96.3	105.6	97.3	98.5	108.3	99.4	100.7	111.2	101.6	102.9

3.3.0 Selection of Base Case for Demand Estimate for 12th Plan (based on the Scenario Analysis):

3.3.1 The implied rates of growth in steel consumption under the three scenarios by taking GDP as explanatory variables are given in the **Table – 3.4** below:

Table – 3.4

		Growth in GDP	Implied Growth in Steel Consumption (based on elasticity of 1.14)
1.	Scenario-I	8.0%	9.1%
2.	Scenario-II	8.5%	9.7%
3.	**Scenario-III**	**9.0%**	**10.3%**
4.	Scenario-IV	9.5%	10.8%

3.3.2 It is proposed to adopt a growth rate of 10.3% in steel consumption as the 'Base Case' (based on GDP growth of 9%) i.e. Scenario-III as envisaged in the 'Approach Paper for 12th Plan' of the Planning Commission.

3.4.0 Total Steel Demand and Required Level of Finished Steel Production:

3.4.1 The World Steel Association, which has been monitoring production, consumption, etc of steel industry in each country since the 1980's, also projects short-range outlook for steel at regular intervals. These projections are inclusive of demand for alloys and stainless steel and take into account contemporary developments affecting steel demand. A look at the data provided by JPC shows that the consumption of alloys and stainless steel has been hovering between 3 and 3.5mt over the past few years. For projecting total demand by the end of the 12th Five Year Plan, the Working Group decided to add 5 Million Tonnes of alloy and stainless steel (phased progressively year-wise over the entire period) to the demand for finished carbon steel projected for the terminal year 2016-17. Accordingly, based on projected growth of 10.3% in carbon steel consumption, the total demand of finished steel in the country has been estimated under two Scenarios and the same is presented in **Table 3.5.**

Scenario 1: assuming zero trade balance in steel i.e. imports and exports of steel in volume terms balance each other.

Scenario 2: including an export demand of 7 million tonnes (net export of 2.0 MMT) by end of 12th Plan or 2016-17.

Table – 3.5

Total Steel Demand and Required Level of Finished Steel Production (Alloy & Non-Alloy) For the 12th Plan (2012-17) (Year-Wise Break-Up)

(Figures in million tonnes)

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Domestic Demand for Carbon Steel	66.5	**73.3**	**80.8**	**89.1**	**98.3**	**108.3**
Domestic Demand for Alloy Steel	3.50	**4.00**	**4.25**	**4.50**	**4.75**	**5.00**
Scenario 1: Total Domestic Demand for Steel	70.0	**77.3**	**85.05**	**93.6**	**103.05**	**113.3**
Scenario 2: Total Demand for Steel including Export Demand	66.3	**75.3**	**84.6**	**94.1**	**105.1**	**115.3**
Imports (estimated)	7.0	**6.0**	**5.5**	**5.5**	**5.0**	**5.0**
Exports (estimated)	3.3	**4.0**	**5.0**	**6.0**	**7.0**	**7.0**
Net Exports	(-)3.7	**(-) 2.0**	**(-) 0.5**	**0.5**	**2.0**	**2.0**

Note: Consumption is net of double counting.

3.5.0 Requirement of Crude Steel Production and Crude Steel Capacity to meet domestic and export demand of finished steel during 12th Plan.

3.5.1 Based on a conversion rate of 90% from crude steel to finished steel and an average capacity utilization rate of 90%, the total required installed steel capacity for 12th Plan has been worked out for steel demand (year-wise) under the two different scenarios specified above. The results are given in Table 3.6 below:-

Table – 3.6

Year-wise Requirement of Crude Steel Production and Capacity for the 12th Plan

(in million tonnes)

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Scenario 1:						
Demand for finished steel	66.5	77.3	**85.05**	**93.6**	**103.5**	**113.3**
Production of Crude Steel	73.7	**85.9**	**94.5**	**104.0**	**114.5**	**125.9**
Crude Steel Capacity	81.9	**95.4**	**105**	**115.6**	**127.2**	**139.9**
Scenario 2:						
Demand for finished steel	66.5	**75.3**	**84.6**	**94.1**	**105.1**	**115.3**
Production of Crude Steel	73.7	**83.7**	**94.0**	**104.6**	**116.8**	**128.1**
Crude Steel Capacity	81.9	**93.0**	**104.4**	**116.2**	**129.8**	**142.3**

3.5.2 As per JPC data, the total installed capacity for crude steel in the country was 78 million tonnes during 2011 and therefore the incremental capacity required by the terminal year of 12th plan (i.e. by 2016-17) to meet the projected demand is

61.9 under scenario 1 and 64.3 million tonnes under scenario 2, respectively, implying an annual average increase of around 10 - 11 million tonnes in capacity.

3.5.3 As far as future growth in capacity is concerned, if it is assumed that crude steel capacity will continue to grow at the historical rate of 8.4% annually as actually achieved in the post-deregulation period, then crude steel capacity will grow to 133 million tonnes by 2016-17. Most importantly, in that case, India will continue to remain a net importer of steel in the 12th Plan period.

3.5.4 However, a growing economy like India cannot afford to plan for lower capacity, especially when there exist significant opportunities to add to per capita consumption of steel. Therefore, this report projects a likely capacity of around 140 million tonnes driven by a demand growth of 10.3% per annum as opposed to the assumptions of Business As Usual (BAU) supply-side growth of 133 million tonnes by 2016-17.

3.5.4 With appropriate policy interventions by the government and discipline in project implementation, the industry has the further potential to achieve a crude steel capacity of 140 – 150 million tonnes by 2016-17 enabling India to become a 'net exporter of steel'.

3.6.0 Likely Supply of Crude Steel by Terminal Year of 12th Plan (2016-17)

3.6.1 Based on available information, the year-wise crude steel capacity build up from 2011-12 to 2016-17 are estimated and given in **Table 3.7**. While a large number of steel projects have been listed by the existing/prospective investors which as per their assessment are likely to come on stream by 2016-17, a realistic assessment on supply side has been made based on the following factors:

a) Actual extent of land already acquired

b) Availability of investible funds with respective companies to support the planned increase in existing capacity

c) Availability of infrastructural network at the project sites and

d) Raw material linkages

Table - 3.7

Projected Crude Steel Capacity Year-Wise till Terminal Year of the 12th Plan

	State	**2010-11**	**2011-12**	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
SAIL		12.84	13	15.27	20.75	20.75	20.75	20.75
Vizag Steel Plant (RINL)	Andhra Pradesh	2.82	2.82	6	6	7	7	7
NMDC Nagarnar	Chhattisgarh					2	3	3
Tata Steel, Jamshedpur	Jharkhand	6.8	7.62	9.22	10	10	10	10
Tata Steel, Kalinganagar	Orissa				1	3.05	5.5	6
JSW Vijayanagar	Karnataka	6.8	8.93	10	10	10	12	12
ESSAR Steel	Gujarat	4.6	6.3	8.5	8.5	9	10	10
JSPL Raigarh	Chhattisgarh	2.4	3	3	3.5	4	4	4
JSPL Angul	Orissa			1.5	2	2	3	4
ElectroSteel Steel Limited, Siyaljori Bokaro	Jharkhand			1.7	2.2	2.2	2.2	2.2
Bhushan Steel Limited Angul-Dhenkanal	Orissa	1.5	2.3	2.3	4	5.2	5.2	5.2
Jindal Stainless	Orissa			0.6	0.8	0.8	0.8	0.8
Others	Multi-Location	32.5	34.13	35.83	37.91	39.79	41.77	43.85
Tata Steel Gopalpur	***Orissa***					***2***	***2***	***4***
JSW SALEM	Tamil Nadu	1	1	1	1	1	**1.6**	**1.9**
JSW ISPAT	Maharashtra	3.3	3.3	3.3	3.3	3.3	**4**	**4.5**
JSPL Pattratu	Chhattisgarh				1.5	2	**3**	**3.5**
POSCO INDIA	**Orissa**							4
Bhushan Power & Steel, Sambalpur	Orissa	1.2	1.8	**2.5**	**2.5**	**2.5**	**2.5**	**2.5**
Uttam Galva	Maharashtra						**0.8**	**1.1**
Monnet Isapat, Raigarh	Chhattisgarh	0.3	0.6	0.9	1.5	1.5	1.5	1.5
Visa Steel, Kalinganagar	Orissa	0.5	0.5	0.9	**1.5**	**1.5**	**1.5**	**1.5**
Others- Medium Scale (Jai Balaji, Kalyani, Mukand, MSPL, Brhamini etc)	Multi-Location	1.5	2	2.5	2.5	4	4	4.5
Total (Firm Projcets)		**78.06**	**89.00**	**103.80**	**117.56**	**126.19**	**135.52**	**140.00**
Additional Capacity not firm but possible		**0.00**	**0.00**	**1.71**	**2.90**	**6.40**	**10.10**	**17.60**
Realizable Capacity considering Possible Slippages		**78.06**	**89.00**	**104.66**	**119.01**	**129.39**	**140.57**	**149.00**

Note: Expansions shown in shaded region are not firm and therfore Realizable capacity has been caculated as - Realizable Capacity=Capacity from Firm Projects + Additional Capacity from Not firm Projects*0.5

3.6.2 Enabling Conditions to achieve the projected level of Steel Supplies

3.6.2.1 On the basis of factors mentioned above, the Working Group has estimated that likely crude steel capacity in the country by the terminal year of 12th FYP (2016-17) will be 149 million tonnes. Comparison of **Tables - 3.5 & 3.7** on crude steel requirement and build up of crude steel capacities suggests that if the implementation of firm projects is on expected lines, the country will be able to meet its domestic demand comfortably. However, for expeditious implementation of the identified projects, it is necessary to create a conducive policy environment to ensure easy availability of physical and financial resources such as raw materials, infrastructural facilities, land, water etc.

3.6.3 Raw Materials

3.6.3.1 Iron Ore is the basic raw material used in steel making. Though iron ore is abundantly available in the country, large scale exports of iron ore have raised serious concerns about future availability of iron ore resources to meet fast rising domestic steel demand. One of the major reasons for export of large quantities of fines has been the mismatch between domestic production and consumption of iron ore fines. The sintering and pelletisation capacity in the country is not adequate to make full use of fines.

3.6.3.2 Another area of concern has been the gradual depletion of high grade ore deposits and lack of domestic technological capabilities to process low-grade iron ores. Going forward in the 12th plan, one of the major challenges is to beneficiate these low grade ores to improve their iron content and to achieve this goal with reasonably high yields.

3.6.3.3 At present export of iron ore is being discouraged through higher tariff levels. It is essential to continue with this policy and if required the tax rates may further be jacked up. At the same time, there is a need to closely monitor the export of iron ore to make sure that higher tariffs alone can effectively tackle the issue of conservation of resources for domestic use. Additional measures such as higher freight rate on export cargo, increase in inland freight rate etc. and other administrative measures may also be considered.

3.6.3.4 Coking Coal is another critical raw material required by the industry. Indigenous availability of appropriate qualities of coking coal is limited and the Industry has to depend heavily on imported coking coal to meet its requirements. The quantum of imports may go up significantly in 12th plan as a large number of listed projects are likely to adopt BF-BOF route of production. To ensure raw material security and minimize the impact of volatility in coal prices, it is desirable to acquire overseas coking coal assets. While a mechanism in the form of International Coal ventures Limited (ICVL) has been put in place to achieve the above mentioned objective, there is a need to examine various constraints with the aim of increasing the effectiveness of the existing mechanism.

3.6.3.5 At the same time there is a need to strengthen the existing port and rail infrastructure to facilitate the high level of import of coking coal anticipated during the 12th Plan. Coal India Ltd. (CIL) and the private sector should be encouraged

(i) to step up investments to develop indigenous coking coal blocks (ii) to set up coal blending facilities near ports/pithead for mixing imported coal with lower ash and domestic coal with higher ash content.

3.6.3.6 Non-coking coal used by sponge iron producers is also increasingly becoming scarce in the country. Rising Demand for non-coking coal from priority sectors such as power, fertilizer etc. may further limit the availability of this critical input in the 12th plan. While the sponge iron producers may opt for import of coal, the economic viability of the sector may be under pressure due to higher prices of imported coal.

3.6.4 Infrastructure Development

3.6.4.1 The growth of steel industry and capacity creation is highly dependent on the growth of infrastructure. Steel Industry is a major consumer of infrastructural facilities especially for rails, road, power and ports. While the demand for infrastructural facilities will increase manifold in the 12th plan, the already overburdened infrastructure in India and more particularly in mineral rich states is a matter of great concern. The transaction costs associated with these infrastructural constraints result in significant loss of competitive edge and intentions of steel expansions can remain on paper if urgent steps are not taken to improve the present status of infrastructure. Chinese Steel Industry has been able to grow exponentially and remain competitive on the back of strong infrastructure facilities.

3.6.4.2 During the 12th plan, emphasis should be laid on specific needs of the steel industry especially with regard to road/rail connectivity from ports/highways to the plant site. While the 12th plan envisages investment of 1 trillion dollars in the infrastructure, there is a need to focus on implementation of infrastructural projects as the past performance leaves significant scope for improvement.

3.6.5 Financial Resources

3.6.5.1 The requirement of financial resources to create an additional capacity of around 60 million tonnes will be approximately Rs. 2.5 lakh crores during the 12th plan. Availability of such large quantum of investible funds at reasonable costs will be a challenging task. In order to ensure sufficient availability of financial resources for the growth of Indian steel industry, it is imperative to review steel related sectoral caps of the banking sector. Government may also consider easing of norms connected with external borrowings (ECBs). FDI in the steel sector has been lagging behind, despite massive investment intentions by some major global steel majors. Special purpose long term financing facility may be created to finance huge investment in new steel plants.

3.6.6 Technological and R&D Inputs

3.6.6.1 While readymade technological solutions for steel making are available in the form of imported technology/equipments, there is a need to develop appropriate domestic technologies which are compatible with the resource endowment of the country. Development of indigenous technologies will also help in reducing capital costs and dependence on imported raw materials which in turn may greatly enhance the competitive position of domestic steel industry. Further, to ensure adequate availability of raw materials for upcoming projects aggressive efforts are required in areas such as beneficiation of low grade iron ore and high ash coal.

3.6.6.2 There is an urgent need to step up existing level of R&D expenditure to: a) bridge the efficiency gaps; b) develop indigenous technologies and c) design & fabricate important equipment related to steel production. There is also a mismatch between skill requirement of steel industry and availability of the same from educational/training institutions. For the 12th plan focus is required to impart training in handling of latest mining equipments and skill development for areas like mining operations, equipment handling, port handling etc. would be required to be expanded. These issues are being dealt in detail in Chapter VI.

3.7.0 Category-Wise Projections of Steel Demand

3.7.1 As steel demand emanates from the various end using segments, category wise estimates of steel demand is best related to the activity levels in segments that account for a major share of consumption of steel in that category. Sectoral growth for instance, in construction, automobile, railway transport, transportation of oil & gas, ship building, capital goods (heavy machinery equipments), consumer durables, agricultural equipments, etc. would by and large account for a significant portion of steel consumption. Although some of the principal end-using sectors have brought out vision statement / corporate plan their growth potential in the next 5-10 years, actualization of these rates in the coming period would depend primarily on –

- Investment in Economic Infrastructure
- Per Capita Income Growth
- Rate of Inflation and associated fiscal and monetary measures
- Rate of urbanization and unlocking of rural market potential
- Global Market Scenario

3.7.2.1 Non-availability of data on actual steel consumption by various sectors has severely restricted the application of econometric modeling under disaggregated methodology for correlating category-wise steel consumption with the growth of end using segments. On an overall basis, consumption of different categories of steel can be allocated amongst a broad array of end-using sectors that account for the largest shares in the consumption of each steel product. Using the estimated relationship between category-wise consumption of steel and activity levels in the principal consuming sectors, future demand for each category of steel can be projected on the basis of anticipated growth of the consuming sectors captured by an appropriate macro-economic variable over the selected time horizon.

3.7.3 The growth of various industry groups under each broadly defined consuming sector is also indicative of the growth trend to be projected. An illustrative list (not exhaustive) of a few major industry groups along with the growth rates achieved in the recent past is shown under **Table – 3.8.**

Table – 3.8

Recent Growth Rates of Production of Selected Steel Consuming Industry Groups: 2008-09 to 2010-11

Item Group	Steel Products used	Growth rates (%)		
		2008-09	2009-10	2010-11
LPG Cylinder	HRC	5.7	55.0	13.9
Drums & Barrels	CR	(-)21.4	42.7	(-)2.5
Complete Tractors	HRC/ Strls.	(-)0.4	26.3	23.9
Refrigerators	CR	3.1	25.8	9.8
Power Transformers	CRGO	(-)1.9	16.5	13.4
Commercial Vehicles	CR/Plate	(-)23.6	36.0	32.8
Passenger Cars	HR/CR/ Plate	6.7	26.0	28.4
Auto Ancillaries & Parts	HR/CR			25.0
Motor Cycles	CR	4.6	24.2	24.7
Agricultural Implements	HR/Plate	(-) 26.6	(-) 11.1	(-)28.2
Material Handling Equipment	Plate/ HRS/ Strls.	(-)3.5	22.9	(-)8.4
Washing Machines	HR / CR	8.1	26.4	(-)0.8
Diesel Engines	HR/ Plate / Strls.	18.8	5.3	11.2

Source: Ministry of Commerce & Industry

3.7.4 The annual average growth rate of each category has been calculated using the category wise consumption of steel data compiled by JPC during 2006-07 to 2010-11, (Refer **Chapter-1, Table – 1.10**). The category wise demand estimates are based on the past growth rate of a given steel product and that of the major explanatory variable accounting for the largest share in consumption of that product along with expected future investment, additions of fresh capacity etc., in that sector. Further, it may be mentioned that growth rates in major steel consuming sectors adopted for projection of demand for the related steel products may not be uniform across categories and may be conditioned by other factors impacting the level and growth of consumption of particular steel category. Consumption of HR and CR has been duly adjusted for double counting, the quantum of which has come down substantially in the recent period with the setting up of backward integration facilities by a number of units. However, keeping in view future developments in the Cold Reducing sector, we may assume an average level of 2.0 Million Tonnes per annum as possible double counting of HR in its aggregate consumption. It is possible to predict the growth trend of each of the major sectors based on its relationship with related macro variables. The 4^{th} column of the **Annexure-3.1** indicates revision, if any in the predicted growth rates of each category of steel in view of assessment of the growth rates of the relevant sectoral explanatory variable and specific observations placed in the 5^{th} column of **Annexure-3.1.** Detailed reasons for revision of category-wise growth rates are elaborated below.

3.7.4.1 Bars / Rods, Structurals, Railway Materials

Bars & Rods: Construction sector in India has achieved 11% growth in 2006-07 and 2007-08 even though growth rates slowed down subsequently after the onset of the global economic melt-down. In reflection of these developments, consumption of bars and rods is seen to have grown by more than 8% during 2006-07 and 2007-08 while in each of the next two fiscals (i.e., 2008-09 and 2009-10) growth slowed down to around 5%. Consumption of bars & rods, however, picked up considerably during 2010-11 registering a growth of 13.1%. Overall, even though consumption of bars & rods grew somewhat tardily in the two post-crisis years, the rate of growth has remained positive throughout the last five years. As creation of infrastructure has been accorded top priority in the12^{th} Plan with an anticipated investment of more than US $ 1 trillion, it is likely that construction of physical infrastructure such as airports, flyovers, bridges, ports, etc., along with industrial complexes would get a boost - thereby accelerating growth in consumption of bars & rods. Taking these factors into consideration, a growth rate of 10% has been adopted for projecting demand for bars and rods during the 12^{th} Plan.

Structurals: On the other hand, consumption of structurals, also linked with the construction sector, has seen fluctuating growth rates in the last 5 years. In 2009-10 consumption of structurals recorded a negative growth of more than 21%, only to be followed by a very steep increase of around 34% in 2010-11. Consumption of structurals is currently facing competition from pre-fabricated structures – a segment growing at a very fast clip. At the same time, despite the competitive pressures, a number of new structural mills (i.e., medium structural mill at DSP, universal beam mill at ISP, etc.) are expected to come on stream in the near future to cater to the growing demand for structurals, particularly in high rise construction. Keeping these conflicting developments in view, a marginally lower CAGR of 9.5% as compared to bars & rods has been adopted for forecasting demand for structurals (same as that observed in 2006-07).

Railway materials: In case of railway materials, it is seen from available records that railway procurement of wagons has come down steeply over the past few years. The dedicated freight corridor projects are expected to commence in right earnest by 2012-13, which would enhance consumption of rails substantially in the 12^{th} plan period. In 2010-11 railway materials registered a growth of more than 11% while it declined by 17% in 2009-10 and grew by 10% in 2008-09. Keeping these wide variations in growth rates in view as also the prospects of higher rail consumption due to thrust on railway connectivity and movement of rail transport, an annual average growth of 5% has been assumed (same as observed in 2006-07) for purposes of demand projection of railway materials during the 12^{th} Plan.

3.7.4.2 Plate, HR Coils, Pipes

Plate consumption went up by 22% and 24% in 2006-07 and 2007-08, respectively. Subsequently, the growth rates came down steeply due to tardy growth in ship building activity and delayed commencement of power projects - both Thermal and Hydel. However, oil and gas sector is poised for high growth because of which demand for API plates is increasing. Also pre-fabricated structural segment is exhibiting good growth potential. Taking into account all these factors, an annual average growth rate of 7.5% has been adopted for projecting future consumption of plates (against 6% observed in the past). Consumption of HR coils has grown by 7.5% annually in the past 6 years driven primarily by a 9.7% growth in Manufacturing IIP. The Government has come out with a new Manufacturing Policy aimed at creating conditions necessary to enable India's manufacturing sector to enhance its share in GDP from the current 16% to 25% and to achieve a growth of 11 – 12% in the coming years. Keeping these initiatives in view, a marginally higher growth rate of 9% has been assumed as against the observed growth rate of 7.5% in the past 5 years. Consumption of pipes went up by 32% in 2010-11. Prior to this quantum increase in the course of a single year, consumption of pipes declined by 15% in 2009-10 after growing by 15% and 14% in the two preceding years of 2007-08 and 2008-09, respectively. Oil & gas sector is the major user of pipes which is growing at an average rate of 15 – 18 %. Keeping in view the massive potential in oil & gas sector, an annual average growth rate of 12% has been adopted for projecting the demand for pipes over the 12th Plan period.

3.7.4.3 Cold Rolled Sheet / coils, Electrical Steel Sheet, tin Plates

Past growth rates have been extrapolated.

3.7.5.1 For projection purposes, the results based on GDP elasticity have been taken as the final estimate of the total (aggregate) demand for finished steel. Minor adjustments have been made to the category-wise projections based on the adopted growth rates to align the category totals to the estimates arrived at by the aggregative approach. The final demand-scenario in the country by 2016-17 is placed in **Table – 3.9**.

Table – 3.9

Summary of Demand Supply Projections (Alloy & Non-Alloy)

(Unit: Million Tonnes)

S.No.	Item	2010-11	2016-17
1.	Demand for Carbon Steel	62.14	108.3
2.	Demand for Alloy/Stainless Steel	3.47	5.0
3.	Total Domestic Demand for Steel	65.61	113.3
4.	Net Export	(-)3.34	0.0
5.	Production (net of double counting)	62.27	115.3
6.	Category-Wise Consumption (Carbon Steel)		
	Bars & Rods	24.44	43.6
	Structurals	5.62	9.3
	Rly. Materials	1.1	1.4
	Total Long Products	31.16	54.3
	Plates	4.76	7.2
	HR Coils/Skelp/Sheet (excl. double counting)	13.07	22.6
	CR coils/sheets (excl. double counting)	6.00	11.2
	GP/GC	4.74	8.8
	Electrical Sheets	0.49	0.8
	Tin Plate/TFS	0.40	0.60
	Pipes	1.54	2.80
	Total Flat Products	30.99	54.0
	Total Carbon Steel	62.14	108.3
7.	Total Requirement of crude steel	-	139.9
8.	Likely Capacity of Crude Steel	78.0	140.0

CHAPTER - IV

RAW MATERIAL ISSUES

4.1.0 Introduction

4.1.1 Raw materials are crucial in determining the competitive growth of any industry. This is more so for an input-intensive extractive industry like steel. Requirement of major raw materials in the steel industry is determined not only by the rate of growth in output but also by the technology adopted for making the required steel. Choice of technology, in its turn, is influenced by the relative costs of raw materials, energy, labour, capital and more specifically by the entire logistics of movement of raw materials and finished products. But at another level, for obtaining access to basic raw material linkages, especially of iron ore and coal, the industry also has to depend on potential intervention by the state and consensus building within the larger social space.

4.1.2 There is an urgent need to address problems of degradation of environment, displaced population and of developing transportation network. These issues are bound to impact indigenous availability, cost of production and usage pattern of all steel making raw materials. Choice of technology and investments in such a scenario will not only be a function of private costs and benefits but will also be influenced by the manner in which availability and cost of raw materials are impacted by the larger framework of social and economic planning aimed at minimization of social costs and maximization of social welfare in the long run.

4.1.3 The current chapter covers status and projections of demand and supply of the principal raw materials and processed inputs for the Indian steel industry. It also discusses the development needs and suggests policy measures to increase availability of the scarce raw materials and conserve finite indigenous resources for future value addition. A summary of projected requirement of major raw materials during the 12th Plan is placed at **Table 4.1**.

Table 4.1

Raw materials Requirement for Projected Iron and Steel Production (Base Case)

(Million Tonnes)

	2011-12	**2012-13**	**2013-14**	**2014-15**	**2015-16**	**2016-17**
Crude Steel production	73.70	85.90	94.50	104.00	114.50	125.90
Pig Iron for sale	6.13	6.88	7.66	8.54	9.38	10.00
Iron Ore	115.03	135.70	149.43	166.66	185.24	206.18
Coking Coal	43.25	52.29	57.91	67.49	77.23	90.16
Non-Coking Coal (for Sponge Iron Sector)	35.31	37.86	36.50	34.71	33.92	28.41
PCI Coal	1.95	2.40	2.66	3.20	3.83	4.54
Manganese Ore	4.03	4.53	4.98	5.57	6.18	6.82
Chromite	2.64	2.90	3.19	3.52	3.93	4.31
Ferro Chrome	0.56	0.61	0.67	0.74	0.84	0.92
Ferro-Manganese	0.46	0.51	0.57	0.64	0.70	0.74
Silico manganese	1.26	1.42	1.56	1.74	1.94	2.16
Ferro Silicon	0.23	0.26	0.28	0.31	0.34	0.38
Refractories		1.29	1.42	1.56	1.72	1.89

4.2.0 Iron Ore

4.2.1 Iron ore remains the most crucial driving force for the steel industry in India and the industry's growth so far can largely be attributed to the domestic availability of low cost and high quality iron ore.

4.2.2 (a) Iron Ore Reserves

4.2.2.1 According to the UN Framework Classification (UNFC) iron ore resources of the country, as on 1.4.2010, are 28.526 billion tonnes, of which 17.882 billion tonnes are haematite resources and 10.644 billion tonnes are magnetite resources.

4.2.2.2 Grade-wise break-up of domestic iron ore resources and mineable reserves are shown below (**Table – 4.2**):

Table – 4.2

Resources and Reserves of Iron Ore in India as on 1.4.2010

(Million Tonnes)

Grade	Reserves	Remaining Resources	Total Resources as on 1.4.2010
Haematite	8093.5	9788.6	17882.1
Magnetite	21.8	10622.3	10644.1
Total	8115.3	20410.9	28526.2

(Source: Indian Bureau of Mines, Ministry of Mines)

4.2.2.3 The states of Odisha and Karnataka, respectively, accounted for 36% and 20% of the total production of ore in India during the third year of the 11th plan (**Annexure-4.1**). Presently, most of the magnetite resources are not available for mining, as these are located in the ecologically sensitive Western Ghat region, where mining is banned on the orders of Hon'ble Supreme Court. Impact of the ban has been limited so far as the domestic steel industry is primarily based on hematite iron ore. With depleting high grade hematite iron ore resources, however, exploitation of these magnetite resources may become necessary to sustain the growth of the domestic steel industry in the long run.

4.2.2.4 The current estimates of iron ore resources presented in **Table 4.2** above are likely to be further augmented for the following reasons:

- Introduction of a new threshold of 45% Fe for haematite ores in place of the earlier norm of 55% Fe, which mandates that lower grade ore should be used;
- Emergence of Banded Iron Formations (BIF), hitherto considered as wastes, as important sources of iron ore with the adoption of suitable processing technology;

- Detailed exploration of the iron ore bearing areas.

4.2.3 Iron Ore Production and Consumption

4.2.3.1 India's iron ore production grew at a CAGR of 6.5% in the first 3 years of the 11th Plan and touched 219 million Tonnes in 2009-10 – up from a level of 188 million Tonnes in 2006-07 as shown in **Table – 4.3**. Production during 2010-11, however, is estimated to have fallen by 10.5 million Tonnes to 208.11 million Tonnes.

4.2.3.2 Domestic consumption of iron ore in India, on the other hand, increased from 78.6 million Tonnes in 2006-07 to 90.62 million Tonnes in 2009-10 and further to an estimated 111 million Tonnes in 2010-11. This translates into an average annual growth of 9.0% in the first 4 years of the 11th Plan **(Table – 4.3).**

4.2.3.3 Exports accounted for around 50% of the cumulative production of iron ore in India between 2006-07 and 2010-11. The export ratio peaked at 53.7% in 2009-10 and was the lowest at 46.9% in the following year i.e., 2010-11 **(Table – 4.3**).

Table – 4.3

Production/ Export/ Import /Domestic Consumption of Iron Ore

(million tonnes)

Year	Production	Export	Import	Domestic Consumption
2006-07	180.92	93.79	0.489	78.6
2007-08	213.25	104.27	0.293	85.28
2008-09	212.96	105.87	0.69	87.41
2009-10 (Prov.)	218.63	117.37	0.897	90.62
2010-11 (Est.)	208.11	97.66	-	111@

Source: For Production & Consumption: IBM (Ministry of Mines);
For Export: MMTC (Department of Commerce).
@ Estimated by the Ministry of Steel

4.2.3.4 The last few years have also witnessed a rise in the production of iron ore in the private sector mines **(Table – 4.4)**. Between 2006-07 and 2009-10 production of iron ore in the private sector has increased from 124.937 million Tonnes to 159.387 million Tonnes - an increase of 27.5% in 3 years. On the other hand, during the same time period iron ore production by the public sector mining companies has declined by 5.6% to 59.25 million Tonnes from 62.76 million Tonnes.

Table – 4.4

Production of Iron Ore (2006-07 to 2010-11)

(Million Tonnes)

Year	Public	Private	Total
2006-07	62.759	124.937	**187.696**
2007-08	66.518	146.728	**213.246**
2008-09	64.746	148.214	**212.960**
2009-10 (P)	59.252	159.387	**218.639**
2010-11 (Est.)	-	-	**208.11**

(P): Provisional *Note: Figures rounded off.*

Source: Indian Bureau of Mines

4.2.3.5 Another development is that the lumps & fines ratio in iron ore produced has changed from 48:52 in the terminal year of the 10th Plan (2006-07) to 42:58 in the year 2009-10, signifying increasing trend in the generation of fines in the production.

4.2.4 Assessment of Iron Ore Demand during 12th Five Year Plan Period

4.2.4.1 About 98 per cent of the iron ore globally is estimated to be consumed in the production of iron and steel. Assuming this to be also true for India, domestic demand (as opposed to export possibilities) for iron ore during the 12th Plan is projected on the basis of anticipated production of iron and steel (including processed and value-added iron-based inputs) within the country. Therefore, the estimates hold good for the iron and steel industry only.

4.2.4.2 In the Base Case Scenario, production of crude steel is being projected to increase to 125.9 Million Tonnes by the terminal year of the 12th Five year plan (2016-17). In addition, the country will produce pig iron on stand-alone basis largely for use in the foundries. Pig iron production on merchant basis is likely to increase to 10 Million Tonnes by the terminal year of the Plan. Total iron ore consumption within the country will depend on the total of crude steel production, pig iron for merchant sales and pellets for exports. Export of pellets has been assumed at the current approximate level of a million tonne per year, in the absence of any specific industry projection. The projections are as below. (**Table – 4.5**)

Table – 4.5

Estimation of Demand for Iron Ore during 12th FY Plan Period

(Million Tonnes)

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Crude Steel Production	73.7	**85.9**	**94.5**	**104.0**	**114.5**	**125.9**
Pig Iron Production	6.1	6.9	7.7	8.5	9.4	10.0
Total Iron Ore Requirement	115.0	135.7	149.4	166.7	185.2	206.2

Source: Estimated on the basis of projections of crude steel and pig iron production during 12th Plan.
Note: The estimates are based on the assumed technology mix in steel production, standard input-output norms and transit and handling losses of raw materials in the process.

4.2.5 Export and Import of Iron Ore

4.2.5.1 Export of Iron Ore increased from 93.79 million tonnes in 2006-07 to a peak level of 117. 37 Million Tonnes in 2009-10. Exports from India, however, have fallen to 97.66 Million Tonnes in 2010-11. About 90 per cent of India's iron ore exports are to China.

4.2.5.2 During 2010-11, export of iron ore declined mainly due to the ban on exports by Karnataka and the fiscal measures taken by the Central Government for restricting export of iron ore from the country.

4.2.5.3 Import of iron ore remains marginal and has increased from 0.49 million tonnes in 2006-07 to 0.89 million tonnes in 2009-10. (**Table - 4.3 above**)

4.2.5.4 Adequate iron ore supply from domestic sources at competitive prices is critical for realization of the potential growth of the steel industry in the country. The main concern of the Indian steel industry is to sustain the domestic iron ore advantage well into the future for continuing global competitiveness. If resource security has to be provided to intended investments in steel capacity, actions for conservation of resources are required to be taken right now. The high export demand in the past several years has driven up the production base in the country, leading to an output level far above domestic demand. Government has taken several important initiatives to discourage excessive mining to satisfy growing export market. These have so far included imposition of fiscal measures such as export duty, increasing railway freight for exports, etc.

4.2.5.5 Export of iron ore will have to be reduced in an orderly and phased manner so that the mining industry gets a breathing space to reorganize its business model. Actions should also be oriented towards planned development of mining capacity in a manner such that there is no compulsion to export surplus output. While the government has encouraged the growth of the pelletizing industry, there will be a need also to monitor their exports, as iron ore may find way to the international market through this route indirectly.

4.2.5.6 With export restricting policies on iron ore and a potential fall in demand for Indian origin iron ore in China, iron ore production capacity will have to be augmented with sufficient caution to avoid over supply as diversion of export volumes to the domestic market is expected to take care of a large share of the incremental domestic demand within the country. At the same time, it should be noted that iron ore capacity enhancement projects take a long time to complete. Although, capacity is likely to be enhanced over the 12th plan period with the opening of new mines, actual supply to the market will depend on new capacities created in the non-captive segment, adequacy of infrastructure to handle movement of these ores, evolving situations related to legal restrictions on mining and movement of the ore and export potential.

4.2.5.7 Iron ore prices are totally free from government restrictions and are determined by the market forces of demand and supply and individual consumer's tie-up for supply with the iron ore producers. Moreover, because of the existence of a large export market for Indian iron ore, domestic prices of iron ore have generally moved in tandem with the international prices. While the production cost of iron ore varies in the range of Rs. 500 per tonne to Rs. 1000 per tonne, depending upon the life of the mine, capacity of the mine and equipments employed, the price of iron ore, ex-mine, has remained much higher than costs in the past few years. This has been one of the main reasons for the Indian steel industry clamouring for allocation of captive iron ore mines, as captive iron ore is most likely to reduce their cost of production substantially.

4.2.5.8 Costs of mining iron ore vary from mine to mine and depend on the mineralogy and other specific local factors. While mining costs on an average can be uniform, the costs of beneficiation may vary significantly from one mine to another. However, the main issues in delivered costs to the users are related not so much to the costs of mining, but, to the transportation of the ore as also rates of taxes, royalty, etc payable on mined material. Iron ore mining and transportation costs have risen manifold in the recent period. Iron ore prices have, likewise, risen through the 11th Five Plan period.

4.2.5.9 Price of iron ore has increased threefold since 2005 (after considering the increase in royalty etc.). Apart from rising costs of mining and transportation along with hikes in taxes & levies, the recent rise in iron ore prices can be attributed mainly to:

- Increases in domestic demand for Calibrated Lump Ore (CLO), and
- Adoption of the principle of global price parity for fines and other lumps by the major iron ore mining companies.

Iron prices in the spot market vary significantly from those set by the mining PSUs such as NMDC and OMC who fix their prices on quarterly basis and make them public **(Table – 4.6)**. The volatility in spot market is driven by local market conditions, differences in grade and transport costs.

Table – 4.6

Iron ore Spot Prices vs. NMDC Ex-Mine Prices (Up to January)

(Rs /T)

	01.04.07	01.10.07	01.04.08	1.04.09	01.01.10	01.04.10	01.07.10	01.10.10	01.01.11
Baila Fines (-0mm)(64%): Source : NMDC (Ex - mines)	1209	1783	1970	1666	1936	2924	3356	3199	3366
Indian Fines* (63.5%)- Spot prices (F.O.B. at Port) *Source: Umetal.net website	2631.4	4582.4	5845.68	2872	4450.8	6163.2	6072.77	5994.73	6994.37

Note: Spot market prices are inclusive of transportation and other duties/levies.

4.2.5.11 Spot market volatility and market based pricing mechanism have led to higher costs in production of steel for all those producers dependent on the market for their iron ore procurement. This also has caused frequent disturbance in their business planning, apart from putting them at a disadvantage vis-à-vis those who have captive resources.

4.2.5.11 Despite the expected rise in domestic demand for iron ore, supplies may not fall short of demand given the abundant mining capacity and potential diversion of exports to the domestic market during the 12th Plan period due to the restrictive measures already taken by the government. The steel producers, however, may still face high prices till the end of the 12th Plan period, due to export linked domestic pricing mechanism, infrastructure bottlenecks, weaker mining capacity growth potential in the case of captive resources and problems related to land acquisition and social disturbance.

4.2.6 Development Issues & Policy Recommendations for the Indian Iron Ore Sector

4.2.6.1 To meet the total demand for iron ore, systematic developmental efforts need to be undertaken including creation of additional mining capacity in a well calibrated manner (in keeping with other policy considerations guiding exports of minerals, conservation of environment and other socio-economic/legal considerations etc.), encouraging investment in advanced mining methods, issuance of environmental and forest clearances within specified time frame, grant and renewal of leases against credible mining plans and grant of fresh leases only against new norms that are in place for assessment of technical and financial capabilities of applicants.

4.2.6.2 Underground iron ore mining technologies should be explored to maximize the potential of unlocking the resources of magnetite ores in the Western Ghat areas of Karnataka also at the same time maintaining environmental discipline. The government should set up a technology mission and form an expert group to monitor such research programmes.

4.2.6.3 For planning and promoting the development of mine-related infrastructure, it would be necessary to put in place an appropriate institutional framework. In the major mining states, we already have Mineral Development Corporations and State Industrial Development and Investment Corporations. It would be necessary to enlarge the mandate of these corporations to include planning, promotion and financing of mining infrastructure.

4.2.6.4 Exports of iron ore have risen sharply in the recent years. It has increased by about 3 times in seven years, from a level of 37.49 million tonnes in 2000-01 to 117.37 million tonnes in 2009-10. In view of the fact that iron ore is a non-renewable natural resource, its unabashed export from the country may have adverse implications for long term growth of the domestic steel industry and of the Indian economy, in general. It is now generally accepted that iron ore resources of the country should be conserved for use by the domestic steel industry and ultimately for the benefit of the Indian people who have one of the lowest per capita consumption of steel within the fraternity of emerging economies.

4.2.6.5 Long term policy measures for curbing iron ore exports should aim at attracting investment in steel making capacity so that value addition and export of finished products are promoted. In the short and more immediate time frame the same may be achieved by taking recourse to appropriate fiscal measures. At present export of iron ore from the country is discouraged through:

- Imposition of an export duty of 20% ad-valorem on iron ore, and
- Charging of significantly higher railway freight on iron ore meant for export.

These measures have contributed to reduction in iron ore prices in the domestic market as compared to the international market and played a vital role in making available iron ore to domestic industries at competitive prices. To effectively discourage export of iron ore from the country, It is recommended that appropriate fiscal measures should be designed and calibrated on a continuous basis in line with the exigencies of the ore market – both domestic and international.

4.2.6.6 While encouraging pelletisation of iron ore, the government will have to ensure that there is no excessive export of pellets, which will defeat the very objective of reducing iron ore exports by converting excess fines into a value added product for replacing iron ore lumps in domestic consumption.

4.2.6.7 Illegal mining of iron ore that has gathered pace in the background of huge export market of iron ore is a major concern for the domestic iron & steel industry. The profitable and assured export market may have led to iron ore mining without requisite permission/ clearances. Such actions have also been responsible for environmental degradation in some areas. Hon'ble Supreme Court of India has recently intervened in the matter and has directed immediate suspension of mining operations and transportation of iron ore from Bellary, Chitradurga and Tumkur Districts of Karnataka on the ground of "over-exploitation" of the mines in the area causing "large-scale environmental degradation." Hon'ble Supreme Court has allowed NMDC Limited, a PSU of the Ministry of Steel, to start its mining operations in its mines in Bellary District up to 1 million tonne per month of ore and to supply the iron ore to the Indian steel industry. Closure of other iron ore mines in the area has caused hardships to the local iron & steel industry of Karnataka and nearby areas, which used be dependent on Karnataka ores. Therefore, it is desirable that export of iron ore may be discouraged through suitable fiscal measures which will help in not only checking illegal mining of iron ore, but will also improve availability of iron ore for domestic iron and steel industry at reasonable price.

4.2.6.8 Allocation of iron ore mines is carried out as per the provisions of the Mines & Minerals (Development & Regulations) Act 1957 and the Mineral Concession Rules 1960. Under the Act, mineral concessions are given in different stages of mining in the form of Reconnaissance Permit (RP), Prospecting License (PL) and Mining Lease (ML). Under the law, a user can operate a mine under a valid mining lease for the period of lease. Many of the large steel investors are setting up their projects on the premise that they will get full linkage of their iron ore requirement through allocation of captive mines. Allocation of captive iron ore mines justifies economies of scale, reduces the production cost and compensates other inputs costs such as imported coal/ metcoke etc.

4.2.6.9 However, except for some of the major steel companies like SAIL, Tata Steel and JSPL, most of the other existing steel producers do not so far have any mining leases for iron ore. Such a distortion has happened because iron ore prices were so low, prior to 2000, that no steel company felt it necessary to own and develop captive iron ore mines. However, with sharp increase in the price of iron ore, steel companies have realized the need for having captive iron ore mines and hence have been striving for getting captive iron ore mines. Therefore, there is a need to give preference to value adders in allocation of mineral concessions by making necessary provisions in the MMDR Act in this regard. Besides, there is a need to have time bound process for allocation of mineral concessions by the competent Government Authority at every stage. A time bound decision making in the process of allocation of mineral concessions will go a long way in speedy development of the domestic mineral sector.

4.2.6.10 Beneficiation potential is low in the case of low grade haematite ores of the eastern region with Fe content in the range of 50 per cent due to high alumina content, which not only raises the costs of beneficiation, but also poses environmental hazards involving tailings. A significant research programme supported by the Government is required in this area and one has to learn from the Indian industry efforts so far.

4.2.6.11 Lastly, although, the present steel capacities in the country are primarily based on hematite iron ore, over a longer period of time, it may also be required to tap the magnetite iron ore resources located in the Western Ghats, where mining activities are currently banned by the Orders of Hon'ble Supreme Court. Unlocking these iron ore resources may need recourse to underground mining technologies, so that the precarious ecological balance in the Western Ghat region is not disturbed while iron ore is extracted. A detailed Feasibility Study needs to be undertaken to examine the techno-economic viability of such technologies.

4.3.0 Coal

4.3.1 Based on coking property and end use, coals are broadly classified into coking coal and non-coking coal. Coking coal is used in the steel plants where it is converted into metallurgical coke (metcoke) in coke ovens, which is then used in the blast furnace as a reductant for iron making. Non Coking coal (with lower ash content) is used in coal based DRI plants (sponge iron plants) as a reductant for iron making in rotary kilns. Non coking coal with higher ash is also used as fuel in thermal power plants as steam coal.

4.3.2 Reserves of Coal

4.3.2.1 As on 01.04.2011, India has total coking coal reserves of 33.474 billion tonnes, out of which 17.67 billion tonnes is of proved category. Out of this, prime coking coal is only 4.61 billion tonnes. Majority of coking coal reserves in the country have high ash content, which is not suitable for steel industry.

4.3.2.2 As on 01.04.2011, India has total non-coking coal reserves of 252.39 billion tonnes, out of which 96.33 billion tonnes is of proved category.

4.3.2.3 The evolution of India's steel industry was based on the presumption that there is sufficient availability of coking coal resources in the country. While the abundance of iron ore in particular has been the driving force behind the steel industry's growth, the quality of coking coal has not been encouraging, despite significant reserves/resources.

4.3.2.4 Coking coal quality problems, consequently, have forced the Indian blast furnace based steel makers to get increasingly dependent on imported coking coal and the high price of this critical raw material in the international market has sharply eroded their competitive position.

4.3.3 Performance of the Indian Coal Industry during the 11th plan 2007-12

4.3.3.1 Coal production of India in the 3rd year of the 11th Five Year Plan reached a level of 532 million tonnes as against the previous best performance of 431 million tonnes during the terminal year of the 10th plan (2002-07) translating into a growth of 23 percent. The average increase in production of coal was of the order of 25 million tonnes per year.

4.3.3.2 Total washed coking coal production in the country was 6.373 million tonnes in 2010-11, declining significantly from a level of 7.025 million tonnes in 2006-07. **(Table – 4.7)** The requirement of the steel industry was met by importing 24.69 million tonnes during 2009-10. Starting from a level of 17.877 million tonnes in 2006-07, coking coal import has been continuously on the rise in this period. The increase was due to non-availability of high quality low ash coking coal in India. The washed non-coking coal production for the metallurgical industry was estimated at 14.917 million tonnes in 2010-11. In addition, Coal India has reported a production of 4.463 million tonnes of coking coal middlings and 3.827 million tonnes of non-coking coal middlings in 2010-11.

Table – 4.7

Trends in Production of Coal, 2006-07 to 2010-11

Million Tonnes

Year	Washed Coal(Coking)	
	Production	growth
2006-07	7.025	-16.1
2007-08	7.171	2.1
2008-09	7.181	0.1
2009-10	6.547	-8.8
2010-11	6.373	-2.7

Source: Coal Statistics: 2010-11

4.3.3.3 Sustained supply of non-coking coal has been the most important factor leading to continued increase in the production of sponge iron in the country. Total supply of non-coking coal to the domestic sponge iron industry during the last five years has been as follows. **(Table – 4.8)**

Table – 4.8

Supply of Non Coking Coal to Sponge Iron Units

Million Tonnes

Year	**Supply of non coking coal to sponge iron units in million tonnes**
2006-07	17.47
2007-08	20.92
2008-09	19.33
2009-10	23.096
2010-11	18.76

Source: Coal Statistics: 2010-11

4.3.3.4 Besides coking coal, India imported 2.572 million tonnes of metcoke in 2007-08. The import volumes dropped to 0.4 million tonnes in 2010-11. This decline has come about due to development of value-added metcoke production capacity within the country. Globally supplies of metcoke have shrunk due to restrictive policy adopted by China, the largest merchant producer of metcoke in the world.

4.3.4 Demand for Coking Coal

4.3.4.1 Based on the forecasts of crude steel and pig iron production, demand for coking and non-coking coal for metallurgical purposes and PCI have been estimated for the 12th Plan period as below. (**Table – 4.9**)

Table – 4.9

Demand for Coking and Non Coking Coal for 12th Five Year Plan

	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Crude Steel Production	73.7	**85.9**	**94.5**	**104**	**114.5**	**125.9**
Total Coking Coal Demand*	43.2	52.3	57.9	67.5	77.2	90.2
Total Production of Coal Based Sponge Iron	21.0	21.2	20.3	19.2	18.7	15.3
Total Non-Coking Coal Demand for Iron & Steel making (For Coal Based DRI and Corex Plants Only)	35.3	37.9	36.5	34.7	33.9	28.4
PCI	1.9	2.4	2.7	3.2	3.8	4.5

Note: * Total coking coal demand includes those for merchant pig iron units as well.

4.3.4.2 In the light of the above, the role of merchant coke producers assumes greater significance. At present, this sector has a capacity of around 5.5 million tonnes per annum and it is primarily located in the western (2.770 million tonnes per annum) and eastern (2.60 million tonnes per annum) parts of India. Gujarat NRE Coke, Balaji Coke and Saurashtra Fuels are the three major players. In addition to the above, the integrated steel plants also play an important role by producing approximately 12.5-13.5 million tonnes of coke per year.

4.3.4.3 Domestic coal prices are determined by Coal India in most cases. A small quantity of coal is sold through auction at prices determined by market demand and supply. Coking coal is largely imported and the prices are contracted between the major coking coal suppliers and buyers on a quarterly basis. The contract prices are changed depending on the global market demand and supply.

4.3.5 Policy and Developmental Issues for Augmenting Supply of Coking Coal to India's Steel Sector

4.3.5.1 In view of the stagnation witnessed in the production of coking coal in the country and its rising demand, efforts should be made to optimally use the reserves of domestically available coking coal to the fullest extent possible and reduce dependence on imported coal. The measures needed would include:

- Those which are in the realm of long term strategy of economic planning and policy reforms aimed at creating a competitive environment in the coal sector to promote efficiency and productivity; and
- Those which relate to the ongoing attempts to rationalize the extant pricing and distribution policies being followed currently.

4.3.6 Recommended Policy Reforms

4.3.6.1 **Phased Deregulation of the Indian Coal Sector:** It is important to deregulate coal sector and allow commercial mining of coal, to bring in competition and thereby improve efficiency of the sector. As a first step, captive block owners who have been able to set up their end-use plants and are able to produce surplus coal after meeting the full normative requirements of their end-use plants should be allowed to sell the excess coal to registered end-users at a fair price to be determined by the regulator. A market platform where all the captive block owners (as sellers) and end-users (as customers) may trade needs to be created. Over a period of time, sale of coal should be allowed freely at market determined prices.

4.3.6.2 **Creation of the Institution of a Coal Regulator**: Concomitant with initialization of deregulation a **Coal Regulator** needs to be appointed with key responsibilities of mine plan, fixing prices for sale of coal, checking illegal mining, etc. Setting up of Coal Regulator to oversee mining related clearances and administer policies related to coal mining will be beneficial for the industry.

4.3.6.3 **Emphasis on Unlocking Underexploited Coking Coal Reserves through Calibrated Deregulation:** The Indian coal mining industry is dominated by Coal India which produces more than 80% of the total coal production of the country. Of the total raw coal production of 531 million tonnes per annum, less than 17-18 million tonnes are of washable grade raw coking coal, despite the fact that the country has 33 billion tonnes of reserves of coking coal and Coal India has a share of 90% in the reserves. As the focus of CIL is on power grade coal, coking coal production in the country has stagnated for last several years. The following policy measures are recommended in the context of developing a domestic coking coal base in the country.

i) The existing coking coal mines should be de-merged from CIL and a separate Coking Coal company should be formed. This new entity can continue to be under the government to begin with and to remain fully responsible for coking coal mining development. Any non-coking coal that is mined in the process can be offered to CIL at a reasonable price to be fixed by the regulator.

ii) The government may also consider additionally or in substitute of the above, offering coking coal assets to steel producers for development on tender basis to go to the highest bidders**.** The steel companies getting such mines should also be allowed to sell the surplus coal mines in the open market.

iii) There are several virgin coking coal assets currently lying undeveloped with CIL and for which CIL does not have plan for development in the XII five year Plan. These assets may be put on auction and the highest bidder may be allocated these blocks.

4.3.6.4 **Systematic Exploration to Expand Mineable Reserves Base:** This would need taking up systematic drilling and exploration programmes.

4.3.6.5 **Promote Beneficiation for Low Grade Coal:** There should also be more focused efforts towards beneficiation and washing of coal so as to reduce dependence on imported coal. Developing capability to beneficiate lower grade coking coal for use in steel industry should be an area of priority. The proposal of Coal India Ltd to beneficiate coal by installing new washeries with state of the art technology / expertise available internationally will go a long way in improving the yield of washed coking coal in India. More than 30 million tonnes of low grade coking coal gets diverted to the power industry due to lack of washery technology and washing capacity in the country. This should be gradually stopped and instead the coal should be supplied to the integrated steel plants for beneficiating and using in their own plants. Long term commitment to such supplies should be linked with the steel companies based on firm proposals.

4.3.6.6 **Intensive Exploitation of Deep-seated Coal Reserves through Underground Mining:** Increased domestic production of coking coal would also involve intensifying exploitation of deep seated coking coal reserves through appropriate underground mining technology to support the growing demand for coking coal and reduce dependence on import. In India, major coking coal resources are lying deep underground. There is a need to develop or import underground mining technologies, so as to exploit the coking coal deposits of the country to the fullest extent. One such case in point relates to the Jharia Coal Fields - one of the largest coking coal mines in the world, from where coking coal could not be extracted on a significant scale due to raging fires. An action plan named Jharia Action Plan has been prepared to shift the population from there and extract the coking coal from Jharia. Although the Government has allotted funds for Jharia Action Plan, constant and regular monitoring by the central government is necessary to ensure its success which is critical for increased availability of prime coking coal in the country. Towards this end, an Apex Committee may be formed with a member each from the Ministry of Coal and Ministry of Steel as also from the state governments.

4.3.6.7 **Measures to Boost Production in the Underexploited Captive Coal Blocks:** It is interesting to note that despite growing domestic market and rising import dependence, production from captive coal mines has remained below potential. The production levels have stagnated, mainly due to delays incurred in getting multiple regulatory clearances and in acquiring land. Captive mining has the potential to be one of the major sources of coal supply in the country, provided a well defined process with prescribed time frame for statutory clearance is developed. Several initiatives/reforms are required to boost production from captive blocks. These are as follows:

i) **Create a nodal agency at the state level to monitor and ensure speedy clearances on a single window basis** with members drawn from the Ministry of Coal (MoC) and Ministry of Environment and Forest (MoEF) besides relevant departments of the state governments.

ii) **Set up a Local Development Authority (LDA) in each coalfield area** (exact area to be defined) which should have representation from the coal block owners as also from the district administration and a representative of the MoC. The LDA can be entrusted with the responsibility of creating a master plan of local infrastructure including rail & road connectivity, utilities like power, water and residential townships having medical and educational facilities. The block owners would contribute on the basis of their planned production as per the mine plan.

iii) **Amend Contract Labour Act to allow coal mining and associated activities through contract mining** as in countries like Australia, Indonesia, etc. which have a developed mining industry.

iv) **Corporatize contract mining by putting in place strict monitoring and compliance** to payment of minimum wages, scientific mining and safety norms. Conservation of resources is extremely important and hence monitoring of mine plans is essential.

v) **Allow sale of surplus coal production over and above the requirement of the end-use plant by the block owners -** Should this not be allowed by the present law, the same should be allowed to be sold at a discounted price to Coal India Ltd. (CIL).

vi) **Mandate extraction of coal in Block Barriers -** Coal locked in block barriers can get lost forever; in fact, the 7.5 m barrier on the surface will increase considerably at higher depths. Hence, it should be mandated in the mine plan itself that the adjacent block owners must work out a joint mechanism to extract this coal.

vii) **Consolidate small plots for scientific mining/ Artificial block boundaries** —To accommodate a number of competing claims for coal by different parties, sub-optimal blocks have been allocated in the past which may not have sufficient area or strike length for scientific exploitation. Hence, it should be mandated that adjacent block allottees of such small plots should develop such blocks as a single entity.

viii) **Set Realistic Timeline for block development** based on a more wide spread consultation to fix the FC and land acquisition timelines.

ix) **Prior approval of the Ministry of Coal** - should be given at the time of coal block allocation in both the cases of PL and LM.

4.3.7 Rationalize Extant Distribution and Pricing Mechanism and Promote Acquisition of Overseas Resources

4.3.7.1 **Supply of Non-Coking Coal to Sponge Iron Industry as Per Provisions of NCDP:** For sponge iron sector, the New Coal Distribution Policy (NCDP) provides that 75% of the quantity based on the normative requirement of coal by the consumers/ actual users would be considered for supply through FSA by CIL **at notified prices** to be fixed and declared by CIL. The remaining 25% of coal requirement of the units will be sourced by them through e-auction/ import of coal, according to their preference. However, according to the representations received by the Ministry of Steel, actual supply of coal by CIL to sponge iron units at notified price is much less than this stipulated quantity. **In** view of this, it is recommended that Ministry of Coal may be requested to direct CIL to offer only that much quantity for e-auction, which is left after fully supplying the quantity provided (75% of the normative requirement for sponge iron units) as laid down in the NCDP.

4.3.7.2 I**nclusion of Pellet Plants within the Purview of NCDP for linkages of Non-coking coal:** Pellet plants are not covered under NCDP, 2007, for linkage for non-coking coal. It is felt that pelletization is a very important process for optimal utilization and conservation of the domestic iron ore resources through beneficiation and utilization of low grade iron ore fines within the country. However, due to substantial capital investment required for setting up pellet plants and also comparatively low margin in pellet production, there is a need for encouraging the process of pelletization through fiscal and other incentives for setting up pellet plants. It is also recommended that pellet plants should be included under NCDP for linkage of non-coking coal.

4.3.7.3 **Acquisition of Coal Assets Abroad and Promotion of Joint Ventures for such Ventures :** Since the quality of coking coal available in India is not up to the mark, imports of low ash coking coal and met coke have been increasing at a fast pace in the last few years.. Moreover, in the recent past coal & coke prices – both domestic and global – have not only risen sharply but also been highly volatile; the situation is likely to remain the same in the foreseeable future too. Therefore, acquisition of coal assets overseas has gained importance for supporting the economics of steel production in India and more importantly, for securing future supply of this critical raw material. Some private steel companies have successfully acquired major coal resources abroad, which is a welcome step towards assuring future supply of coal for their operations. The Government is also encouraging formation of joint ventures between steel companies to acquire coking coal assets abroad**.** The Ministry of Steel has set up A Special Purpose Vehicle, International Coal Ventures Limited(ICVL), with the participation of Coal India Limited, Steel Authority of India Limited(SAIL), National Thermal Power Corporation(NTPC), Rashtriya Ispat Nigam Limited(RINL) and NMDC Limited**,** for acquisition of coal assets abroad. Besides, PSUs are also independently scouting for coal assets abroad.

4.3.7.4 **Bilateral Negotiation backing Acquisition of Overseas Acquisition**: Though ICVL and others in the private sector are working towards acquisition of overseas coking coal mining assets similar efforts through bilateral negotiations with the governments of the respective countries may also strengthen the success potential of the Indian companies.

4.3.7.5 **Allocation of Unsold Low Grade Coking Coal Stocks with CIL to the Domestic Met-Coke Industry:** The met coke industry is faced with significant excess capacity and one of the reasons for that is that they do not have adequate access to local coking coal. It is learnt that Coal India Ltd. continues to have large stock of unsaleable coking coal stocks. It is recommended that such stocks should be allocated to the met coke plants so that the overall supply of met coke increases in the country.

4.3.7.6 **Long term Fuel Supply Agreement (FSA) between CIL and integrated steel plants**: It has been observed that the domestic steel industry has shown little interest in locally available coking coal despite offers by Coal India. Coal India has reported rising stock of the material with them as the steel producers prefer imported coking coal to maintain the required operational standards/efficiency levels. It is necessary to have co-operation of both sides in maximizing the use of domestic coking coal. While the steel plants need to blend the domestic coal supplies to the maximum extent possible with imported coal, the domestic coal producer must also be able to maintain adequate supply to the steel producers at the right price. Long term FSA between coal companies and integrated steel plants is necessary for the steel companies to plan their long term sourcing of coking coal which is mostly being imported currently.

4.4.0 Natural Gas

4.4.1 Natural gas in the steel industry is used almost totally in producing sponge iron. Currently, there are only three gas based sponge iron producing units: Essar Steel Ltd., JSW Ispat Industries Ltd. and Welspun Maxsteel Ltd., all located on the western coast of the country.

4.4.2 Demand and Supply of Natural Gas in the Steel Industry

4.4.2.1 Supply of natural gas to the sponge iron units is based on priority-based allocation – the norms being set by the state. However, the priorities assigned to the iron and steel sector has been changed frequently by the various authorities over time. As a result, gas supplied to the iron and steel units also underwent frequent cutbacks as priority levels were lowered from time to time.

4.4.2.2 The three gas based sponge iron units of Essar Steel, Ispat and Welspun Maxsteel were initially allocated natural gas by the Gas Linkage Committee(GLC) to the extent of 5.46 MMSCMD which was subsequently curtailed by the Ministry of Petroleum and Natural Gas(MOP&NG), GOI, to 1.86 MMSCMD as detailed below **(Table – 4.10**)

Table – 4.10

Original and Revised Allocation of Natural Gas to Steel (Sponge Iron) Producers

Sl No	Name of Plant	Original GLC Allocation (in MMSCMD)	Revised GLC Allocation and Gas Supply (in MMSCMD*)
1	Essar Steel	3.11	0.70
2	Ispat industries	1.35	0.75
3	Vikram Ispat/ Welspun	0.90	0.40
	Total	5.46	1.85

***** Million Metric Standard Cubic Meter per Day.

4.4.2.3 The current total demand of the above units is approximately 7.64 MMSCMD for sponge iron manufacturing process. The Empowered Group of Ministers (EGOM) decided to allocate 4.19 MMSCMD only to the above units. (**Table – 4.11**)

Table – 4.11

Demand and Current Allocation

Sl No	Name of Plant	Process Gas Requirement (in MMSCMD)	GLC Gas Supply (in MMSCMD)	RLNG Supply (in MMSCMD)	RIL KG D6 Allocation (in MMSCMD)	Current Gas allocation (In MMSCMD
1	Essar Steel	5.50	0.70	1.60	3.20	5.50
2	Ispat industries	1.34	0.75		0.59	1.34
3	Vikram Ispat	0.80	0.40		0.40	0.80
	Total	7.64	1.85		4.19	7.64

*****Million Metric Standard Cubic Meter per Day.

4.4.2.4 However, very recently in a further revision of the earlier order, the MoP&NG has directed Reliance Industries Ltd. (RIL) to curtail gas supplies to the steel sector units and prioritize supplies to fertilizer, power, LPG and CGD sectors. Accordingly, RIL has cut gas supplies to the iron and steel units and is currently supplying only 10% of the original allocation. The current gas supplies to the above unit are as shown in **Table – 4.12**.

Table – 4.12

Demand and Supply of Natural Gas

Sl No	Name of Plant	Process Gas Requirement	GLC Gas Supply	RLNG Supply	RIL KG D6 Allocation	Total Supplies	Shortfall
1	Essar Steel	5.50	0.70	1.60	0.32	2.62	2.88
2	JSW Ispat industries	1.34	0.75		0.06	0.81	0.53
3	Vikram Ispat	0.80	0.40		0.04	0.44	0.36
	Total	7.64	1.85	1.60	0.42	3.87	3.77

Source: Industry

4.4.2.5 Since the above units use natural gas as a feed stock and have no other alternative/substitute available readily, the current level of gas shortage amounting to more than half of the requirement is likely to cripple these production facilities and possibly force the units to close down in the course of time. The alternative to domestic allocation is imported LNG which can only be the last option. As in most cases and in most of the time, given their prices, use of imported LNG is not economically viable for the industry.

4.4.3 Additional Gas Demand

4.4.3.1 Given the above supply and demand situation and the upcoming (planned) gas based iron and steel plants in the country, the additional gas demand by the units is projected in **Table – 4.13** below.

Table – 4.13
Additional Gas Demand by Consumers in the Steel Sector

	Name of Company	Quantity (MMSCMD)
1	Welspun Maxsteel	0.25
2	Remi Metals Gujarat	0.04
3	Welspun Gujarat Stahl Rohern	0.66
4	Essar Steel Vizag	0.8
5	Essar Steel Paradeep	1.5
7	Essar Steel Vizag – Integrated Steel Plant	1.7
6	SAIL	5.5
7	JSW Ispat Industries Ltd.	3.091
	Total	13.541

Source: Individual Companies

4.4.3.2 The Ministry of Petroleum and Natural Gas allocates gas to various consumers within the country on the basis of a policy of prioritization. Since gas allocation to the sponge iron and steel industry is likely to fall further due to higher preferences accorded to the priority sectors, the gas users in steel and sponge iron sectors are likely to get adversely hit.

4.5.0 Manganese Ore

4.5.1 Manganese ore is used in the form of ferro-alloys and also as a direct feed to the blast furnace in the process of steel making. About 94% of the manganese ore produced globally is utilized in the production of manganese alloy, with the balance being consumed in batteries, chemicals, aluminium and copper alloys. Again, about 90% of the manganese alloy is used in the production of steel for desulphurization and strengthening of steel.

4.5.2 Manganese content in ore on an average has come down globally from 34.8% in 2001 to 30.6% in 2009 which indicates larger requirement of Manganese ore to produce same the quality of manganese alloys as compared to earlier periods.

4.5.3 Indian Reserves/Resources

4.5.3.1 Total resources of manganese ore in the country, as per the UNFC system, as on 1st April 2005, are 378 Million Tonnes **(Annexure-4.2**). Presently only 36% (i.e., 138 Million Tonnes) of the total resources are in mineable range reserve category and remaining 64% (i.e., 240 million tonnes) are in the remaining resource category which requires additional exploration to be converted into mineable reserves. Grade wise, Blast Furnace (BF) grade accounts for 34 % of the resources followed by medium grade (8%) and ferro-manganese grade (7%). The remaining 51% are of mixed/ low and other grades including 0.5 million tonnes of battery / chemical grade. Madhya Pradesh, Maharashtra, Odisha and Karnataka are the leading manganese producing states in India and together account for about 90% of total production.

4.5.4 Production, Export & Import of Manganese Ore in India

4.5.4.1 Year-wise production, export and import of manganese ores of different grades are as shown in **Table – 4.14**. Bulk of the exports are in the manganese content range of 30-35% and those falling under the category “Others and Concentrates”. Imports, on the other hand, consist of high and medium grade ores. The emerging features of the Indian Manganese Ore Market are as below:

- Domestic production of Manganese Ores grew by around 8% annually from 2.10 Million Tonnes in 2006-07 to 2.96 Million Tonnes in 2010-11.

- Barring a decline in 2009-10 on account of global economic recession, the import of manganese ores has been on the rise. In the first 3 years of the 11th Plan, imports increased by a CAGR of 41% from 0.284 Million Tonnes to 0.798 Million Tonnes between 2006-07 and 2010-11.

- During this period (i.e., the first 3 years of the 11th Plan) India remained a net importer of Manganese ores with exports growing at 22.6% per annum as compared to a 41% annual growth in imports. It is also noted that most of the imports belong to the high and the medium grades while relatively low grades are exported.

<u>Table – 4.14</u>

Production, Import and Export of Manganese Ore in the 11th Five year Plan

Year	Production (Million Tonnes)	Imports (Million Tonnes)	Exports (Million Tonnes)	Net Imports (Million Tonnes)
2006-07	2.10	0.284	0.157	0.127
2007-08	2.70	0.686	0.208	0.478
2008-09	2.80	0.852	0.205	0.647
2009-10	2.44	0.798	0.289	0.509
2010-11	2.86	Na	Na	Na
CAGR	**5.1% (2007-10) 8.0% (2007-11)**	**41.1% (2007-10)**	**22.6% (2007-10)**	

Source: Ministry of Mines

4.5.5 Production Cost of Manganese Ore

4.5.5.1 Manganese ores in India are mined by opencast as well as underground methods of mining. In the total production of manganese ores, opencast mining has a share of about 25 per cent. Most of the high grade ore is produced from underground mining. Cost of production for opencast mining depends largely on the nature of the deposit, geology of the ore, stripping ratio, recovery factor etc.

and it differs from state to state as per the deposits. Generally speaking, the cost of production for underground mining is higher than that for opencast operations.

4.5.5.2 The cost of production of manganese ores has been on the increase throughout the 11th Five Year Plan and is likely to increase further over the 12th plan period. The main factors leading to this include:

- Rise in input costs,
- Additional requirement of removal of overburden,
- Need to mine at lower depths.

The cost escalations are likely to be moderated by higher production volumes and resultant economies of scale and improved cost management measures. In spite of the higher costs of production, it is expected that India will remain one of the lowest cost manganese ore producing countries in the world. However, the point of concern is that higher grades account for only 30 per cent of the total domestic production with the balance being shared by medium (50%) and lower (20%) grades.

4.5.6 Pricing Issues

4.5.6.1 Manganese prices were fairly stable during 2005-07. During the year 2007-08, however, demand for manganese ores went up and prices increased in response. Prices peaked in October, 2008 and then fell sharply starting October, 2008 onwards to March, 2009 due to the global meltdown. Recovery in prices of manganese ore started after October, 2009. The uptrend continued till October, 2010. Thereafter, due to increase in supply of manganese ore (domestic and imports) in the market, prices started decreasing again and average sales realization also fell. In view of substantial expansion in global capacity in the recent past, it is expected that manganese ore prices will be under pressure during the 12th plan period as availability will continue to exceed the requirement of global steel production. The average sales realization during the 11th Five Year Plan is placed in **Table 4.15** below.

Table – 4.15
Trend in Price of Manganese Ore

(INR/MT)

		11th Five Year Plan				
Year	06-07	07-08	08-09	09-10	10-11	11-12
Price (M/T)	3210	6500	11600	7700	10700	7600

Source: MOIL

4.5.7 Projection of Production and Consumption/Demand of Manganese Ore in the 12th Five Year Plan

4.5.7.1 Expected consumption of different categories of Ferro-alloys during the 12th Plan has been worked out based on the projected growth rate of 10.3% in steel consumption and the required crude steel production to meet the emergent demand between 2012-13 and 2016-17. Demand for manganese ore, in turn, has been worked out on the basis of:

- requirement of manganese Ferro-alloys for projected crude steel production in the 12^{th} Plan Period,
- availability of slag, and
- consumption of manganese ore in other industries,

Manganese ore demand has been estimated to be **about 6.819 million tonnes by the end of 12^{th} Five Year Plan** as shown in **Table – 4.16**.

4.5.7.2 During the same period, production of manganese ore is expected to reach a level of 4.2 million tonnes by 2016-17, growing at 7% per annum supported by expansion of existing mining operations and renewal of existing projects. Based on these projections, demand and supply gap for manganese ores within the country is estimated to reach 2.619 million tonnes by 2016-17 as shown in **Table – 4.17.**

4.5.7.3 From **Tables – 4.16 & 4.17**, it is seen that-

- Out of a total estimated demand of 6.819 Million Tonnes of manganese ore by 2016-17, an estimated 5.192 Million Tonnes shall be used for domestic production of Ferro-alloys and other uses while the remaining 1.626 Million Tonnes shall be used in producing Ferro alloys for exports.

- Considering the expected production of manganese ore during 2016-17 i.e. 4.2 million tonnes, about 2.619 million tonnes demand gap is envisaged.

Table – 4.16

Projection of Manganese Ore Demand in the 12th Five Year Plan

(Thousand Tonnes)

	Requirement Of	Consumption Norm (T/T)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
1	Mn Ore for FeMn (High Grade)	2.4T/T of FeMn	1286	1445	1591	1793	1958	2086
2	Mn Ore for SiMn (Medium Grade)	1.8T/T of SiMn	2270	2549	2804	3125	3483	3881
3	Total = 1+2		3556	3994	4395	4918	5441	5967
4	FeMn slag for SiMn	0.6T/T of SiMn	757	850	935	1042	1161	1294
5	FeMn Slag available	0.9T/T of FeMn	482	542	597	672	734	782
6	Mn Ore added to compensate slag shortfall		274	308	338	369	427	512
7	Mn Ore for Ferro Alloys =3+6		3830	4302	4733	5287	5868	6479
8	Mn Ore for other uses (@5% of total)		202	226	249	278	309	341
9	**Total Projected Demand for Mn Ore in 12th Plan=7+8**		4032	4528	4982	5565	6177	6820
	Mn Ore for Domestic Consumption		2477	2963	3408	3981	4576	5193
	Mn Ore for Export Production of Ferro Alloys		1555	1565	1574	1584	1601	1627

Table – 4.17

Projected Production and Demand of Manganese Ore During 12th Five Year Plan

(Thousand Tonnes)

Manganese Ore	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Production	3000	3210	3430	3670	3930	4200
Demand	4031	4528	4983	5565	6177	6819
Gap between Supply and Demand	1031	1318	1553	1895	2247	2619

4.5.8 Beneficiation of Manganese Ore

4.5.8.1 Depleting reserves of high grade ores and stringent environmental constraints pose considerable challenges to the future of supply of manganese ore/alloys to the steel industry. There is a need to develop efficient processes for beneficiation of low/medium grade ores and run of mine manganese ores to high grade/high value products. This is more so in case of silicate ores (as opposed to oxides) which cannot be separated economically by normal gravity and magnetic separation processes. In case of ferruginous Mn ore, beneficiation technique requires reduction roasting and magnetic separation. Again sintering and agglomeration process is required which is very expensive.

4.5.9 Development and Policy Recommendations for Manganese Ore

4.5.9.1 The major recommendations are as below:

Manganese ore production will have to be raised to fully meet the domestic demand by enhancing output from the existing mines and by opening additional virgin deposits. The industry can raise supply of manganese ores by acquiring mines overseas.

i) Focused attention is needed to ensure higher rate of recovery of manganese and improve the quality of the ores by engaging beneficiation and sintering processes.

ii) Geological Survey of India (GSI) may undertake extensive drilling to identify new ore deposits in higher depths. Deep-sea nodules can be a potential resource for manganese in the future.

iii) Renewal of mining leases and grant of new leases can be expedited by a single window clearance system especially in respect of obtaining environment and forest clearances

iv) Infrastructure development, such as railways, roads and ports, linking the mining areas to the consumption areas and export markets may be taken on priority basis so that the overall transportation costs are lowered.

v) Since the manganese ore is not widely traded and there is no benchmark price domestically available, it is recommended that a third party and neutral e-market portal may be developed. The industry, both the ore producers and the ore consumers such as ferro-alloys and the steel may together support such a venture.

vi) With technological advancement, the specific consumption rate of manganese in steel making has reduced from 46 kg per tonne to as low as 30 kg per tonne. There is a need for development of techno-commercially viable value added intermediates for exports like beneficiated manganese ore agglomerates such as sinter and pellets.

vii) R & D is required for reclamation of old mined out areas, and to ascertain the impact of manganese mining on the ecology (air and water).

4.6.0 Chrome Ore

4.6.1 Chromite is the only economic source of chromium. It has a wide range of use in metallurgical, chemical, refractories industries. The properties of chromium that make it most versatile and indispensable are its resistance to corrosion, oxidation wear and galling and enhancement of hardenability. 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. Hard lumpy chromite is used for high carbon ferro chrome while friable ore and fines briquettes are used for low carbon ferro chrome. Both briquetted fines and lumpy ore are used in production of charge chrome.

4.6.2 Due to high melting point, 1700 – 1800 degree Celsius, high quality lump chromite ore is used for manufacturing of chrome magnesium brick to be used as insulating lining in blast furnace.

4.6.3 Indian Reserves/Resources of Chromite

4.6.3.1 As per the UNFC system, total resources of Chromite in the country, as on 1st April 2010, are estimated at 203 million tonnes, comprising of 54 million tonnes of reserves (26%) and 149 Million Tonnes of remaining resources (74%). Sukinda Valley in the state of Odisha, with one of the largest single deposits in the world, accounts for 97% of Indian chromite ore deposits. Minor deposits are scattered over Manipur, Nagaland, Karnataka, Jharkhand, Maharashtra, Tamil Nadu and Andhra Pradesh. (**Annexure – 4.3**)

4.6.4 Production, Export & Import of Chrome Ore in India

4.6.4.1 Domestic production of chromite has been on a decline since 2006-07. Production fell from a peak of 5.296 Million Tonnes in 2006-07 to 3.143 Million Tonnes in 2009-10 (**Table 4.18**). This decline has mainly been on account of poor market demand – both global and domestic.

Table – 4.18

Production of Chromite, (2005-06 to 2009-10)

(In '000 tonnes)

India	2005-06	2006-07	2007-08	2008-09	2009-10 (P)
ALL India (Total)	**3714**	**5296**	**4873**	**4073**	**3143**

Source: Indian Bureau of Mines

4.6.4.2 Export and import of chromite during 2000-01 to 2009-10 are furnished in **Table – 4.19** below. While imports of chromite have not been significant, they are on a higher level in the first three years of the 11th FY plan while exports continue to be disturbingly high with substantial year to year variations. The rising exports are to be seen in the context of the fact that in comparison to the world reserve of chromite which is in excess of 11 Billion Tonnes, India's reserves are only about 203 Million Tonnes.

Table – 4.19

Export and Import of Chromite

('000 Tonnes)

Year	Export	Import
2000-01	660	55
2001-02	1182	1
2002-03	1098	2
2003-04	745	2
2004-05	1117	3
2005-06	693	5
2006-07	1203	5
2007-08	907	121
2008-09	1899	94
2009-10 (P)	689	96

Figures rounded off
(P) : Provisional
Source DGCI & S, Kolkata

4.6.4.3 Chromite resources in the country are not abundant. The country possesses only about 1.8% of the total chromite ore reserves of the world but exports 30-35% of world share. The steel industry has sought restrictions on exports of chromite ores. The government has put in place a fiscal framework to discourage excessive export of chromite ores.

4.6.5 Consumption of Chromite in India

4.6.5.1 The reported consumption of chromite in the organized sector increased by 8% from 2,162 thousand tonnes in 2008-09 to 2,344 thousand tonnes in 2009-10, mostly in Ferro-alloys/charge-chrome category (**Table 4.20**). In addition, chromite in substantial quantities is also consumed in small-scale Ferro-chrome units for which information is not reliably available.

Table – 4.20

Reported Consumption of Chromite, 2005-06 to 2009-10 (By Industries)

(In 000'tonnes)

Industry	2005-06	2006-07	2007-08	2008-09	2009-10(P)
All Industries	1345	1786	2499	2162	2344
Chemical	5	5	5	5	5
Ferro-alloys (including charge-chrome)	1319	1757	2470	2132	2314
Refractory (including iron & steel)	21	23	23	24	24
Others (foundry, ceramic, glass)	++	1	1	1	1

Figures rounded off.
(P) : Provisional
++ - Negligible/less than one thousand tonnes
Source: Data collected on non-statutory basis.

4.6.6 Projections of Demand and Production of Chromite duringe 12th Five Year Plan

4.6.6.1 Chromite ore is used to produce Ferro chrome and charge chrome. Ferro Chrome, in turn, is used in the production of stainless steel of 200, 300 and 400 series and also of chromium base alloy steel. On the basis of around 3.39 Million Tonnes of projected demand for stainless steel by the end of the 12th Five Year Plan, total requirement of Ferro chrome in the year 2016-17 has been estimated to reach 1.726 million tonnes.

4.6.6.2 Total demand for Ferro-chrome / Chrome Alloys in the terminal year of the 12th Five Year Plan has been estimated at about 1.726 Million Tonnes based on the following assumptions:

- A 10% annual growth in demand for stainless steel from a base level of 2.10 Million Tonnes in 2011-12 reaching a level of 3.39 Million Tonnes by 2016-17
- Projected demand of 0.5 Million Tonnes of Chromium based Alloy Steels by 2016-17.

4.6.6.3 Based on the above projections of output growth in the principal end-using sectors, demand for Chromite, in its turn, has been estimated to reach a level of 4.313 Million Tonnes by 2016-17 (**Table – 4.21**) on the basis of the following assumptions:

- A specific consumption norm of 2.5 Tonnes of Chromite ore to produce 1 Tonne of Ferro Chrome/ Chrome Alloy,
- Exports reaching 0.805 Million Tonnes in 2016-17 from a level of 0.500 Million Tonnes in 2011-12.

Table – 4.21

Demand Forecast for Chromite

Projected Demand/Requirement	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Stainless Steel (Million Tonnes)	2.1	2.31	2.54	2.8	3.08	3.39
Chromium based Alloy Steel (Million Tonnes)	0.35	0.4	0.43	0.45	0.48	0.5
Ferro Chrome Requirement for Projected Domestic Production of Stainless Steel & Chromium based Alloy Steel (Thousand Tonnes)	**555**	**611**	**672**	**741**	**838**	**921**
Projected Exports of Ferro Chrome (Thousand Tonnes)	500	550	605	665	732	805
Total Ferro Chrome Demand (Thousand Tonnes)	1055	1161	1277	1406	1570	1726
Total Chromite Requirement (Thousand Tonnes)	2638	2903	3193	3515	3925	4313

4.6.6.4 Assuming a growth rate of 7% per annum, the year-wise projected production of Chromite during the 12th Five Year Plan is shown in **Table – 4.22**.

Table – 4.22

Production Forecast of Chromite

Projected Production/Output	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Chromite (Thousand Tonnes)	3500	3745	4007	4288	4588	4909

4.6.6.5 It is interesting to note that production forecast for the terminal year of the Plan at 4.909 million tonnes is lower than the peak production level of 5.3 million tonnes reached in 2006-07. Chromite production has been on the downtrend since then as exports tapered due to weak global market conditions. This is a welcome development from the point of view of conservation of local resources for future value-addition.

4.6.7 Development and Policy Recommendations for Chromite

4.6.7.1 Following are the major recommendations for development of the Chromite sector in India:

i) Extensive exploratory drilling through national agency is required to convert the remaining resources of 149 million tonnes of chrome ore into the reserve category and to explore new areas for addition of mine reserves. To augment supply of chromite ores, the following measures can be taken: (a) Exploration of deep seated ore bodies on priority basis by central and state government agencies; (b) development of technology for extracting friable and deep seated chromite ore of Sukinda Valley by underground mining methods; and (c) promotional drilling by GSI/ MECL in the potential chromite bearing areas; (d) Intensive R & D efforts for using low grade ore, with or without blending.

ii) The ore deposits of Sukinda valley of Odisha are generally of friable nature and all of them are the open pit mines which have reached the optimum pit limit. The stripping ratio in some cases has reached 1:20 and therefore immediate efforts are required for underground method of mining.

iii) A comprehensive plan to develop the Sukinda Valley through some national agency is essential in order to make the entire mining of the area more scientific, systematic and planned.

iv) It is expected that domestic production is sufficient to meet the requirement of Ferro-Chrome production required for projected steel production by the terminal year of the 12th Five year plan.

v) Chromite resources in the country are not abundant. The country possesses only 1.8% of the total chromite ore reserves of the world but exports constitute 30-35% of the world trade. Therefore, there is an urgent need to conserve this critical input for the use of domestic industry and bring in fiscal measures against exports.

4.7.0 Ferro Alloys

4.7.1 Ferro alloy units initially came up in the four states of Andhra Pradesh, Karnataka, Maharashtra and Odisha, mainly due to proximity to raw material resources. After deregulation of the Indian steel industry in 1991-92 many units came up in Arunachal Pradesh, Bihar, Chhattisgarh, Gujarat, Goa, Jammu, Jharkhand, Kerala, Madhya Pradesh, Meghalaya, Sikkim, West Bengal, etc. where ‘Power’ was made available at reasonable tariff as compared to other States.

4.7.2 Capacity in the Indian Ferro Alloys Industry

4.7.2.1 The furnace capacity in the Industry was around 600 MVA prior to liberalization. Capacity addition was over 700 MVA before the 11th Five Year Plan. An additional 1600 MVA capacity has been added during 11th Five Year Plan. As a result, the furnace capacity has crossed 2900 MVA and by tonnage capacity has crossed 4.65 million tonnes per annum. The break-up of the same is given hereunder-

	Capacity (Million Tonnes)
Manganese Alloys	2.75
Chrome Alloys	1.60
Ferro Silicon	0.25
Noble Alloys	0.05
TOTAL	**4.65**

4.7.3 Production, Export & Import of Ferro Alloys

4.7.3.1 The Indian Ferro Alloys industry is operating at below 70% of its capacity. Production of bulk and noble Ferro Alloys during 11th Five Year Plan are shown below in **Table – 4.23**.

Table – 4.23

Production of Ferro alloys during 2005-06 to 2009-10

(Tonnes)

Production	2009-10	2008-09	2007-08	2006-07	2005-06
Bulk Ferro Alloys	2462775	2224502	2385537	1973688	1622378
Noble Ferro alloys	30858	27235	29185	27763	23049
Grand Total	2493633	2251737	2414722	2001451	1645427

4.7.3.2 Export of Ferro alloys has increased over the years from 15% of the production in 1991-92 to around 30% and further to 40% at present. In terms of value, exports which were at around Rs. 2500 million have reached Rs. 68778 million in 2008-09. Exports during the 11th Five Year Plan have been as shown in **Annexure - 4.4**.

4.7.3.3 Imports of bulk Ferro- alloy were negligible in the past, except for Ferro nickel. During 10th and 11th Five Year Plans, imports of bulk Ferro alloys have increased due to drastic reduction in import duty rates. Ferro silicon is the main bulk Ferro alloy to be imported. Details of import and export of Ferro-alloys are placed in **Annexure – 4.4 & 4.5**.

4.7.4 Projections of Demand/Consumption and Production of Ferro Alloys during the 12th Five Year Plan

4.7.4.1 **Bulk Ferro Alloys** (viz. ferro manganese, ferro silico manganese, ferro silicon, ferro chrome, etc.) manufactured in submerged arc furnaces, and Noble Ferro Alloys
(viz. ferro molybdenum, ferro vanadium, ferro tungsten, ferro silico magnesium, ferro titanium, ferro boron, etc.) manufactured through the alumino thermic process, are used in the production of steel as deoxidants and alloying agents to impart particular physical properties to finished steel products. Growth in the steel industry, therefore, drives the demand/consumption for Ferro-alloys. Depending upon the process of steel making and the type of steel being made, the requirement of different Ferro alloys varies within a wide range.

4.7.4.2 Based on the demand forecasts of steel for the 12th Five Year Plan, projected consumption of Ferro Manganese and Silico Manganese together has been estimated at 3.024 Million Tonnes and that of Ferro-chrome at 1.726 Million Tonnes by the end of 12th Five Year Plan. The year-wise projections also include possible exports and are shown in **Tables – 4.24 & 4.25**.

Table – 4.24

Projection of Manganese Alloys Demand During the 12th Five Year Plan

PARTICULARS	Consumption Norm (Kg/T)	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Ferro manganese							
a) in Crude Steel (Thousand Tonnes)	5Kg/T CS	380	430	473	520	573	630
b) in Stainless Steel (Thousand Tonnes)	50 Kg/T SS	76	84	93	102	98	109
Total Domestic Demand (Thousand Tonnes)		456	514	566	640	698	739
c) Projected Exports (Thousand Tonnes)		80	88	97	107	118	130
d) Total Demand for Ferro Manganese including Exports (Thousand Tonnes)		**536**	**602**	**663**	**747**	**816**	**869**
Silico Manganese							
a) in Crude Steel (Thousand Tonnes)		911	1031	1134	1248	1374	1511
b) Projected Exports (Thousand Tonnes)		350	385	424	488	561	645
c) Total Demand for Silico Manganese (Thousand Tonnes)		**1261**	**1416**	**1558**	**1736**	**1935**	**2156**
TOTAL MANGANESE ALLOYS (Ferro & Silico Manganese) (Thousand Tonnes)		**1797**	**2017**	**2221**	**2483**	**2751**	**3024**

Table – 4.25

Demand Projection for 12th Five Year Plan For Chrome Alloys

PARTICULARS	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
STAINLESS STEEL DEMAND (IN MILLION TONNES)	2.1	2.31	2.54	2.8	3.08	3.39
CHROMIUM BASED ALLOYS STEEL (IN MILLION TONNES)	0.35	0.4	0.43	0.45	0.48	0.5
DEMAND FOR FERRO CHROME (IN '000' TONNES)	367	404	444	490	462	508
FOR 200 SERIES STAIN LESS STEEL						
DEMAND FOR FERRO CHROME (IN '000 TONNES)	153	168	185	204	259	285
FOR 300 SERIES STAIN LESS STEEL						
DEMAND FOR FERRO CHROME (IN '000 TONNES)	29	32	35	39	108	119
FOR 400 SERIES STAIN LESS STEEL						
CHROMIUM BASED ALLOYS STEEL (IN '000 TONNES)	6	7	8	8	9	9
TOTAL IN '000 TONNES	**555**	**611**	**672**	**741**	**838**	**921**
EXPORT IN '000 TONNES	500	550	605	665	732	805
TOTAL FERRO CHROME IN '000 TONNES	1055	1161	1277	1406	1570	1726

4.7.4.3 Production of Manganese and Chrome Ferro Alloys is likely to keep pace with rising demand during the 12th Five Year Plan. The current capacity in different segments of the Ferro Alloys industry is expected to be adequate to meet the total domestic demand and the projected exports during the 12th Plan period. It should be noted that the industry is currently operating at 70% of the installed capacity.

4.7.4.4 Projected requirement of Ferro silicon during 12th Five Year Plan is estimated to be around 0.419 Million Tonnes by 2016-17 **(Table – 4.26)**.

Table – 4.26

Projected Demand for Ferro Silicon During the 12th Five Year Plan

Projected Demand/Consumption/Production	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
Projected Crude Steel Production (Million Tonnes) Projected Demand for Ferro Silicon	75.94	85.90	94.50	104.00	114.50	125.90
a) in Crude Steel Production (Thousand Tonnes)	230	258	284	312	344	378
b) for Exports (Thousand Tonnes)	25	28	31	34	37	41
Total Ferro Silicon Demand (Thousand Tonnes)	**255**	**286**	**315**	**346**	**381**	**419**

4.7.5 Development Issues and Policy Recommendations for Ferro- Alloys

4.7.5.1 The various development issues and related policy recommendations for this sector are as given below:

i) Manufacture of Ferro-alloys is power intensive and there is a strong need to ensure steady power supplies to the industry at a stable price. In the absence of competitively available electrical power, the domestic industry will face stiff competition from imports leading to possible closure or underutilization of the capacity in the industry.

ii) Implementation of the new Electricity Act, 2003 has to be expedited in full spirit. This will help the industry grow competitively.

iii) The ferro-alloys industry should focus on captive power generation and use non-conventional sources of energy. In this connection allowing the industry to have a higher rate of depreciation (30 %) for its captive power plants may be considered. Similarly, the industry may be allowed duty free imports of used power industry equipment. These measures would provide the necessary fiscal support and enhance the attractiveness of the captive power projects.

iv) Use of more and more agglomerated feed in the manufacture of chrome and manganese ferro alloys needs to be actively promoted. 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. There is a need for suppliers to offer lower cost smaller capacity pelletization plants, considering the existing small and medium size furnaces in use.

v) There is a need for government sponsored research in collaboration with industry in beneficiation of low grade manganese ores of eastern India with high Fe content.

vii) The government may also consider allocating coal blocks on captive basis to power plants attached to ferro-alloys producing units. The government may further waive the import duty on anthracite coal (under Tariff Heading 27011100), from the current level of 5 per cent ad valorem.

viii) There is tremendous potential to increase exports, after fully meeting domestic demand, provided the industry is accorded competitive global parity in power tariff.

4.8.0 Refractories

4.8.1 Refractory used in the steel industry is commonly grouped into four categories of material, viz.,:

(1) Containing mainly alumino silicates;

(2) Made predominantly of silica;

(3) Made of magnesite, dolomite or chrome ore, termed basic refractories, and

(4) A miscellaneous category usually referred to as special refractories

4.8.2 Production, Consumption, Import & Export of Refractories

4.8.2.1 Production and Consumption and Trade in refractory materials during the 11th Five Year Plan are shown in **Table – 4.27** below.

Table – 4.27

Production, Consumption, Import and Export of Refractory Materials During the 11th FY Plan

	2007-08	**2008-09**	**2009-10**	**2010-11**	***2011-12(est)***
Total Production (Tonnes)	1254901	1251919	1252340	1277387	*1283774*
Average Refractory Consumption (kg/Tonne of Crude Steel)	18.81	17.33	16.75	16.04	*14.97*
Import (Tonnes)	519085	913898	396350	501644	-
Export (Tonnes)	*190303*	*885735*	*497436*	*210188*	

4.8.2.2 Details of import and export of refractory and their raw materials can be seen at **Annexure – 4.6, 4.7 and 4.8.**

4.8.3 Projected Production and Demand for Refractories in the 12th Plan Period

4.8.3.1 Estimated requirement of refractories during the 12th Five Year Plan is based on the projected demand for iron and steel and the norm of average consumption of 15 kgs. of refractories per tonne of steel. This norm has been adopted in consultation with the Refractory Division of SAIL and Indian Refractory Makers Association (IRMA).

4.8.3.2 Production of refractories has to be geared up from present level of about 1.3 million tonnes to 1.89 million tonnes by 2016-17, to meet the requirement of refractories derived on the basis of projected steel production. It may be noted that due to improvement in the quality of the refractories and the operational practices adopted in iron and steel making units, specific consumption of refractories has fallen by about 30% over the years.

4.8.3.3 From the current level of about 1.3 Million Tonnes, production of refractories in the country is forecast to rise by about 0.2 Million Tonnes annually till the terminal year of the 12th Plan to around 1.8 Million Tonnes by 2016-17 (**Table-4.28**). This means, there will still be a gap between demand and supply of refractories in the country and the same will have to be imported. Imports will be mostly in the high technology and sophisticated product categories with the basic products to be supplied by the domestic industry. The domestic industry has already the capacity to meet the incremental demand for common refractories. This will support the industry to raise its capacity utilization and also turn more profitable with that.

<u>Table – 4. 28</u>

Projection Of Steel Production Vis A Vis Requirement of Refractories During 12th Five Year Plan

	2012-13	2013-14	2014-15	2015-16	2016-17
Projected Crude Steel Production (Million Tonnes)	85.90	94.50	104.00	114.50	125.90
Refractory Consumption per tonne of steel (Kg/T CS)	15	15	15	15	15
Projected Refractory Consumption (Tonnes)	1288500	1417500	1560000	1717500	1888500

4.8.4 Development Issues & Policy Recommendations for Refractory Sector

4.8.4.1 Development needs of this sector along with policy suggestions are placed below:

i) Close coordination between the refractory makers and operational establishments is essential for optimisation of operational parameters and standardization of the same.

ii) Mushroom growth in refractory industries in the unorganized sector has brought in unhealthy competition within the industry. The government may see that such units are strongly brought under the ambit of law.

iii) The R&D works for refractory is inadequate and needs to be improved. The stringent specifications of input raw materials for refractory restricts the used of indigenous raw materials. However, R&D is required for enhancing the use of indigenous inputs by developing suitable technical specifications.

iv) Standardization of shapes and size of refractory bricks is essential for smooth production and inter-changeability in the industry.

CHAPTER – V

INFRASTRUCTURE FOR STEEL INDUSTRY AND ASSOCIATED MINING INDUSTRY

5.0 Overview

5.1.0 Steel manufacturing involves bulk movement of raw materials and finished products over long distances and across the country. Movement of raw materials requires special attention as extraction of mineral resources is largely confined to remote and relatively inaccessible areas in the eastern and southern regions of India. Mining areas in general are characterized by poor transport and logistics network, power shortage and water scarcity. These infrastructural constraints continue to dent steel industry's competitiveness on account of higher transportation cost, higher tariffs, and long delays.

5.1.1 Till now as part of the plan formulation , the issue of infrastructure development has always been appraised at the macro level only, with no separate focus on industry specific requirements like that of steel making or its associated mining industry. Even the Working Group on Steel for the 11th Five Year Plan (2007-12) had not fixed any specific targets on the subject. Today this approach is no longer valid because every tonne of steel produced requires movement of at least four tonnes of crucial raw materials like iron ore, coal, limestone and other minerals. This implies that the total traffic demand emanating from the steel industry will nearly double in the next five years i.e., by 2016-17. Therefore the transport logistics for the industry will have to be intensive, quicker and more efficient to take on larger traffic load to sustain the manufacturing operations.

5.1.2 Keeping in view crucial factors like the terrain of the mining areas, the distance to be covered and the need for bulk movement of raw-materials the three main infrastructure linkages required for transportation by the industry are railways, roads and Ports. The industry's existing facilities, prospects and development options under each of these three options is detailed below:-

5.2.0 Railways

5.2.1 Railway transportation is dependent on two factors i.e.

(1) Rail infrastructure which includes railway network, load bearing capacity and speed, allied infrastructure such as sidings, facilities for repair and maintenance , availability of rolling stock , communication facilities etc. and

(2) Rail-customer interface and terminal infrastructure.

5.2.2 As far as augmentation of rail infrastructure is concerned, Railways has already taken the initiative to augment its infrastructure through:

(1) Identification and augmentation of routes that require additional capacity. Indian railways have several important projects in hand currently which will provide a much better transport infrastructure in the major steel and related mining areas.
(2) Commissioning of work for setting up of the eastern and western dedicated freight corridors
(3) Induction of sufficient fleet of wagons/locos.
(4) Increasing axle load of wagons to 25 tonnes.
(5) Running of long haul trains

5.2.3 In the case of steel industry the terminal Capacity both at loading and unloading end plays a crucial role in handling of rail borne traffic. A number of the terminals at integrated steel plants and ports do not have adequate infrastructure to handle rail borne traffic in an efficient manner leading to abnormal detention of wagons/locos. The terminal performance is further affected due to frequent break down of handling equipment at the terminal. For handling of rail borne traffic, appropriate infrastructure is necessary which will help in seamless service to the industry. Similarly development of unloading terminal has to be given priority to meet growing demand.

5.2.4 Presently, no data is available to link investment made by Indian Railways directly to the requirement of the steel and the related minerals industries, although the projects where new railway connectivity is required have been identified. The projects listed in Indian Railways Vision 2020 document as on 1st April 2009, have experienced serious cost overruns. A lot more funds are required to complete these projects. While a lot of progress has been reported to have been made since the status in 2009, Indian Railways will require substantial additional funding in aggregate.

5.2.5 An important point to be noted is that for most steel makers, infrastructure development will have to be seen initially in the context of the prospects of development of the minerals. Several iron ore mining companies like NMDC Ltd., Sesa Goa, MSPL Ltd. etc., have already reported plans for enhancement of their iron ore mining capacity. Similarly steel companies having captive mines are also expanding their mining capacity. In addition, in the past few years, several small and mid size mining leases have been accorded the necessary clearances to start mining. As per the preliminary estimate, based on the discussions with the mining industry, one may expect iron ore mining capacity in the country to rise to about 360 million tonnes by by 2015. The scale of investment required for providing supportive linkages for movement of these mined raw materials across the country is therefore quite high.

5.2.6 A substantial portion of iron ore is transported by road from mine heads to the loading stations. Transportation by road is an expensive proposition. Besides such bulk movement of minerals also puts considerable strain on the road network leading to frequent breakdown, with implications for other users of the roads. Therefore it is desirable to opt for rail linkages to mines for reducing dependence on roads.

5.3.0 Railways in Eastern Region

5.3.1 Augmentation of rail infrastructure in the eastern region of the country is vital as most of the mines and steel plants are located in this area About 30% of India's iron ore resources are located in the states of Odisha and Jharkhand. The combined production from these two states was about 102 million tonnes out of the total all India production of 218 million tonnes in 2009-10. It is, therefore, evident that infrastructure facilities in this region are of utmost importance from the point of view of the domestic steel industry.

5.3.2 Given the advantages of proximity to high grade iron ore, a number of mega steel projects have been planned in the states of Odisha, Jharkhand and Chattisgarh. These include the projects of Tata Steel (Kalinga Nagar, Gopalpur, POSCO's project near Paradip, Bhushan Steel and Bhushan Power and Steel Ltd.'s projects, JSPL's projects at Angul, etc. in Odisha; Nagarnar project of NMDC in Chhattisgarh and JSW Steel's project in the State of Paschim Banga. Besides most major steel producers are on course to add capacity at their existing sites. These projects have invariably been based on promised captive iron ore mines and also assurance provided by the state governments to develop the necessary infrastructure. The state governments have also undertaken the responsibility of providing land, water and other supportive linkages needed for the projects.

5.3.3 The constraints in the eastern sector include lack of proper rail connectivity to ports, delays in completion of railway projects, inadequate rail capacity connecting domestic steel plants and iron ore mining areas, lower haulage capacity, higher lead time, length of rake being small compared to other countries and poor loading and unloading systems.

5.3.4 The existing facilities cannot possibly support the future growth in production and movement of steel and iron ore in the region. The rail traffic density in the eastern states is already very high. Steel Authority of India Ltd. (SAIL) has already reported possibility of extensive constraints in moving their goods with their own traffic expected to rise from the approximately 61 million tonnes in 2010-11 to about 98 million tonnes by end of the 12th plan period i.e. 2016-2017.

5.3.5 From iron ore mining areas of Barajamda, Barbil, Banspani, etc., iron ore is transported by railways to steel plants and to the ports of Haldia and Paradip. In order to increase the carrying capacity, several new railway projects have been undertaken in this region such as Banspani – Daitari, Haridaspur – Paradip line, Angul – Sukinda Road line, Jharsuguda – Sambalpur line, etc. While Banspani-Daitari project has been commissioned, work is in progress in Haridaspur – Paradip, Angul – Sukinda rail link work. The Jharsuguda – Sambalpur (doubling) project has been recently sanctioned. The early completion of these projects is crucial for the industry. One option for expeditious completion of projects will be for the Ministry of Railways to develop freight corridors jointly with rail users – private foreign and domestic companies and Public Sector Undertakings (PSUs).

5.4.0 Railways in Southern Region

5.4.1 In the southern region Iron ore from Bellary-Hospet sector moves to ports such as Chennai, Krishnapatnam, Goa, Karwar, Belekeri and new Mangalore, mainly for exports. At present movement has completely stopped following the Supreme court ban on mining**.** Railways have sanctioned projects to augment capacity on various sections connecting the above ports through doubling of Hospet – Vasco section, Obulavarapalle – Krishnapatnam connectivity and Attipattu – Puttur new line**.**

5.4.2 There exists a dedicated railway line between Bailadila and Visakhapatnam (Vizag) port, which carries iron ore for exports and also for domestic consumption, catering to major consumers such as the Visakhapatnam Steel Plant of RINL, Essar Steel, JSW Ispat Industries Ltd. and Welspun Maxsteel plant. To ensure and sustain the movement of increased tonnage by the railways, it is necessary to strengthen the existing railway facilities.

5.4.3 The iron ore mines in Goa are located close to rivers and therefore iron ore movement within Goa is mostly by barges to Mormugao and Panjim ports. However, iron ore from Bellary Hospet is moved by railways and exported through Mormugao. It may therefore be viable to use ports for coastal movement of iron ore too as and when new steel plants are set up in various states of the country in coastal locations.

5.4.4 Also keeping in view the growth potential of mining and the steel industries, Indian Railways may also add more wagons, upgrade technology and have dedicated freight corridors for sectors such as Howrah-Mumbai and Howrah- Visakhapatnam.

5.4.5 Beside iron ore, coal required by the industry needs to be transported by the railways. A large portion of the coking coal required by the industry is imported. Non-Coking coal required for power generation by steel makers also needs to be efficiently transported.

5.4.6 A list of several important Railway projects intended to improve transport infrastructure in the major steel and related mining areas are given at **Annexure – 5.1**. Besides, Indian railways are also on a mission to upgrade their rolling stocks and renew tracks so that carrying capacity can be enhanced significantly.

5.5.0 Railways : Policy Recommendations

5.5.1 Infrastructure development related to iron ore mining has so far been focused primarily on the export business. This is so in case of railways and ports in particular. While there is a common use of the infrastructure not only for domestic business but also by other industries and trade, the focus on the profitable iron ore export business seems to have led to excess capacity in certain areas related to railways and ports. At the same time, lack of connectivity remains a major constraint for domestic iron ore consuming industries.

5.5.2 One of the reasons for this anomaly may be differential railway fare structure for exports and for domestic industry. Exports railway freight is almost three times the domestic railway freight and this makes railway projects meant for export business more attractive. It may be, therefore, necessary to have a relook at this differential freight policy. Further, the steel industry needs to move other raw materials such as coal, limestone, dolomite, etc., apart from finished iron and steel products. Therefore, the focus needs a change.

5.5.3 Also, the issues related to infrastructure for transportation of minerals have to be examined with reference to the specific requirement of the major/large mining companies or steel producers and for, the requirement for the small and medium enterprises. Normally, the large steel and mining companies can afford to build their own mine linked infrastructure. In many ways such investments are financially viable due to the advantages from economies of scale. The smaller and medium size steel and mining units, on the other hand, cannot do so and have to depend primarily on the common infrastructure built by the government agencies.

5.5.4 Though the large mining companies and steel producers with captive mines tend to construct some of their own mine-linking infrastructure, it is often far beyond their capabilities to build the entire infrastructure they need for their business themselves. SAIL has indicated that a 3rd line between Manoharpur and Asanboni with connectivity to Chiria mines may be expeditiously built up. Similarly, there is also a requirement of doubling of Barsua-Kiriburu-Meghahatuburu and Bimlagarh-Bondamunda lines to support the movement of iron ore from their captive mines. The slow progress of work on the Dalli – Rajhara –Rowghat is a point of major concern for Bhilai Steel Plant of SAIL. SAIL has also sought connectivity between Bimlagarh and Talcher.

5.5.5 Indian steel producers procure their limestone in substantial quantities from Jaisalmer in Rajasthan. The annual movement for SAIL itself is likely to rise from the present 1.6 million tonnes to 2.5 million tonnes. The volume can increase to 4-5 million tonnes if other producers also start using these resources. Presently, limestone is carried by road from Jaisalmer upto Sanu, from where there is availability of railway line. It is desired that a 60 kilometer long railway line maybe built connecting Jaisalmer to Sanu to improve transportation of limestone in this region.

5.5.6 It is recommended that Ministry of Railways develop product-specific railway freight corridors jointly with rail users –foreign and domestic companies and Public Sector Undertakings (PSUs). A project is under consideration connecting Haridaspur and Paradip by rail at an estimated cost of Rs.560 crore in which POSCO is likely to contribute Rs.27 crore initially for its 10% stake. This will provide a dedicated rail corridor connecting its steel plant with Paradip port in consortium with PSUs and private companies like JSPL, JSL, SAIL and mining company MSPL. This project is being developed by a Special Purpose Vehicle (SPV) led by Rail Vikas Nigam Ltd. This new railway corridor will be an alternative to the Cuttack railway line which will reduce the distance and time of transportation of raw materials like iron ore and coal from Odisha’s Keonjhar and Angul districts to the plant site.

5.5.7 Over 50 million tonnes of pelletizing capacity is also expected to be commissioned by the terminal year of the 12th Plan. These capacities are mostly in the mining areas of Jharkhand, Odisha and Karnataka. The Ministry of Railways will have to rework their operational plans to see smooth movement of pellets to different sponge iron and steel plants in the country.

5.6.0 Roadways

5.6.1 Most of the highways in the steel plants and mining areas are narrow and congested. In several areas, they are not even double-laned. The quality of the roads in the mining areas is grossly inadequate to support heavy traffic and lack of funds with the concerned agencies has led to poor maintenance, further adding to the woes.

5.6.2 Captive iron ore mines of SAIL are located in the district West Singhbhum of Jharkhand and district Keonjhar & Sundergarh of Odisha. At present, most of the roads in the mining areas, both in West Singhbhum district of Jharkhand and Keonjhar and Sundergarh districts of Odisha are in dilapidated condition and are a major cause of hardship. It is very difficult to transport machinery and other materials like explosives, liquid fuels, spares to the mines. This delays the supplies of machinery and spares. For timely expansion and development of mines the roads connecting to mines from the National Highways/major towns needs to be improved.

5.6.3 In the absence of adequate rail capacity in the eastern sector, a large quantity of iron ore is moved by roads in the eastern sector to feed the local sponge iron and steel plants in addition to support exports. In view of the growing demand of iron ore within the country, it is recommended that all the road projects undertaken in the mining area be completed as soon as possible. Some of the road routes critical to Indian mining sector in this region are:

- (i) Rajamunda-Barbil (NH215) – 60 kms
- (ii) Barbil-Panikoili (NH215) – 189 kms
- (iii) Chandikhole – Paradip (NH5A) – 77 kms
- (iv) Jamshedpur – Haldia (NH) 33, NH 6, NH 41) – 200 kms
- (v) Jaintgarh – Chaibasa – Haldia (NH 75E) – 100 kms

5.7.0 Roadways: Policy Recommendations

5.7.1 The state governments should properly plan the road networks and develop them prior to signing a MoU with those intending to set up a steel plant. In practice however, it has been found to be the other way round in most cases.

5.7.2 Special attention needs to be given to expeditious completion of the road projects and to the quality of the roads. There should be minimum four lane and preferably six lane highways, for allowing higher multi-axle loads to be carried on them for smooth, faster and cheap freight movements.

5.7.3 The government of India has fully appreciated the fact that the focus in respect of roadways development has to shift from pure connectivity to building strong, wide and express highways. The states locating steel plants and bearing minerals in particular demand more attention in this regard. It is also to be noted that inadequate growth in railway infrastructure has led to use of roadways in substitution, which from the industry point of view is only a second best option. Also, in respect of connectivity, road development should be able to service the steel industry to secure its raw materials and move its finished goods at a low cost.

5.8.0 Ports

5.8.1 Indian ports handle iron ore for both exports and domestic consumers and imports of coking coal. In 2008-09, iron ore traffic at Indian ports accounted for almost one-fifth of the total traffic. According to the estimates of the Ministry of Shipping, iron ore traffic is expected to increase to 164 million tonnes by 2015. Ports in Odisha and Andhra Pradesh (excepting Krishnapatnam) are expected to account for 42% of this traffic by 2015. However, these projections are subject to some uncertainty due to slowdown in global demand, growing domestic needs and possible curbs on exports of iron ore. Iron ore export has already fallen from its peak in the year 2010-11 due to several restrictive measures. The ports development in the country, therefore, should be refocused to cater to the domestic steel industry's requirement, namely, import of coking coal, non-coking coal, limestone as well as coastal movement of raw materials and finished goods within the country, etc.. It is noted that with the rising steel industry capacity, the dependence of the major steel producers on the port and railway infrastructure will increase significantly. Although the government has already taken note of this potential increase, the capacity planning in various ports will have to be in line with the steel industry capacity expected in the years ahead.

5.8.2 As per the projections made by SAIL, their dependence on Visakhapatnam and Gangavaram port for coking coal import will rise from the current level of 4.908 million tonnes to 5.859 million tonnes. The increases are projected to be of much higher order in case of Haldia and Paradip (plus an additional port) ports rising from the current 4.248 million tonnes to 6.373 million tonnes and from 1.07 million tonnes to 5.59 million tonnes respectively by the terminal year of the 12th Plan.

5.8.3 Tata Steel has projected that their dependence on Dhamra port will increase significantly for coking coal import for both their Jamshedpur and Kalinga Nagar works. The company will depend on Haldia, Paradip and Kolkata for their finished goods (steel) movement.

5.8.4 JSW Steel, on the other hand, is planning to depend more on Chennai, Krishnapatnam and other ports in southern India for import of their raw materials in the case of their existing plant in Karnataka. For their proposed Greenfield project in Jharkhand, which is still to be firmed up, they are planning to make use of the ports such as Dhamra, Haldia and Paradip in the eastern coast in Orissa and Paschim Banga. The expanded production at Vizag Steel Plant of RINL will lead to additional dependence on the ports of Vishakhapatnam and Gangavaram to handle their import cargoes of coking coal, limestone, and non-coking coal and export cargoes consisting of finished steel products and pig iron. Bhushan Steel Ltd., located in eastern India has planned increased dependence on Paradip and Dhamra ports. NMDC has indicated exclusive dependence on Vishakhapatnam port for import of coking coal for their Nagarnar plant.

5.8.5 Two major ports that handle iron ore from this sector are Haldia and Paradip. Paradip can load a vessel of only about 70,000 DWT due to draft limitations. Paradip is also a congested port. The draft needs to be raised for berthing bigger vessels. The draft limitations are expected to be removed once the project which includes a berth, that will be able to handle ships up to 1, 25,000 DWT, in PPP mode at Paradip Port, is completed.

5.8.6 At present, Haldia can handle a ship up to 90,000 DWT capacity. Dredging is required in the port. Although dredging is being done regularly, due to the very specific nature of the port, it is not serving any purpose. Hence, in the case of Haldia, high sea loading through barges is the way out. Simultaneously, Gangasagar which is at the end of 24 Paraganas should be developed into a ship loading point.

5.8.7 Several new port projects namely Dhamra and POSCO's captive port are under consideration for quite some time. In fact, Dhamra port has state of the art facilities and has an annual capacity of 10 million tonnes which is likely to be expanded further. It is recommended that support should be provided to this project by way of separate allotment of rakes by the railways.

5.8.8 However, from the point of view of the steel industry, coking coal supplies are of prime importance and therefore the ports continue to give due priority to unloading of coking coal, till the time, capacity of the port is adequately raised. In the ultimate analysis what is required is better planning of the movement of vessels and reduction in turnaround time.

5.8.9 Much of the coal movement for both the steel sector as well as for imports is carried out through the 12 major ports in the country. About 95 % of the country's trade by volume and 70 % by value are moved through the ports. However, as discussed above, the low draft, high turnaround time, congestion leading to demurrage, low mechanization and lack of storage space within the port area have been some of the challenges that the steel industry has been facing for some time.

5.8.10 It is essential to have deep draft ports that would enable handling of bigger ships, especially for coal. It is also important to have mechanization of facilities as well as railway terminals, along with proper storage and warehousing facilities. Better connectivity to new ports, and faster and safer loading and unloading of raw material and finished steel are also required.

5.8.11 Most of the ports have plans to ramp up their capacity, especially for coal handling. Paradip port, whose current capacity is 76 million tonnes, plans to ramp it up to 135 million tonnes by 2012. Other major coal handling ports like Vizag, Kolkata and Ennore have plans to expand their coal handling capacities. Besides the addition of Dhamra, Krishnapatnam, Gangavaram with their higher draft, better turnaround time, better hinterland connectivity and latest equipment would help resolve a lot of problems currently faced in coal handling at ports. Adani Group itself will have fully-mechanized capacity to handle close to 90 million tonnes of coal at various ports; including Mundra which itself is expected to handle 60 million tonnes.

5.8.12 The projected traffic of major and non-major ports is to move through the land transport infrastructure providing port connectivity which needs considerable expansion to keep pace with accelerating trade growth. In fact, inadequate capacities in hinterland transport often lead to higher costs and delays on account of suboptimal mode choices, circuitous routing and congestion in the hinterland transport links, all of which directly impact trade competitiveness.

5.8.13 Though all the major ports have rail and road connectivity with national rail and road network, yet more thrust is to be made for faster and efficient evacuation of cargo to and from ports.

5.8.14 Coastal movement of steel industry based raw materials and steel products has been so far limited. While this has significant prospects of increase given their better economics in many cases, the use of coastal shipping has been limited by the absence of separate queue for domestic cargoes and facilities. While in the queue alongside import and export cargoes, coastal shipping becomes unviable due to incurrent heavy demurrage costs.

5.9.0 Ports: Policy Recommendations

5.9.1 The Ministry of Shipping recently has published a vision document called Maritime Agenda 2010-20. The document contains details of the projects to be undertaken in developing port capacity and raising efficiency. Various subjects related to the movement of iron ore, coking coal, etc. have been covered in detail in this document as also policy prescriptions. These need to be followed earnestly.

5.9.2 The industry has noted that the present government policy in respect of developing commercial ports and multipurpose jetties are not flexible and industry friendly because of concession policies. Building a captive jetty is more beneficial than going for a commercial jetty. However, the roadmap of making captive jetty is still not easy because of continuous delay from the concerned agencies in making the policy framework. The procedure for selection of developers for the multipurpose jetties and cargo terminals are still governed by existing Government Resolution of 2005, which needs to be looked into and reframed in the light of the current scenario. Looking at the export potential in the country, both in respect of steel and raw materials, there should be more deep sea ports with mechanized facilities supported with connected road/rail infrastructure for proper flow of incoming/outgoing traffic of the port.

5.9.3 PPP models should be encouraged for developing the port infrastructure in the country. State government should form consortium with states having port facilities and should encourage the industries of using sea network for domestic movements over rail and road. With this the dependency on road and rail will be reduced and there will be an optimum usage of our sea networks.

5.9.4 Steel industry development cannot take place in isolation and for that there will have to be a creation of an efficient and strong raw materials base coupled with a strong transport and logistics infrastructure to move them to the users. The conversion of any raw materials into intermediates like ferro-alloys involves extensive consumption of power. Water is another item, not really considered as a raw material, but seen only as a utility, will also play a critical role in determining technology and steel production in the country.

5.10.0 Other Issues Related to Development of Infrastructure

5.10.1 Infrastructure development has to be on priority for the steel and the mining industries to develop to meet the estimated production of about 130 million tonnes of crude steel in the country by 2016-17. Infrastructure investment itself will trigger steel demand rise and if that does not take place, both steel demand and production will fall short of the forecast, estimated at 9% GDP growth rate.

5.10.2 The Infrastructure linkages whether in ports, railways or roads will have to be futuristic and should be oriented to support the heavy loads and specific requirement of the iron and steel industry and its connected raw materials.

5.10.3 A very critical issue linked to infrastructure development is the subject of land acquisition for such projects as well as obtaining of other statutory clearances like forest and environmental clearances etc. These issues have not been focused upon in detail as they basically involve consensus building for resolution. This is because the matter does not come under the purview of any single department or constitutional entity i.e. it needs consensus building not only at the centre or departmental level also at the state level wherever such projects are like to come up. The subject is therefore complex and it is welcome that government is already working on the necessary policy framework to resolve issues amicably between conflicting interests involve in land acquisition and resettlement. However, the process will have to be speeded up and implemented at the earliest so that the ambitious plans of expansion and modernization of steel making in the country or not adversely affected.

CHAPTER - VI

TECHNOLOGICAL ISSUES AND PROMOTION OF RESEARCH & DEVELOPMENT IN IRON & STEEL MAKING

6.1.0 Introduction

6.1.1 During 2010-11, domestic Crude Steel Production was approximately 70 million tonnes and is expected to reach a level of 140 million tonnes by the end of the 12th Plan, i.e., 2016-17, if growth forecasts are realized. To sustain the industry's competitive growth, there is an urgent need for adoption of modern and state-of-the-art technologies in both existing and new plants. This should also be accompanied by development of indigenous technology and innovative products by pursuing appropriate Research & Development (R&D) programmes**.**

6.2.0 Process Routes of Production of Iron & Steel

6.2.1 Indian steel industry has witnessed substantial growth in the 60's and 70's. There was a period of stagnation from the 70's to 90's when no new capacity was added nor was there any modernization /expansion of the existing plants. Early, 90's saw liberalization, when new plants with state-of-the –art technologies were set up in the private sector. In the interim period, existing steel plants of SAIL and Tata Steel were also modernized and expanded to adopt some of the modern technologies. With liberalization and deregulation of the steel sector, a large number of coal based sponge iron and electric Induction Furnaces have also come up in the country and today India is the largest producer of coal based sponge iron as well as induction furnace based steel in the world. Besides, the country also boasts of a large number of Rolling Mills and Processing Mills.

6.2.2 The Indian steel industry is, thus, characterized by a mix of old and new technologies together with integrated and stand-alone mills, and the different technologies and process routes currently in use are summarized as below:

i) Coke Oven - Blast Furnace (BF) -Basic Oxygen Furnace (BOF) /Twin Hearth Furnace(THF) using Coking Coal and Iron Ore (Lumps/Sinters) as basic inputs for production of steel flat & long products.

ii) COREX – Basic Oxygen Furnace (BOF) using non-coking coal and iron ore (lumps/pellets) as basic inputs for production of steel flat product.

iii) Direct Reduced Iron (DRI) – Electric Arc Furnace (EAF)/Electric Induction Furnaces (EIF) using Natural Gas/Non coking Coal and iron ore (lumps/pellets) as basic inputs for steel production.

iv) Direct Reduced Iron (DRI) / Blast Furnace (BF) – Electric Arc Furnace (EAF) using iron ore, DRI and coke as basic inputs for steel production where in hot metal from BF is used as partial substitute of scrap (40-50%) for optimizing power/electrode consumption and tap-to-tap time.

v) Mini Blast Furnace (MBF) – Energy Optimising Furnace (EOF) using coke and iron ore lumps and scrap as basic inputs for steel production.

vi) Stand-alone Electric Arc Furnaces using steel scrap and purchased sponge iron as basic inputs mainly for production of steel semis & long products.

vii) Standalone Electric Induction Furnaces using steel scrap and sponge iron as basic inputs mainly for production of steel semis & long products.

viii) Standalone Mini Blast Furnaces using mostly iron ore lumps and coke as basic inputs for pig iron and ductile iron spun pipe production**.**

ix) Stand alone Gas/Coal DRI Furnaces using iron ore lumps/pellets and Natural Gas/ Non Coking Coal as basic inputs for production of Direct Reduced Iron (Sponge iron).

x) Stand alone Rolling /Processing Mills using purchased/imported inputs for production of long & flat rolled steel products including coated sheet products.

6.3.0 Present Technology Profile

6.3.1 With the setting up of several new production facilities and adoption of best available technologies in existing plants, the technology profile of Indian iron and steel industry is fast changing. With availability constraints of iron ore lump, processes such as Pelletisation and sintering have received good response in the Industry. Energy saving measures such as waste energy/heat recovery, charging of hot DRI and hot metal in EAF/EIF are drawing the attention of the Steel companies. Adoption of conventional continuous casting together with thin slab casting are also being used for improved energy efficiency.

6.3.2 The salient features of the present technological profile of the Indian Iron & Steel Industry, sector wise, are given below:

i) Coke Making Technology:

In the Coke making area, though several plants have adopted some of the modern technological innovations viz. pre and post carbonization techniques, more emphasis is needed on adoption of these technologies by all the plants. This would ensure economic production of coke using inferior coal in an environment friendly manner. Stamp Charging as well as Partial Briquetting offer significant improvement in productivity and quality of coke, even with relatively inferior coal. These need to be promoted given the problems of scarce and precious prime coking coal.

Most of the Integrated Steel Plants have set up top charge, byproduct coke oven batteries. But the Steel major - Tata Steel has installed the Stamp charge batteries in their 3 million tone expansion programme to ensure higher utilization of medium coking coal and Semi Soft coals. Due to environmental concerns, many steel units established non recovery ovens like JSW, JSPL, Tata Steel etc. Some of these ovens are also equipped with modern technological innovations like vibro-stamp charging and co-generation of power. The new technology has helped to tackle pollution due to leakage of gases from the ovens, as typically found in the conventional by-product coke ovens. The Integrated Steel units need Coke Oven Gas as the fuel for various heating purposes within their plants. If non recovery ovens are put up, the coke oven gas will not be available to meet the energy needs of the steel plants. Besides, the area requirement for non recovery oven is much higher than that required for the conventional ovens of similar capacity. Therefore, the choice of either of the technologies will need to be subjected to the dual consideration of environmental concerns and energy efficiency.

In the quest for adhering to the environmental norms, the Industry has started adopting Coke Dry Quenching (CDQ) technology. But there is a problem of discharging treated waste water from coke oven (which presently finds application in wet quenching of coke) which may be contrary to the objectives of zero discharge. This is an issue to be deliberated on and resolved by the industry and the Pollution Control Authorities.

The trend of new investments in top charge batteries is towards establishing taller batteries. While SAIL, RINL and Neelachal Ispat have installed 7 m tall batteries, Bhushan Steel is in the process of setting up a 7.60 m tall battery, the tallest in the country. Taller batteries increase the productivity and reduce the environment pollution due to oven leakages effectively. However there is a need to understand the effect of increased oven height on the AMS (arithmetic mean size) of coke which is considered important for the Blast Furnace operators.

ii) BF/Corex Iron Making Technology**:**

Blast furnace technology is the most widely adopted technology for Iron making given the scale of operation, Thermal and chemical efficiency together with high level of automation. In India, Steel Producers such as SAIL, RINL, Tata Steel, JSW, JSPL, Bhusan Steel and others have set up or are in the process of setting up high capacity BF (volume over 3800 m^3) with many state-of the-art technologies which have shown excellent results in terms of productivity, quality and consumption norm. A single BF producing 8000 tons of hot metal per day with a productivity level of upto 2.8 t/m3/day with lower coke rate, higher coal injection, lower slag rate is a reality today. However since the availability of lump ore is dwindling, a need for charging pellets in place of hard lump has been felt by the industry and some of the units have already started using pellets. Other units are also setting up pellet plants to use large share of Pellets. It is also satisfying to note that there is an attempt to reduce coke rate by injection of coal or other substitutes to coking coal.

Presently, the Indian Iron & Steel Producers have Blast furnaces of varying sizes ranging from very small (50 m3 volume) to big production capacities (around 4000m3). In general, smaller furnaces suffer from lower productivity and inferior consumption norms. Secondly, due to escalation of raw material costs (especially coal/coke), hot metal becomes too expensive and unless there is viable use of the hot metal viz. production of casting/DISP, special steel etc, the process route becomes unviable at times. There is therefore, immediate need to modernize/renovate the existing production facilities to improve productivity, reduce cost and avoid obsolescence, failing which they may be phased out.

In India, Corex technology (C-2000 Module) is well established at JSW Steel, Bellary producing 1.6 million tones of hot metal per year. Following the success of the technology, ESSAR Steel is also putting up two units of the same module at Hazira. Though the technology was developed to utilise non coking coal for iron making, the normal practice today is to use weak coking coal, preferably with some portion of metallurgical coke, for techno-economic considerations.

iii) DRI Making Technology**:**

India remains the world leader in DRI production. There are three natural gas based sponge iron producers adopting shaft kilns based on Midrex and HYL-III technologies. Further, there are over 300 coal based sponge iron producers adopting rotary kilns. Since Natural Gas (NG) availability was limited to few states and locations, these processes were not finding wide acceptability in India, despite the fact that they offered better quality and productivity. No fresh capacity of natural gas based DRI has therefore been added during the 11th Plan period. However one plant based on Midrex technology using synthetic-gas is under installation at JSPL, Angul (Orissa). One more synthetic-gas based plant adopting HYL technology is also coming up at the same location. Essar Steel is setting up a gas based plant wherein use of natural gas for reformer heating will be substituted by Corex gas while JSW Steel is investing in Shaft Furnace using Corex gas in place of natural gas.

The use of Rotary Kiln process using non coking coal for DRI making has grown substantially during the current financial year. The rotary kiln process currently utilizes Iron ore lump and non coking coal for DRI production. Since the availability of hard lumpy ore in the iron ore mines is diminishing rapidly, a few units have already switched over to the use of pellets and their number is likely to grow subject to availability of pellets.

Coal based DRI process has established itself as a viable technology in terms of locational flexibility, productivity and kiln campaign life but there is potential for further improvement in terms of product quality and environment concerns.

iv) Steel Making Technology:

In India, steel making technology may be classified under three major groups, namely, BOF (45%), EAF (24%) & EIF (31%). While BOF and EAF are able to produce the stringent quality steel for high end product segment, EIF sector mostly caters to the need of construction sector.

a) Basic Oxygen Furnace (BOF) Steel Making :

The Integrated steel Plants in India are equipped with large and small as well as old and modern BOFs. Bokaro Steel Plant has established a large capacity BOF vessel (300/315 T) which has inherent techno economic advantages over smaller BOFs. Tata Steel is in the process of establishing 300 t BOF shop at Kalinganagar, Orissa. Some of the BOFs are being equipped with the latest technological innovations like concurrent top blowing and bottom stirring practices, modern automation & control facilities including dynamic charge control and better shop floor practices. JSW Steel has recently setup state-of-the-art BOF based steel making shops.

Use of carbon bonded magnesia bricks and slag splash /slag engineering (MgO enrichment) have led to substantial increase in refractory lining life. Over 5000 heats are consistently achieved by BOF steel producers. However, there are still units within India and abroad, which have achieved vessel life beyond 10000 heats. Bhilai (SAIL) has achieved average converter life of 9500 heats with a campaign record of 12325 heats. The industry is engaged in finding ways and means to consistently achieve higher campaign life through hot metal pretreatment, bottom stirring and stable foam practice.

b) Electric Arc Furnace (EAF) steel making :

The technological profile of the industry is continuously improving. Essar Steel has successfully established DC Electric Arc Furnace. JSPL has set up an electric arc furnace of capacity 250 t which is the largest electric furnace in India. Most of the plants are also equipped with common modern gadgets like water cooled wall, water cooled roof, oxygen injection, foamy slag practice, ladle furnace, eccentric bottom tapping, cored wire injection etc. leading to achieving improvements in terms of higher productivity, lower consumption of electricity, electrode, refractory etc. One of the most significant achievements of the EAF sector is their output of tailor made, high quality alloy/special steels catering to customers like the auto sector, railways, defence etc. These products require steel of stringent quality and composition. The EAF sector with modern technologies is able to meet such requirements.

A few units have set up blast furnaces for production of hot metal for use in EAF thereby utilizing the chemical/sensible heat of the hot metal resulting in very low power/electrode consumption. CONARC process which is hybrid of BOF and EAF is taking a deep route in India. Besides JSW (ISPAT Dolvi), ESSAR Steel and Bhushan Steel have also put up such a facilities for steel production for high end applications. The process is proven and is highly flexible in respect of iron bearing materials for melting. The technology is up scalable for even large capacities. A similar process is in existence in other Steel Production units such as Usha Martin, Sunflag Iron & Steel etc.

c) Electric Induction Furnace (EIF) steel making :

India is the largest producer of induction furnaces as well as the largest producer of steel adopting the Induction Furnaces technology. The industry has grown not only in terms of overall capacity but also in terms of sizes of furnaces. Today, EIFs upto 40 tonnes capacity are in operation in the country.

Though, over 30% steel is produced in India adopting the EIF route, the sector has technological limitations to refine the steel which is necessary to produce quality steel with respect to low sulphur, low phosphorous and low inclusions as required by national/international standards. The problem is more acute for those who do not get good quality shredded scrap and hence forced to use coal based DRI, pig iron and cast iron. A large number of units have recently set up captive DRI facilities. Notwithstanding the technological limitations, with increasing demand for quality steel, some of these units have taken initiatives for producing quality steel by using shredded scrap with/without part DRI or a mix of DRI (70-80%) and pig iron. A few units have also set up tiny BFs/ Cupola Furnaces to produce hot metal in EIFs to reduce electric power consumption to the extent possible. Also a few units have set up secondary refining vessels in their endeavor to produce quality steel as far as possible.

Most of the Induction Furnace units are engaged in production of mild steel ingots/billets and long products for mass consumption. Some are also producing stainless steel sheets for utensils. Most of the units are also dependent on State Electricity Boards (SEBs) for electricity, which is costly in most of the states. This makes them uncompetitive and the production capacity of this industry remains underutilized.

v) Secondary Metallurgy/Refining:

Over the years, Secondary metallurgy/Refining has been widely adopted by several ISP and alloy steel producers for the production of high quality steel. A few EIF units have also set up Ladle Furnaces to partially refine the steel produced. However, in other steel plants, adoption of these technologies is insignificant and hence their contribution to the production of alloy/special steel is very limited.

It is felt that conventional ladle furnace may not be a solution to improve the effectiveness of mini units particularly with EIF process. A good refining methodology in Ladle furnace ensures substantial reduction in sulphur. However there are no solutions for ‘Phosphorous ’ and ‘Nitrogen’ related issues. Of late, some technological solutions to reduce sulphur and phosphorous viz. Induction Refining Furnace (IRF) has been developed but their use has so far remained limited mainly on account of technological limitation and cost considerations.

vi) Continuous Casting:

ISPs and majority of the EAF and some of EIF units have adopted the continuous casting technology to reap the benefits of productivity, yield and product consistency. Today, ratio of continuously cast steel is around 70% and it is on the increase. Modern technologies such as ‘vertical Bend mould’, ‘Liquid core reduction’, ‘EMBR’, ‘mould and strand stirrers’, ‘shrouded casting’, mould powders for high speed casting, ‘water models for smooth casting’ etc have been developed recently and some of them have been already adopted in some of the casters.

For achieving overall operational efficiency in terms of productivity, quality and consistency, steel producers are expected to improve the casting technology in line with the current technological developments. However, mini steel producers, by and large, use pencil ingot technology. Hence there is a need for the mini steel producers still using the ingot route to switch over to continuous casting so as to improve their plant performance.

vii) Rolling & Finishing Mills:

Over the last five years, many steel plants with state-of-the-art technology like JSW Steel, ESSAR Steel and Bhushan Steel, have set up hot rolling mills. Tata Steel is in the advanced stage of commissioning the second HSM adopting CSP. Another example is the sophisticate Plate Mill, the widest so far in India, commissioned by ESSAR recently. In the long product segment, advanced bar and wire rod mills have also been installed (JSW, JSPL, Tata Steel etc) and these mills are capable of achieving tight tolerances in terms of ovality, dimension and good surface quality.

Almost all the major Steel producers have well laid plans for their green field and brown field expansion. In the next five years, many more state-of-the-art rolling facilities are expected both in the flat and long product segments.

Till the end of 90's, most of the Galvanizing units were producing steel for construction industry. Tata Steel set up such a Continuous Galvanizing Line for auto grade production in early 2000.

The construction sector has started demanding value-added products such as Galvalume and Colour Coated/Prepainted/Precoated steels for applications in roofing and cladding. During the last 5 years, Colour Coating Plants have been set up by several Steel Producers such as Uttam galva, JSW Steel, Bhushan Steel, Sree Precoatd Steel(Essar), National Steel etc. Galvalume Lines have also been set up by Bhushan Steel and JSW Steel for direct sale/export as well as for further processing into colour coated sheets. Tata Steel – Blue Scope JV is likely to be commissioned shortly to colour coated sheets. Due to these projects of capacity augmentation in the area of coating, the industry has been able to meet not only domestic demand but also emerged as one of the largest exporters of such products during the last 5 years.

6.4.0 Assessment of The Current Status Of Technology

6.4.1 A cursory examination of the present status of Performance Indices shows that the technological performance of Indian Steel Plants in terms of specific consumption of raw material/ consumables, specific energy/power consumption, environmental and pollution norms has been improving over the years. However, it has a long way to go to catch up with the plants in the advanced countries as may be seen from **Annexure – 6.1**.

The poor performance of the ISPs may primarily be attributable to poor quality of raw materials/inputs and obsolete technologies in older plants. Use of appropriate and state of the art technologies coupled with process optimization tools and improved quality inputs (through beneficiation and agglomeration) will enable ISPs to improve their performance indices at par with international standards/benchmark. At the same time, some of the parameters in some plants, though limited, reveal high standards of performance of Indian industry.

The inherent benefits of the industry on account of indigenously available low cost primary raw materials (iron ore) or low cost labour have been gradually eroding over the years. Therefore, a greater focus is needed on technological aspects to reduce cost of production, improve quality and produce new and value added products which are needed by the customers.

However, in some areas, our plants have become world leaders on account of adaptation of appropriate technology as well as the development of indigenous technology. Today India is the largest producer of DRI in the world. Some Indian companies are also acknowledged as global leaders in the application of technologies like coal and gas based DRI, hot charging of DRI in Electric Arc Furnace, flexible Con-Arc furnace and alternate route of iron making like COREX and thin slab casting.

6.5.0 Challenges before the Indian Steel industry

6.5.1 Though, the BF-BOF as well as DRI-EAF/EIF routes of production are well established, there is a serious mismatch between the indigenous availability of raw material vis-à-vis the techno-economic requirements of these processes. Though our reserves of iron ore are considered adequate to sustain the growth and development of steel sector, there are areas of concern in terms of their quality like high alumina content, high alumina-silica ratio and also high alkali loading in inputs which adversely affect the operation & productivity of BF, the quality of hot metal and thereby the cost of production. Indian coals (both coking and non-coking) are of very inferior quality which significantly influence the productivity, efficiency of iron making processes and quality of hot metal/steel produced. As a result there is heavy dependence on import of large quantity of coking coal. Technological solutions for these problems need to be explored considering the increasing demand and rising prices of these inputs.

6.5.2 Presently, most of the steel plants wash and (partially) beneficiate their primary raw materials particularly, iron ore and coal. But with adoption of the modern and suitable beneficiation techniques, yield and the quality of the prime output can be improved. Indian coal is characterized by lower rank and high ash content with very difficult washability characteristics. It requires high precision washeries with much finer technological controls which are not available in some of the existing domestic washeries. As a result, critical key performance indices such as coal ash and yield of washed coal are severely affected. With increasing ash content of indigenous coal, the need for the imported coal with lower ash content increases to meet the overall quality and quantity requirements of the coke ovens. Tata Steel has developed and adopted a superior beneficiation technology for their use. However, the overall scenario on coal washing remains unsatisfactory and needs to be improved. For this the Coal companies may have to be encouraged to explore the possibility of further lowering the ash content and thereby improving the overall yield in their existing and upcoming washeries

6.5.3 Because of the specific nature of the feed materials like high gangue ore and high ash coke, Indian steel plants end up with high volume of slag resulting in poor productivity and higher energy consumption. Techno-commercial solutions for the raw material related issues are the need of the hour. The undesirable gangue from ore/coal needs to be removed as early as possible in the overall process. This calls for extensive beneficiation of Indian iron ore and coal by developing relevant technologies in-house through R&D intervention.

6.5.4 It is generally believed that any ore of any impurity level can be beneficiated by selection of a suitable beneficiation process. It is true that Magnetite ores are easily beneficiated regardless of the initial iron content but this may not be applicable for Hematite ores. Along with hematite, there are a few iron bearing minerals such as limonite, goethite etc which have inherent lower iron values. The frequently present gangue minerals / substances with hematite are gibbsite and clay. If the iron bearing minerals containing low iron and the gangue are interspersed as fine particles in hematite, beneficiation to higher value of iron (65% and above) will become difficult. Very fine grinding of the ore to liberate the gangue particles will actually make the process uneconomical. So, relevant technology for beneficiating these ore needs to be developed.

6.5.5 The availability of hard iron ore lump is gradually dwindling. Most of the iron ore deposits have higher fractions of friable ore. The generation of fines during mining is continually on the rise and hence the agglomeration processes such as pelletisation and sinter making are becoming quite essential. In general, Indian ores have higher Alumina and the percentage alumina increases with the fineness of the iron ore. Appropriate beneficiation technology needs to be adopted to make the beneficiated ore suitable for the BF operation. About 20% of ROM, which is known as ‘slime’ has very fine size (less than 150 micron) and this has high percentages of alumina and silica. Iron value in slime is less than 55% and further beneficiation at this stage is not considered commercially viable. There is an immediate need to find out solutions for the realization of iron value to be used in the Iron making processes.

6.5,6 Beneficiation of Banded Hematite Quartzite/Jasper (BHQ/BHJ), abundantly available in the country, is also a techno economic challenge before the industry to enhance substantially our iron ore resource base. There is a need to take up projects on the beneficiation of BHQ / BHJ for their gainful utilization.

6.5.7 To increase the life of coal mines, there is an imperative need to expand the coal base for the Iron making processes. Coking coal middlings, which are currently used for power generation, should be up graded to coke-making variety by development of suitable washing processes. Similarly, the Industry should engage on finding suitable applications for Jhama Coal, which is considered as mine wastes today. Its suitability for power generation, coal gasification, sinter making and coal injection needs to be explored. Up gradation of coal washeries and development of processes to reduce coal ash and improve the yield are vital for the Iron and Steel Industry. Some of the coal mines are gassy and the mining operation hence becomes unsafe. At present, CMM (coal mine methane) is released into the atmosphere after diluting it with copious volume of air. Therefore, focused initiatives are needed for recovery of CMM by suitable technology

6.5.8 Similarly, the DRI and Electric furnace sector is constrained by insufficient indigenous availability, respectively, of hard iron ore lump and steel melting scrap. DRI units based on natural gas are losing their competitive edge due to rising price and non availability of natural gas. Quality and availability of non coking coal for coal based units is also not satisfactory. These issues need technological solutions.

6.5.9 Steel making results in slag generation of about 180 – 200 kg / TCS in Indian plants. While a small portion of BOF slag is recycled through sintering operation, most of it is used for land filling. But neither of these processes ensure the most effective utilization of BOF slag. The disposal of EAF slag, likewise, is equally difficult. Effective solutions for reuse of BOF and EAF slags are to be found taking into account the valuables (CaO and Fe) that they contain.

6.5.10 Notwithstanding their technological limitations to produce quality steel, Electric Induction Furnaces (EIF) account for over 30% of steel production in the country. One of the most critical problems with the process is its limitation to refine steel to reduce phosphorous content below the desired limits. Higher phosphorous and pick up of nitrogen during induction melting make the final product hard and brittle and unusable for many critical applications. Besides, the quality of sponge iron, which is sourced mostly from coal based production units, is also of poor quality, particularly in terms of metallization and phosphorus content. Because of these drawbacks, higher use of DRI in EIF results in low yield and higher energy/power consumption as well as higher phosphorous in the steel. Solutions to these problems need to be found out, if the EIF route is to sustain production in the long run.

6.5.11 Customer expectations with respect to steel quality and grade requirements are continuously increasing in terms of surface stringency, steel cleanliness and strength levels. Therefore, improvement in process, product and equipment is required. Matching global standards is a major challenge which essentially emphasizes product quality, cost competitiveness and customer satisfaction. In view of this, there is a need to develop economical processes for the production of steel with low contents of ‘S’, ‘P’, ‘N’ and ‘Oxide inclusions’.

6.5.12 In view of increasing production of special grades of steel of very stringent quality standards, there is a considerable demand for ferro-alloys of appropriate quality, particularly, for very low residual ferro-alloys. One of the issues which require immediate attention is beneficiation of manganese ore for production of low phosphorous ferro-manganese. There is also need for development of suitable technology for production of extra low phosphorous Ferro manganese for wide range of low carbon grades of steel by reducing phosphorous content of manganese ores. Similarly, suitable beneficiation technology needs to be evolved to make effective use of low grade, friable Chromites ore (less than 30% Cr_2O_3) fines, which are available in sizable quantity in India. Besides, production of ferro-alloys using alternate technologies viz. smelting reduction of Manganese

Ore, solid state reduction of Chromites ore fines/concentrates in fluidised bed reactor using natural gas also have growth potential in view of rising costs of electricity.

6.5.13 Lastly, Steel Industry is poised for a period of high growth and there is a distinct possibility of doubling of the capacity in less than ten year. A big challenge before the Indian Steel Industry is to sustain growth, avoid obsolescence of existing facilities and improve the newly adopted technologies. A concerted effort to synergize the design and manufacturing capabilities and in house R&D would be critical to meet the above challenge.

6.6.0 Strategies to overcome the Challenges

6.6.1 A large gap exists in the performance levels between Indian Steel plants and the global benchmark of best practices. To bridge the gap, the Indian steel industry has to improve the technological and economic parameters of operation of the existing plants in all areas starting from raw material to the finished product. The existing units, which face several hurdles due to technological obsolescence, need immediate improvement / modernization / renovation through adoption of energy efficient and cost effective technologies and modern shop floor practices. It is imperative that all the green field and brown field projects select appropriate and proven technologies to rectify the chronic causes of inefficiency.

6.6.2 Strategies that are considered necessary to bridge the gaps between the Best Steel Producers (technology leaders) and the Indian Steel units may include:

- Adoption of modern commercially available relevant technologies to achieve globally comparable business and product performance e.g., Technologies to address the issues related to raw material, process performance and product. All these technologies need to be critically examined and the most appropriate technologies chosen to address problems specific to the Indian steel industry.
- Beneficiation of iron ore and coal and use of agglomerated burden in BFs to the maximum extent possible.
- Partnering with world leaders to establish State of the Art Technologies through JV which will help in acquiring Technology and Process knowhow
- Promotion of new technology in association with renowned equipment supplier / technology provider
- Development of new technologies / process / product through own research. This will require resources in terms of funding, talented manpower and well equipped laboratories and all of them need to be developed to achieve a robust Research and Development process.

6.7.0 Assessment of Promising and Emerging Technologies:

6.7.1 A large number of new technologies are presently available in the world particularly in the technologically advanced countries. These are classified according to the technical areas viz. iron ore and coal processing, beneficiation, agglomeration, direct reduction, smelting reduction, coke oven and by-products, blast furnace, basic oxygen furnace, electric furnace, secondary refining, rolling etc. Some of these technologies have already been introduced in India by some producers while others are yet to be explored / introduced. The relevance of these technologies and their feasibility for introduction / adoption in the Indian scenario are discussed in the following paragraphs

6.7.1.1 Beneficiation of Raw Materials

There is a lot of scope for research in the beneficiation of materials. Keeping in view the likely shortage of water for beneficiation purposes, the Industry may explore the possibility of dry beneficiation processes such as pneumatic flotation (popular in China).

Research on the use of Micro wave in the beneficiation process indicates that the process has the following advantages:

- Reduction in grinding energy
- Improvement in final product yield

The selection of chemicals in flotation process plays an important role in

- Improvement of product yield
- Reduction in ash of coal
- Better flocculation leading to higher recovery of process water

Technologies are available to improve the yield in flotation process. Some of these are:

- Development of models to eliminate the dead zones in mechanical cells of fine coal flotation
- Improved Spurger designs

6.7.1.2 Coke Making

a) <u>Conventional coke making (By-Product Recovery coke oven)</u>

Technological innovations like Stamp Charging & Partial Briquetting of Coal Charge (PBCC), Tall ovens/batteries, Leak Proof Doors, Coke Dry Quenching (CDQ) etc may be considered for extensive adoption for enhancing productivity, improving quality and reducing pollution. SCOPE 21, a revolutionary coke production process, which is being developed by Nippon Steel, is expected to reduce energy consumption significantly and also boost production efficiency. Conservation of energy comes from preliminary coal processing and other measures.

b) <u>On-line heating control technology for coke ovens</u>

In today's scenario, Level-II computerized controlled battery heating and automation system is essential for all coke ovens to improve coke quality and reduce energy consumption in coke making. This also facilitates adherence to pollution control norms besides reducing coke rate in Blast Furnace. The technology is available with only a few select countries: CETCO, Netherlands, CODECO, Germany, Rautarukki, Finland and Amano, Japan. A version of this technology has also been developed in-house by RDCIS, SAIL for optimization of heat consumption during coal carbonization and has been implemented in BSP, SAIL and DSP, SAIL.

c) Other technological developments for adoption

- Development of suitable models to optimize the coal blend to minimize total cost, improve coke quality and oven health and promote ease of pushing.
- Accelerated/up-graded automation to improve productivity and quality i.e. level-1 or level-2 depending on the need
- Refractory welding for quick repair
- Other energy conservation programmes

d) Dry-cleaned and Agglomerated Pre-compaction System (DAPS)

The DAPS is a new coal pretreatment process for coke making to enhance coke strength and suppress dust occurrence to improve the environment friendliness of coke making by drying coal, separating fine coal from lump coal and forming the fine coal into agglomerate in dry. In addition to suppressing the dust occurrence, the DAPS has improved the caking property of fine coal by increasing its bulk density. As a result, benefits achieved are:

- The strength of the DAPS coke is markedly better than that of the CMC coke both in terms of cold as well as hot strength.
- The DAPS makes it possible to increase the use of non or slightly-caking coals by 30% compared to the conventional wet coal charging process, and by approximately 20% compared to by the CMC process, without deteriorating the coke strength
- The charging density of coal with the DAPS is approximately 0.80 t/m3, and together with the reduction of coking time due to the decrease in coal moisture, productivity of coke ovens improves by 21% compared with the conventional wet coal charging process.
- The DAPS decreases the heat consumption of coke making due to lower moisture content of coal and productivity. The heat consumption decreases by approximately15% compared to the conventional wet coal charging process at the same production rate.

6.7.1.3 Sintering and Agglomeration

A number of new technologies namely, increased use of multi slit burners, “proper MgO addition’ etc. are available which have to be introduced in the existing sinter plants to make them more energy efficient. Similarly, measures available for increase in productivity from existing facilities viz. use of super fines in sinter mix (e.g. HPS process), vibrating granulation equipment, high agitating mixture, extension of grate width, modern high pressure sintering, increased bed height/width and suction etc. have to be introduced selectively. Energy conservation & reduction and Emission Control in Sinter Plant are challenging tasks and modern energy conservation & pollution controls need to be considered on priority.

Pellet sintering technology (CAP process), which combines pelletisation and sintering process holds promise to take care of the availability of finer grade iron ore fines.

6.7.1.4 BF Iron Making

Different technological innovations that need to be considered under Indian conditions to improve the productivity and quality of hot metal and to reduce the consumption of fuel are elaborated hereunder:

a) Process improvements

Introduction of Cu- staves, silicon carbide or other improved refractory system in high heat load areas, revamping/conveyorisation of stock house and screening efficiency of ore, sinter and coke, strengthening stoves capacity, increasing blast volume and flow rate, increasing oxygen enrichment of blast, hot blast temperatures of at-least 1100^0 C, application of close circuit water for better cooling efficiency, increasing the inner useful volume by the use superior quality refractories (by 150-200 M^3), introduction of alternate fuel injection in blast furnaces, augmentation of cast house facilities including powerful mud gun and drilling machines and installation of latest instrumentation, automation and control systems for improved process control will have to be given immediate importance.

b) Increased use of prepared burden

Prepared burden (sinter, pellets, DRI and other metallics) has to be increased to the extent of 80-90%, if not more, to achieve consistent quality of hot metal and better performance efficiency of furnaces.

c) High level of alternate fuels injection

In order to reduce coke rate, incorporation of technologies for injecting pulverized/ granulated coal (+ 200 kg/tonne of hot metal), oil (100 kg/ tonne of hot metal), Natural gas (100 kg/ tonne of hot metal) and waste plastics granules have to be seriously considered.

d) Cost reduction measures

Technologies such as - Top Gas Recovery Turbine, use of waste heat stove gas for preheating of gas, high efficiency stoves etc. need to be evaluated and introduced in existing and new blast furnaces.

e) Increase in campaign life

Introduction of various measures like copper staves, Silicon carbide and monolithic linings in stack and bosh, closed circuit de-mineralized water and provisions for regular monitoring of heat flux all along the furnace height and cross-section, use of titanium bearing material as a regular hearth protection measure etc. will have significant impact in extending campaign life of furnaces.

f) Application of sophisticated probes and computerized expert system

Extensive use of probes (under and overburden probes, vertical probes etc), models and computerized Expert system for process analysis, control and optimization are importfant tools for bringing about quantum improvement in productivity levels of Indian blast furnaces.

g) Efficient casting practice

This can be promoted through up-gradation of cast house equipment, clay mass and liquid disposal system. Incorporation of powerful mud gun and drilling machines are important and need to be considered for incorporation.

6.7.1.5 Direct Reduction and Smelting Reduction

a) Coal gasification for DRI production

A revolutionary and challenging new alternative likely to be suitable under Indian conditions is non-coking coal gasification by the well established coal gasification (Lurgi Technology) and use of the synthesis gas thus generated (in lieu of natural gas) as the reductant in vertical Shaft Furnace to produce gas based DRI. Indian steel companies adopt this technology to tackle the problem of non availability of natural gas.

Several Smelting Reduction technologies, doing away with coke making or separate agglomeration facilities, have been developed over the years and several are under development. These processes are known for their eco-friendliness and use of non-coking coal directly as reducing agent and energy source and appear to fulfill the requirement of “sustainable development”, i.e. environmental control, pollution control and safety. Therefore, the relevance of these technologies has to be carefully assessed for compatibility in the Indian context.

The promising alternative technologies which have been commercialized / are in the process of commercialization and appear to be relevant are:

b) COREX Process

In the COREX process, all metallurgical work is carried out in two separate process reactors, the reduction shaft and the melter gasifier. Since, coking and sintering plants are not required for the COREX process, substantial cost saving up to 20% can be achieved in the production of hot metal. Regarding environmental concerns, COREX plant emissions contain insignificant amounts of NOx, SO2, dust, phenols, sulfides and ammonium with emission values are far below the maximum values allowed by future European standards. Furthermore, waste-water emissions from the COREX process are far lower than those in the conventional blast furnace route.

While there are several merits in adopting the process, there are a few concerns, which need to be considered before selecting this process for iron making.

- Need for pellets and metallurgical coke/coal to achieve productivity and process consistency
- Lower modular sizes requiring large numbers and hence large investment for mega steel plants
- High consumption of oxygen
- Need for gainful utilization of COREX gas for economic viability. Use for power generation or a reducing fuel is essential for process viability.

There are a number of COREX units operating in India and worldwide. In India, JSW Steel in Karnataka has two COREX reactors. Essar Steel, Hazira is also acquiring two corex C-2000 modules.

c) <u>FINEX process</u>

The limitations of the COREX process with respect to use of iron ore fines directly has led to development of FINEX process at Pohang, POSCO. The process has been successfully demonstrated at 1.5 MTPA level in South Korea.

The unique feature of Finex process, is the direct use of iron ore fines and non coking coal to make liquid iron. However, the Melter Gasifier, which melts the reduced iron as well as generates the gas for use in the fluidized beds –appears to need inputs largely in lumpy form requiring compaction of reduced ore at the high operating temperature and reducing atmosphere. While it has been possible to avoid use of coke in Melter gasifier like that in Corex plant, the process needs either lumpy coal or coal briquettes. Briquetting calls for use of binders and suitable processing technology to get strength levels of coke. The Finex plant at Pohang reportedly uses coal injection thereby lowering need of high strength briquettes. Similarly, the reduced iron to be charged in the melter gasifier is also in the form of lump/ briquettes. Thus, while need for agglomeration(pelletising) of ore and use of coke are avoided, these are functionally substituted by alternative, major processing steps requiring substantial additional cost apart from operating and maintenance difficulties. Further, like Corex gas, Finex gas is also of high calorific value and needs to be utilized gainfully to make the process economically viable.

The above technological issues and the techno-economics of a commercial scale plant of 1.5 MTPA would decide the commercial viability of the process route. If proved viable on a commercial scale, Finex technology may emerge as a leading iron making technology that will contribute to the sustainable growth to the Steel Industry. It is reported that adoption of this process is also being considered for POSCO’s venture in Orissa. SAIL has signed an agreement with POSCO to incorporate the technology under JV for creating a 2.5 – 3.0 MTPA additional capacity at Bokaro Steel Plant.

d) <u>HISMELT process</u>

This process differs from Corex or Finex in that it makes direct use of iron ore and coal fines in a single step reactor. The salient feature of the process is that it involves moderate to high degree (70% and above) of post combustion. The gas generated during the reactions is post combusted to around 50% just above the bath and the heat energy of the post combustion is transferred back to the main process through the liquid fountain of molten iron bath, instead of recovering it as export gas. This reduces the coal and oxygen requirement of the process.

A distinguishing feature of the process is the oxidation level of the slag bath (5% FeO in slag), which helps in partitioning of a large portion of phosphorous to slag. Further, silicon is practically absent, making the hot metal an ideal feed for BOF. Therefore, this process seems to have considerable promise.

The first demonstration plant of 0.8 MTPA was commissioned in 2005 at Kwinana, Western Australia. The Plant had a major shut down in February, 2006 for modification. Since its restart in March, 2006, the Plant achieved a production rate of about 60% of its capacity. The hot metal produced had low phosphorus (less than 0.05%) and very low silicon (less than 0.05%). There were further plans to scale up the size (internal diameters) of the Smelting Reduction vessel from 6m to 8m for achieving a production of 2 MTPA from the single module. However, with the market softening in 2008, the demonstration unit was shut down without any definite plan for restart. JSPL recently signed an agreement with Rio Tinto for the transfer of the existing demonstration plant to JSPL site to take the development forward.

Hence it can be said that the technology is still at the demonstration stage and would be available for the commercialization, once the teething problems are sorted out.

e) <u>FASTMET/FASTMELT Process</u>

This process envisages reduction of ore-coal composite pellets in Rotary Hearth Furnace (RHF). Various carbon sources such as coal, coke breeze and carbon bearing wastes can be used as a reductant in this process. The DRI product with high degree of metallization can be charged in conventional iron & steel making furnaces or can be smelted in Electric Iron Furnace (EIF) to produce hot metal directly from the Hot DRI adopting the FASTMELT Process. This process may be attractive for small to medium iron producing units.

The process was successfully demonstrated by MIDREX Corporation, USA jointly with Kobe Steel Ltd., Japan and subsequently, a demonstration plant was set up at Kobe Steel Ltd's Kakogawa Works. MIDREX Corporation is currently marketing the FASTMET process for mill waste oxides. Several commercial FASTMET units have been installed at Kobe Steel and Nippon Steel. Iron Dynamics, a subsidiary of Steel Dynamics currently operates a rotary hearth furnace to produce 85% reduced iron pellets which are subsequently melted in a sub-merged arc furnace to produce hot metal for use in a EAF shop.

However, the total energy efficiency of this process is not very high as compared to blast furnace or other coal based technologies for production of iron. The techno-economics of this process in Indian conditions will have to be judged after an in-depth study of the process vis-à-vis other established process for production of DRI or Hot Metal.

As it stands, this process as developed by Kobe has remained as a method for the recovery of iron value from steel plant waste materials.

f) ITmk3 Process

Developed by Kobe Steel, Japan, the process uses a rotary hearth furnace to turn green dry pellets made from low grade iron ore fines and pulverised coal into solid iron nuggets of superior quality(97% Fe) DRI, suitable for use in EAF, BOF and foundry applications. The process is unique in that nearly all of the chemical energy of the fuel used is consumed and no gas credit is exported from the system. It is claimed that the process is more energy efficient (consuming 30% less energy compared to BF-BOF route), more environment friendly with 40% less emissions and involves less capital and operating cost compared to other technologies, making it attractive for steel plants in the small and medium segments.

The process has a very good separation between iron (realized as metallic nuggets) and slag and the purity of iron is also very good. Recovery of iron value from the iron bearing materials is expected to be very high. RHF may be one of the processes for efficient recovery of iron value using the mine wastes such as iron ore slime and Jhama coal. However, in this process considerable percentage of coal ‘S’ gets into metallic nuggets and hence the use of the product in place of scrap in steel making is likely to be restricted.

A commercial plant of capacity 500000 tpa was set up by Mesabi Nuggets at Minnesota, USA. Success of the plant will pave the way for rapid commercialization of the process. SAIL has entered into an agreement with Kobe Steel under JV to set up a 0.5MTPA facility in Alloy Steel Plant, Durgapur.

6.7.1.6 Pretreatment of Hot Metal

Requirement for steel with low residuals e.g. S, P, N etc. has been on the increase. Nippon Steel uses KR process to produce low S steels ($\leq$0.002%). Japanese laboratories are engaged in the research activity of in situ generation of magnesium vapor in the hot metal ladle. Burnt dolomite with Fe-Si or aluminum is used for the production of magnesium vapour, which in turn, leads to De-sulphurisation.

To produce low phosphorus steels, apart from various ladle / torpedo based processes, Japanese industries, of late, have been using two stage converter processes e.g. LD-ORP or LD-NRP. In this process, the first blow (also termed as ORP blow) is for De-Si and De-P, followed by a second blow (termed as main blow) meant for De-C. In between these stages, there is intermediate tapping and recharging of ORP hot metal. The main advantage associated with

LD-ORP is that there is no need for prior De-Si. Other benefits of this process are low lime consumption and reduction of BOF slag by half.

6.7.1.7 Dynamic BOF process control

The key to process optimization in BOF is the exact determination of the end point of the blow. Accurate determination of end-point is a good enabler to achieve clean steel, improvement in yield and reduction in aluminum consumption. Level-2 models, which work in conjunction with continuous analyses of the converter off-gas to provide real time dynamic control of the process, have been developed. This has helped in achieving consistent and reproducible turn down condition. The other technologies used for this purpose are smart-lance or sub-lance. Tata Steel has recently introduced smart-lance in one of the BOF converters. Japanese steel plants use sub-lance quite extensively. Some of the other plants are also planning to adopt these systems in the immediate / near future.

6.7.1.8 Zero waste BOF steel making

Different wastes are generated in a BOF Shop. These are: slag (150 – 200 kg/tcs) and sludge. Sludge is recycled through sintering process. BOF Slag is mostly used for land filling. BOF slag contains valuables e.g. Fe and CaO and therefore, ways for effective use of the slag need to be explored. Unlike other steel plant wastes, only a fraction of BOF slag can be recycled through the sinter making route as high ‘Phosphorous’ and high FeO restrict its use as raw mix in cement making.

Some units are exploring the possibility of using the slag in

- brick making
- construction
- ballast applications

Pilot scale trials through smelting-reduction of BOF slag show a great potential for 100% effective re-utilization. Use of slag as a flux / iron bearing material in cupola has proved to be successful. Worldwide attention is focused on reducing these generations and utilizes them gainfully to realize ‘value from waste’.

6.7.1.9 Electric Steel Making

a) EAF Steel Making: A few plants in this segment, particularly those which are of large size, are world class and have adopted most of the state-of-art-technologies for higher productivity, lower energy consumption and reduced environment pollution. However, others, particularly those in smaller sizes, are burdened with technological obsolescence. State-of-the-art-technologies like Ultra High Power (UHP) furnaces with ratings of 0.9-1 MW/tonne, Oxy-fuel (side) burners, roof burners, water cooled electrode holders economizers, continuous feeding through delta region, enlarged shell for single charging, eccentric bottom tapping (for slag free tapping), electromagnetic stirrer (EMS), utilization of waste heat for scrap preheating (Finger Shaft Furnace, Echo-Arc Furnace), are recommended for adoption in the EAF sector in India to ensure increased productivity, reduced energy and electrode consumption and improved environment friendliness. Adoption of these technologies may be considered on priority by the EAF based mini steel plants through technological upgradation of existing facilities or phasing out of obsolete facilities. Use of hot metal in EAF is a well established technology to reduce electric power consumption and may be tried wherever feasible.

b) Electric Induction Furnace: The IF industry is also undergoing changes in terms of its size profile, adoption of continuous casting and secondary refining etc. However these improvements are not broad-based and are required to be adopted extensively across the segment for its survival. Technological limitations of this sector need to be dressed urgently through suitable technological interventions and directed efforts are necessary on the part of both the industry and the Government. These may include finding out ways and means to refine the steel, if possible in the IF proper or outside the IF (Ladle Refining Furnace/ Induction Refining Furnace) to reduce the harmful elements viz Sulphur, Phosphorous, inclusions, slag entrapment etc. and thereby enabling these producers to make quality steel as per relevant standards.

6.7.1.10 Secondary Refining and Continuous Casting

a) Developments in Secondary refining

In view of increasing demand for quality steel by the consumers, it is apparent that the steel industry needs to pay more attention towards secondary refining and also to continuous casting to improve the quality of steel, reduce energy consumption and increase yield and thereby produce steel at reduced cost. There are several well established technologies viz. RH / RH-OB process, CAS-OB process, LF/ AOD / VOD / VAD / VD for secondary refining which may be adopted depending on their suitability for the specific steel production units.

Some of the new technologies that are worth considering are:

- Selective use of 'Wire Feeders' to reduce variation of steel alloying elements
- 'Slag Free' tapping to improve steel cleanliness and reduce aluminum consumption.
- Improve 'Ladle Insulation' to reduce heat loss and achieve better control on super heat.

b) Developments in continuous casting of conventional slabs:

- Ladle Car Technology (instead of 'Turret System') with 'H/L' type tundish to make ladle changeover time zero.
- 'Tundish Heating' for superior steel temperature control
- 'Auto Mould Powder' feeding to reduce slag entrapment / uniform mould lubrication.
- 'Dynamic Soft Reduction Technology' to improve internal soundness of cast products i.e. reduction in centerline segregation
- Auto scarfing and 'Grinding' to remove sub-surface defects and produce sliver / lamination free coils

c) Billet caster

The casting technology for conventional billet production is also undergoing a massive change. Processes are developed to improve the casting speed (for 130 mm billets) beyond 7 m/min. This will allow the steel producers to achieve high productivity, quality and efficiency. High cast speed helps in production of billets with extremely high residual thermal load which improves the hot charging efficiency.

d) Near Net Shape Casting

Strip Production: Casting the product to a size, which will need minimum working to achieve the final product, has the following benefits.

a. Minimum energy to roll to the final size and hence reduction in CO_2
b. Reduction in inventory of semi finished products
c. Reduction in process, time and cost to get the final product

Out of the few thin strip casting installations in the world, the Castrip process, developed by Nucor / BHP, is a major technological breakthrough for producing thin gauge flat rolled steel sheets. In this process, liquid steel is directly cast into steel strip by the use of twin roll casting process followed by an in-line one stand hot rolling strand to get a desired thickness between 0.7 – 2.0 mm. The Castrip process represents a step-change over thin slab casting and conventional slab casting process. It eliminates the hot rolling process completely and to some extent the cold rolling process as well. This amounts to tremendous cost saving in terms of capital outlay, operational expenditure and the most important being the huge reduction in energy requirements.
Long Products: Near net casting is getting popular in the long product segment too. Steel players may take note of these technologies to improve their operations and cut costs. Casting of thin strip or wire rod has just started getting implemented in a few steel making units in the world. The technology of continuous casting of wire rod is presently being developed by the Arcelor Group and is currently on a pilot scale level. In future when the technology is scaled up to commercial level, the following advantages are expected to accrue:

- Possible to cast ϕ 15.0 mm rods
- Direct feeding of coils to wire rod mill
- Higher yield and low cost of production

JSPL has installed a Beam Blank caster at Raigarh and SAIL has planned a Beam Blank caster facility at Burnpur.

6.7.1.11 Hot Rolling Technology

a) Hot strip rolling

Several state-of-the-art rolling mills have been set up by the Indian steel plants and others are in the process of acquiring such mills. Some plants are practicing latest techniques like Hot Charging of Slabs, though partially Compact

Strip Processing etc in hot rolling areas and reaping benefits in terms of productivity and energy conservation. Schedule-free rolling, high pressure descalers, AWC (Automatic Width Control), Use of HSS rolls, Hydraulically controlled AGC for gauge accuracy, Finishing stands with level-2 automation, Roll cross pair, Edge preheaters, Ultra Fast Cooling in ROT and edge masking system are other developments designed to improve the productivity, quality and rolling efficiency. Improvement in heating efficiency and reduction in fuel consumption in reheat furnaces can be achieved by installation of HEC (High Efficiency Combustion) regenerative burner, which also has a favourable effect on CO2 emission.

b) Hot Finishing Facility

The hot rolled steel requirements of automotive customers are shifting to high strength steels with wider and thinner sections. Flatness and surface quality becomes extremely important when thin gauge hot rolled sheets replace cold rolled steels. Thin gauges ($\leq$2 mm) and soft grades are prone to coil breaks and edge waviness. Hot finishing facility such as skin pass mill is required to correct these problems and also provide the following benefits:

- Opportunity for inspection and removal / rectification of defective portions.
- Parting of coil as when required.
- Improving the coil winding, when it is telescopic.

c) On-line surface inspection system for hot rolled flat products

Auto-SIS system is a tool by which the early detection of defects for trouble shooting purposes is rendered possible. Installation of auto inspection system in all the processing lines and their link up with a central server helps in improving productivity and quality. At present, Tata Steel has put an Auto-SIS system at hot strip mill and it is working satisfactorily in detecting gross defects. Tata Steel is also working concurrently to develop such systems for application in cold mill and galvanizing lines. Auto-SIS not only complements manual inspection, but also helps take quick preventive and corrective action to reduce / eliminate occurrence of these defects on steel sheets.

6.7.1.12 Cold Rolling and Finishing (Coating)

a) Tandem mill / PLTCM

In the last two decades, robustness of the mill and the quality of rolling have immensely improved. To improve the gauge consistency and shape, work roll bending, CVC crown, intermediate roll shifting, Feedback & Feed forward gauge control, Hydraulically operated AGC, sophisticated X Ray gauges and Level-2 automation system have been introduced. Most of the above have been adopted by the Steel Producers, who supply steel for high-end applications. To improve the overall yield and reduce scrap, PLTCM (pickling line tandem cold mill) has been installed. Producers supplying steel for surface critical automotive and appliance applications may adopt the PLTCM concept to derive the benefits of improved yield.

Though some of the older plants are still operating with sulphuric acid pickling, most of the newer plants have adopted more efficient hydrochloric acid pickling. Other developments in the Pickling area are Tension Levelers (to loosen the scale for faster pickling), shallow / fully granite blocks, turbo pickling, acid less pickling, Acid Regeneration System, Auto Inspection etc. These processes facilitate quality and improved productivity.

b) Continuous Annealing

The recent years have witnessed a phenomenal growth in India's automotive sector. Batch annealing process (BAF) presently employed in Indian mills has limitation in terms of productivity, yield and production of high strength steel grades. Besides, the batch annealing process introduces certain defects, which reduce the overall yield. To address these limitations of BAF, Japanese mills developed the continuous annealing process in the 70's. The Continuous Annealing Technology has spread worldwide because of its inherent advantages vis-à-vis the BAF in terms of higher yield, productivity and ability to produce high strength grades. These benefits are the main drivers to switch from BAF to Continuous Annealing Lines.

c) Galvanizing

Research is in progress to improve the corrosion performance, aesthetic look and above all achieve considerable reduction in the production cost and reduce environmental impact through a host of innovative primary and secondary coatings. Primary coatings generally are metallic coatings and few examples in this category are, ZnMgAl, Al-Si (also called Alusi), Zn-Ni and flash coats. Secondary coatings are organic or inorganic coating, primarily applied to improve the formability, weldability and paintability e.g. Ni-Mn phosphate coating (also called L coat), thin organic coating (TOC), Nano-hybrid silica sol-gel etc. Adverse environmental impact of Cr^{6+} led to the development of new secondary coatings i.e. Cr^{3+} and Cr-free passivation on the galvanized sheet/strip. Fretting corrosion is a serious problem in galvanized steels and it occurs due to inter-wrap vibrations, which take place during surface transportation through long distances. Secondary coatings help reduce fretting corrosion problem as well.

d) Galvannealing

Galvannealing (GA) is a proven technology for the production of coated steel for automotive panels. GA sheets are considered better than GI on account of their superior weldability and hence most of the Korean and Japanese auto producers prefer GA to GI, in spite of the cost advantage of GI steel. Production of low strength grades by Galvannealing process is well established. However the production of high strength steel (HSS / AHSS) needs careful selection of chemistry and good understanding of the oxidation characteristics of the alloying elements. Any error due to wrong selection of alloying elements leads to the occurrence of bare spots in the zinc coating and after GA treatment, the surface reveals the uncoated regions clearly, thereby making the product unsuitable for the auto application. Research in the area of zinc coating without bare spots will trigger the development of HSS for high end application of automotive.

Zn-Mg alloy coatings are found to be superior to the current GI and the corrosion resistance of newly developed coating is reported to be more than two times that of ordinary GI. Zn-Mg coating is currently used for the construction application in Europe. Due to the superiority of the new coating with respect to powdering characteristics, it is likely to replace GA in near future. Zn-Mg coating also has a good potential to replace the conventional Zn-Al (galvalume) coatings.

e) Drivers for new products development support services

Strict emission norms in the automotive industry led to reduction of overall car weight and this necessitated the development of high strength steel grades in the flat product category. Significant growth in automotive segment also calls for development of skin panel grades, both in galvanized and cold rolled and annealed category. Environmental norm and customer expectations are the major force behind development of host of new coatings to improve the performance in terms of forming, welding, painting etc. In the construction segment, the drivers relate to providing low cost solutions and new design of product application. The General Engineering sector calls for development of electrical steels (CRGO & CRNO), API grades and steel grades for beverage can application.

Product support is becoming increasingly essential to support the new areas of application and maintain leadership in the high-end product segment. Foreign steel companies e.g. Nippon Steel, Arcellor-Mittal, Posco have full-fledged product services group to render application support to end users. Knowledge development on customer processes such as forming, welding, joining, pretreatment and painting facilitates yield improvement and lead to value creation for both the customer and the supplier. Regular interactions with customers to capture their changing needs and EVI (Early Vendor Involvement) help design, develop, and commercialize new products faster in the market place. Die quenching technology (also called hot stamping) to produce 1200 MPa steel is becoming popular and market requirement for this grade is likely to grow.

6.7.1.13 Bar and Rod mills

In both LCWR (low carbon wire rod) and HCWR (high carbon wire rod), the customers need major improvement in drawability to achieve higher drawing speeds. This requires wire rods with improvements in microstructure and cleanliness. Controls on dimensional tolerances (+ / - 0.10 mm on diameter) and ovality (0.12mm max) need focus. Product stringency with respect to surface quality and central looseness is continually on the rise. Dimensional tolerances and ovality greatly improve with the Installation of RSM (reducing Size Mill) and improved quality rolls. Due to stricter environmental norms, the acid pickling will be replaced by mechanical descaling. This will necessitate setting of rolling parameters to achieve loose flaky scales after rolling.

At the wire rod mill, the length of the Stelmor conveyor places limitation on the consistency of property that can be achieved both in low carbon and high carbon steel. Some of the developments in the cooling area are

- Direct inline patenting,
- Mist cooling
- Retarded cooling.
- ‘Hybrid cooling’ system to achieve rebars with YS>700 MPa (Developed by NSC)

A technology for endless casting and rolling (similar to thin slab rolling) has been developed for the production long products. The casting technology for the conventional billet production is also undergoing a massive change. Processes are developed to improve the casting speed (for 130 mm billets) beyond 7 m / min. This will allow the steel producers to achieve high productivity, quality and efficiency. High cast speed helps in production of billets with extremely high residual thermal load which improves the hot charging efficiency.

In the bar & rod category, High Speed finishing rolling and delivery system has been developed for the production of rebars. The main advantage that is claimed is achieving high productivity even in case of small size rebars (6mm). There is a growing demand for seismic resistance and corrosion resistance rebars. Demand is also on the rise for fire-resistant, cryogenic resistant, and explosion resistant rebars.

Compliance to tighter tolerance norms and improved drawability of LCWR and HCWR wire rods is the need of the hour.

Growth in the automotive sector calls for development of tire cord steels, which no steel maker in India is currently producing. The market demand for the forging quality steel, bearing steel, and boron steel is also expected to increase in near future.

6.7.1.14 Rail mill

a) <u>Universal rolling of rails</u>

In conventional rolling due to smaller reduction ratio and heterogeneous rolling, crack formation is encountered. Universal rolling of rails results in improved surface quality, full section forging by direct pressure, lower roll consumption, and improved mill productivity. Dimension tolerances are also improved using universal rolling.

b) <u>Head hardening of rails</u>

Increase in axle load and traffic speed induces a greater performance demand of the rails. Normal C-Mn rails have limitation in performance in such severe condition. To cater to the demands of Indian Railways, head hardening of rails is necessary. A suitable method to produce head hardened rails offline/online has to be developed to cater to the demands of Indian Railways.

6.8.0 Policy Framework for adoption of relevant technology

6.8.1 According to the industrial policy in force, import of technology is freely permissible up to a certain limit in the iron & steel sector. Foreign Direct Investment is also allowed up to 100% in the iron & steel sector. Import of equipments/capital goods whether new or second hand is also permitted. Entrepreneurs are free to adopt relevant technologies based on their commercial judgments and discretion.

6.8.2 The most important area of positive Government intervention would be in the sphere of adoption/ adaptation of promising/ emerging technologies like the FINEX, ITmk3, HISMELT etc. to supplement the conventional coke oven-sinter plant-blast furnace based technologies, thereby reducing dependence on hard lumpy iron ore/pellets/sinter, coking coal and harmful emissions. Simultaneously, the Government may also intervene and encourage modernization/ renovation of the existing plants to adopt the state-of-art technologies in the conventional route of iron and steel making.

6.10.0 Design, Engineering and Manufacturing (DE&M) facilities

6.10.1 In the initial phase of growth of the Indian steel industry during the 60's and the 70's, a pressing need was felt for developing indigenous capability to support the growing industry in the areas of 'Design & Engineering' of steel plants and 'Manufacture' of steel-making machinery. In pursuance of this objective, two agencies namely MECON (i.e., Metallurgical Engineering Consultants - a design agency) and HEC (Heavy Engineering Corporation - a machinery manufacturing centre), were set up in the public sector. These institutions were entrusted with the responsibility of providing DE&M services to support future additions of steel capacity in the country. These units, however, failed to attain their full potential due to a number of structural constraints including stagnation in domestic steel capacity. During the post deregulation second wave of steel capacity expansion in the 90's, once again the requirement for domestic DE&M expertise was keenly felt. In the absence of indigenous DE&M capabilities, the steel producers had to depend on imports of state- of –the- art facilities at phenomenal cost.

6.10.2 In the last decade the Indian steel sector has seen an exponential growth. The total production has doubled and is likely to further double by 2020. To avoid the recurrence of the problem of dependence on imported DE&M services, faced in the 80's & the 90's, suitably equipped 'design centers' and 'manufacturing facilities' need to be set up to achieve the following:

- Renovate/ modify obsolete facilities/machinery put up in the last 20 years
- Develop capability to modify / customize 'emerging technologies' to meet country specific requirements
- Make R&D activities commercially viable
- Reduce capital expenditure of future installations

6.10.3 Till the early 80’s, all the cold rolling facilities were totally imported. Due to continuous efforts of a few domestic D&M facilities, India is now in a position to put up high quality 6-Hi and twin strand mills. Even the processing lines e.g. galvanizing/colour/ coating/slitting and cut-to-length/pickling lines are indigenously available and because of that capital costs of putting up a cold rolling complex has come down substantially. Similar D&M facilities need to be developed in the areas of iron making, steelmaking, hot rolling, high speed tandem mills etc.

6.10.4 Establishment of good DE&M facilities is crucial for growth and sustenance of India’ssteel industry. Following strategies are proposed for the development of such facilities:

6.10.4.1 Design & Engineering Centers

- Set up small design centers at steel units to take care of minor modification or process improvements, which are essential for improvement in productivity, quality and new product development
- Take help of approved / renowned manufacturing facility within the country to modify / add machinery for the above objectives
- Establish design centers with or without government support (number commensurate with the anticipated growth)

These centers should have expertise to address the complex and high value design requirements of steel industry. It is a known fact that many ‘design centers’ have got established in China during the last 10 years to achieve and sustain the rapid growth in China’s steel industry. The design centers may develop expertise in specific areas e.g. blast furnace, coke ovens, sinter plants, alternative iron making processes, steel making etc. They should also equip themselves to address the overall requirements including the integration of machinery and process. To develop such ‘centers for design excellence’, human resource development plays an important role. In the beginning, a center may seek help of known equipment designers of Europe or Japan on a short/long term basis.

6.10.4.2 Manufacturing Centers

- Development of manufacturing centers requires massive investment. It may not be possible for an individual steel producer to put up such a facility. A group of steel companies may enter into an MOU and jointly set up the facility. They may also seek the help of government for garnering the required resources.

- The revival of HEC into a modern manufacturing center may also be an option

Evolution of any new technology is a long drawn process. It may take about 5~20 years and beyond to achieve maturity of a concept/idea. This requires concerted research, on one hand, and an enormous funding backed up by D&M, on the other. Steel companies may associate themselves with known equipment suppliers, preferably from Europe or Japan, individually or as a group, to promote new process development activities. The main benefit of such a development is the generation of key knowledge and IPRs, which will make the process easily adoptable during the commercialization stage. Government may think of suitable incentives for such activities.

6.11.0 Human Resource Development

6.11.1 Status

Steel industry requires technical manpower from different engineering disciplines and varying knowledge levels. As it has been described in the preceding chapters, technical personnel are required for various activities such as operation, project, engineering (design), maintenance, technology and R&D. Depth of knowledge and expertise required to perform the assigned job depend upon the hierarchical level and the department in which the employee is placed. The persons in the supervisory cadre are required to have, at least, a diploma in engineering and they pick up their required professional skills over a period of time from shop floor training and various other training opportunities provided. They operate the machinery and supervise the shift level operations. For officer level positions, the industry requires engineering graduates who should possess

- Good understanding of technology in the respective engineering discipline.
- Ability to adapt to the rigours of manufacturing sector (job rotation).
- Ability to manage resources optimally.

The technology and R&D positions need technical professionals who have the ability to do self-study, understand state-of-the-art or benchmark processes, analyze complex problems and explore new solutions. Generally, such positions demand personnel with high learning ability, mental agility and application orientation. These departments prefer personnel with high qualifications and floor experience.

The steel plants often outsource research projects to research labs and academic institutions. Good quality research output is possible, only if the research and educational institutions also have well equipped labs and competent research personnel.

6.11.2 Challenges

With the opening up of a large number of engineering colleges in the private sector in the last decade, it has become easier for students to get admitted for a degree course in the Engineering disciplines as compared to earlier periods. As a result, availability of diploma holders needed for supervisory shop-floor jobs is on the decline.

The manpower requirement of the Indian steel industry for all engineering disciplines, other than metallurgy, can be met from the large number of graduates passing out every year. A degree in metallurgical engineering is obtained from the national level institutes such as the IITs and the NITs where the best and the brightest of the students are selected on the basis of a rigorous nation-wide entrance test. The highly competitive nature of the examinations requires the students to invest a lot of energy and financial resources in the preparations for the test. These inter-related and complex socio-economic factors have resulted in a situation where the students' expectations are raised substantially, especially in terms of the type of employment and the entry level salary. It is seen that engineering graduates, in general, prefer white collar jobs with the highest available pay package. As a result, quality manpower is hardly available for the manufacturing sector where salaries are lower than the financial and other service sectors and working conditions are relatively onerous.

Sometime in the early 80's, most of the premier institutes reduced the duration of engineering degree course from 5 to 4 years. In this process of reducing the duration of the course, several important topics were dropped from the course curricula. This resulted in substantial lowering of the standards of metallurgical engineering courses taught.

Over the years, professors with PG/PhD qualifications from overseas universities that focus more on 'materials' rather than metallurgy, have given importance only to materials technology in the B. Tech courses. It is now seen that institutes do not have faculty for subjects related to metals/metallurgy. Most of the professors who used to teach Iron & Steel and other metals have retired. The institutes do not have appropriate facilities to carry out any relevant research in I&S, since the focus is now shifted to materials. As a result, graduates do not have any domain specific knowledge and interest in metals. So they opt for jobs which promise the highest salary and the least amount of shop floor work. Good students take up jobs in the financial sector or go to the United States to study materials engineering. In this situation, students of other engineering disciplines, sometimes without the necessary background or motivational level, usually fill up the PG seat in metallurgy. The problems that research institutes face are very similar to those of academic institutes.

The manufacturing industry, in general, is growing and as a result the trained and high quality manpower has alternative job opportunities outside the I&S industry, causing attrition like never before. This creates a perennial shortage of trained manpower. To make good the dilution of metallurgical education, a long and intensive training is needed to make a diploma holder / engineering graduate suitable for the job. It is also to be borne in mind that overall interest in metal/metallurgy has declined as number of persons pursuing higher education has come down drastically of late.

6.11.3 Strategies:

The fundamental reason for the decline of metallurgical education stems from the dilution of metallurgical degree course. At present, the degree is offered as 'Metallurgical and Materials Engineering'. Even in the Premier Institutes', the focus is more on 'Materials' than 'metals' for different reasons. Since the importance of metals is growing in this country, the educational institutes may think about offering four year degree courses separately for 'metallurgical engineering' and 'materials engineering'.

If the faculty members for 'metallurgical degree' are not available in the Premier Institutes presently, the existing faculty may be trained with the help of

Industry and Research Institutions. Creation of 'Steel Technology Centres' at the location of the Steel Plant sites will help in the development of faculty quickly.

With improvement in the standard of the Engineering Graduate Courses (B. Tech), standard of post graduate courses also would improve. To make indigenous research useful and effective, development of 'domain experts' is crucial. The post graduation courses should enable the students to specialize in specific areas i.e. iron making & steel making, physical metallurgy etc. Specialization in specific fields would help the industry in taking up Research Projects of complex nature to reduce dependence on imported technology. Good quality indigenous research is inevitable to address immediate and pressing needs of steel industry.

The students do not get exposure to practical Iron and Steel production processes. They are under the impression that the working atmosphere in steel plants is hot and dusty. They are not even aware that the steel industry has modernized itself considerably in the last two decades. If they know that IT and automation are best used in Steel Industry, graduates may not be flocking to IT and financial sector.

Industry would value the Researchers, when they become experts and prove their mettle. Development of Researchers into 'Domain Experts' is a time taking process. Recognition of the performance happens only when the projects are implemented successfully in the business process. An STC located at the steel plants provides an important platform for carrying out industrial research combining academic expertise with shop floor experience.

Some of the Steel companies employ graduate engineers for the shift level operating and supervisory positions. They get disillusioned quickly due to lack of empowerment and personal growth opportunities. Competency mapping and drawing of appropriate job description at the entry level of the Graduate Trainees will help the Steel Industry to improve the morale of the trainees and reduce the attrition rate.

6.12.0 Technology : Conclusions & Recommendations

- An examination of the present status of Performance Indices shows that the technological performance of Indian Steel Plants in terms of specific consumption of raw material/ consumables, specific energy/power consumption, environmental and pollution norms is significantly lower than those in the advanced countries.

- Inferior performance of the ISPs is primarily attributable to poor quality of raw materials/inputs, prevalence of obsolete technology and lack of R&D to overcome the technological gaps.

- Iron ore quality in terms of high alumina content and high alumina to silica ratio is a serious concern. There is a need to reduce the coal ash substantially to make our coals suitable for coke making and iron making operations.

- It is suggested that the improvement in raw materials be achieved through selection of appropriate beneficiation process and improvement in operational practices of ore beneficiation / coal washing circuit.

- About 20% of the ROM (run of mine) which is known as 'slime' has low percentage of iron (less than 55%). This has size lower than 150 micron and further beneficiation is difficult and not economical. There is an immediate need to find out solutions for the realization of iron value. Alternative iron production process such as FASTMET or ITmk3 may be useful to realize the iron value efficiently.

- Use of mine wastes such as Jhama coal in Iron and Steel production will be helpful to increase the mine life. Coal gasification of non coking coals and recovery & utilization of CBM are some of the steps to address the issues such as coal / coke shortage and CO_2 emission.

- Large size Blast furnaces with the state- of –the- art facilities have done well in terms of productivity, consumption norms and HM quality. With installation of such furnaces in future, the need for agglomerated burden (sinter + pellet) is likely to increase. The improvement in burden quality will facilitate higher injection of coal fines and thereby reduction in metallurgical coke requirement and overall fuel rate.

- DRI – HM –EAF and DRI – IF routes have been suffering due to non availability of hard iron ore lump, high cost of natural Gas, non availability of good quality coal, absence of good scrap and rising prices of raw material inputs for BF. To alleviate the shortage of iron ore lump, there is a need to put up pellet plants. Coal gasification is believed to be a good option to replace natural gas for the production of synthesis gas (reducing gas in shaft kiln process).

- Large quantity of slag is produced in BOF / EAF. It is not easy to dispose of the steel making slag due to the presence of free lime and high percentage of iron oxide. Technologies have been developed (ORP, MURC) in Japan to reduce the generation of slag and reduce the 'Phosphorous' level below 0.010%. Some of the technologies for reuse in the form of 'brick for pavement / construction of dykes', 'flux / iron bearing material in cupola' and construction material after sufficient aging can be adopted to gainfully utilize the slag. There is also a possibility to recover the iron values through smelting reduction.

- DRI – EIF route suffers from lack of refining ability. The steel melted by the process has higher percentages of P and N. Rotary kiln DRI-EIF route in terms of quality and environment needs to improve its technology substantially to avoid obsolescence, loss of competitiveness and market acceptability.

- Dynamic soft reduction and Near net shape casting will result in quality improvement and energy saving respectively and these emerging technologies are likely to be adopted in the coming years by the Steel Industry.

- Due to increasing demand for High Strength Steel, current BAF (Batch Annealing Furnace) technology may get replaced with Continuous Annealing Technology.

- Environment would be a major criterion for the selection / adoption of new technology in near future. Therefore the steel industry may have to carry out research in the areas of carbon foot print, CO_2 absorption and sequestration.

6.13.0 **Research and Development in Iron and Steel Sector**

6.13.0 Present Status

6.13.1 Research & Development in iron and steel sector in India is carried out mainly by the iron and steel plants themselves, National Research Laboratories, Academic Institutions etc. Though, marginal improvements in various areas of Iron & Steel technology have been realized, in overall terms, the initiatives can be considered to be meager. There is very little concern and achievement on basic research and development of indigenous technology to address the typical problems of the industry.

6.13.2 Indian Steel Companies, until recently, have remained too small in size to be able to afford significant investments in Research and Development and establish state-of-the-art laboratories. The main focus of investments of Private Sector was mostly into establishing new manufacturing facilities, capacity expansion and quality control laboratories rather than Research and Development. However during the last few years, a few steel companies have grown in size and capacity and have built adequate resources for developing their own R&D facilities. They have also started supporting research activities in academic and Research Institutions.

6.13.3 Investment in research and development in Indian steel industry in general has been limited. Actual investment vary in the range of 0.15-0.25% of the sales turnover. This is much lower when compared with the R&D investment in some of the known steel plants abroad. This scenario needs to be reversed in the interest of the country. Ministry of Steel has been supplementing R&D investment in the steel sector from Steel Development Fund and Government Budgetary support.

6.13.4 With the growth in production capacity in the country, there is an imperative need for the Indian Steel Industry to develop new products / processes /technology to sustain its competitive edge in a globally integrated economy. India has adequate raw material resources for the production of Iron and Steel and a growing domestic market. What is needed is an inherent urge to 'achieve' and add values to indigenous raw materials through R&D, innovation and technology. This would call for both establishing appropriate policies and initiating concerted efforts to promote research at company/corporate and government levels.

6.14.0 R&D Action Plan and Thrust Areas

6.14.1 According High priority to R&D: The low priority to indigenous R&D and associated design engineering and manufacturing has given rise to dependence on imported technologies and equipment. Secondly there are India specific problems which require indigenous R&D solutions. For example, resource position of indigenous raw materials requires development of relevant technologies, which can use indigenously available coking & non-coking coals and iron ore. However, lack of innovation and adaptation to Indian conditions is resulting in large-scale import of coking coal and low performance in iron making. Aggressive R&D efforts would, therefore, be required to create manufacturing capability for production of iron & steel of international quality at competitive cost using the indigenous resources in an environment friendly manner. In line with the recommendations of the National Steel Policy 2005 and Working Group for the 11th Five Year Plan, the Working Group recommends that the individual steel companies may attach the required importance to R&D and step up India's R&D investment in the Steel Sector. Government may also create appropriate environment to facilitate growth in R&D investment.

6.14.2 Encourage and Emphasize Steel Plants to increase R&D investment: The Working Group for the 11th Five Year Plan (2007-2012) had expressed concern over low R&D expenditure in Indian steel sector and recommended that the Indian steel fraternity, particularly the large steel companies must address the problem more seriously and endeavour to increase expenditure on R&D including new process/product development to at-least 1% of their turn over, by the terminal years of the 11th Five years Plan period. These objectives have not been fulfilled. The Working Group reiterates that major steel companies must increase their R&D investment during the next five years in the 12th Five Year Plan and achieve the target of 1% of sales turnover by the terminal year (2016-17). This may be achieved through

- Allotment of substantially increased budget by Steel companies
- Government support

6.14.3 Measurement of R&D Investment/ Expenditure: The Working Group has deliberated upon the issue of calculation of R&D expenditure with regard to its coverage as well as expressing the investment in terms of EBIT/ PAT instead of turnover as per the existing practice. The Working Group is of the view that the present method of calculation which is also the global practice by most of the steel companies, may be continued to facilitate comparison of R&D expenditure across the globe. However as regards the R&D content, the Working Group has noted that the Steel plants normally do four kinds of technical activities namely testing, standardization, improvement and innovation. The first two types are routine and they are not to be part of the Research Expenditure. The last two activities have research elements and the expenses on them qualify to be research expenditure. Standard tests or analyses conducted for quality control activities should not be considered as expenditure on R&D. Similarly, salaries of persons involved in quality control activities should also be not included.

6.14.4 The Working Group accordingly recommends that for the purpose of calculation of R&D expenditure, only the expenses incurred under the following heads may be covered under 'Research and Development Expenditure'.

- Development of new products and new processes/technology.
- Productivity or yield improvement.
- Quality improvement.
- Salaries of professionals involved in R&D activity.
- Adaptation of new / emerging technologies in Indian condition.
- Development of design,engineering and manufacturing activity, such as setting up a pilot plant etc.
- Collaborative research with academic institutes, research institutions and other steel plants in India or abroad.

6.14.5 Proposed Research Agenda: Though the choice of technology will be largely determined by the entrepreneurs based on techno-economic considerations, the Government would encourage/facilitate development and adoption of such technologies which are relevant to natural resource endowment of the country, which minimize damage to the environment, optimize resource utilization, facilitate achievement of global standards of productivity and efficiency and development of front end and strategic steel based materials. Towards these objectives prime focus area should be to improve the quality of the iron ore, coal and other inputs which interalia may include the following:

Area	**Research Topic**
Raw Materials & Iron-making	• Iron-making process which does not require coking coal – Emerging Alternative Iron making processes • Conversion of non-metallurgical coal into coking variety • Improve washing to increase yield and reduce ash for coking and non coking coals • Beneficiation of lean / fine and friable iron ores and suitable agglomeration for iron making • Use of mine wastes • Recycling of Steel Plant wastes to reduce / conserve the raw material inputs • Achieving world bench norms in Productivity / Quality / Raw material consumption • Low carbon technology • Coal Blend optimization in coke making • Studies on the production of Pellets from Indian iron ores for different iron making processes
Steel-making & Ferro-alloys	• Refractory life of steelmaking furnace e.g. refractory quality, sintering characteristics, brick making, recycling etc. • New process/technology for ferro-alloy making to reduce the cost and CO2 emission • Standardization and optimization of EAF with hot metal charge to improve overall performance of EAF • Low capacity vacuum technology for small alloy steel producers to improve quality and yield • Effective external de-sulphurization technology to achieve ultra low

	sulphur steel (S≤0.002%) • Clean Steel Technology for high end products • Development of low 'P' steel with optimized lime consumption – ORP, MURC etc
Modelling , Instrumentation & Simulation	• Up gradation of Automation and Technology – Level -2 and Level-3 control systems for improved productivity and product consistency • Tundish water modeling/FEM to understand fluid flow phenomena for clean steel production • Simulation techniques/FEM for process optimization • Auto Inspection Systems
Products	• Creation of stringent steel standards in line with international developments, customer needs & societal requirements • Development of high strength steels for automotives in Flat (AHSS such as TRIP, TWIP, DP, Hot forming grades) • Development of Steel for automotive in Long Product segment (Steel for tire cord) • High Strength Steel Plates for high pressure oil and gas pipelines (API – 80, API - 100 etc) • Electrical Steel - CRGO • Q&T plates (Strength level 1200MPa) • Steel for turbine application • Rails for High Speed Aplication • Steel for strategic / defence ballistic application • Development of ultra fine grained steel with YS>800 MPa in Long Product segment • Characterization of Steel Products in terms of micro structure, mechanical properties, formability, corrosion resistance, weldability etc
Environment	• Reduction of CO2 and sequestration of CO2 • Re-use and recycling of LD slag • Reduction in water consumption and over all energy requirement per ton of steel production.

6.14.6 Assistance for Secondary Steel Sector: Integrated Steel Plants may start improving their Research capability, because of their expanding volume. However units in the secondary steel sector would require assistance from the Government in establishing R&D to address the issues related to:

- Environment
- Product Quality and
- Global Competitiveness.

The Interim Report of the Expert Group on low Carbon Strategies for Inclusive Growth of Planning Commission, Government of India has recommended drastic reduction of coal based DRI-EIF capacities to reduce the carbon dioxide emission. Suitable strategies including R&D intervention may be required for the survival of the coal based DRI and EIF sector.

6.14.7 <u>Tax relief:</u> The present tax relief on R&D related expenditure is 200%. It may be continued at the same rate to spur bigger investment on R&D. However the present policy and methodologies for coverage of R&D content needs a review so as to allow the expenses incurred under various head mentioned at para 2.3 under this chapter. This may also include Pilot Plant and large scale Demonstration Plant also

6.14.8 <u>Development of Centres of excellence</u>: A few integrated steel companies have established their R&D Departments. However special efforts are needed to enhance their capabilities further to carry out high level research in Iron and Steel production. Special mechanisms are needed to bridge the widening gap and asymmetry between the Industry and Academia. To a large extent the above issues can be addressed, If the few existing Research centres are developed into 'Centres of Excellence' by joint funding between Industry and Government. Private – Public partnerships in R&D on Iron and Steel production between academia, Research Labs and Industry are essential. The Working Group recommends that a few world class research laboratories may be developed to meet the need of the steel industry. The Working Group has also noted that the designated Task Force under the new National Steel Policy is already addressing these issues at length and recommends that appropriate policy decision may be taken by the Ministry in consultation with the industry for setting up of such Centres of Excellence.

6.15.0 **Government Initiatives & Projects for promotion of R&D**

6.15.1 R&D with Steel Development Fund(SDF)

6.15.1.1 To supplement R&D in the steel sector, the Government had decided in 1997-98 to fund upto Rs. 150 crore per year for R&D projects in iron & steel sector 'upto Rs. 150 crore per year,' from the interest proceeds of Steel Development Fund (SDF). An Empowered Committee (EC) has been set up under the chairmanship of Secretary (Steel) and members from Ministry of Science & Technology, Steel Producers, Research Laboratories and Academic Institutes.

6.15.1.2 However, actual investment on R&D projects under this scheme has been limited. So far, 68 projects have been approved by the Empowered Committee costing Rs. 544 crore including SDF contribution of Rs. 263 crore. Since inception, Rs. 146 crore (approximately) has been disbursed from SDF on completed and ongoing R&D projects. Year-wise release of SDF fund during the last 5 years is given below:

S. No.	*Year*	*Investment (Rs. Crore)*
1	*2006-07*	*19.41*
2	*2007-08*	*10.12*
3	*2008-09*	*7.27*
4	*2009-10*	*11.26*
5	*2010-11*	*20.65*

6.15.2.1 **R&D with Govt. Budgetary support (Plan Fund) - Plan Assistance/Allocations for the Steel Industry - 12th Five Year Plan**

6.15.2.1 **Allocation for Ongoing Scheme for promotion of R&D in Iron and Steel Sector**: During the 11th Five Year Plan Government had allocated Rs. 118 crore for Promotion of R&D in Iron and Steel Sector. Being the first Scheme, it took some time to evolve and prepare the **Expenditure Finance Committee (EFC) Memorandum** in consultation with Planning Commission and others. A draft Scheme (EFC Memorandum) was prepared in consultation with the IFD (MOS) and sent to the Planning Commission and others on 18.03.2008. The Planning Commission accorded in-principle on 16.06.2008. The Expenditure Finance Committee under the Chairmanship of Secretary(Steel) and comprising Members from Department of Expenditure, Planning Commission and SS&FA approved the Scheme on 21.11.2008. The EFC also decided that under this Scheme research initiatives should aim at three broad areas namely,

a) Development of innovative/ path breaking technologies for utilization of iron ore fines and non-coking coal.
b) Beneficiation of raw materials like iron ore, coal etc. and agglomeration.
c) Improvement in quality of steel produced through the induction furnace.

However the Scheme was actually approved by Department of Expenditure, Ministry of Finance on 23/01/2009 with a rider that the scheme may be operated in the next financial year i.e. (2009-10).

In consultation with the stakeholders, MOS took short listed 8 R&D proposals of national importance for grant in aid under the aforesaid Scheme. The Project Approval and Monitoring Committee (PAMC) in its first meeting held on 11.02.2010 approved four R&D projects. Four more projects were approved in the second meeting of PAMC held on 23.11.2010. The total cost of the eight projects is Rs. 143.87 crore with funding from Plan Fund of Rs. 111.11 crore. Details of the approved R&D projects and year wise fund disbursal/requirement are given in **Annexure - 6.2.**

Actual work in these projects started w.e.f. 2009-10. So far Rs.31.17 crores has been released and the year-wise release of fund is in the following Table.

Year-wise disbursement of Plan Fund

Sl.No.	Year	Fund released (Rs.in crore)
1.	2009-10	4.13
2.	2010-11	27.05
3.	2011-12 (Planned)	39.00

Major projects covered under the scheme include exclusive R&D initiatives to upgrade Indian low grade iron (including BHQ/BHJ) and Indian coking/non-coking coal. Presently, these projects are at the preliminary stage of work but when completed, and if results are successful; these may go a long way in making available high quality inputs from lean ore/coal for the iron/steel industry.

R&D work in all the projects have already been started and progressing well. The tenure of the R&D projects are two to three years. This being the last year of the 11th FY Plan period, except the R&D project at Sr. No. 3, all other seven projects will continue beyond the 11th FY Plan period. So Government has to provide for meeting the balance fund during the 12th FY Plan. This year (2011-12) Rs. 39 crore has been allocated for the eight projects.

Under this background it is proposed that an amount of Rs. 50 crore may tentatively be earmarked for the ongoing R&D projects in the 12th FY Plan period.

6.15.2.2 New R&D Project Proposals for 12th Five Year Plan:

i) In addition to the ongoing projects, it is expected that few more high value projects of national importance, particularly related to technology development and adaptation are likely to be taken up in the 12th FY Plan Period. Some of these are:

- Adaptation of HISMELT technology for Indian raw materials:
- Development of relevant iron making process using steel plant wastes:
- Indigenous development of innovative products like CRGO:

Total cost of these projects as per preliminary estimates may exceed Rs. 1500 crores and proposed Government support may be estimated at around Rs 500 crores and the details are provided in the table given below:

Sl. No.	Projects	Govt. support (Rs. Crore)
1.	Adaptation of HISMELT technology for Indian raw materials	330
2.	Development of relevant iron making process using steel plant wastes	20
3.	Indigenous development of innovative products like CRGO	150
	Total	500

For undertaking the above projects, it is proposed that budgetary allocation of Rs. 550 crores (Rs. 50 crore for the ongoing R&D projects and Rs. 500 crores for the new R&D projects) may be provided during the 12th FY Plan Period.

6.15.3 Research & Development : Conclusions and Recommendations

- There is a need to develop sound indigenous capacity to develop technologies to a) suit indigenous raw materials, b) improve energy input norms through energy-efficient technologies and c) meet national norms for emission per ton of products and comply with global responsibilities for carbon foot print.

- The Research and Development systems should also match the composite structure of the steel industry in the country. While some large corporate houses capable of affording in-house R&D and acquiring plants overseas could adopt global approaches for developing and acquiring technologies, R&D and technology needs of several small units engaged in manufacturing remain unaddressed. The large deviation of the national technology indicators from the global bench marks is partially on account of small enterprises not being able to leverage the benefits of improved technologies emerging globally.

- R&D outputs from public funded research are not adequately leveraged into manufacturing advantage by the industrial sector, either in the corporate or in the small and medium enterprise sectors. Such outputs require further work and translational research and development, if they were to deliver national outcomes. Currently, efforts on translational research in steel sector are marginal in the country. Unless linkages between the R&D systems in the public funded institutions and the industrial sector are substantially improved, translational research needs of the country would remain unaddressed. Special schemes may need to be developed for challenging the public funded research for finding solutions to problems of Indian manufacturing industry.

- Steel Technology Centres would need to be created under PPP model in industrial sites for promoting translational research under industrial conditions. A well designed and structured scheme for investing Steel Technology Funds into Steel Technology Centers in industrial premises could be developed and implemented. The scheme could develop transparent criteria for making competitive bid for public funds for establishing Steel Technology centers within industrial sites.

- Pre-competitive research in steel related technologies for a) energy-efficiency, b) emission control, c) solid waste minimization, d) more efficient use of Indian coal resources and e) value addition to indigenous raw materials in public and private sector R&D would need to be promoted through a Challenge Award Scheme. International Science & Technology cooperation in the area of steel making technologies would be a valuable forward considering that the total number of indigenous experts engaged in R&D in steel making is significantly low. Synergies within the country and through international cooperation may need to be developed for growing industry-relevant R&D activities.

- It may be necessary to expand the R&D base in steel related technologies in the country. This would require strengthening of both human and institutional capacities for R&D. So far, Public-Private Partnerships for growing R&D in steel related technologies have not been adequately leveraged. This is a much needed mechanism for targeted research and development in areas of relevance to Indian industries.

CHAPTER - VII

ENVIRONMENT MANAGEMENT AND SAFETY ISSUES

Energy and Environment

7.1.0 Introduction

7.1.1 Steel as a finished product may be one of the most environment friendly products used in our daily life, owing to its excellent mechanical properties, versatility and its recyclability. Today steel usage also ranges from the ordinary household items to the complex construction and defence equipments. However, the process of steel making itself is highly 'energy and fossil fuel' intensive and therefore the cause of environmental concerns across the world. In fact, the manufacturing process involves a myriad operations which may contribute to three basic sources of pollution i.e., of Air via volumes of emissions by the plants, of water via liquid effluents discharged and of soil via disposal of solid wastes.

7.1.2 Over the years the domestic steel industry has updated its technology and maintenance systems and many of the new units coming up have also opted for adoption of state -of -the -art technology to ensure quality, productivity and efficiency of operations. But globally we are far behind our competitors not only in terms of productivity or quality but also the energy consumption levels and introduction of sustainable production techniques.

7.1.3. Locally steel making industry is normally perceived to be "large; old; dirty and polluting" by civil society and environmentalists and this has often come in the way of obtaining clearances for setting up of new production capacities. So despite the industry's contribution towards for providing large value added products and services the environmental concerns linked to the sector and its associated mining industry has become a serious matter to be addressed on a priority basis.

7.1.4 Our per capita consumption levels of steel is expected to go up in the coming years and this implies increased investment in large scale expansion of existing facilities and of setting up of new capacities.. This would also imply increased extraction of natural resources and their processing .So unless there are reduction in the existing consumption norms as well as specific emission intensities it may be difficult to achieve a balance between increased production and minimum possible damage to the environment by the industry .

7.2.0 Energy Efficiency and Carbon intensity

7.2.1 Given the various process combination of steel making from iron ore, there exist substantial differences in the specific energy consumption & carbon emissions levels or intensities. The Electric Arc Furnace (EAF) route using steel scrap involves the lowest energy intensities as it is required only to melt the scrap. On the other hand the BF-BOF route which produces steel from iron ore through many intermediate operations generally involves higher energy consumption and associated carbon emissions. The energy and carbon intensity of steel production from iron ore is the lowest for Gas based DRI-EAF route, followed by BF-BOF route and with the Coal DRI- EAF/IF route being the highest.

7.2.2 Over the years, the energy intensity in integrated steel plants has been brought down substantially by improvements in raw material quality, processes and operational practices to current level of 6.0-6.7 GCal/tcs. This is still higher than the 4.5-5.5 Gcal/tcs levels achieved by steel plants in other countries. The energy intensities (in Gcal/tcs) for some of the steel plants in India during 2008-09 and 2009-10 were as given below:

Unit	BSL	BSP	DSP	ESSAR	ISPAT	JSPL	JSW	RINL	RSP	TATA
2008-09	6.36	6.28	6.50	5.81	5.61	6.61	7.34	6.11	6.22	6.45
2009-10	6.36	6.38	6.55	5.89	6.01	6.38	6.69	6.09	6.18	6.01

7.2.3 With gradual reduction in energy intensity of Indian steel plants, the carbon intensities have also been declining and the actual values (in tonnes/tcs) for the above two years were as shown below:

Unit	BSL	BSP	DSP	ESSAR	ISPAT	JSPL	JSW	RINL	RSP	TATA
2008-09	2.62	2.71	2.68	1.51	1.86	2.70	2.97	2.63	3.12	2.39
2009-10	2.71	2.74	2.65	1.46	2.04	2.59	2.68	2.55	3.00	2.42

The differences in the energy consumption levels may be explained by factors such as economies of scale, the level of waste energy recovery , the quality of raw materials used , operational know how and quality control standards adopted .

7.2.4 With higher cost of energy and introduction of regulatory and voluntary initiatives, the Indian steel industry has been gradually modernized and renovated to adopt energy efficient and environment friendly technologies. Newer facilities are also being set up with clean and green, state-of –the - art technologies. However, due to technological and space constraints diffusion of energy efficient technologies has remained relatively lower in the case of old/existing units.

7.2.5 Given below are some of the important energy conservation technologies that can be harnessed to improve the energy intensity of domestic steel industry:

Technology	Potential reduction
1. Sinter cooler – waste heat recovery	500-550 MCal/ton of sinter
2. Coke dry quenching	200-280 Mcal/ton of coke
3. Coal moisture control in coke ovens	70 Mcal/ton of coal
4. Top gas recovery turbine in BF	40-60 kwh/ton of iron
5 Waste heat recovery from stove waste gases of Blast furnace	18-20 Mcal/ ton of iron
6. OG boiler in BOF	80 MCal/ton of steel
7. Regenerative burners	10-15 Mcal/ton of steel

7.2.6 Of the above mentioned technologies, the Top gas recovery turbine in BF (TRT) has been adopted by several plants like RINL, Tata Steel, JSW Steel and JSW Ispat Steel. Coke Dry Quenching (CDQ) has also been adopted in RINL and NINL. Sinter cooler waste heat recovery has been adopted in JSW Ispat Steel. While other technologies are yet to be fully harnessed,, technologies like TRT and CDQ, waste heat recovery from stoves and sinter cooler have also been introduced as part of the expansion programmes of several steel plants.

7.2.7 With a number of large new steel making capacities being added based on the BF-BOF route, the share of this segment is expected to increase in future leading to reduction in the overall carbon intensity. As regards the secondary steel producers, supply constraints of natural gas, good quality scrap, high grade ore for sponge iron making, along with the compulsions to adhere to energy reforms and reduced energy intensity/carbon emissions may put pressure on them to improve productivity, energy efficiency and environmental sustainability. This can not be avoided, if they are to ensure their survival.

7.2.8 Currently, tax benefits are being provided to promote implementation of energy conservation measures. It is imperative that all the steel units to exploit this opportunity for conserving energy and also to reduce costs of operation. Since it is the secondary steel makers that need to catch up urgently in terms of energy efficiency, a separate scheme to benefit them is being proposed for implementation during the 12th plan as below :

7.2.9 About 40% of India's crude steel is produced by the mini steel plants comprising of Electric Arc Furnace (EAF) and Electric Induction Furnace (EIF) units. Besides more than 60% of long steel products are also produced by the Secondary Steel Sector i.e., the EAF, EIF as well as the Re-rolling Mills. The Re-rolling Mills normally source their inputs, viz., pencil ingots and continuously cast billets, mostly from the EAF and EIF units. All these units are characterized by high levels of energy consumption and Green House Gas (CHG) emissions. Therefore, adoption of clean, green and energy efficient technology by them has become over the years a subject requiring special attention both from the point of view of improving their productivity as well as for ensuring environment protection. **The Ministry of Steel has devised a New Scheme for improving energy efficiency of the Secondary Steel sector – the details of which are given in the section on New Schemes in Chapter VIII.**

7.2.10 As regards policy implementation for ensuring energy efficiency, the Steel industry is also required to conduct at regular intervals an energy audit by certified energy auditors and Energy efficiency labeling for the equipment. The minimum percentage of electricity to be purchased from renewable sources are also notified by the various SERCs (State Electricity Regulatory Commission) as provided in National Electricity Policy and the policy framework provided by the Electricity Act, 2003. Renewable energy sources (solar energy, bio-mass, municipal waste, small hydro power, wind energy etc) also qualify under these provisions. The Industry is also expected to meet their Renewable Energy Purchase Obligation as and when applicable and mandated by respective State Electricity Regulatory Commission (SERC) in order to meet the Govt. of India's target under National Solar mission, under NAPCC (National Action Plan for Climate Change).

7.2.11 The specific areas of focus during the 12th plan (2012-17) for reducing carbon and energy intensity may therefore need to cover:

- Technological upgradation in the existing steel units by adoption of energy conservation measures.
- Adoption of clean and green energy efficient technologies by all new plants.
- Diffusion of energy efficient technologies in all segments of iron and steel making
- Research & Development in improving raw material quality (coal & iron ore)
- Process and energy efficiency of operations in secondary steel sector
- Utilising incentives available for energy conservation; and
- Energy auditing and energy leveling

7.3.0 Other Environmental Issues

7.3.1 As already mentioned the manufacture of steel from ore involves a large number of operations covering large scale usage of mineral resources and high levels of energy consumption. While the large integrated steel plants based on the BF-BOF route (with associated coke ovens & sinter plants) are highly polluting, the EAF and EIF route using scrap and DRI are relatively less polluting due to lower scales of operations. The coal based DRI units also are often criticized for not adopting/operating pollution control facilities.

7.3.2 Coming to statutory provisions for ensuring environment sustainability, the domestic iron and steel industry is governed by a number of regulations, like the Environment (Protection) Act, The Air (Prevention and Control of Pollution) Act, The Water (Prevention and Control of Pollution) Act - besides certain voluntary initiatives like the Corporate Responsibility for Environment Protection(CREP) etc. Besides there are also industry specific and generic rules and regulations laid down by the Government. As per the policy decision of the Government of India, Central Pollution Control Board (CPCB) along with its counterparts State Pollution Control Boards (SPCBs) is also responsible for implementation of legislations for prevention and control of environmental pollution. Issues linked to compliance to these regulations by the industry are as detailed below:

7.3.3 Air environment:

7.3.3.1 The environmental concern with respect to air pollution by the industry arises mainly due to particulate emissions (dust) from process and non process operations. The emissions of volatile matter associated with coke oven and dioxins from sinter plant operations also have serious health implications. Other gaseous pollutants like oxides of sulphur and nitrogen are another cause of worry wherever the Integrated Steel plants are large and are located in the vicinity of large thermal power plants.

7.3.3.2 The specific emissions of air pollutants like dust, oxides of sulphur and nitrogen in some Indian steel plants are still above 1.0 kg per ton of steel as compared to less than 0.5 kg per ton of steel in developed countries. A substantial reduction in specific air emissions may be possible with introduction of larger capacity units like sinter plants, blast furnaces, taller coke ovens, increased size of steel converter etc, by reducing the number of process operations. But given the very high operational costs linked to air pollution control, the introduction of state of the art pollution control facilities in smaller units, though technically feasible, may not be economically viable to them . There is a need to limit the capacity of the processing units to a “threshold” level, like introduced for sponge iron plants.

7.3.3.3 As regards high dust emissions from the sponge iron units based on coal, this has attracted adverse opinion leading to suspension of operations of some of the units. The high emissions are mainly due to inadequate design of pollution control systems to handle widely varying type of raw materials in the kilns. Since this route is the main supplier of raw material for secondary steel production, there is an urgent need to share the best practices for environment control by developing a Best Available Technology (BAT) document for the secondary steel sector.

7.3.3.4 Over the years, there has been substantial improvement in particulate control technologies like scrubbers, bag filters and electrostatic precipitators. Bag houses (bag filters) have now emerged as the main technology for dust control in steel plants with capabilities to meet extremely stringent emission standards at marginally high cost. The efficiency of installed dust control equipment in some of the steel plants however continues to be poor, due to improper design of hoods and mismatch of estimated and installed ventilation volumes. Considering the very high energy cost of operation, there is an urgency to introduce improved practices for design of control equipment for effective capture and control at lower cost. The use of mathematical models like Computational Fluid Dynamics (CFD) can be very useful in this respect.

7.3.3.5 The control of fugitive dust emissions from non process operations is another major concern in large integrated steel plants and some of the available technologies for their control are as given below:

Area	Control systems
1. Raw material handling	Bag filters, Dust suppression, Enclosures
2. Raw material storage	Wind nets, Covering by tarpaulins, Chemical spray, Green belt
3. Raw material movement	Tyre washing, Covering of material, Speed control
4. Sinter/pellet plant	Large capacity ESP or bag filter
5. Coke ovens	
Coal charging emissions in coke ovens	Efficient aspiration of COG in top charge batteries. Dedusting car or charge gas transfer car in stamp charged batteries.
Coal carbonization	Good oven doors, Water sealed AP caps, good operational practices
Coke pushing emissions	Stationary bag filters
6. Blast furnace	Bag filters for stock house and Cast house dedusting.
7. Hot metal pretreatment	Bag filters for secondary emissions
8. Secondary dust emissions from BOF, EAF, Furnaces	Large capacity Bag filters

7.3.3.6 As may be noted, the major contributory factors to air pollution by the industry are on account of the quality of raw materials, operational practices, process controls etc. Al these factors may separately or else jointly be responsible for fugitive emissions and need to be addressed accordingly.

7.3.3.7 In integrated steel plants, sinter plant and thermal power plants are the major sources of emission of SOx and NOx. Several technologies for control of sulphur dioxide and nitric oxides from waste gases have been developed in other countries, though at very high costs. The use of low sulphur coal in coke ovens and desulphurization of coke oven gas can lead to reduction of more than 80% of SO2 emissions from integrated steel plants and is recommended for SO2 control. Further reductions can be made by introducing desulphurisation of waste gases from sinter plants, though at extremely high capital and operating costs. Similarly NOx emissions in integrated steel plants can be controlled by use of staged burners, suitable selection of fuels etc. Further reductions can be made by introducing denitrification of waste gases from sinter plants, though at extremely high capital and operating costs.

7.3.3.8 The state of the art technologies available for emissions control in various areas of steel plant operation are given below:

Area	Technology
Coke Ovens	Induced aspiration of leaking gases by HPAL or steam. Forced aspiration by ID fans Individual oven pressure control during coal charging Coke pushing emission control with stationary bag filters
Sinter Plant	Dust :Air fine system(VAI) ESP: Pulse energisation(Coromax); Movable electrode(Mitsuibishi) Gas & dust conditioning DeSOx & DeNOx : Lime injection ; wet scrubbing after ESP ; Activated carbon Dioxin removal by high efficiency particulate control
Blast furnaces	Secondary emission control during charging. Dry gas cleaning using bag filters. Cast house fume extraction systems,
Steel melting	BOF: Dry type ESP for gas cleaning

7.3.4 Water Environment:

7.3.4.1 The steel making process involving high temperature operations also uses a large volume of water in cooling and cleaning operations. Over the years, the fresh water consumption for steel production has been brought down from 12-15m3/tcs to less than 5 m3/tcs, with some integrated steel plants operating at volumes less than 3.0 m3/tcs, against a norm of 5m3/tcs for flat and 8 m3/tcs for long products. This is one of the major achievements by the integrated steel sector in the 11th Five Year Plan. Actual water consumption in major steel plants during the year 2008-09 and 2009-10 were as given below:

Unit	BSL	BSP	DSP	ESSAR	ISPAT	JSPL	JSW	RINL	RSP	TATA
2008-09	4.48	3.04	4.70	2.67	2.57	3.62	2.90	2.64	5.13	4.72
2009-10	5.00	3.00	4.63	2.53	2.63	2.62	2.48	2.31	4.19	4.11

(Figures in cubic meter per tonne of crude Steel)

7.3.4.2 Given the importance of water as a scarce resource, the Ministry of Environment and Forests (MoEF) has emphasized on “Zero” water discharge from industries, which may require innovative solutions and techniques for effectively recycling treated wastewater. Total water management audits will help in identification of potential areas for improvement and ensuring transition to zero discharge. Some of the techniques/technologies considered necessary to ensure zero discharge by the steel industry may include the following:

Area of water usage	Measures
Water storage	Use of chemicals to reduce evaporation from large ponds
Fresh Water treatment	Use of slurry dewatering equipment; Control of TDS in fresh water by suitable mixing
Water usage in cooling towers	Continuous Blow down control; use of chemicals; Fin-Fan heat exchangers; Improved COC; leakage control; High recycle rates aiming at >98% recycling
Water cascading	Blow down from one unit to be used as make up of another unit, after assessing water chemistry
Water reuse	In less critical applications like ore washing, slag and coke quenching; gardening, spray on raw material yards and roads etc
Reverse osmosis	Recovery of good water from blow down water
Evaporation of RO rejects	In evaporators using steam/electricity.

7.3.4.3 The existing technology for water treatment systems in Indian steel plants are at par with the best available for the industry and the performance of Indian steel plants in terms of meeting compliance to wastewater discharges has also been satisfactory except for coke ovens, with respect to presence of cyanides. SAIL-RDCIS is currently carrying out a study of development of a suitable technology for treating coke plant wastewater. Further several modifications and upgrades of the coke oven wastewater treatment are also being made in steel plants to improve the performance. Another area of concern is the usage of treated wastewater from coke ovens after the introduction of coke dry quenching technology in coke ovens and this aspect needs to be taken into account while planning installation of CDQ facilities.

7.4.0 Solid Wastes

7.4.1 During the iron and steel making process, the impurities present in the raw materials like iron ore, lime stone and coal are normally removed as slag. Further, the operations of air and water pollution control equipment generate dusts and sludge. Currently this volume of solid wastes generated in Indian steel plants is relatively high at 600-800 kg per ton of steel as compared to 400-500 kg in developed countries. This is mainly due to higher impurity levels in the raw materials. The steel industry has been successfully converting these wastes into useful byproducts for recycling or else for use as a raw material in other industries.

7.4.2 Over the years, the utilization of these products has improved substantially and most of the wastes except BOF/EAF slag are being consumed either internally or sold. The material efficiency, defined as the ratio of production of salable products to sum of salable products and wastes is an important indicator of efficiency of raw material usage in integrated steel plants and the performance in this regard during 2008-09 and 2009-10 were as follows:

Unit	BSL	BSP	DSP	ESSAR	ISPAT	JSPL	JSW	RINL	RSP	TATA
2008-09	87	98	97	99	85	92	88	100	89	95
2009-10	92	92	97	99	87	97	85	100	91	97

(Figures in % (crude steel + by products)/(crude steel + by products + waste).

7.4.3 The limited use of steel slag from BOF and EAF in Indian steel plants (less than 30%, mainly used in sinter plant as lime substitute, and use of recovered metallics in steel making) remains a matter of concern. In contrast in developed countries, the steel making slag is used as construction material ensuring 100% utilization. The main reason for the lower domestic slag utilization may be attributed to the presence of free lime, which makes it unfit for construction industry due to its hydration and expansion after aging. Reportedly steel slag (with less than 5% free lime and a maximum 5% expansion during steam testing) can be effectively used as a construction material. This can be achieved by weathering of slag; granulation by air or water. JSW Steel has introduced a BOF slag granulation facility using water (BSSF technology) which is reported to reduce free lime content in the slag to less than 5%.

7.4.4 Steel slag can be effectively used as a material for construction, substituting other natural resources like aggregates and sand, first by developing a product standard for steel slag by the steel plants and later mandating its use in construction as has been done in case of fly ash. Steel slag after removal of metallics can also be used as soil conditioner for conditioning acidic soils and also to some extent in cement making. The use of slag generated in hot metal pretreatment and secondary metallurgy is another potential area of use to be studied by the industry.

7.4.5 Dusts and sludge collected from air and water pollution control equipment is extremely fine and is currently recycled through sinter making. However, in case of larger units, the recycling of large volumes of micro fine dusts is problematic, as it hinders the productivity of sinter plant. Many of our integrated steel plants have evolved innovative means of recycling dust and sludge and this need to be shared amongst other steel plants. Some of the practices followed are as given below;

Process dusts/sludge	Interim usage	Preferred usage
ESP dust from sinter/pellet plants	Recycle in sinter plant	Micropellets
Flue dust from Blast furnaces	Sinter plant depending on alkali loading	Micro pellets
Dust from bag filters of coke ovens	Power plants	Micro pellets
Sludge from gas cleaning plant of blast furnaces	Disposed	Micro pellets after dewatering
Dust from secondary fume extraction system(ESP or bag filter)	Sinter plant/ BOF converters	Micro pellets for use in sinter plant/briquetting for use n converters after dewatering
Sludge from gas cleaning plant	Sinter plant/ BOF converters	Micro pellets for use in sinter plant/briquetting for use n converters after dewatering
Mill scales from caster and Mills	Sinter plant, depending on oil content	Briquetting for use in BOF converters.

7.4.6 Reportedly JSW is planning a 0.2 Mtpa mill scale briquetting plant and a 0.6 Mtpa micro pellet plant for use of all the dusts and sludge generated in the steel plant. Essar steel is also planning a similar installation for recycling iron and carbon bearing dusts. Although there are other technologies like rotary hearth furnace, Oxy-cup, Primus etc which utilize some of these wastes for recycling, they are all expensive and are of limited applicability.

7.4.7 Steel plant operations also generate hazardous wastes and the relevant regulations for Inventorisation and effective management of this hazardous waste cover the following:

Area	Hazardous waste	Usage/Disposal
Coke ovens	Decanter sludge, BOD plant sludge, Tar sludge	Used in coke ovens
	Still bottoms	Incineration / Cement plant
Blast furnace	High zinc containing flue dust	Hazardous waste disposal or sale
Others	Acidic, alkaline sludge, sludge from water treatment,	Hazardous waste disposal
	Waste and used oils, electric wastes.	Sale to authorized agencies for recycling

7.4.8 It is to be noted that the management of dusts and sludge depends on the steel plant configuration and requires innovative solutions. There is a need to share the experience of successful recycling schemes with other steel plants.

7.4.9 Finally as per the survey by UNEP, the generation and management of e-wastes shall remain one of the major thrust areas for the countries like China &

India. However, subsequent to the recent notification by the Govt. of India for the management of e-wastes, Steel Industry would certainly manage its e-wastes in a more sustainable way.

7.5.0 Focus of the 12th Plan for Environment Control in the I&S industry

a) Diffusion of Pollution Control Technologies

7.5.1 While the diffusion of environment control technologies is relatively high in case of new units, the same is not true in case of existing units. The main barrier for diffusion of environment control technology has been the very high capital(up to 6-8% of capital costs) and operational costs(up to 2-3% of operating cost). Though there are fiscal benefits like 100% depreciation for installation of pollution control equipment, the incentives are still not considered adequate by the industry. It is therefore necessary to enhance these benefits to 200% to make it more attractive like in case of investments on R&D.

7.5.2 One of the main reasons for environmental pollution in the vicinity of steel plants is clustering of several steel and steel related ancillary industries in a single area, leading to serious environmental degradation due to limitation on the carrying capacity of the surrounding area. The sitting considerations for large industries based on "carrying capacity" approach need to be adopted to reduce the cost of environment control.

7.5.3 **The focus of the 12th FYP for environment control and diffusion of technologies will be on:**

- Adoption /retrofication of Best Available technologies for pollution prevention/control to minimize air pollution
- Reduction of process dust emissions to less than 1.0 kg/tcs
- Online monitoring of Stacks in all plants
- Use of low sulphur coal in coke making& desulphurization of coke oven gas, wherever applicable.
- Staged combustion in burners to reduce NOx emissions, wherever applicable.
- Reduction of fresh water usage to less than 4.0 m3/tcs in integrated steel plants and work towards achieving "Zero" water discharge.
- 100% usage of BOF & EAF slag by introduction of a product standard.
- Sharing of best practices for recycle of micro fine dust and sludge
- Comprehensive waste audit and attain 100% recycling of wastes to achieve zero wastes generation
- Installation of site specific Pelletisation plants to minimize the environmental pollution and conservation of minerals.
- Remove barriers for investment on environmental control facilities by enhancing the depreciation benefits to 200%
- Environmental Capacity building through specialized training
- Promotion of renewable energy generation (Solar and non solar) towards green economy and sustainability.

b) Regulatory frame work

Environment

7.5.4 The expansion and installation of new steel making capacity beyond 30,000 tons per annum and sponge iron units with capacity beyond 200tpd, requires environmental clearance from Ministry of Environment and Forests. The units with capacities below these threshold capacities require clearance from the respective State Governments and Pollution Control Boards. MoEF has notified environmental standards(norms) for environment quality for individual processes, with the state pollution control boards being made responsible for their implementation.

7.5.5 The Ministry of Environment & Forest (MoEF) had launched in association with the steel industry an innovative scheme, "Corporate Responsibility for Environmental Protection (CREP)" for the steel industry in March 2003. The purpose of CREP was to motivate the industries to aim “beyond compliance” of regulatory norms. The Charter had set time based targets concerning conservation of water, energy, reduction of pollution, waste minimization etc. A Task Force was constituted by central Pollution Control Board(CPCB) for monitoring the progress of implementation of CREP recommendations, which also facilitated as a forum to discuss the environmental performance of different steel making units and to assist the industry in resolving issues faced by them in terms of bench marks, process improvements, gaps in technology, identification of research needs and regulatory issues if any.

7.5.6 The CREP has been effective in bringing the industry and the regulators on a common platform for sharing knowledge and to seek clarifications on several regulatory issues and also playing a major role in implementation of several new technologies for energy and environment in the integrated steel plants.

7.5.7 The CREP introduced in 2003, needs to be revisited by the steel industry and MoEF, considering the current status of technology, its diffusion, technologies, considering the current environmental issues of Climate change and other international legislation applicable for steel industry. The revised CREP should also include DRI and secondary steel producers.

International Legislation

7.5.8 Steel, is a heavily traded commodity with large volumes being imported/exported across countries. Environmental standards and their effective compliance is becoming important as “environment” is increasingly being seen as an important factor in providing a level playing field for steel producers. Further, the financial institutions are now imposing stricter conditions for environment compliance often stricter than the National standards. It is therefore necessary for the Indian steel industry to focus its attention to adopt a proactive role in designing their facilities to meet international legislations like those published by the World Bank.

Energy

7.5.9 Recognizing the importance of energy conservation, Government has enacted the Energy Conservation Act, 2001 and the integrated steel plants have been identified as one of the eleven designated consumers. The Act stipulates regular energy audits, requirements of energy managers, submission of returns, energy labeling etc. The Act has been recently amended by introducing energy consumption norms.

7.5.10 India's climate policies for the industrial units are contained in the National Mission for Enhanced Energy Efficiency (NMEEE) and are aimed principally at improving energy efficiency rather than CO2 reduction. The aim is to reduce the emissions intensity of its GDP by 20-25 percent from 2005 levels by 2020. Under the National Action Plan on Climate Change (NAPCC), National Mission for Enhanced Energy Efficiency (NMEEE) has planned four new initiatives:

- Perform Achieve and Trade Scheme (PAT), a market based mechanism, involving the trading of energy saving certificates, to enhance cost effectiveness of improvements in energy efficiency in large industries like steel.

- Market Transformation for Energy Efficiency (MTEE) to accelerate the shift to energy efficient appliances including leveraging of international funds for promoting energy efficiency and implementing a National Energy-Efficiency Clean Development Mechanism (CDM).

- Energy Efficiency Financing Platform (EEFP) allows for the creation of mechanisms that would help finance demand side management programmers in all sectors by capturing future energy savings,

- Framework for Energy Efficient Economic Development (FEEED) by creating two fiscal instruments to promote energy efficiency, Partial Risk Guarantee Fund (PRGF) and Venture Capital Fund for Energy Efficiency (VCFEE)

7.5.11 PAT is an energy efficiency certificates trading program. It is an intra country trading program that will apply to facilities in nine energy-intensive industries, including iron and steel. PAT will commence from April 2011 and apply to nearly 685 designate consumers of which nearly 110 units are in the iron and steel sector with planned reduction target of 4.16% in energy consumption. Under the PAT scheme, the regulatory role is played mainly by the BEE.

Best Available Technology (BAT)

7.5.12 The information on best available technologies for energy efficiency and environment protection is important and has helped the industries of developed countries to improve their efficiencies in a sustained manner. This has also helped in bringing together the regulatory authorities and industries on a common plat form. BAT documents for the steel and other industries areas are regularly being published in other countries. Similar document for the Indian steel industry covering all routes of steel production will be a very important step in ensuring a smoother route to sustainable steel production.

7.5.13 **The focus of the 12th FYP for the regulatory frame work will be on**

- Preparation of BAT documents for primary and secondary steel sectors
- Revision of CREP in association with MoEF for all sectors of steel making, taking into account the current best available technology; revision to environment standards; research needs; threshold limit of capacities; siting guideline for industries and to act as a forum for sharing knowledge amongst the industry. etc
- 100% Use of EAF & BOF slag
- Facilitate industries in utilizing opportunities available under the NMEEE

Low Carbon Economy

7.5.14 Climate change is a major threat faced by the mankind, needing global attention. The Indian steel industry emitted 117 million ton in 2007, with projections of emissions up to 450 million ton by 2020. Any policy intervention by the Government in CO2 reduction will affect the steel industry directly.

7.5.15 It is noted that the overall sectoral CO2 emissions from the steel sector in the country will depend not only on the CO2 intensity of each process routes (BF-BOF, Scrap/DRI-EAF and EIF), but also on their share in steel production. It is therefore important to understand clearly the impacts of process routes on carbon intensity and guide the steel industry in the future towards a low carbon economy

7.5.16 The focus on low carbon economy will remain on the availability of raw materials for steel making. Considering the non availability of large volume of scrap for EAF/EIF steel making and natural gas for DRI making, iron ore will remain the main stay of crude steel production in the country for the foreseeable future. The routes for steel making from iron ore will thus be confined only to two routes viz BF-BOF process and Coal-DRI/EAF-EIF.

7.5.17 Amongst these two routes, the BF-BOF route has lower carbon intensity and needs to be promoted. However it should be noted that low levels of energy and environmental efficiencies can only be achieved at larger capacities, necessitating installation of new facilities with larger capacities.

7.5.18 It is imperative for the Coal based DRI route to steel making upgrade its technology through R&D and technological up gradation to improve its energy efficiency for sustaining its share of production in the Indian steel industry.

7.5.19 While the integrated steel producers are familiar with the issues of climate change and its impacts, similar understanding among the secondary steel producers is lacking. With Climate change throwing up several opportunities like soft financing from other developed countries; it is necessary that the secondary steel sector is also made aware of such opportunities. The committee feels that a Climate Change wing is created in MOS with representation from primary and secondary steel producers with responsibility for bringing in awareness on climate change and the role of steel industry; Estimation and reporting of emission intensities from individual steel sectors; Develop policy initiatives for facilitating low carbon growth; Identify research needs at international, national and industrial levels.

7.5.20 It is felt that even after implementing energy conservation and efficiency improvements projects mentioned earlier, the anticipated CO2 reduction from the steel sector will still be higher. Thus there is a need to look at other technologies like carbon capture and sequestration(CCS) and new routes to carbon free steel making. Currently, there are several research activities being carried out in this direction and it is necessary that steel industry/Ministry is actively involved in them.

7.5.21 **The focus of the 12th FYP for the Low carbon economy will be on**

- Set up a Climate Change Committee (CCC) under MOS
- Interact with other industrial sectors like power for research on CCS and its applicability.
- Facilitate either directly or through involvement in research on new routes to steel making and in projects like ULCOS.
- Pursue Climate change initiatives listed under low carbon economy
- Facilitate in development of LCA for various steel products
- Promote environment friendliness of steel products.
- Steel industry to promote a recycling oriented society
- Introduce EMS(ISO-14001) in all sectors of steel making

7.6.0 Conclusions and Recommendations

7.6.1 The Indian steel industry currently in transition to the next Five Year Plan, is at a crucial stage with challenges faced due to impact of climate change. While the industry is expected to ramp up steel production to meet the needs of its population by infusion of additional capacity, global issues like Climate change necessitates guided growth through low carbon intensive routes for steel production. It is therefore imperative that all the steel makers across the country adopt energy efficient and environment friendly technologies in all areas of iron and steel making in line with SOACT and BAT guidelines. It is also necessary that all protection measures are adopted at the planning stage itself, as the cost of correction at a later date will be very high. Existing plants need to evolve short term and long term action plan to phase out the old and obsolete facilities by state-of-art clean and green technologies with an aim not only to achieve higher standards of productivity but also to harness all waste energy with minimized damage to the environment.

7.6.2 The 12th Five Year Plan for the steel industry must envisage expansion and growth within the framework of Sustainability and Low Carbon Growth Strategy. For a developing country like India, steel will play a vital role to sustain overall economic development of the country. Therefore, increase in capacity in iron and steel making is inevitable. Therefore, what is necessary is that the growth in steel capacity must ensure a balance with social, economic and environmental considerations.

7.6.3 Since the costs of energy and environment management are expected to be high, it is imperative that Government evolve suitable measures in the form of capital subsidy or incentives to promote adoption of such measures.

Safety Measures in Steel Industry

7.7.0 Introduction

Steel making process poses difficult challenges in the area of Safety, Health and Environment when compared to many other industries due to complex nature of its operation and maintenance activities and wide range of associated hazards. Despite considerable technological progress, focused attention is needed for reinforcing safe behaviour and improving safety culture at job site. In the present scenario maintaining high standards in the arena of Occupational Safety, Health and Environment in steel industry is of paramount importance.

7.7.1 Identification of Hazards & Control Strategies

7.7.1.1 The whole process of production of iron and steel right from the raw material to the finished products ridden with many inherent hazards and risks. Hazards are also associated with the very nature of the shape and size of operation, and machines. There are physical hazards (noise, vibration, heat and cold stress, slip & fall etc.), chemical hazards (inhalable gases/ vapour/dust/fumes, asbestos, insulation wools etc.), Biological hazards, radioactive hazards etc.

7.7.2 Present Safety Status

7.7.2.1 Year wise fatality figures for major steel producers of the country are given below-

Company	**2006**	**2007**	**2008**	**2009**	**2010**
SAIL (Incl. Mines)	23	22	25	28	33
TISCO (Incl. Mines)	11	8	6	4	6
RINL	5	2	4	4	3
NINL	0	1	0	2	4
Essar Steel	4	0	0	2	7
Ispat	NA	3	4	2	Nil
JSW	-	-	-	2	Nil
Bhusan Steel Ltd.	-	-	-	-	3

7.7.3 Present Safety Efforts/Activities

- Major Steel Plants have comprehensive Safety policy.

- Safety aspects are incorporated in Standard Operating Practices (SOP) and Standard Maintenance Practices (SMP) adherence to which are monitored at Shop Floor Level of organized sectors.

- Consistent efforts are made for compliance of applicable statutory rules, regulations, norms, procedures, work instructions etc. at organized sectos.

- Annual Performance Plans (APP) in the areas of Safety and Fire services are formulated and review of implementation of APP is done by plants & SSO.

- Internal and external safety audits are conducted as per schedule at plant level / hazardous areas. The recommended points are implemented/ monitored. Compliance status of previous audits is reviewed before re-audit.

- Personal Protective Equipments (PPEs) like safety shoes, safety helmets, hand gloves etc. are provided to the workers including contractor workers.

- All major capital repairs/shut downs are closely monitored round the clock to prevent accidents.

- Regular preventive inspections of unsafe acts & conditions are being done on the basis of checklist and corrective actions are taken.

- Joint Inspection of cable galleries and underground cellars are done as per schedule and their upkeep is ensured to negate the chances of fire.

- Work-permit/Protocol system are in vogue for hazardous jobs where multiple agencies are involved like jobs on Gas lines, Steam lines, Pressure vessels, Lifting equipments, Electrical installations, Electrically Powered Machines, Hydraulic lines, while working in confined space, working at height etc.

- Job/area specific safety instructions are displayed at strategic locations to caution employees about associated hazards and take precautionary measures.

- Periodic campaigns are conducted to inculcate safety awareness up to grass root level. Regular publications of educative materials are being made by organized sectors in the form of Journals, Manuals, Reports, Bulletins, Booklets etc containing wide range of information pertaining to Safety, Health & Environment.

– On-site disaster management plans are updated and mock drills are conducted at regular intervals as an emergency preparedness.
– All accidents are investigated and remedial actions are taken to prevent their recurrence.

– Safety training is imparted for contractor workers before issue of gate pass. In addition, job specific safety training is also imparted at site by the executing agency before starting the job.

– HRD intervention in the area of safety covers Senior executives, Line Managers & Departmental Safety Officers / Safety inspectors etc. Besides, area specific workshops are organised on identified themes like gas safety, rail/road safety, safety in iron, steel & coke making etc for sharing of best practices in safety management in organized sectors.

– Skill oriented job specific safety training is being imparted to various target groups like Crane Operators, Loco Operators, Porters, Riggers, Welders, Gas Cutters, Electricians, Heavy Earth Moving Equipment Operators etc.

– Safety awareness among housewives, school children etc. is generated through various workshops, campaigns, competitions etc in organized sectors.

– Movement of heavy vehicles is restricted during shift change hours to avoid any road accident. Entry of persons riding two wheelers without crash helmet is not allowed inside the plant premises. Surprise checks are also conducted for ensuring the usage of the same.

– Plants of organized sectors have well equipped Fire Services deptt. manned by qualified and trained fire professionals. The adequacy of existing fire protection system in the shop is periodically reassessed through structured system of inspections and augmented on continual basis. Employees are extensively trained in the use of suitable fire extinguishers and other fire suppression systems.

– Major plants of organized sectors have well established OHS centre primarily entrusted with preventive functions and responsible establishing and maintaining a safe and healthy work environment. It undertakes occupational health surveys / studies w.r.t Dust, Noise, Heat illumination etc. in identified hazardous locations and control measures are adopted accordingly. Various education and training programs are organized on Health related topics to apprise the employees about all possible adverse impacts of work environment on their health

– A bipartite forum named Joint Committee on Safety, Health and Environment for Steel Industry (JCSSI) headed by Director(Technical), SAIL as its Chairman & Executive Director(Safety), SAIL as Vice Chairman and having representatives from Management of all Steel Plants & Units of SAIL, RINL, TISCO, Ispat Group, ESSAR, NINL, Bhusan Steel Ltd., Ispat Steel Ltd as well as Central & Plant level Trade Unions is functioning at National level for enhancing the overall standard of Safety, Health & Environment in respective member steel plants.

7.7.4 Thrust in next Five Years

a) Sustaining / Accreditation of OSHAS: 18001:2007 certification.

b) Universal usage of user friendly Personnel Protective Equipments (PPEs) and modern safety appliances by regular as well as contractor workmen.

c) Safety aspects are to be integrated at design stage as well as during operation and maintenance at steel plants entailing minimum exposure to safety hazards.

d) Upgradation of Occupational Health Centres with modern facilities for maintaining Occupational Health Standards of employees and computerisation of health records.

e) A culture of safety to be propagated with the involvement of workemen and assistance of bi-partite forums like JCSSI etc.across Steel Industry.

f) Usage of Audio Visual Aids, Safety films etc.for imparting effective training particularly to contractor workers.

g) Safety standards to be monitored by agencies like JPC, NSC, FICCI, CII etc. in order to bring about improvement in the secondary steel making sector consisting of Sponge Iron Plants, Mini Steel Plants, Re Rolling Mills etc.

h) Treating the Contractor Workers at par with Regular employees in matters related to safety and Occupational health aspects.

i) Pre-commissioning and regular Safety Audits to be conducted at regular intervals in both organized and unorganized sector.

j) Concept of Behaviour Based Safety management to be propagated & implemented across the industry in order to bring about basic change in perception towards performance of ones duty to achieve ultimate goal of producing accident free steel.

k) Modern water tight fire detection, protection, control and response system to be installed / maintained.

CHAPTER - VIII

RECOMMENDATIONS

8.1.0 Introduction

8.1.1 As a part of the general economic reforms programme, deregulation of the Indian Steel industry was initiated in the year 1992. The new policy regime consisted of measures such as decontrol of steel prices and distribution, de-licensing/ de-reservation of capacity and liberalization of foreign trade. Industry's future prospects are now largely determined by market forces and the role of the Government in the new economic order has changed from a regulator to that of facilitator and coordinator.

8.1.2 It is a matter of satisfaction that as a result of these policy measures, Indian Steel Industry has emerged much stronger while facing forces of competition in the last 20 years. Due to relatively strong growth registered by Indian Steel Industry in the post-liberalization era, India has become the 4th largest producer of steel in the World. The benefits of the process of liberalization are, however, not limited to steel producers. Consumers of steel have been equally benefited by the process of liberalization as they have easy availability to quality steel both from domestic as well as overseas sources.

8.1.3 At the same time it is a matter of concern that there are many areas where the performance of Indian Steel Industry has fallen short of expectations. Firstly, 11th plan period (2007-2012) has seen significant moderation in creation of green field capacities; even though the domestic demand for steel has seen a quantum jump in the last few years. The situation has resulted in large scale imports of steel thus depriving Indian economy the benefits of domestic value addition and generation of local employment.

8.1.4 It may be appreciated that India has miles to go before it can match the infrastructure and per capita consumption of steel in the developed world and the newly industrialized economies of the Asia. While the outlook for India's steel demand remains positive, there is an urgent need for making suitable changes in some of the policy/regulatory areas to facilitate time bound implementation of green field capacities. In the absence of these regulatory/policy changes, it will be a challenging task for Indian steel Industry to capitalize on the opportunities offered by a fast growing domestic economy.

8.1.5 Further, due to large scale import of steel in the country, in the last few years, India's potential to become a major exporter of steel has been overlooked. It is felt that if a more conducive policy environment especially for creation of new capacities is provided, India may become net exporter of steel as well as the 2nd largest producer of steel in the world soon.

8.1.6 Secondly, on the eve of 12th Plan, the growth prospects of Indian Steel Industry are clouded by loss of competitiveness in some of the traditional areas of strength. The cost of raw materials including those available domestically has risen at a quick pace in the last few years. On the other hand, despite the fact that some of the individual steel companies have achieved substantial improvements in productivity and efficiency, the efficiency gains, at a more general level, have been much slower and shallower. The inefficient use of resources, large scale exports of iron ore, over-dependence of industry on imported coking coal, rising labour costs, rising cost of land acquisition, rising interest rates, illegal mining and lack of commitment towards R&D activities are some of the areas which have the potential to threaten the long term economic sustainability of Indian Steel Industry.

8.1.7 These areas of weakness need to be addressed with greater priority in 12th Plan period through joint efforts of Government and Industry. While in a market driven economy the onus of enhancing competiveness lies with the industry, the Government has the responsibility to provide a level playing field to the domestic steel industry. At the same time the Government has an obligation towards steel consumers for ensuring production of quality steel as per the standards and specifications suited for various end applications.

8.1.8 However, the most important role of the Government in the 12th plan period will be to ensure a sustainable and an inclusive growth of the steel industry. It is now being increasingly felt that only such development is sustainable, which takes into account not only the economic sustainability of industry but also respects the ecological constraints and the imperatives of social justice. Therefore, sustainable development needs to become an integral part of the overall planning and growth process of steel industry.

8.1.9 Another important role of the Government in the 12th plan period will be to ensure transparency in business transactions and especially with regard to the process of public procurement and grant of mining/prospecting concessions. While deciding mineral concessions, preference to value addition or for any other technical reason, though is highly desirable in national interest, should be explicitly stated in rules/guidelines etc. Transparency is not only desirable on moral grounds, it will help in avoiding litigations/judicial review of decisions, as the lack of the transparency is slowing down the growth of steel industry.

8.2.0 Area Specific Recommendations

8.2.1 Demand Side Management

8.2.1.1 The base case scenario presented in the report assumes 10.3% growth in steel consumption per annum during the 12th plan. Considering high level of global uncertainties, achieving a double digit growth in steel consumption in 12th Plan is going to be a challenging task. It is certain that 'Business as Usual' (BAU) approach is not expected to yield the desired results. To achieve double digit growth in steel demand, it is therefore, necessary to take new initiatives and make necessary policy adjustments. However, a more crucial factor will be expeditious implementation of the key proposals of the Government, such as investment of $ 1 trillion in infrastructure and setting up of National Manufacturing and Investment Zones (NMIZs).

8.2.1.2 This is especially necessary since the demand for steel is a derived demand. Therefore, the growth in steel consumption will depend on overall growth in economy at a more general level, but more particularly on growth of user industries such as Infrastructure, automobiles, real estate, consumer durables etc. At the same time, there exist substantial latent possibilities of increasing steel demand by increasing steel intensity in construction, deeper penetration into rural markets and through market & product development. Despite a challenging macro-economic environment, the projected growth of 10.3 percent is therefore achievable by tapping new opportunities, framing innovative policies and by reducing gap between intentions and actual realization.

8.2.2 Accelerated Implementation of Infrastructural Projects:

8.2.2.1 Investment in infrastructure will be the key driver of steel demand in the 12th Plan. An anticipated investment to the tune of Rs. 45 lakh crore or $ 1 trillion in the infrastructure during 12th plan is quite substantial by any standards. While there is a general appreciation that massive investments in infrastructure in the 12th plan will substantially boost steel demand in the country (roughly by around 40 MT per annum), it is felt that so far the implementation of infrastructural projects has been quite slow. Large infrastructural projects are held up for a variety of reasons such as land acquisition, lack of co-ordination among various agencies, problems of financing etc.

8.2.2.2 To bridge the financing gap, it is essential to ensure that PPP (Public private partnership) mode of investment facilitating private investment in infrastructure reaches 50 percent in the 12th Plan period from 30 percent level in 11th plan. Long term financing needs of infrastructural projects must be ensured through funding from Infrastructure Debt Fund (IDF).

8.2.2.3 Further, “Project management’ capabilities must be improved in a significant way as otherwise a substantial part of investment may not be realized and may therefore pose significant downward risks to demand projections. At the same time, there is a need to complete the infrastructural projects without significant cost over runs so that performance in physical terms may not lag behind. In fact, the experience of the developed world suggests that higher usage of steel in construction activities may shorten the project execution time. Cement to steel ratio in India for construction activities is much higher than the developed world and correction in this ratio may open up latent possibilities of increasing steel demand in the infrastructure.

8.2.3 Implementation of National Manufacturing and Investment Zones (NMIZs) for Higher Growth of Manufacturing Sector:

8.2.3.1 The sustainability of India’s growth story is now being increasingly linked with more rapid growth of manufacturing sector than has been achieved so far in the post-reforms period. The thrust on manufacturing sector augurs well for increasing domestic steel demand as the manufacturing sector is one of the most powerful driver of steel demand apart from construction sector. The proposed ‘New Manufacturing Policy’ envisages raising the share of manufacturing sector in GDP from the current level of 16% to 25% by 2025. For this to happen, the Government has evolved a strategy to make India as the global manufacturing hub.

8.2.3.2 The most striking feature of the NMP is the proposal for setting up National Manufacturing and Investment Zones (NMIZs) equipped with world-class infrastructure. The investment earmarked for NMIZs is likely to create an exclusive industrial cluster along the long Delhi-Mumbai Highways (to be extended to other parts of the country). Speedy implementation of various provisions/projects as proposed in the 'New Manufacturing Policy' would be essential to sustain higher growth in steel demand.

8.2.4 Focus on Product Development/Diversification

8.2.4.1 **Import Substitution**: India imported 6.8 million tonnes of saleable steel in 2009-10, which came down marginally to 6.2 million tonnes in 2010-11. The major volume of imports belongs to HR Coils, CR Coils/Sheets, Plates, GPGC Sheets, Electrical Steel, Pipes, Tinplate and Bars & Rods with little quantity of semi-finished steel. Although, a part of the imports are due to price considerations, a significant component of imports is due to non-availability /low availability of some of the key steel items. There is need to focus on product development for some specific products which at present are being imported in significant quantities. The priority areas/items for product development for the 12th plan are as follows:

a. CR Sheets / Coils for Auto Sector
b. CRGO and High Grades of CRNO
c. Over Dimensional Plates, Quenched and Tempered Plates, Special grades of Boiler Quality Plates, etc.
d. Organic coated, Vinyl coated sheets.
e. Prime quality Tinplate (OTSC Grade)
f. API Grade large dia pipes

8.2.4.2 **Sectoral changes in the Demand Pattern:** There is a paradigm shift in the pattern of demand for steel by the major segments. The demand for high strength steel and thinner sizes is increasing for achieving the objective of reducing the total weight and for improving the overall performance. For example, Advanced High Strength Steel (AHSS) provides an optimized balance of strength, weldability, toughness, ductility, corrosion resistance and formability besides reducing the overall weight by around 16% in fabrication and erection.

8.2.4.3 **Automobiles**: The Contribution of automobile sector to domestic steel demand would be predominant in 12th Plan period in view of increasing per capita income level and the rising aspirations of Indian population to enjoy a better quality of life in the new development scenario of the country. The demand for auto grade steel particularly those belonging to Dual Phase steel, Trip steel, AHSS grade, Ultra Fine Grain steel, Nano steel, etc. would be required in increasing volume by all the auto majors who have set up their facilities in the country or are in the process of setting up fresh units. The safety regulation as per Euro norms would further require stringent specification of cold rolled products by the automobile sector.

8.2.4.4 **Power Sector**: The demand for cold rolled grain oriented steel (CRGO) by the power sector for manufacturing of transformers is being currently met exclusively from import, as no indigenous facility has yet been created. With the setting up of a number of ultra mega projects, the demand for CRGO steel which at the current level may be put around 1.5 lakh tonnes would increase substantially in the 12th plan period.

8.2.4.5 **Real Estate / Construction**: Pre-fabricated steel structures are now penetrating areas such as high rise buildings and infrastructure. These steel structures are not only environment friendly but make execution much faster. One of the emerging areas of application of pre-fabricated steel structures is its use in 'urban infrastructure'. This is due to the fact that the speed of execution is an important consideration, while building urban infrastructure. Such needs may go up significantly in future with rapid urbanization. The emerging capacity being created by Indian Steel Producers must cater to the above requirements of special grade steel structures required for these applications.

8.2.5 Unlocking of the Demand Potential of Rural India

8.2.5.1 More than 70% of India's population lives in rural India. Per capita consumption of steel in India is extremely low and therefore rural India offers tremendous opportunities to increase steel consumption. Major reasons for low per capita consumption in rural India has been a) low purchasing power of rural populace b) low availability of steel in rural India and c) Poor rural infrastructure. However, it is a matter of satisfaction that these problems are being resolved in a phased manner. Rural incomes are slowly rising as a result of schemes like Mahatma Gandhi National Rural Employment Guarantee Scheme (MGNREGS), higher procurement prices for agricultural products, financial inclusion and pick up in agricultural growth. As a result, more recently, there has been a perceptible rise in steel consumption in the rural economy.

8.2.5.2 Projects like Bharat Nirman, Pradhan Mantri Gram Sadak Yojana, Rajiv Gandhi Awaas Yojana have led to increasing demand for constructional steel items like TMT Bars, Light and medium Structurals, GP & GC sheets. The demand for steel is expected to rise further in the 12th plan as the social sector investments are expected to get further boost. To tap the potential of rural economy, the following strategies are suggested:

- Greater thrust on design, product development and capability building in fabrication or articles needed by the rural economy
- Widening of distribution network to cater to the retail demand of rural population
- Subsidies for purchasing agricultural implements/machinery- through effective targeting by Unique Identification (UID) mechanism being implemented for greater efficiency in social sector schemes.

8.2.6 Market Diversification:

8.2.6.1 An aggressive export strategy has been missing in the overall growth strategy of steel companies during 11th plan period. Rising domestic demand coupled with international uncertainties have been the prime reasons of lack of thrust on exports. As the developed economies of Europe and USA are struggling to overcome the sovereign debt crisis, the outlook on exports to these countries does not look promising. Diversification of markets based on the changing dynamics of growth in the world economy is crucial to ensure sustained and accelerated growth of exports.

8.2.6.2 As compared to developed world, the momentum of future growth would lie with Developing and Emerging Economies which are expected to register higher growth rates. The markets in Asia including ASEAN, Africa and Latin America would be important in the future. Product diversification as per the needs of importing countries and production of quality steel compatible with standards followed internationally has to become an integral part of export strategy. Working out conducive trading arrangements with trading partners holds a crucial place in the entire strategy of export promotion. The efforts towards successful conclusion of free trade agreements (FTAs) with our important partners must receive utmost attention.

8.3.0 Supply Side Management

8.3.1 As per the report of International Finance Corporation, 2011; India is ranked 165 out of 183 countries for starting a business and is ranked 134 out of 183 economies in terms of 'Ease of Doing Business'. These rankings need to be changed, through second generation reforms, if India is attract large scale investments in the industrial sector. Steel supplies, in the 11th plan have lagged behind due to lack of adequate investments and implementation of intended capacities especially in the integrated steel sector.

8.3.2 Procedural delays, problems in land acquisition, lack of raw material security, delays in enactment of important legislation etc. have been some of the important reasons which explain India becoming a net importer of steel despite the inherent strengths and competitiveness of the Indian steel Industry. Meeting domestic demand which is likely to grow at a rate of 10.3 percent per annum will be a highly challenging task. It is clear that in a Business as Usual (BAU) scenario domestic supply of steel will fall short of domestic demand. However, it is a matter of satisfaction that a large number of investors both domestic and foreign are keen to invest in Indian steel sector to capitalize and grow on the back of rising Indian steel demand. However, a pro-active role of government will be required to convert these investment intentions into reality.

8.4.0 Raw Material Security

8.4.1 **Iron Ore**

8.4.2 **Export of Iron Ore** :

Iron ore remains the most important driving force for the steel industry in India and the steel industry's growth so far can largely be attributed to the availability of low cost and high quality iron ore in the country. Large Scale export of iron ore from the country is a matter of concern and is not in the interest of sustainable growth of domestic steel industry. It is recommended that Export of iron ore from the country should be highly discouraged for the following reasons:

a) Large scale export of Iron ore will deprive the country the benefits of value addition and generation of employment in steel sector.
b) Most of the iron ore resources are in the forest and tribal regions. Over-exploitation of mineral resources without commensurate benefits to the domestic economy will have large social and environmental implications.
c) Evidence suggests that unbridled export of iron ore during last decade has led to illegal mining, unethical practices and large scale environmental degradation
d) There exist large potential to increase per capita steel consumption of the country, as the current level of India's per capita consumption is way behind not only in comparison to the developed world but also global averages. If India is to build a strong infrastructure, alleviate poverty and achieve economic prosperity, the country will need a strong and a competitive domestic steel industry which will require raw material security for sustained growth.
e) Magnetite resources of the country are predominately found in Western Ghats which is an ecologically sensitive area. If the potential of these resources is to be exploited in a environmentally sustainable manner, the same is possible mainly though underground mining. It is appreciated that underground mining requires huge investment costs and therefore the same will negatively impact the competitiveness of Indian steel industry.

f) If large scale export of iron ore is allowed, the domestic steel industry will have to depend on use of low/lean grade ore, sooner than later. Since cost of beneficiation at present is high and yields are generally low, it will dilute the competitiveness of Indian Steel Industry. However, if exports are moderated, it will push the dependence of steel industry on low grades to a later date by which time, it is expected that research and development (R&D) activities being pursued by the Industry and Government will be able to find cost effective solutions for beneficiating low/lean grade ores.

The objective of value addition and conservation of ore at present is being achieved mainly through increase in export duties. At present the duty on export of all types of iron ore is 20 percent on ad-valorem basis. This coupled with administrative measures taken by the Karnataka Government and that of judicial intervention played a key role in moderating exports.

The situation, therefore, needs to be closely monitored and the export duties may be further increased, if required. Further, in future, fiscal measures may be coupled with administrative measures, if the policy makers are of the opinion that fiscal measures alone are not effective to achieve the objective of conservation and domestic value addition. Further, while a part of pellets produced may be diverted to export markets; the Government needs to ensure that there are no excessive exports of pellets.

8.4.3 **Additional Strategies to ensure long term Availability of Iron ore for Steel Industry** :

a) It is a matter of satisfaction that ‘Value addition clause’ for the purpose of ‘Prospecting’ has been incorporated in the MMDR Bill, 2011. As per the new Bill, the state governments have got the flexibility to frame necessary guidelines. The State Governments, **therefore, should provide for an effective preference for value adders while framing such guidelines/ rules.**

b) The MMDR bill, 2011 stipulates that grant of **direct mining concessions** will be only through competitive bidding. The Working Group feels that there is a need for restricting such bidding to existing/prospective steel producers, value-adders and mining companies having domestic ore linkages. The restriction will ensure domestic value addition and will discourage exports.

c) Some of the new provisions of the MMDR bill, listed below, are in the right direction and may be retained in the MMDR Act to ensure faster and sustainable growth of the mining sector:

- Transferability of reconnaissance, prospecting and mining leases
- “Extension” rather than “renewal” of concession to ensure complete exploitation of mineral deposit
- Special provisions for allowing small deposits in cluster, and making cooperatives eligible for the purpose
- Enhanced penalties for violation of provisions of the Act including illegal mining, empowering Central Government to issue directions and setting up of special courts
- Ensuring sustainable and scientific mining through provision for a Sustainable Development Framework
- Use of funds of District Mineral Foundation for sharing of benefits with local population and creation of local infrastructure
- Setting of National Mining Regulatory Authority for suggesting strategies for increasing investment, revision of royalty rates and launch prosecution in respect of large scale illegal mining

d) Inordinate delay in granting necessary statutory clearances is one of the most important reasons for low investment in the mining sector. It is necessary to evolve a time bound strategy for grant of leases and other statutory clearances required for development of mines.

e) There is an urgent need to augment the existing reserve base of iron ore resources through exploration activities. It is estimated that current reserves of iron ore will not last beyond next 20-25 years if the projected rate of growth in steel industry is to be achieved. Since financial resources of government/public sector companies are limited, greater thrust/investment on exploration activities will have to come through innovative Public Private Partnerships (PPPs) models.

f) Techno-Economic feasibility studies of various technologies of underground mining may be undertaken to unlock the potential of magnetite resources in the Western Ghats

g) Imported technologies for beneficiation of ores have limitations to deal with Indian ores as the characteristics of different ores vary widely. It is therefore necessary to develop appropriate beneficiation technologies through Research & Development (R&D) which are cost effective and are successful in dealing with different/specific grades of ore found in India. At the same cost effective technologies are needed to utilize slimes which at present is being dumped by the industry.

h) To optimally utilize the current resources of iron ore, it is suggested that excise duty on beneficiation of low grade ores may be dispensed. Further, the industry may be allowed to import equipments/machinery for beneficiation and pelletisation at zero duty. Since the capital cost of setting up beneficiation & pelletisation is quite high, it is recommended that setting up of such plants may be encouraged through an Interest Subsidy. A scheme for Plan assistance for encouraging beneficiation and pelletisation is placed in the Section on New Schemes in this chapter.

8.4.4 **Coal**

8.4.4.1 It is a matter of great concern that India has become over dependent on imported coking coal over last few years. The dependence on imports is likely to go up further as the new capacities are expected to come mainly through BF-BOF route. Dependence on import of non-coking coal is also likely to go up to sustain the growth of power sector and other sectors including coal based sponge iron sector. Following initiatives/reforms are required to boost production of coal from domestic sources:

a) The Ministry of Environment & Forests had adopted a policy of ‘Go – No Go’ areas by which coal mining was completely banned in No Go areas. The move has resulted in stagnation of production of coal. While concerns on environment are justified; it will be necessary to evolve mechanisms through which a suitable balance can be struck between the energy requirements of development and the need for environmental protection.

b) At present Coal India Ltd. enjoy monopoly in production and development of coal assets except in case of coal for captive use. It is being appreciated that stagnation in coal production is largely due to restrictions on investment by private sector. De-regulation of the coal sector, is therefore, the need of the hour to bring in competition, enhance efficiency and improve production performance.

c) The focus of Coal India Ltd. is more on the power grade coal, and the required drive for the development of coking coal assets has been missing in the growth strategy of CIL. To give a greater thrust to development of coking coal assets in the country, it is desirable that the existing coal mines should be demerged from CIL and a separate coking coal company should be formed.

d) Diversion of low grade coking coal to power sector should be gradually stopped by increasing the washing/beneficiation capacity in the country in the 12th plan period.

e) Timely Implementation of ‘Jharia Action Plan’ is crucial for increasing the availability of coking coal and therefore the ‘Jharia Action Plan’ should be monitored closely by the Government to achieve an early implementation.

f) For faster development of captive coking blocks the following policy initiates are recommended
(i) Single Window System for granting clearances
(ii) Permit coal mining and associated activities through contract mining
(iii) Allow companies to sell surplus coal left after captive use
(iv) Provide flexibilities to adjacent block allottees to develop blocks as a single entity

g) Underground coking coal mining has the potential of greatly reducing the disturbance caused to the environment. There has been very little fresh investment in underground mining and there is an urgent need to increase the scope and share of underground coal mining for which participation of the private sector will be a necessity.

8.4.4.2 Despite best possible efforts to enhance indigenous production of coking coal, India may continue to depend heavily on imported coal to meet the requirements of domestic steel industry. It is therefore necessary to develop necessary port and rail capacity to meet the enhanced requirement of imported coal. Considerations of raw material security justify a policy of acquiring coal assets abroad. It may be mentioned that in the oil and gas sector, an institutional mechanism namely ONGC Videsh has already invested $11 billion in oil/gas assets.

Similar investments should be undertaken aggressively in coal sector in the 12th plan by acquisitions in resource rich countries .While an initiative in the form of International Coal Ventures Limited (ICVL) has already been taken, the performance of ICVL so far has been far from satisfactory. A grater thrust and an aggressive policy stance is needed in this area in the 12th plan period. Bi-lateral agreements may play a vital role in enhancing the raw material security of steel industry.

8.4.4.3 In view of a large number of representations received from sponge iron producers about non-fulfillment of commitment made by CIL ; it is recommended that Ministry of Coal may be requested to ensure supply of coal to sponge iron producers as per the provisions of New Coal Distribution Policy (NCDP). Further, it is recommended that pellet plants should be included under NCDP for linkage of non-coking coal.

8.4.5 Natural Gas

8.4.5.1 Natural gas is a preferred input for steel plants for considerations of environmental sustainability. Even then, even the existing demand of gas based DRI producers is not being met through indigenous sources. As per the existing system of allocation of natural gas, Steel sector has been accorded a much lower priority. Switching to imported 'LNG' is an expensive option. Presently, natural gas from the KG basin and other domestic sources is priced at $4.2–5.7 per mmbtu whereas the price of imported LNG ranges from $13-14 mmbtu. Therefore, steel plants based purely on imported 'LNG' are not viable. The country should take urgent steps for extensive exploration and to enhance the output from existing sources such as KG Basin.

8.4.5.2 Due to reasons of poor availability, low priority to steel sector in allocation and high prices of imported LNG, growth of gas based steel production has stagnated for last several years. Non-conventional gas resources, particularly shale gas and also coal bed methane (CBM), hold a lot of potential for the steel industry. A major thrust needs to be given to the identification of shale gas resources in India and the determination of the feasibility of exploiting them. Expansion of CBM should also receive priority attention in the 12th Plan.

8.4.6 Manganese Ore, Chrome Ore, Ferro-Alloys and Refractories

8.4.6.1 There is a need to conserve the precious resources of manganese and chrome ore for future use by domestic steel & ferro-alloy industry through quantitative and fiscal measures.

8.4.6.2 Focused attention is needed to ensure higher rates of recovery of manganese and improve the quality of ores by beneficiation and sintering processes.

8.4.6.3 Geological Survey of India (GSI) may undertake extensive drilling to identify new Manganese and chrome ore deposits at lower depths. Further, exploratory efforts are required to convert the remaining resources of 149 million tonnes of chrome ore into reserve category. Deep-sea nodules can be a potential source of manganese in the future and its potential should be tapped.

8.4.6.4 R&D is required for reclamation of old mined out areas and to ascertain the impact of manganese mining on the ecology.

8.4.6.5 For further exploitation of ore deposits in the Sukinda Valley (Orissa), switching to underground mining is necessary as the stripping ratio has reached 1: 20.

8.4.6.6 Ferro-Alloys industry of the country has a lot of export potential. With the help of fiscal incentives, the export potential of the industry can be further enhanced.

8.4.6.7 There is a need for greater standardization of shapes of the refractories. Steel industry and the refractory makers should work together to achieve this objective and for enhancing the performance of the refractories.

8.4.6.8 Basic raw materials for refractories are being largely imported at present. R&D is required for enhancing the use of indigenous inputs.

8.4.7 **Financial Resources**

8.4.7.1 Requirement of financial resources to build an additional capacity of around 60 million tonnes will be approximately Rs. 2.5 lakh crores during 12th plan. Availability of such large quantum of investible funds at reasonable costs will be a challenging task. In order to ensure sufficient availability of financial resources for the growth of Indian steel industry, it is imperative to review steel related sectoral caps of the banking sector. Government may also consider easing of norms connected with external borrowings (ECBs). Due to various reasons, implementation of steel projects generally takes a lot of time. Special purpose long term financing facility may be created to finance huge investment in new steel plants.

8.4.7.2 Development and adoption of new technologies at a commercial scale is a high risk area. Even when the new technologies have been commercially proved elsewhere in the globe, the performance of these technologies may be different with local raw materials. Experience suggests that adoption of new technologies requires a lot of time for stabilization.

8.4.7.3 Some of the new technologies which use non-coking coal and fines are compatible with resource endowment of the country. However, investors are unwilling to take risks as investments on a commercial scale steel plant are huge. It is therefore the need of the hour to attract “Risk Capital” in the steel sector for development of new technologies. Apart from concessions such as duty free imports and Tax Holidays; innovative financing methods, contribution to the equity by the Government and “Technology Development Bonds” on the lines of infrastructure bonds are some of the other mechanisms which may be explored for development/adoption of new technologies. Similarly, there is also a need to attract “Risk Capital” in the area of exploration and prospecting of minerals.

8.5.0 Infrastructure

8.5.1 General Issues

8.5.1.1 Since financial strength of steel companies will be leveraged for creation of additional steel capacities in the 12th plan, the onus of creating primary infrastructure will be on the Government. However, since resource constraints will continue to limit public investment in infrastructure, PPP-based development needs to be encouraged wherever possible e.g. for internal roads, connection to main rail routes etc. Large integrated steel producers may be persuaded to go for PPP mode of investment with railways, NHAI, State Governments etc. for creation of secondary infrastructure. It is necessary to review the factors/PPP models which may be constraining private investment, and take necessary steps to rectify the problems. An institutional mechanism for co-ordination among small/medium and large producers located in the same area will be required to enter into PPP mode and pool resources for creation of common infrastructure.

8.5.1.2 The availability of land has become a major constraint on expansion of steel industry as well as creation of new infrastructure. A Bill has been introduced in Parliament with an objective to balance the social and economic interests of the country. Notwithstanding the need to critically review some of the provisions of the bill based on the feedback from industry associations, finalization of this legislation is critical for growth of steel industry as well as creation of required infrastructure.

8.5.1.3 Rail freight in India is amongst the highest in the world. High transportation cost leads to inefficiencies in the economy as inefficient producers located in far-flung/remote areas continue to survive on the back of higher freight costs payable by efficient producers. There is a need for rationalization of freight rates by bringing down the level of cross subsidization between freight and passenger transport. Further, procedural delays related to building private rail sidings by the steel producers need to be tackled in an effective manner.

8.5.1.4 Completion of dedicated rail corridor must be taken up on top priority as it will help in faster and cost efficient movement of raw materials and finished steel.

8.5.1.5 General infrastructure facilities such as all-weather roads, rails etc. are grossly inadequate in country's mining belts. Development of high quality roads and rail connection for movement of ores to steel plants rather than to ports for exports should be taken as priority in 12^{th} Plan. At present, rail and road infrastructure is suited for exports rather than for domestic value addition and there is an urgent need to correct this anomaly. Funds to be made available to proposed Mineral Development Fund may be used for creation of infrastructure in the mining belts.

8.5.1.6. Special attention is needed to upgrade port capacities and associated rail/road infrastructure to meet the quantum jump in the requirement of imported coking coal in the 12^{th} plan. Since import of thermal coal will also increase substantially in the 12^{th} plan, adequate increase in port capacity, handling facilities etc. may be taken on priority so that the situation of shortage of coking coal does not emerge for the steel industry.

8.5.1.7 National Manufacturing Investment Zones (NMIZs) have been proposed as a part of New Manufacturing Policy. These zones will be equipped with world class infrastructure. NMIZs may provide an excellent potential location for setting up new steel plants as the transportation costs will be minimized due to close proximity to consumers of steel. However, for this to happen, it is desirable that in the perspective planning for setting up NMIZs some of the NMIZs are planned in the eastern region and mineral rich states.

8.5.1.8 The government may also consider setting up special purpose vehicles (SPVs) to execute the preliminary work such as land acquisition, land development, obtaining all government clearances in identified steel plant sites with the same to be handed over to the prospective investors on commercial terms

8.6.0 Specific infrastructural requirements

8.6.1 Some of the important infrastructural projects required for the growth of steel industry have been discussed in the Chapter on Infrastructure Issues. These projects need to be implemented expeditiously to ensure timely completion of steel projects. However, to take a more comprehensive view on the overall requirements of the steel industry, a study has been initiated by the Ministry of the Steel and the consolidated requirements of the steel industry for the 12th plan will be communicated to the Planning Commission separately.

8.6.2 Since Infrastructural projects have long gestation periods, it is further proposed that specific infrastructural needs of the steel industry are assessed not only for the 12th Five Year plan but also for 13th, 14th and 15th Five Year Plans i.e. for next 15 to 20 years. For this mapping of potential sites based on availability of minerals, water resources, proximity to rail corridors, current status of general infrastructure and categorizing areas on the basis of ecological and social sensitivities will be required.

8.7.0 Human Resource: Issues in Availability, Training & Safety

8.7.1 Human resources are a source of sustained competitive advantage and should be treated as most valuable assets both by the Government and industry. Despite rapid growth of Indian steel Industry in the post-liberalized era, overall requirement of human resources in the steel industry has not grown in a significant way due to substantial gains made by the industry in the area of labor productivity.

8.7.2 However, due to increased automation and use of Information Technology in steel industry, there have been extensive changes in the qualitative requirements of workforce. The industry's requirement is shifting in favor of Management Graduates, Metallurgists and Engineers from diversified fields, finance professionals and various specialists required at the shop floor. To achieve higher rates of growth and improve overall efficiency and productivity in the steel industry, the following initiatives are needed in the area of human resources in the 12th Plan:

1) The best of India's engineering graduates no longer prefer to work in the factories. They work for Management Consultants, IT industry or for banking/ financial sector. Besides paying completive pay packages, a strategy/policy at the national level is required to ensure regular flow of talent towards Industry/Manufacturing.

2) Professionals/ engineers continue to have the impression that the working atmosphere in steel plants is hot and dusty. They are not aware that steel industry has modernized over the years and with the use of IT and automation working conditions in steel plants have become much cleaner & comfortable. Steel Industry must change its brand image by regular interaction with students/faculty of engineering colleges, inviting more & more students for training and increasing awareness through mass media.

3) At present there is a mismatch between the needs of steel industry and skill development process in our educational system. Firstly there is a shortage of top-end engineering colleges who award a degree in Metallurgy. Secondly, even in the existing premier colleges, the focus is more on ‘Materials than Metals’. Since the importance of metal industry is growing, educational institutions should offer degree courses separately for Metallurgical engineering and Materials engineering. The change will require training of faculty members which may be facilitated by the steel industry through creation of ‘Steel Technology Centers. Thirdly there is an urgent need to reorient the curriculum of metallurgical engineering courses to make them more relevant to the changing demands of the steel/metal industry.

4) At the same time, there is need to revisit the curriculum to prepare metallurgists/engineers not only for steel operations but also for R&D work. It has been felt that R&D activities in the steel sector should be undertaken with more vigor and for this the right kind of manpower will be essential. To attract bright students to R&D there is a need to substantially increase the scholarships offered to P.G./Ph.D. students pursuing higher education/research in steel metallurgy. The country also needs to provide greater autonomy to our best Engineering colleges to enter into collaborative R&D partnership with the best universities abroad.

5) Nothing is more important than the safety and health of the people who work in our steel industry. As per the sustainability indicators released by World steel Association, lost time injury frequency rate for the member companies of WSA has come down to a level of 2.3 injuries per million man-hours in the year 2010. In contrast, the performance of Indian steel Industry on safety front has been much poorer since it has reported a large number of fatal accidents along with high frequency rate. The industry should aim and make efforts to achieve the goal of ‘Zero Fatal Accident’ in the 12^{th} Plan.

6) Experience suggests that though accreditation of OSHAS:18001: 2007 is highly desirable, it is not a sufficient condition to ensure high level of safety in work environment. Safety aspects are to be integrated at the design stage as well as during operation and maintenance so as to minimize the occupational risks. To achieve this objective, a number of strategies have been proposed in the Chapter on ‘Safety Measures in Steel Industry’. These suggestions should be communicated to the steel companies and concerned departments in the central/State governments for necessary follow up. The suggestions will help in creating a more stringent regulatory framework and will ensure a safe working environment in the industry in the 12^{th} plan.

8.8.0 Issues in Technology and R&D

8.8.1 Technology

8.8.1.1 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. The industry need to acquire new strengths and improve efficiencies in a globalized world. It is a well known fact that overall efficiency and productivity levels of Indian steel industry are way below the global benchmarks. Further, efficiency levels vary widely within Indian Steel Industry. At one end we have plants with most modern facilities which are trying to catch up with the best in the world. On the other end we have small, inefficient, uneconomical and environmentally unsustainable steel units which have mushroomed due to rising domestic steel demand.

8.8.1.2 Investors, in a market driven economy, are free to choose technology based on commercial considerations. The role of the government in choice of technology is therefore limited. However, Government can incentivize and encourage specific technologies which a) are compatible with resource endowment of the country b) are energy efficient and c) help in mitigating the concerns on environment & climate change. Further, the Government can regulate adoption of certain technologies/routes which are counter-productive to above mentioned objectives and other national priorities. The following strategies are suggested to develop a modern, efficient and technologically superior, Indian Steel Industry:

a) DRI-EIF route suffers from lack of refining ability. The steel melted by the process has higher percentages of P and N. Rotary Kiln DRI-EIF route need to improve its technology and scale to avoid obsolescence, loss of competitiveness and market acceptability. Due to imperfect market conditions and especially those relating to growth of large scale, modern integrated steel plants; inefficient units have continued to survive and grow in last two decades. There is no denial of the fact that these units have contributed significantly in meeting the rising domestic steel demand and has helped the country to avoid flooding of steel imports. To balance the objectives of high volume growth and concerns on efficiencies and environment; it is desirable that these units are modernized.

b) The Chapter on 'Technology & R&D' report presents an inventory of latest technologies already in use by some plants and also of emerging technologies along with relative strengths and weaknesses of each technology. These technologies need further critical examination for prioritization and incentivization by the Government. Adoption of latest technologies may be facilitated through a) Tax holidays b) Zero duty on import of plant equipments and by providing "Risk Capital".

c) Some of the existing and emerging technologies which have potential to achieve stated objectives are as follows (i) Coke Making: Non-Recovery Coke Ovens, Stamp Charging & Partial Briquetting of Coal Charge, Tall Ovens, Coke Dry Quenching, SCOPE21, DAPS, on-line heating control technology for coke ovens, optimization of coal blend, refractory welding etc (ii) Sintering/Agglomeration: Increased use of multi slit burners, "proper MgO addition", use of super fines, vibrating granulation equipment, high agitating mixture, high pressure sintering, pellet sintering technology etc. (iii) BF Iron Making: Higher use of alternate fuels, Increase in oxygen enrichment and hot blast temperature, introduction of Cu-staves, increasing blast volume and flow rate, increasing the useful volume by superior refractories, increased use of prepared burden, us of waste plastic granules, TRT, use of waste heat stove gas, extensive use of probes, models and expert system for process analysis, up-gradation of cast house equipment, incorporation of powerful mud gun and drilling machines etc. (iv) Direct Reduction and smelting reduction: coal gasification, COREX process, FINEX process, HISMELT process, FASTMET/FASTMELT process, ITMK3 process etc.

d) In addition, new developments are taking place in areas such as pre-treatment of Hot metal, electric steel making, secondary refining, continuous casting, near net shape casting, billet caster, Bar & rod Mill, hot strip rolling, hot finishing, cold rolling and finishing, rail mill, processes for development of high strength steels, continuous annealing and product development. The cost-benefit analysis of these technologies should be taken at a greater pace by the industry for an early adoption of efficient technologies.

e) The most important area of positive Government intervention in the 12^{th} plan may be in the area of adoption/adaptation of promising/emerging technologies like FINEX, ITmk3, and HISMELT etc. so as to supplement the conventional coke oven-sinter plant-blast furnace technologies. Adoption of these technologies will help in reducing dependence on Iron Ore lumps, imported coking coal and will also help in reducing harmful emissions.

f) Due to absence of good Design, Engineering and Manufacturing (DE&M) facilities in the country, the steel producers have to depend on import of state of the art facilities at phenomenal cost. Though, the country lags behind significantly in this area, it is desirable that a beginning is made in this area in the 12^{th} plan, to avoid long term dependence on imports of equipment. Since financial resources may be a constraint especially for creating the manufacturing facilities, pooling of resources by steel companies through a MOU may be undertaken with Government providing necessary incentives/subsidy. Participation of known equipment designers of Europe or Japan may be beneficial at least in the short and medium term.

8.8.2 Research & Development

8.8.2.1 According to Economist Intelligence Unit (EIU), 2009, India's rank in the Economist Group's Global Innovation Index for 82 countries has progressed from 58th place in 2006 to 56^{th} in 2008, with a further progression predicted to 54^{th} place by 2013. However, India's major innovation achievements are limited to the fields of Information technology, space research, life sciences and pharmaceuticals. R&D Investments in Indian Steel Sector has been quite low and vary in the range of 0.15-0.25% of turnover. This is despite the fact that Indian Steel industry has enjoyed a decent level of profitability in the last few years.

8.8.2.2 The lack of seriousness on 'Research and Development' activities in the Indian steel sector has resulted in a) high capital costs for modernization and building new steel capacities as India continues to depend on the 'West' for import of major equipment and technologies b) high level of dependence on imported raw materials and especially coking coal as we have failed to develop indigenous technologies which are compatible to resource endowment of the country c) Increased threats on sustainability of resources especially adequacy of iron ore resources as the country is yet to develop cost effective beneficiation / pelletisation technologies suited to Indian ores and d) large scale imports as

R&D in product development area is inadequate to meet the growing demands of growing sectors such as automobiles, power, ship building etc. To overcome the above mentioned challenges, the following strategies are suggested for implementation in the 12th plan:

a) Aim at achieving a strategic goal of increasing R&D expenditure to 1% of turnover, by the end of terminal year of 12th plan (2016-17). This will require stepping up R&D expenditure both by the Industry and Government. To further incentivize R&D activities by the Industry, it is proposed to widen the scope of tax concessions (currently at 200%) to cover items such as expenses related to design, development and running of a pilot plant/ large scale demonstration plant. It is further proposed that Govt. budgetary support for R&D activities in the steel sector may be increased from Rs. 111.1 crore in 11th Plan to Rs. 450 crore in the 12th Plan (see Box-1 for details of Plan Scheme).

b) The real objective of incentivizing industry for taking up R&D may be lost through innovative accounting methods. It is therefore proposed that expenditure on routine activities such as testing and standardization should not be classified as R&D expenditure and accordingly expenditure incurred only on two I's namely Improvement and Innovation may qualify as R&D expenditure. Details of various heads which are proposed to be covered under R&D expenditure are listed in the Chapter on R&D.

c) There exists enough scope to leverage the Government grants for R&D for increased contribution from the Industry. So far the mechanism of Public-Private Partnerships in the area of R&D has not been adequately utilized. It is suggested that Steel Technology Centers are created under PPP model in industrial sites for promoting research under industrial conditions. A well designed and structured scheme for investing in Steel Technology Centers in industrial premises could be developed and implemented. The scheme could develop transparent criteria for making competitive bid for public funds for establishing Steel Technology centers within industrial sites.

d) To improve the efficiency of R&D expenditure, R&D activities will have to become more market driven and relevant to the requirements of industry. At present, R&D outputs from public funded research are not adequately leveraged into manufacturing advantage by the industry. Such outputs require further work and translational research and development, to deliver national outcomes. Currently, efforts on translational research in steel sector are marginal in the country. Unless linkages between the R&D systems in the public funded institutions and the industrial sector are substantially improved, translational research needs of the country would remain unaddressed. We therefore, need to create a policy framework that takes into account the entire life cycle of ideas beginning with discovery/creation to commercialization, extension and value addition.

e) One of the major problem areas for undertaking large scale R&D activities in India is that of migration of highly skilled manpower to the West. International co-operation is one of the strategies to overcome the shortage of R&D experts in the country. This would also give us head-start in areas where substantial work has already been done by international experts. Another strategy which has been followed in past by Indian companies has been overseas acquisition of high tech companies. Such acquisitions provide an access to international experts and world class innovative practices.

f) Thrust/Priority areas of undertaking R&D activities in the 12th Plan the field of raw materials, iron making, steel making, ferro-alloys, modeling & simulation, product development & environment management have been identified and are listed in Chapter on Research & Development. These priority areas need to be considered for incentivizing the industry as well as for public funding of research projects.

8.8.3 Sustainable Development- Issues in Environment Management, Energy Efficiency and Climate Change

8.8.3.1 The strategies for development of steel sector should not only focus on volume growth but also on quality of growth. It is necessary to evolve an appropriate sustainable development framework which balances the need for rapid growth of the steel industry and also addresses the concerns on environment and climate change. India will be one of the most vulnerable countries to the adverse effects of climate change and it must address this issue in a coordinated/collaborative manner with other countries without compromising growth.

8.8.3.2 Steel Industry is a resource intensive industry and therefore it has the potential to negatively impact the environment unless regulated adequately. Indian Steel Industry is generally perceived as “old; dirty and polluting” industry. There is a consensus that there exists a lot of scope for the Indian Steel Industry to contribute to the National Mission on Enhanced Energy Efficiency (NMEE) as well as National Action Plan on Climate Change (NAPCC), 2008. Suggestions, strategies and thrust areas for the 12th plan to achieve a sustainable growth of steel industry are given below:

1) Energy recovery and conservation technologies such as Coke dry Quenching (CDQ) and waste heat recovery from sinter cooler provide significant opportunities of reduction in energy consumption in BF-BOF route of steel production. At present the use of these technologies is limited to a few plants. A more encompassing adoption of these technologies would lead to substantial reduction in energy consumption by the Indian Steel sector. Therefore there is a need to examine the various constraints limiting the use of these technologies and a suitable strategy may be worked out to incentivize the industry for adopting these technologies. Other technologies such as top gas recovery turbine in BF, coal moisture control in coke ovens, OG boiler in BOF, regenerative burners etc. also provide significant opportunities of energy reduction as well as for management of CO2 emissions.

2) National Mission for Enhanced Energy Efficiency (NMEEE) has planned four new initiatives namely ‘Perform Achieve and Trade Scheme (PAT)’; Market Transformation for Energy Efficiency (MTEE); Energy Efficiency Financing Platform (EEFP) and Framework for Energy Efficient Economic

Development (FEEED). The aim of these initiatives is to reduce the emission intensity of India's GDP by 20-25 percent by 2020 from the 2005 level. The potential of these initiatives should be fully exploited by steel companies and especially small and medium enterprises if they have to survive in a stricter regulatory environment aimed at compliance with the stated goals. Ministry of steel should facilitate the Industry in the process of utilizing opportunities available under the NMEEE.

3) Availability of information on best available technologies for energy efficiency and environment protection is extremely important and has helped the industries of developed countries to improve their efficiencies in a sustained manner. Similar documents for the Indian steel Industry covering all routes of steel production will be a very important step in ensuring faster progress towards the goal of sustainable development. These documents will be especially useful for the small and medium enterprises which have relatively limited knowledge of research and technological developments.

4) Even after implementing suggested energy conservation and efficiency improvements, the anticipated CO2 reduction from the steel sector will still be high. Thus there is a need to look at other technologies like carbon capture and sequestration (CCS) and new routes to carbon free steel making. Currently, there are several research activities being carried out in this direction and it is necessary that steel industry/Ministry is actively involved in them. To focus on various issues related to climate change, there is a need to set up a Climate Change Committee (CCC) under MOS.

5) For an effective environmental management in the steel sector, the following thrust areas have been identified for implementation in 12^{th} Plan:

- 100% usage of BOF & EAF slag by introduction of a product standard
- Reduction of fresh water usage to less than 4.0 m3/tcs in integrated steel plants and work towards achieving " Zero" water discharge.
- 100% recycling of wastes to achieve zero wastes generation
- Reduction of process dust emissions to less than 1.0 kg/tcs
- Staged combustion in burners to reduce NOx emissions
- Online monitoring of stacks in all plants etc.
- Introduce EMS (ISO-14001) in all sectors of steel making

8.8.4 Information System: Issues in Scope and Quality of Data

8.8.4.1 Greater emphasis need to be placed on information system so that it provides reliable inputs for framing policies & take sector specific interventions. A good database also facilitates investors in taking efficient investment decisions. Timely access to accurate and relevant data/information is a must in order to understand prospects, direction and specific avenues of growth in the Indian iron and steel sector. It is in this context that the respective roles of the Joint Plant Committee (JPC) and Economic Research Unit (ERU), JPC assumes critical dimension for, in an information-driven world.

8.8.4.2 The existing 'Data Collection' institutional mechanism therefore, should be strengthened by providing it the necessary administrative/legal mandate for timely collection of data/information from the industry. Further, it is felt that there exists a potential to improve the quality and reliability of the existing database on steel sector.

8.8.4.3 It is recommended that 'Demand Assessment' studies for each of the important user segments such as Construction, Automobiles, Oil & Gas, Capital Goods, Consumer Durables etc. may be taken up on priority basis to provide important inputs to policy makers and investors.

8.8.5 Consumer Rights: Issue of Quality and Standardization of Steel Items

8.8.5.1 The Government may ensure timely implementation of the mandatory certification of steel products so that availability of steel in market is consistent with the requirement of various steel products/applications. Mandatory Certification of steel products is essential in areas where consumer health/safety is involved**.** Retail customers in our country are generally unaware of the adverse effects of using non-standard steel products in applications such as house-hold construction, packaging etc. Retail consumers in India are more concerned about initial price of steel products. Initial price has been the dominating factor in decision making of consumers, not only because of low purchasing power, but also due to ignorance about the concept of life cycle costing. As a result there is a large scale use of non-standard, low quality steel products by the Indian customers.

8.8.5.2 There is a need to make consumers more aware about these issues through advertisements in electronic and print media. Simultaneously, government needs to strengthen the existing administrative mechanism to ensure an effective enforcement of quality standards. At an appropriate time, the scope of mandatory certification may be further widened to include more steel items. However, a calibrated approach may be followed so as to maintain a judicious balance between imperatives of volume growth and need for producing quality steel.

8.9.0 Plan Assistance/Allocations for the Steel Industry during the 12th Five Year Plan (2012 – 17)

8.9.1 On-going Scheme

Scheme for promotion of R&D in Iron and Steel Sector:

Based on the recommendations of the Working Group on Steel Industry for the 11th Five Year Plan (2007-12), this Scheme for Promotion of R&D in Iron & Steel Sector was approved for implementation during the 11th Plan with an outlay of Rs.118.00 crore. The objective of the Scheme is to promote and accelerate R&D activities in development of innovative / path breaking technologies consistent with domestic resource endowments. The Scheme was formally approved on 23rd January, 2009 for implementation from financial year 2009-10 (the details may be seen at Chapter – VII)

Till now, under the scheme, a total of eight R&D projects have been approved. The duration of these projects is from 2 to 3 years.

The total cost of the eight projects is Rs. 143.87 crore with a planned component of Rs. 111.11 crore. Details of the approved R&D projects and year wise fund disbursal/requirement are given in **Annexure - 6.2.**

So far Rs.31.17 crores has been released and the year-wise release of fund is as shown below:

Year-wise disbursement of Plan Fund

Sl.No.	Year	Fund released (Rs.in crore)
1.	2009-10	4.13
2.	2010-11	27.05
3.	2011-12 (Planned)	39.00

8.9.2 In addition to the ongoing projects, it is expected that few more high value projects of national importance, particularly related to technology development and adaptation are likely to be taken up in the 12th FY Plan Period. Some of these may include Adaptation of HISMELT technology for Indian raw materials, Development of relevant iron making process using steel plant wastes and Indigenous development of innovative products like CRGO, etc.

Taking into account the assistance required for both ongoing as well as new projects to be undertaken a total budgetary allocation of Rs.550 crore is proposed for continuation of the scheme during the 12th Plan. The proposed outlay includes Rs.50 crore for ongoing R&D projects and Rs.500 crore for new projects to be taken up during the Plan period.

8.10.0 NEW SCHEMES (Proposed)

8.10.1 Scheme to provide incentives for Promotion of Beneficiation & Agglomeration of Low grade Iron Ore & Iron ore Fines

8.10.1.1 Presently the domestic Steel Industry uses mostly medium and high grade iron ore lumps and use of low grade ores and fines is limited. Given the projected growth of Indian Steel Industry, the demand for iron ore is likely to increase manifold and unless we are able to utilise the low grade ores the reserves of the high grade /medium grade ore are likely to get exhausted in the coming 20-25 years. Therefore there is an urgency to explore options for utilisation of the low grade ore including fines and slimes to sustain the industry's future growth. Government has recently reduced the threshold limit of iron ore of Hematite grade from 55% Fe to 45%Fe and this also calls for economic utilisation of low grade ore up to 45% Fe.

8.10.1.2 However, low grade ore cannot be utilised in the conventional process of iron making for techno-economic considerations. Such ores have to be necessarily beneficiated to produce high grade concentrate. Besides these concentrates also need to be agglomerated in the form of pellets to make them suitable for use in Blast Furnace (BF) or in sponge iron production. Therefore beneficiation and pelletisation normally go hand in hand.

8.10.1.3 The use of agglomerated burden like pellet and sinter also has several techno-economic benefits in iron making. But at present the domestic pelletisation capacity is limited . The slow growth in beneficiation of low grade ore and pelletisation in India has been on account of the following three reasons :

(1) Comfortable domestic availability of medium to high grade lumpy ore

(2) High cost of setting up of beneficiation plants. The average cost of setting up a beneficiation plant is estimated to be around Rs 150 to around Rs 200 crores per million tonnes of concentrate.

(3) Lack of technology/equipment for setting up smaller production Capacities suitable for smaller mine owners. Earlier the design capacity for pellet plants available used to be 3 to 4 million TPA and above.

8.10.1.4 The minimum techno- economic capacity of pellet plants has since changed and now technologies are available for smaller size pellet plants of capacity as low as 0.6 million TPA.A few pellet plants of these capacities have have also been set up in the country over the last few years but they are far short of our requirements. With government already taking initiatives towards conservation of iron ore through imposition of custom duty @ 20% on exports the stock of fines and low grade ores are bound to go up further and action may need to be taken for their increased indigenous use. Therefore it is recommended that a scheme may be introduced to promote use of low grade ores through provision of suitable incentives for increased investment in beneficiation /agglomeration and pelletisation by the domestic steel industry.

8.10.1.5 The incentives provided may be in the form of interest subsidy for loans taken for investing in such projects. As per tentative estimates made for an additional capacity of 50 million tonnes (including those in the pipeline) for pelletisation the interest subsidy on loan @ 5% and assuming a ten year loan repayment schedule , the total fund requirement may work out to about Rs 1200 crores during the 12th plan period (2012-17) and around Rs 850 crores for the 13 th plan period (2017-2022) The total interest subsidy for the loan period will accordingly add up to Rs 2050 crores.

8.10.1.6 However details of actual requirements under the scheme (scope eligibility criteria, cost of plant , fund requirement and releases , period of implementation etc) may have to be examined and finalised in consultations with all stakeholders concerned . This may be done by constitution of a Task Force with representatives of the iron ore producers, the steel industry and all other stakeholders concerned. **Pending the same the proposed scheme may initially be approved for implementation during the 12th plan (2012-17) with a token provision of Rs 1 crore.** This would enable the ministry to initiate immediate action on this crucial issue linked to ensuring raw material security for the domestic steel industry.

8.10.1.7 Details of the tentative estimates for fund requirement for the above mentioned scheme are given at **Annexure – 8.1.**

8.11.0 Scheme for improvement of Energy Efficiency in Secondary steel sector

8.11.1 About 40% of India's crude steel is produced by the mini steel plants comprising of Electric Arc Furnace (EAF) and Electric Induction Furnace (EIF) units. Further, more than 60% of long steel products are manufactured in the secondary steel sector i.e. EAF, EIF as well as the Rerolling mills. The Rerolling mills normally source their inputs viz. pencil ingots and continuous cast billets mostly from the EAF and EIF units. All these units are characterised by high levels of energy consumption and Green House Gas (GHG) emissions. Therefore adoption of clean, green and energy efficient technology by them has become over the years a subject requiring specific attention both from the point of view of improving their productivity as well as for ensuring environment protection.

8.11.2 The EAF sector is well equipped to produce quality steel but their energy consumption levels are relatively higher. To addressed this issue there are a number of established technologies currently available for the sector viz. Oxygen assisted melting, oxygen fuel burner (side wall/roof),Eccentric Bottom Trapping etc but the problem is that the use of these technologies remain restricted mainly on account financial reasons i.e. the high capital expenditure involved and the limited resources of the small and medium level enterprises. Therefore it is proposed that under above scheme suitable incentives may be provided to the sector in the form of subsidy @ 5% on the loan taken from financial institutions or commercial banks. The financial implication involved for this segment of the sector as per tentative estimates, may work out to around Rs 30 crores to be dispersed over a period of next ten years i.e. 12th and 13th plan.

8.11.3 In the case of EIF sector, over the years a large number of small furnaces (one to five tonne capacity) have mushroomed and they are mostly engaged in production of mild steel for construction purposes. While the energy consumption of EIF units using steel scrap as input may be low but that of other units using very high sponge iron with pig/cast iron as inputs it may be much higher. The issue can be partially addressed by phasing out of smaller furnaces and installing bigger ones, setting up additional vessels with Oxygen(O2) lancing for refining work, phasing out of ingot casting by continuous casting, synchronisation/sequence casting etc. These are all technical options requiring high capital investment and therefore at present not economically viable. Therefore to promote adoption of energy efficiency EIF units may also be covered under the above scheme. Based on an interest subsidy @ 5% the total tentative financial implications for this segment of the industry may works out to Rs 60 crores during the 12th &13 th plan.

8.11.4 In the Rerolling segment of the secondary sector, most of the units covered are very small and they find it difficult to invest in energy efficient technologies like regenerative burners in reheating furnaces as well as go in for design modification in the mill /furnace. If these units are also covered under the proposed new scheme for improving their energy efficiency then the total tentative cost implication involved works out to Rs 40 crores for next ten years 12th and 13th plan.

8.11.5 As regards the Coal based Direct Reduced Iron (DRI) sector, the technical options available for improving energy efficiency include setting up of waste heat recovery project that will enable power generation and replace equivalent fossil fuel consumption. A few units have already adopted this technology but to encourage its spread to other units this segment may also be brought under the above scheme. The tentative financial implication based on an interest subsidy @5% may work out accordingly to Rs 330 crores to be dispersed over a loan period of 10 years i.e. covering the 12th and 13th plan.

8.11.6 It is the financial implications that are largely stalling adoption of energy efficient technologies by the secondary steel sector and the proposed scheme intends to assist them by helping to cover a part of the huge costs of the required project investments. However details of the scheme (the scope ,targeted beneficiaries, actual fund requirements ,mode of implementation etc) can only be finalised after discussions amongst all the stakeholders concerned which may require constitution of a Task Force by the ministry with representatives of various segments of the secondary steel sector , experts and other stakeholders.

8.11.7 However pending the same, the proposed scheme may initially be approved for implementation during the 12th plan period (2012-17) with a token provision of Rs 1 crore . This would enable the ministry to initiate action on improving energy efficiency of this sector of the domestic steel industry. Details of the segment wise tentative estimates for the above mentioned scheme are given at **Annexure – 8.1.**

8.11.8 The total and scheme-wise break-up of the total budgetary support required for the 12th Plan (2012 – 17) including both ongoing and new schemes proposed is as shown below:

I*n Rs. crores)*

Sl. No.	**Name of the Scheme**	**11th Plan (2007-12) (Outlay)**	**12th plan (2012-17) (*proposed*)**
A.	Ongoing scheme		
1	Scheme for promotion of R&D in Iron & Steel sector	118.00	550.00*
B.	New schemes proposed		
2	Scheme for improving energy efficiency of secondary steel sector	**-**	1.00**
3	Scheme for promotion of beneficiation & agglomeration of low grade iron ore & ore fines	**-**	1.00**
	Total outlay (A+ B)		**552.00**

***** This includes Rs.50 crore for R&D projects under implementation.

**** token provision only.** *The detailed actual budgetary requirement for these schemes will need to be worked out after consultation with all stakeholders concerned.*

Annexure – I

No.I&M-3(30)/2011
Planning Commission
(Industries Division)

Yojana Bhavan, Sansad Marg,
New Delhi, the 29th April, 2011

OFFICE MEMORANDUM

Subject: Constitution of Sector Specific Working Group on Steel sector for the Twelfth Five Year Plan (2012-2017)

In the context of preparation of Twelfth Five Year Plan (2012-2017), it has been decided to set up a Working Group on Steel Sector. The Composition and Terms of Reference of the Working Group would be as follows:

I. Composition

1.	Shri P.K. Misra, Secretary, Ministry of Steel	Chairman
2.	Shri S. Machendranath, AS & FA, Ministry of Steel	Member
3.	Dr. Daleep Singh, JS, Ministry of Steel	Member
4.	Shri Udai Pratap Singh, JS, Ministry of Steel	Member
5.	Shri Upendra Prasad Singh, JS, Ministry of Steel	Member
6.	Shri J.P. Shukla, JS, Ministry of Steel	Member
7.	JS, Ministry of Coal	Member
8.	JS, Ministry of Petroleum & Natural Gas	Member
9.	JS, Ministry of Road Transport & Highways	Member
10.	JS, Ministry of Shipping	Member
11.	JS, Ministry of Environment and Forest	Member
12.	JS, Deptt of Public Enterprises	Member
13.	JS, Deptt of Commerce	Member
14.	JS, Deptt of Expenditure	Member
15.	JS, Ministry of Consumer Affairs	Member
16.	Representative of Railway Board	Member
17.	Representative of Central Electricity Authority	Member
18.	Secretary (Steel & Mines), Govt. of Orissa	Member

19.	Secretary (Mines), Govt of Chhattisgarh	Member
20.	Secretary (Industry), Govt of Jharkhand	Member
21.	Secretary (Industry), Govt of West Bengal	Member
22.	Principal Secretary (Industry), Govt of Andhra Pradesh	Member
23.	Principal Secretary (Industry), Govt of Karnataka	Member
24.	Representative of SAIL	Member
25.	Representative of NMDC	Member
26.	Representative of RINL	Member
27.	Representative of MECON Ltd.	Member
28.	Representative of MOIL Ltd	Member
29.	Representative of Tata Steel Ltd	Member
30.	Representative of JSW Steel Ltd.	Member
31.	Representative of Sponge Iron Manufacturers' Association	Member
32.	Representative of Alloy Steel Producers Association of India	Member
33.	Representative of Steel Furnace Association of India	Member
34.	Representative of All India Induction Furnace Association	Member
35.	Representative of Federation of Indian Mineral Industries	Member
36.	Representative of Cold Rolled Steel Manufacturers' Association	Member
37.	Representative of All India Steel Re-rollers Association	Member
38.	Representative of Joint Plant Committee	Member
39.	Representative of CSIR	Member
40.	Representative of NCAER	Member
41.	Representative of R&D Centre for Iron & Steel – SAIL	Member
42.	Representative of Institute of Steel Development and Growth	Member
43.	Adviser (Industry) – Planning Commission	Member
44.	Adviser (Minerals) – Planning Commission	Member
45.	Industrial Adviser, Ministry of Steel	Member
46.	Economic Adviser, Ministry of Steel	Member-Secretary

II. Terms of Reference

(a) To articulate the mid and long term goals to be achieved in the sector.
(b) To evaluate the present situation vis a vis achievements and contributions of the Steel Industries including Public Sector Enterprises during the 11th Five Year Plan Period and highlight the key issues / gaps those affect the industry.
(c) To recommend measures for making the industry internationally competitive in terms of cost and quality.
(d) To assess the relevance of new and emerging technologies and make recommendations for introduction of promising technology both in public and private sectors.
(e) To suggest policy measures and institutional mechanism to promote R&D in the steel industry including through the plan scheme as implemented by the Ministry.
(f) To assess the requirement of raw materials and inputs including coking coal, their likely supplies from indigenous sources and from imports and examining the need for foreign acquisition of crucial raw materials.
(g) To assess the requirements of physical infrastructure as well as investment in complementary sectors like mining, power, transport including railways and refractories, etc.
(h) To recommend a policy for production, import and exports of ferro alloys and iron ore keeping in view their demand-supply scenario.
(i) To review broadly the status of environmental protection, pollution control and safety measures and suggest measures for implementation.
(j) To assess the manpower development needs of the industry and to recommend the strategy vis a vis achieving the projected level of investment.
(k) To recommend policies for operational efficiency of companies via improvement in techno economic parameters, quality standards, restructuring including technical/financial support, diversification, etc.
(l) To specify the milestones to be achieved in the 12th Plan period in order to achieve the longer term goals as laid out in TOR (a) above.
(m) To suggest/recommend programmes/schemes that are to be terminated in the 11th Plan or initiated or continued in the 12th Plan period, together with the broad budgetary implications, if any.

2. The Chairman may constitute Sub-Groups/Task Forces as considered necessary and co-opt other members to the Working Group for specific inputs.

3. The expenditure towards Travelling Allowance/DA in connection with the meetings of the Working Group in respect of official members will be borne by their respective Ministry/Department. In case of non official Members of the Working Group, expenditure towards their TA/DA would be met by Ministry of Steel as admissible to the class I officers of the Government of India. Air travel may be undertaken by Air India.

4. The Working Group will be serviced by Ministry of Steel.

5. The Working Group would submit its report to the Chairman of the Steering Committee on Industry by 30th August, 2011.

6. Shri Anshuman Mohanty, Senior Research Officer, Planning Commission, New Delhi (Room 439/Tel 2304-2455, Yojana Bhawan) (e-mail: anshuman.m@nic.in) will act as Nodal officer for this Working Group and any further query/communication in this regard may be with the Nodal Officer.

(Dr. Renu S. Parmar)
Adviser (Industry & VSE)
Telefax: 2309 6605
Email: rsparmar@nic.in

To

The Chairman and All Members of the Working Group

Copy forwarded to:

1. PSs to Deputy Chairman/MOS (Planning)/Members/Member Secretary, Planning Commission.
2. Prime Minister's Office, South Block, New Delhi
3. Cabinet Secretariat, Rashtrapati Bhavan, New Delhi
4. All Ministries/Departments of the Government of India
5. All Principal Advisers/Advisers (including JS (SP & Admn.), Planning Commission.
6. Director (PC), Planning Commission
7. Administration I/General-I and Gen-II, Planning Commission
8. Accounts-I, Planning Commission
9. Information Officer, Planning Commission – **for uploading in the website of Planning Commission**
10. Library, Planning Commission

(Dr. Renu S. Parmar)
Adviser (Industry & VSE)
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Email: rsparmar@nic.in

Annexure-II

F.No. BGT-1(24)/2010
Government of India
Ministry of Steel
(Budget Section)

*****

Udyog Bhavan, New Delhi
Dated the 25th May, 2011

Subject:-Constitution of Sub-Groups by the Working Group on Steel sector for 12th Five Year Plan (2012-2017) – Reg.

The Working Group on Steel sector for 12th plan (2012-17) under the Secretary (Steel) had held its first meeting on Thursday the 19th May, 2011 in Conference Room, Udyog Bhawan, New Delhi. As decided in the meeting three Subgroups have been constituted to review sector specific issues and to submit their recommendations by 15th August, 2011. The details relating to the terms of reference as well as composition of the three subgroups are as follows:-

A. Sub-Group-I: Demand and Supply of Iron and Steel

(a) Terms of Reference

(i) To review the performance of domestic Steel sector during the 11th Plan (2007-12), assess its present status and likely growth in the light of emerging market trends and global economic scenario;

(ii) To assess the category-wise demand and availability trends including potential exports during the 12th Plan (2012-17) based on existing capacities and proposed additional capacity creation;

(iii) To suggest a policy framework for achieving the targets including increase in output from existing integrated steel plants through modernization, diversification as well as addition of balancing facilities through mini steel plants, sponge iron units etc;

(iv) To recommend policy for production, import and export of various products of iron and steel as well as ferro-alloys like ferro-manganese, ferro-silicon, ferro-chrome, etc. keeping in view the domestic availability and estimated demand for these items by end of 12th Plan i.e. 2016-17;

(v) To review the trends in domestic steel consumption (urban and rural) and recommend measures for improvement in domestic steel usage;

(vi) To review contribution of the secondary steel sector with focus on their specific demand and supply constraints and

(vii) To recommend such other measures as the Sub-Group may consider relevant.

(b) Composition

1	Shri S. Machendra Nathan, AS&FA, Ministry of Steel	-	**CHAIRMAN**
2	Smt. Chandralekha Malviya, Economic Adviser, M/o Steel	-	Convenor
3	Representative of Steel Authority of India Limited (SAIL)		Members
4	Representative of Rashtriya Ispat Nigam Ltd (RINL)		
5	Representative of Tata Steel Ltd.		
6	Representative of JSW Steel Ltd.		
7	Representative of Central Electricity Authority (CEA)		
8	Chief Economist, ERU, JPC and his team of officers comprising Shri Shri P. Prashanth and O.P. Verma, Joint. Chief Economists & Shri S.K. Saluja, Asstt. General Manager (Technical)		
9	Representative of Planning Commission, New Delhi		
10	Representative of Institute for Steel Development and Growth (INSDAG)		
11	Representative of Federation of Indian Chambers of Commerce & Industry (FICCI)		
12	Representative of The Indian Ferro Alloy Producers' Association		
13	Representative of Sponge Iron Manufacturers' Association (SIMA)		
14	Representative of Society of Indian Automobile Manufacturers (SIAM)		
15	Representative of Cold Rolled Steel Manufacturers Association of India (CORSMA)		

B. Sub-Group-II: Raw material and Infrastructure issues in Iron & Steel

(a) Terms of Reference

(i) To review the steel sector demand for critical ores/minerals during the 11th plan (2007-12), identification of issues linked to availability and the likely requirement during the 12th plan (2012-17);
(ii) To assess cost of production and pricing issues linked to crucial raw materials for the sector i.e. iron ore, coal, manganese ore, ferro alloys and others including refractories;
(iii) To assess the issues and targets for improving efficiency of mining operations of critical ores including adoption of environment friendly/sustainable mining activities for minimizing damage to local air, water and soil conditions;
(iv) To examine issues linked to up-gradation of ore quality, quality of alternate inputs like metal scrap and sponge iron and procurement of raw material through foreign acquisition specially coking coal;
(v) To review the progress of critical infrastructure support linkages for the sector (i.e. roads, railways, ports, shipping etc) during the 11th Plan (2007-12), the potential requirements during 12th Plan (2012-17) vis-à-vis the planned additional capacity creations and identification of likely constraints/issues in implementation;
(vi) To examine Policy issues linked to both raw material availability and infrastructure linkages for the steel sector (including the secondary steel sector) i.e. tariffs, foreign trade, environment and forest clearances, and acquisition and rehabilitation etc;
(vii) To recommend such other measures as the Sub-Group may consider relevant.

(b) Composition

1	Shri U.P. Singh, JS, Ministry of Steel	-	**CHAIRMAN**
2	Shri Sanjay Mangal, Director, Ministry of Steel	-	Convenor
3	Ms. L. N. Tochhawng, CCA, Ministry of Steel		Members
4	Shri G.K. Basak, Executive Secretary, Joint Plant Committee		
5	Representative of Railway Board		
6	Representative of Ministry of Road Transport & Highways		
7	Representative of Ministry of Shipping		
8	Representative of Ministry of Environment and Forest		
9	Representative of Ministry of Coal		
10	Representative of State Government of Jharkhand		
11	Representative of State Government of Karnataka		
12	Representative of State Government of Orissa		
13	Representative of State Government of Andhra Pradesh		
14	Representative of NMDC Ltd.		
15	Representative of MOIL Ltd.		
16	Representative of MSTC Ltd.		
17	Representative of Indian Bureau of Mines (IBM)		
18	Representative of Planning Commission		
19	Representative of Federation of Indian Mineral Industries (FIMI)		

C. Sub-Group - III: R&D and Technology Issues in iron & steel sector

(a) Terms of Reference

(i) To assess the relevance of new and emerging technologies for domestic iron and steel production and to make recommendation for introduction of promising technologies both in Public and Private sectors including the secondary sector;

(ii) To review the status of present technologies as well as emergent technologies, including long term commitment to introduction of green technology.

(iii) To review trends in crucial techno-economic parameters vis-à-vis global benchmarks, R&D initiatives by the industry and the present and future level of expenditure required to improve the sector’s global competitiveness;

(iv) To review the status of initiatives for environment protection, pollution control and safety measures and suggest measures for improvement;

(v) To review issues linked to implementation of a separate R&D policy for the sector including the secondary steel sector;

(vi) To review the 11th plan performance of the Ministry's ongoing *Plan scheme for Promotion of Research & Development in Steel sector*, and propose justification for its continuation in the 12th Plan with budgetary support requirement;

(vii) To recommend such other measures as the Sub-Group may consider relevant.

(b) <u>Composition</u>

1	Dr. Dalip Singh, JS, Ministry of Steel	-	**CHAIRMAN**
2	Shri A.C.R. Das, Industrial Adviser, Ministry of Steel	-	Convenor
3	Representative of Ministry of Science & Technology		Members
4	Representative of Planning Commission		
5	Representative of National Metallurgical Laboratory (NML), Jamshedpur		
6	Representative of Bureau of Indian Standards		
7	Representative of NMDC Ltd.		
8	Representative of MECON Ltd.		
9	Representative of RDCI&S (SAIL)		
10	Representative of Tata Steel Ltd.		
11	Representative of JSW Steel Ltd.		
12	Representative of ESSAR Steel Ltd.		
13	Representative of Dastur & Co		
14	Representative of Alloy Steel Producers Association of India		
15	Representative of All India Induction Furnace Association		
16	Representative of Steel Furnace Association of India		
17	Shri S.K. Saluja, Asstt. General Manager (Technical), ERU (JPC)		

2. The Sub-Groups may co-opt any other Experts as Members of their respective Sub-Groups.

3. The Sub-Groups will submit their report by 15th August, 2011 to the Chairman of the Working Group on Steel sector for 12th Five Year Plan (2012-17).

(Chandralekha Malviya)
Economic Adviser & Member Secretary
Tel. No. 23063020

To

The Chairman and all the Members of the Working Group/Sub-Groups

Annexure – 1.1 (a)

Performance of Different segments of Iron and Steel Industry during 11th plan period

Merchant Pig Iron

1 Merchant Pig Iron is cold iron, cast into ingots and sold as ferrous feedstock for the steel and metal casting industries. It falls into the category of ferrous metallics, of which iron and steel scrap comprises by far the largest volume, others being direct reduced iron (DRI), hot briquetted iron (HBI) and various other “alternate iron’ materials. Merchant pig iron is, by definition, produced by dedicated merchant plants all of whose production is sold to external customers.

2 However, some of integrated steel plants also produce and sell surplus hot metal as pig iron which is sold to other users. However, increasingly this is not being considered an economically acceptable business proposition and the integrated plants, barring RINL and SAIL, have literally stopped production of pig iron. Even at the SAIL plants and RINL, production levels have dropped significantly in the recent years.

3 The merchant pig iron units have grown at a rapid pace commanding a large share of the market now **(Refer Table – 1.1 (a**). Due to a modest increase in merchant pig iron capacities in the country, India has been able to meet almost all of its requirement through domestic production and also exported 0.35 million tonnes of pig iron in 2010-11.

4 Merchant pig iron comprises three main types : Basic Pig Iron, used mainly in electric steelmaking, Hematite pig iron also known as foundry pig iron, used mainly in the manufacture of grey iron castings in cupola furnaces and nodular pig iron used in the manufacture of ductile iron castings. Some of the merchant pig iron producers in India have necessary technological sophistication to meet the specialized requirement such as pressure tight precision castings, automobile engine blocks, crankshaft, gears, rolling mill rolls, motor and generator housing, sanitary fittings, machine tools etc.

5 According to JPC data merchant pig iron production in India has increased only marginally from 4.99 million tonnes in 2006-07 to 5.58 million tonnes in 2010-11. Further it is observed that production of merchant pig iron has dropped in 2009-10 & 2010-11. It may be mentioned here that the data on production of pig iron may not fully reflect the underlying high growth of user industries such as automobile, capital equipment, infrastructure etc. In this connection, trends in production and consumption of pig iron should be interpreted after taking into account the following facts:

a) Some of the steel units have gone for backward integration to produce pig iron in-house. The captive consumption by definition is not counted as merchant pig iron.

b) In recent years, some of the pig iron units have gone for forward integration for production of iron pipes and other iron castings which has reduced the quantity of pig iron sold in the open market.

Table – 1 (a): Production of Pig Iron in India, 2006-07 to 2010-11

Year	Main Producers (Million Tonnes)	Other Producers (Million Tonnes)	Production for sale (Million Tonnes)	Share of Other Producers (%)
2006-07	0.86	4.13	4.99	82.8%
2007-08	0.94	4.38	5.32	82.3%
2008-09	0.59	5.62	6.21	90.5%
2009-10	0.73	5.22	5.95	87.7%
2010-11 (P)	0.58	5.00	5.58	89.6%

Source: JPC, P=Provisional

Table – 2 (a): Trend in Consumption of Merchant Pig Iron in India during 11th Plan

Year	Production for Sale	Import	Export	Availability	Variation in Stock	Apparent Consumption	% Growth
2006 - 07	4.953	0.003	0.707	4.249	-0.087	4.336	4.8
2007 - 08	5.284	0.011	0.560	4.735	0.114	4.621	6.6
2008 - 09	6.207	0.008	0.350	5.865	-0.005	5.870	27.0
2009 - 10	5.884	0.011	0.362	5.533	0.002	5.531	-5.8
2010 - 11 (P)	5.541	0.009	0.358	5.192	0.039	5.153	-6.8

Source: JPC, P=Provisional

Performance of Different segments of Iron and Steel Industry during 11th plan period

Sponge Iron

1 As mentioned earlier, India is currently the largest producer of Sponge Iron in the world. Over the years, production of sponge iron in the country has grown at a much faster rate than that of crude steel largely due to emergence of electric arc furnace/Induction furnace route which uses sponge iron as the major feedstock due to its better domestic availability and relatively lower prices compared to melting scarp.

2 The robust growth of the sponge iron in the country vis-à-vis growth in crude steel production over last 10 years and especially after 2002-03 is illustrated through **Table-1 (b).** The relative higher growth of sponge iron production continued in the 11th plan except for one year i.e. in 2008-09. However, it must be noted that growth of sponge iron sector in the first four years of 11th plan was relatively modest as compared to that achieved in last 10 years i.e. from 2001-02 to 2010-11.

Table-1 (b): Production and growth rates of sponge iron and crude steel

Year	Production Sponge Iron	% Change	Production Crude Steel	% Change
2001 – 02	5.658	3.2	27.96	4.0
2002 – 03	7.858	38.9	34.71	24.1
2003 – 04	9.877	25.7	38.73	11.6
2004 – 05	12.537	26.9	43.44	12.2
2005 – 06	14.825	18.2	46.46	7.0
2006 – 07	18.345	23.7	50.82	9.4
2007 – 08	20.376	11.1	53.86	6.0
2008 – 09	21.091	3.5	58.44	8.5
2009 – 10	24.326	15.3	65.84	12.7
2010 – 11 (P)	26.709	9.8	69.58	5.7
CAGR 11th Plan	9.8%		8.1%	
CAGR last 10 years	18.8%		10.7%	

Source: JPC data base

Table – 2 (b): SPONGE IRON ROUTE-WISE

000 tonnes

	2005 - 06	2006 - 07	2007 - 08	2008 - 09	2009 - 10	2010 - 11
GAS BASED	4545	5265	5845	5516	6148	5642
COAL BASED	10280	13080	14531	15575	18178	21067
% Share Coal based	69.3%	71.3%	71.3%	73.8%	74.7%	78.9%
TOTAL	14825	18345	20376	21091	24326	26709

3 This growth has come due to a remarkable expansion in the number of coal-based units that have started operating in the Eastern Region (West Bengal, Orissa, Jharkhand), Western Region (Chhattisgarh, Maharashtra, Goa) and in the Southern Region (Andhra Pradesh, Tamil Nadu, Karnataka). Gas based production has remained somewhat stagnant and confined to the existing three plants – Essar Steel, Welspun Max Steel and Ispat Industries – located in the Western region.

4 Other factors which contributed to the rapid growth of sponge iron sector include: a) Relatively easy availability of Non-Coking coal in the country as compared to coking coal b) Easy availability of iron ore lumps at competitive prices c) short gestation periods and low capital costs d) Cheap labor and availability of main equipments indigenously. Further, some of these advantages are not sustainable due to following factors:

- Globally gas based DR processes dominate DRI production as coal based processes contribute only 20-23% of total DRI. In contrast, coal based DRI dominates in India. The share of coal based plants has further gone up in 11th plan i.e. from 71.3% in 2006-07 to 78.9% in the year 2010-11.

  Source: JPC Database

- Coal based units have relatively higher energy consumption and pollution load of these units is much higher than gas based units. India is gearing itself for substantial reduction in CO2 emissions through suitable policy initiatives which may moderate the growth of coal based industry if necessary technological adjustments for green growth are not taken by the industry.
- In past many of the coal based sponge iron units have got allocation of captive iron ore/coal blocks. Besides, sponge iron units will have to purchase critical inputs at market driven prices. Further, easy availability of lump ore in the country is likely to worsen in the future.
- Moreover, the country is heading for overall non-coking coal shortage due to anticipated demand from priority sectors such as power and fertilizer.

Performance of Different segments of Iron and Steel Industry during 11th plan period

Ferro-Alloy Industry

1 Ferro alloys is a basic input for production of all types of steel and especially for production of alloy and special steels and stainless steel. The capacity of the ferro-alloy industry as measured through furnace capacity was around 600 MVA prior to liberalization. Capacity addition was over 700 MVA before the 11th Five Year Plan. During 11th plan period, the industry has added another 1600 MVA capacity. As a result, the furnace capacity has crossed 2900 MVA and by tonnage it has crossed 4.65 million tonnes. The broad-break up of the capacity is as follows:

Table-1 (c): Existing Capacity of Ferro Alloy Industry

	Type/Category of Ferro Alloy	Existing Capacity (MTPA)
1.	Manganese alloys	2.75
2	Chrome Alloys	1.60
3	Ferro Silicon	0.25
4	Noble Alloys	0.05
5	Total	4.65

Source: IFAPA

2 Though the demand for Ferro Alloys is directly linked to the growth of steel production, Indian ferro alloy industry has grown at a much faster rate than growth in domestic demand of steel on the back of substantial increase in export of ferro-alloys. Growth in production and export of Ferro Alloys was impressive at 9.6% and 27.9% respectively during first four years of 11th plan **(Table-3 (c).** As a result, the share of exports in total production of ferro-alloys has increased from 25.52% in 2006-07 to 47.27% in 2010-11 as per the details given in the **Table-2 (c)** below:

Table-2 (c): Trend in exports of Ferro Alloys during 11th Plan Period

	Exports (000 Tonnes)	Value Rs. Crore	% share of exports in total production (on tonnage)
2006-07	510.56	164.27	25.52%
2007-08	878.71	488.50	36.39%
2008-09	960.09	687.78	42.64%
2009-10	862.77	413.94	34.60%
2010-11	1363.93	850.00	42.27%

Source: IFAPA

3 India is a net exporter of ferro alloys and the net export in the year 2011-11 was to the extent of 1.16 million tonnes. At the same time, import of ferro alloys is increasing at high rate due to progressive reduction in customs duty on ferro alloys. Ferro Silicon is the main Bulk ferro alloy imported from China, Kazakhstan, Russia, Ukraine and Bhutan.

4 Relatively higher cost of electrical energy in India is considered a major area of concern by the industry. Other major problem faced by the ferro alloy industry is that of inadequate availability of required quality of raw materials. The basic raw materials are Manganese Ore, Chrome Ore, Quartz, Limestone, Dolomite and reductants such as coal, coke , charcoal, Non-Coking coal and anthracite and carbon paste. It is being felt that if the exports of ferro alloys are to be sustained at current share of production, the country will have to conserve the precious reserves/resources of manganese and chrome ores.

Annexure – 1.1 (c) (contd)

Table – 3 (c): Production, Export and Import of Ferro Alloys in India, 2006-07 to 2010-11

(Thousand tones)

Production	2006-07	2007-08	2008-09	2009-10	2010-11
High Carbon Ferro Manganese	281.01	364.91	372.29	341.88	390.00
Silico Manganese	738.31	886.32	889.43	1066.48	1250.00
Ferro Silicon	92.63	96.97	110.74	97.68	117.00
HC Ferro Chrome / Charge Chrome	801.14	964.81	790.07	890.92	1030.00
Others	60.6	72.53	61.97	65.81	65
Total Bulk Ferro Alloys **(%) Change**	**1973.69 21.7%**	**2385.54 20.9%**	**2224.50 -6.8%**	**2462.77 10.7%**	**2852.00 15.8%**
Ferro Molybdenum	3.12	2.90	2.11	2.82	3.05
Ferro Silicon Manganese	11.39	13.52	13.40	17.13	18.50
Ferro Aluminium	9.95	8.88	8.17	7.02	7.60
Others	3.3	3.88	3.55	3.89	4.21
Total Noble Ferro Alloy **(%) Change**	**27.76 20.4%**	**29.18** 5.11 %	**27.23 -6.7%**	**30.86** 13.3%	**33.36 8.1%**
Total Ferro Alloys CAGR	**2001.45 21.64**	**2414.72 20.65%**	**2251.74 (-) 6.75**	**2493.63 10.74%**	**2885.36 15.70%**
Exports	510.56	878.71	960.09	862.77	1363.93
Imports excluding Ferro Nickel	127.16	155.97	132.75	180.59	204.45

Source: Indian Ferro Alloys Producers' Association (IFAPA)

Performance of Different segments of Iron and Steel Industry during 11th plan period

Refractories

1 The Indian Refractory industry started its journey with first line of production in Kolkata in 1874. Today, the industry comprises over 100 established units, with 11 large plants, 24 medium scale units and rest in small-scale sector. It is estimated that 75% of the refractories that are manufactured find application in the steel industry, 12%in the cement industry, 5-6% in non-ferrous industries, 3% in glass industry and balance in other industries.

2 Refractories are used either where high temperature or high rate of abrasion/corrosion/erosion is involved. The refractory materials are used in the steel industry for the construction of linings of equipments such as blast furnaces and steel making furnaces. Traditionally, refractories are made of naturally occurring minerals such as bauxite, kyanite, magnesite, fireclay, chrome ore etc. Lately, however, the industry has been using man-made raw materials such as brown-fused alumina, tabular alumina, fused magnesia, silicon carbide, magnesia alumina etc. The industry enjoys domestic raw materials base. India has substantial reserves of high quality fireclay and Dolomite, refractory grade Bauxite, natural Magnesite, Chromite, Zircon and Sillimanite. Some raw materials of high purity levels and with specific desired characteristics are also being imported.

3 The refractory production and consumption during the 11th Five Year Plan is given in **Table- 1 (d)**. Refractory production in India has almost remained stagnant and has resulted into low capacity utilization of the industry. Domestic consumption has also not grown much during the 11th plan and has hovered around 1.17 million tonnes. Increased refractory life cycle in the critical areas of steel making process has been mainly responsible for stagnation in the demand of refractories. The saving in material consumption has been achieved by improving refractory quality, improved refractory maintenance technique and better operational practices. It is estimated that specific consumption of refractory material in the steel industry has dropped from 18.81 kg/tonne in 2007-08 to 16.04 in 2010-11. Apart from the problem of falling specific consumption, this industry has also faced increased import competition especially from China in the last few years.

Annexure – 1.1 (d) (contd)

Table – 1 (d): Production of Refractories, 2007-08 to 2010-11

(Thousand tones)

Type	**2007-08**	**2008-09**	**2009-10**	**2010-11**	**2011-12 (estimated)**
Fireclay Refractories	264.3	308.9	304.0	310.1	311.7
High Alumina Refractories	436.9	342.4	357.9	365.0	336.84
Silica Refractories	62.4	67.8	71.2	72.7	73.04
Basic Refractories	262.4	223.7	233.4	238.0	239.27
Special Products	42.7	43.5	45.3	46.2	46.41
Others (including monolithies)	115.0	198.5	171.4	174.8	246.53
Total Production CAGR (%)	1254.90	1251.92	1252.34	1277.39	1284.77
Imports	**519.1**	**913.9**	**396.3**	**501.6**	**-**
Exports	**190.30**	**885.74**	**497.44**	**210.19**	**-**
Net Available Qty.	**1583.68**	**1280.08**	**1151.25**	**1568.8**	**1565.34**
Net Consumption	**1171.93**	**1100.87**	**1128.23**	**1176.63**	**1252.27**
Avg. Refractory Consumption Kg/Tonne of crude steel	**18.81**	**17.33**	**16.75**	**16.04**	**14.97**

Source: MOIL

Annexure-3.1

Assumed Growth Rates for Projection of Category – wise Demand for Steel

Category	Growth Rate (CAGR) 2005-2011 (%)	CAGR of major explanatory variable during 2005-06 to 2010-11	Growth rate assumed for 12th Plan (%)	Reasons /Remarks	Projection Based on assumed growth rate (2016-17) MnT
Bars & Rods	7.9	Construction (8.3%)	11.0	Proposed Investment in infrastructure	44.1
Structurals	4.6	Construction (8.3%)	9.5	Prefabricated Structures, High Strength steels	9.4
Rly. Material	1.9	Construction (8.3%)	5.0	Dedicated freight Corridor to commence by 2012-13	1.4
Total Non-Flat	7.0	-	10.5	-	54.9
Plates	5.9	Consumption of Petrol & Gas (8.9%), GDCF in plant & machinery (8.9%)	7.5	Ship breaking tardy growth, fabrication to grow	7.3
HR Coils/sheets /skelp	7.5	IIP in manufacturing (9.7%)	9.0	Manufacturing Policy Thrust	23.8
CR Coils/Sheets	10.7	IIP in transport equipment (12.8%), PFCE (8.1%), Consumption of petrol (4.3%)	11.0	Auto demand, rising per capita income-demand for household appliances	11.8

Annexure – 3.1 contd.

Category	Growth Rate (CAGR) 2005-2011 (%)	CAGR of major explanatory variable during 2005-06 to 2010-11	Growth rate assumed by ERU for 12th Plan (%)	Reasons /Remarks	Projection Based on assumed growth rate (2016-17) MnT
Electrical Steel	7.7	PFCE (8.1%), Installed Capacity in Power (6.6%)	8.0	Power Sector Demand to grow	0.8
Tin Plates/TFS	8.8	GDCF in plant & machinery (8.9%)	8.0	Threat from Tetrapack, demand from container	0.6
Pipes	9.0	GDCF in plant & machinery (8.9%)	12.0	Massive Potential in oil & gas sector	2.9
Total Flat	9.2	-	11%	-	56.0
Total Carbon Steel	8.1	-	10.8%	-	110.9
Total Carbon+Alloy/Stainless	8.5	-	10.2%	-	115.9
Double Counting	-5.5			-	2.0
Grand Total Finished	9.6	-	10.3%	-	113.9
Net Export	NA	-	NA	-	2.0
Finished Steel production	9.7	-	10.4%	-	115.9

Annexure – 4.1

State-wise Production of Iron Ore IBM

State	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10(P)
All India	**80762**	**86226**	**99072**	**122838**	**145942**	**165230**	**187696**	**213246**	**212960**	**218639**
Andhra Pradesh	336	374	657	1402	2808	4148	4985	9164	10112	6205
Chhattisgarh	20016	18660	19781	23361	23118	26084	28731	30997	29997	26476
Goa	14564	14784	17889	20246	22672	24027	28723	30526	31195	39320
Haryana	++	-	-	-	-	-	-	-	-	-
Jharkhand	12403	13068	13702	14682	16719	17975	18608	20752	21329	23008
Karnataka	18902	22595	24797	31635	37962	39843	40719	48990	46971	43016
Madhya Pradesh	126	102	128	94	216	464	1212	2256	412	1078
Maharashtra	22	33	36	118	669	520	523	662	294	250
Orissa	14382	16602	22077	31288	41750	52151	64178	69883	72627	79274
Rajasthan	11	8	5	12	28	18	17	16	23	12

(P) : Provisional

Figure rounded off

Source: National Mineral Inventory as on 1.4.2010

Annexure-4.2

Reserves/Resources of Manganese ore

As on 1.4.2010 (P)

(Grade wise)

(In '000 tonnes)

State/Grades	Reserves	Remaining Resources	Total Resources
All India (Total)	**141,977**	**288,003**	**429,980**
Battery/Chemical	112	240	352
BF	49,894	95,961	145,855
Ferro-manganese	12,869	22,585	35,455
Ferro-manganese & BF	2,425	13,902	16,327
Ferro-manganese, Medium & BF Mixed	34,541	31,162	65,703
Low (-)25% Mn	1,647	7,505	9,152
Medium	8,694	40,034	48,729
Medium & BF Mixed	12,263	32,024	44,287
Mixed	1,763	11,617	13,380
Not Known	2,731	6,702	9,433
Others	7,871	6,053	13,923
Unclassified	7,167	20,216	27,383

Figures rounded off.
Sources: National Mineral Inventory as on 01/04/2005

Annexure-4.3

Reserves/Resources of Chromite

As on 1.4.2010 (P)

(By Grade)

(In '000 Tonnes)

Grade	Reserves	Remaining resources	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

Reserves/Resources of Chromite

As on 1.4.2010 (P)

(By State)

(In '000 Tonnes)

State	Reserves	Remaining resources	Total Resources
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

Annexure-4.4

Exports of Ferro Alloys and percentage of Exports over Production during 2005-06 to 2009-10

Quantity in Tonnes

Product	**2009-10**	**2008-09**	**2007-08**	**2006-07**	**2005-06**
BULK FERRO ALLOYS					
Ferro Manganese: Carbon containing > 2 % by weight	48,640	101,289	101,878	42,025	3,958
Other Ferro Manganese	17,883	20,244	12,580	12,200	6,790
Ferro Silicon containing >55 % of Si	16,636	27,939	7,280	7,437	1,070
Other Ferro Silicon	3,471	9,228	2,094	506	119,274
Ferro Silico Manganese	298,299	300,421	262,592	152,050	241,445
Ferro Chromium; Carbon containing > 4 % by weight	466,219	488,700	476,911	284,597	14,550
Other Ferro Chromium	5,734	2,974	6,042	3,163	2,871
Charge Chrome	-	1,001	-	-	
TOTAL (A)	**856,882**	**951,796**	**869,377**	**501,978**	**389,958**

Annexure-4.4 (contd)

Exports of Ferro Alloys and percentage of Exports over Production during 2005-06 to 2009-10

Quantity in Tonnes

Product	**2009-10**	**2008-09**	**2007-08**	**2006-07**	**2005-06**
NOBLE FERRO ALLOYS					
Ferro Molybdenum	1,766	888	820	466	342
Ferro Tungsten	1	3	7	32	84
Ferro Titanium	5	2	146	132	159
Ferro Vanadium	30	387	787	1,971	101
Ferro Niobium	116	192	316	177	12
Ferro Phosphorus	11	169	1,135	807	396
Ferro Columbium	1	-	-	-	-
Ferro Silico Zirconium	1	24	30	31	-
Ferro Silico Magnesium	3,597	3,295	2,156	2,742	281
Ferro Boron	3	2	-	4	-
Ferro Silico Chromium	-	26	64	121	268
Ferro Silenium	-	-	2	-	-
Ferro Zircomium	-	-	-	6	-
Others	356	3,303	3,869	2,096	12,156
TOTAL (B)	**5,887**	**8291**	**9,332**	**8,585**	**13,799**
GRAND TOTAL (A) + (B)	**862,769**	**960,087**	**878,709**	**510,563**	**423,531**
Value (Approx.) Rs in Lakhs	**41,394.46**	**68,777.66**	**48,849.50**	**16,426.72**	**12,707.77**
Percentage of exports over production	**34.60%**	**42.64%**	**36.39%**	**25.52%**	**25.74%**

Annexure-4.5

Imports of Ferro Alloys for the period 2005-06 to 2009-10

(Quantity in Tonnes)

	2009-10	2008-09	2007-08	2006-07	2005-06
BULK FERRO ALLOYS					
Ferro Manganese: Carbon containing > 2 % by weight	9,292	6,012	1,988	1,074	3,801
Other Ferro Manganese	19,312	15,996	19,763	10,963	12,302
Ferro Silicon containing >55 % of Si	111,243	58,703	62,547	64,797	36,130
Other Ferro Silicon	13,895	24,048	33,763	22,038	25,905
Ferro Silico Manganese	1,377	239	513	207	1,287
Ferro Chromium; Carbon containing > 4 % by weight	3,706	3,346	1,738	1,316	714
Other Ferro Chromium	13,518	9,028	17,564	17,737	10,468
Charge Chrome	500	-	869	10	-
TOTAL (A)	**172,843**	**117,372**	**138,745**	**118,142**	**90,607**

Annexure-4.5 (contd)

Imports of Ferro Alloys for the period 2005-06 to 2009-10

(Quantity in Tonnes)

	2009-10	2008-09	2007-08	2006-07	2005-06
NOBLE FERRO ALLOYS					
Ferro Silico Chromium	6	-	59	114	5
Ferro Molybdenum	1,111	840	481	262	323
Ferro Tungsten	20	45	67	87	61
Ferro Titanium	1,843	558	570	441	334
Ferro Vanadium	881	242	195	523	509
Ferro Niobium	769	1,779	1,599	1,706	860
Ferro Phosphorus	1,138	1,336	1,264	1,098	922
Ferro Zirconium	4	10	-	5	20
Ferro Silico Zirconium	189	115	298	58	82
Ferro Silico Magnesium	1,523	3,833	4,062	1,758	1,591
Ferro Boron	263	198	197	175	462
Ferro Cobalt	-	-	-	-	13
Others	7,363	6,420	8,433	2,787	1,544
TOTAL (B)	**15,110**	**15,376**	**17,225**	**9,014**	**6,726**
GRAND TOTAL (A) + (B)	**180,590**	**132,748**	**155,970**	**127,156**	**97,333**
Total Value Rs in Million	**15,165.36**	**15,299.80**	**10,894.46**	**7,798.22**	**5,913.40**
Percentage of increase in Import Value	**(-) 0.88 %**	**40.44%**	**39.70%**	**31.87%**	
Import Duty	**5%**	**0%**	**5%**	**7.5%**	**10%**

NOTE: Import of Ferro Nickel is not shown, as the same is not manufactured indigenously.

Annexure-4.6

Details of Imported & Indigenous Raw Materials for Refractories

ITEMS	IMPORT	INDEGINOUS
FUSED MAGNESITE 97%	MgO (Min) 97.00% SiO_2 (Max) 0.60% CaO (Max) 1.20% Fe_2O_3 (Max) 0.80% Al_2O_3 (Max) 0.20% LOI (Max) 0.25% B.D. gr/cc(Min) 3.50 A.P. (Max) 2.5 B_2O_3 (Max) - Crystal Size 400 Microns (min) Lime Silica ratio (Min) -2	Not available
BROWN FUSED ALUMINA	A SiO2 (Max) 1.00% Fe2O3 (Max.) 0.30% TiO2 (Max.) 2.80% CaO (Max.) 0.60% Sp. Gr. (Min.) 3.93% Free Iron (Max.) 0.10% with total Fe2O3 0.30% (Max.)l2O3 (Min.) 95.00%	Available from one source for limited quantity.
ROUND KILN CALCINED BAUXITE	Al_2O_3 (Min) 87.00% SiO_2 (Max) 6.00% Fe_2O_3 (Max) 2.00% TiO_2 (Max) 4.00% CaO (Max) 0.40% K_2O+Na_2O (Max) 0.30%. MgO (Max) 0.30% B.D. gr/cc(Min) 3.20	Al_2O_3 84 % Fe2O3 3.5 %

SEA WATER MAGNESITE	` GRADE I Grade II MgO (Min) 97.00% 97.00% SiO_2 (Max) 0.40% 0.40% Al_2O_3 (Max) 0.10% 0.10% Fe_2O_3 (Max) 0.20% 0.20% CaO (Max) 2.10% 2.10% B_2O_3 (Max) 0.025 0.060% A.P. (Max) 2.00% 2.00% B.D. gm/cc(Min) 3.43 3.43 Crystal Size Microns (Min.) 100 100	Not available
Fused Mullite (Grains & Fines	Al2o3 (Min.) 70% SiO2 (Max.) 29% Fe2O3 (Max.) 1% Na2O (Max.) 0.6% Moisture (Max) 0.7%	Limited quantity available from two sources.
SILICON CARBIDE	SiC (Min) 96.00% SiO2 (Max) 00.80% Al2O3 (Max) 00.80% S (Max) 00.02% Si (Max) 00.40%	Sources are limited.
DEAD BURNT MAGNESITE	MgO (Min.) 93.00% SiO2 (Max) 3.50% B.D. gr/ cc(Min.) 3.20	Mgo 84 % Sio2 7.5 %

Source : SAIL Refractory Division

Annexure-4.7

IMPORT OF REFRACTORY ITEMS DURING 11th FIVE YEAR PLAN

IMPORT OF REFRACTORY ITEMS IN INDIA IN METRIC TONNENES	2007-08	2008-09	2009-10	2010-11
Fire clay Bricks and Shapes	17600	34420	3440	27820
High Alumina Bricks & shapes	3400	5720	4620	4840
Silica bricks and Shapes	34130	36840	11360	10320
Basic bricks and shapes	203539	219631	107308	178162
Monolithics/Castables	58806	53747	61672	87082
Special products	35300	15390	10150	62600
Others	166310	548150	197800	130820
TOTAL IN TONNENES	**519085**	**913898**	**396350**	**501644**

Source : IRMA

Annexure - 4.8

EXPORT OF REFRACTORIES DURING 11 TH FIVE YEAR PLAN

EXPORT OF REFRACTORY ITEMS IN INDIA IN METRIC TONNENES	**2007-08**	**2008-09**	**2009-10**	**2010-11**
Fire clay Bricks and Shapes	10640	30940	198040	12780
High Alumina Bricks & shapes	47710	609200	64660	36360
Silica bricks and Shapes	6420	6270	7130	9980
Basic bricks and shapes	18424	30582	32034	13066
Monolithics/Castables	24429	31103	24942	41982
Special products	31750	84040	87840	35400
Others	50930	93600	82790	60620
TOTAL IN TONNES	**190303**	**885735**	**497436**	**210188**

Source : IRMA

Annexure- 5.1

A LIST OF ONGOING PROJECTS TO CATER TO THE EXISTING AND FUTURE STEEL AND RAW MATERIAL TRAFFIC ON INDIAN RAILWAY

S. No.	Rly	Name of the Project	KMS	Cost 11-12 (Rs.Cr.)
NEW LINE				
1	ECoR	Banspani-Daitari	155	1326.63
2	ECoR	Haridaspur-Paradeep	82	1000
3	ECoR	Angul-Sukinda Road (Suppl.)	98.7	638.5
4	ER	Hansdiha-Godda	30	267
5	SCR	Obulavaripalle-Krishnapatnam	113	788.81
6	SCR	Bhadrachalam Road-Sattupalli	56.25	337.5
7	SECR	Dallirajahara-Jagdalpur	235	1105.23
8	SR	Attipattu-Puttur	88.3	446.87
9	SWR	Kottur-Harihar via Harpanhalli	65	354.06
10	SWR	Hubli-Ankola (Suppl.)	167	337.82
DOUBLING				
1	ECoR	Sambalpur-Titlagarh	182	950.84
2	ECoR	Vizianagram-Kottavalasa 3rd line	34.7	194.89
3	ECoR	Raipur-Titlagarh incl. NL Mandi Hasaud-Naya Raipur(20 km) and new MM for conversion of Raipur(Kendri)-Dhamtari&Abhnapur-Rajim branch line(67.20 km)	270.2	691.67
4	ECoR	Banspani-Daitari-Tomka-Jakhapura (Suppl.)	180	942.95
5	ECoR	Brundamal-Jharsuguda flyover connection to join DN Line (Suppl.)	-	88.02
6	ECoR	Sambalpur-Talcher	174.11	679.27
7	ECoR	Kirandul-Jagdalpur	150	826.57
8	ECR	Chandrapura-Rajabera-Chandrapura-Bhandaridah	10.6	34.87
9	ER	Kajra-Kiul (Suppl.)	15.85	47.55
10	ER	Barharwa-Tinpahar	16.49	74.61
11	ER	Chinpai-Sainthia, Prantik-Siuri	31.61	595.91
12	ER	Tinpahar-Sahibganj as PH-I of doubling of Tinpahar-Bhagalpur	37.81	167.84
13	ER	Sahibganj-Pirpaniti	10.45	129.45
14	SCR	Gooty-Renigunta - Patch doubling	151.04	532
15	SECR	Bilaspur-Urkura	110	321
16	SECR	Bilaspur-Salka Road	39.4	144.19

Annexure- 5.1
(contd)

A LIST OF ONGOING PROJECTS TO CATER TO THE EXISTING AND FUTURE STEEL AND RAW MATERIAL TRAFFIC ON INDIAN RAILWAY

S. No.	Rly	Name of the Project	KMS	Cost 11-12 (Rs.Cr.)
17	SECR	Salka Road-Khongsara Patch Doubling	26	143.87
18	SECR	Khodri-Anuppur with flyover at Bilaspur	61.6	385.54
19	SECR	Byepass at Champa	14	37.64
20	SER	Goelkera - Manoharpur 3rd line (Chakradharpur - Bondamunda Section)	40	271.69
21	SER	Padapahar-Banspani	32	155.28
22	SER	Barbil-Barajamda	10	52.5
23	SER	Bimlagarh-Dumitra	18.3	115.66
24	SER	Gokulpur-Midnapur New bridge on diversion alignment with substructure & steel super structure on Bridge No. 143.	2	52.14
25	SER	Banspani-Jaruli	9	90.88
26	SER	Panskura-Kharagpur 3rd line(44.7 km) with new MM Panskura-Ghatal(32.8 km) NL 11-12	77.5	529.23
27	SER	Rajkharsawan-Sini-3rd line	15	91.61
28	SER	Rajgoda-Tamluk-Phase-II of Panskura-Haldia Doubling	13.5	86.91
29	SER	Dongaposi-Rajkharsawan 3rd line (Suppl.)	75	309.44
30	SER	Champajharan-Bimlagarh	21	151.09
31	SER	Sini-Adityapur 3rd line	22.5	95.29
32	SER	Bhojudih -Mohuda	23	134.19
33	SR	Kankanadi-Panamburu Patch Doubling (Suppl.)	19	149.2
34	SR	Omalur-Mettur Dam doubling with electrification	29.03	149.61
35	SWR	Dharwad-Kambarganvi (Suppl.)	26.68	127.44
36	SWR	Hubli-Hebsur (Suppl.)	17.17	77.79
37	SWR	Arasikere-Birur (Patch doubliing)	44.28	149.88
38	SWR	Hospet-Hubli-Londa-Tinaighat-Vasco-de-Gama	352.28	2127
39	WCR	Guna-Ruthiyai	20.5	66.5
40	WR	Udhna-Jalgaon with electrification	306.93	714.6

Annexure 6.1

Performance of Indian Steel Sector vis-à-vis Global Benchmarks

Sl.No.	**Item**	**Unit**	**Global Benchmark**	**Indian Iron & Steel Sector**
1.	BF Productivity	(t/day/m3 of working volume)	2.5 – 3.5	1.5 – 2.5/2.8
2.	Coke Rate		350 – 400	500 – 600
3.	PCI	(kg/t-HM)	150 – 250	50 – 100
4.	Agglomerate	%	85 – 90	65 – 75
5.	BF Slag rate (kg/t-HM)		200 – 300	300 – 400
6.	Energy Consumption	(G-cal/TCS)	4.4 – 5.5	6 – 6.5
7.	SMS Slag rate	(kg/TCS)	Less than 100	180 – 200
8.	CO2 emission	(t/TCS)	1.7 – 1.9	2.8 – 3.0

Source: IISA

Annexure – 8.1

Estimation of Interest Subsidy Required for the proposed New Scheme

Sl. No.	Sector	No. of Units/Capacity to be covered in 12th Plan	Specific Cost	Total Cost (Rs.Crore)	Loan Component based on Debt:Equity Ratio of 2:1	Total Subsidy for 5 yrs (12th Plan	Total Subsidy for 5 yrs (13th Plan	Total Subsidy for 10 yrs
1.	Beneficiation	50 Million Tonnes	200 crore / million tonne	10000	6667	1209	847	2055
2	Pelletisation	50 million tonnes	200 crore / million tonne	10000	6667	1209	847	2055
3.	Total (1+2)	100 million tonnes	187.5 crore / million tonnes	20000	13333	2417	1693	4110
4.	Electric Arc Furnace	10 units	15 crore / unit	150	100	18	13	31
5.	Induction Furnace	100 furnaces	3 crore / furnace	300	200	36	25	62
6.	Coal Based DRI	100 units	16 crore / unit	1600	1067	193	135	329
7.	Re-Rolling	100 units	2 crore / unit	200	133	24	17	41
8.	Total (4+5+6+7)	310 units	7.3 crore / unit	2250	1500	272	191	462
9.	Total (3+8)			22250	14833	2689	1884	4573

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Abbreviations

ASC	-	Apparent Steel Consumption
BF	-	Blast Furnace
BOF	-	Basic Oxygen Furnace
BSL	-	Bokaro Steel Plant
BSP	-	Bhilai Steel Plant
CAGR	-	Compound Annual Growth Rate
CAS-OB	-	Composition Adjust by Select Argon bubbling with Oxygen Blowing
CMC	-	Coal Moisture Control
CONARC	-	Converter Arcing
CR Coil	-	Cold Rolled Coil
DAPS	-	Dry-Cleaned and Agglomerated Pre- Compaction System
DC	-	Direct Current
De-C	-	De Carbonization
De-P	-	De Phosphrization
De-Si	-	De Siliconization
DRI	-	Direct Reduced iron
DSP	-	Durgapur Steel Plant
EAF	-	Electric Arc Furnace
EIF	-	Electric Induction Furnace
EOF	-	Energy Optimization Furnace
ERU	-	Economic Research Unit
FOB	-	Free on Board
GDCF	-	Gross Domestic Capital Formation
GDP	-	Gross Domestic Product
GFCF	-	Gross Fixed Capital Formation
HR Coil	-	Hot Rolled Coil
ICVL	-	International Coal Ventures Limited
IIP	-	Index of Industrial production
ISP	-	Integrated Steel Plant
ITMK3	-	Iron Making Technology Mark Three
JPC	-	Joint Plant Committee
JSPL	-	Jindal Steel and Power Limited
JSW	-	Jindal steel Works

JV	-	Joint Venture
LD	-	Linz Donawitz
LD-NRP	-	LD New Refining Process
LD-ORP	-	LD Optimized Refining Process
MTPA	-	Million Tonnes Per Annum
NG	-	Natural Gas
NISST	-	National Institute of Secondary Steel Technology
NMDC	-	National Mineral Development Corporation
NMIZs	-	National Manufacturing Investment Zones
NMP	-	National Manufacturing Policy
POSCO	-	Pohang Iron & Steel Company
RINL	-	Rashtriya Ispat Nigam Limited
RSP	-	Rourkela Steel Plant
SAIL	-	Steel Authority of India Limited
TMT	-	Thermo Mechanically Treated
TRIP	-	Transformation Induced Plasticity
TSL	-	Tata Steel Limited
WSA	-	World Steel Association
WSD	-	World Steel Dynamics
/TCS	-	Per Tonne of Crude Steel