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REPORT

OF THE

WORKING GROUP ON IRON AND STEEL FOR THE IXth FIVE YEAR PLAN

योजना आयोग
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MINISTRY OF STEEL

December 1996

I N D E X

S.NO	SUBJECT	PAGE NO.
	Foreword	i-ii
	Acknowledgements	ii(a)
	Introduction	iii-xiii
	Executive Summary	1-6
Chapter - I		
	Performance and status of Indian Iron & Steel Industry	7-18
Chapter - II		
	Category-wise demand-availability of finished steel (mild) during 9th Plan and upto 2006-07	19-50
Chapter - III		
	Measures for making Indian steel industry internationally competitive	51-71
Chapter - IV		
	Raw materials - demand - supply and constraints	72-103
Chapter - V		
	Raw materials for refractories	104-113
Chapter - VI		
	Metallics - Steel Melting Scrap & DRI	114-117
Chapter - VII		
	Financial Management, Investment Projections and Project Implementation	118-154
Chapter - VIII		
	Technology Issues	155-221

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FOREWORD

Developments in the past few years have shown that while steel consumption in the developed countries is either stagnant or on the decline, the same is increasing at a rapid pace in large parts of the developing world. When the major producers of steel such as the USA,Europe and Japan started reducing steel making capacity and also production,some of the newly developing countries started to develop steel industry in a big way. These countries are not only blessed with rapidly growing domestic markets but also have low labour and raw materials costs to be able to compete against imported steel produced in the developed countries. The developed countries, in the face of stagnating or shrinking home markets, received another jolt when they lost their export markets in these developing countries. They suffered even more as they started losing their home markets to cheaper imports from developing countries. The steel industry has come to occupy an increasingly important role in these developing countries in Asia and Latin America, which have become growth centres in the global steel map. There are very firm indications that the global battle for steel market will continue to be in favour of steel industries in the developing countries who have already made substantial advance. The prospects of the Indian steel industry for the next decade will have to be seen in this global context.

India had long followed a policy of import substitution to achieve self-sufficiency in steel. While doing so, the country was protected from the vagaries of a volatile and fluctuating international market, but it fell behind many, like those in South East Asia, in the international markets. Following liberalisation in economic policy since 1991, India can now reassert its role as a significant player in the global market. Depending on the products in which India has a comparative advantage, a policy for aggressive export promotion can be adopted.

The per capita consumption of steel in India is among the lowest even in the developing world, which indicates that there is excellent potential for increasing consumption of steel. This is also reflected in the overall technology in construction, particularly housing and storage,low levels of farm mechanisation and very low levels of ownership of motorised vehicles and consumer durables. The huge increase in production and consumption of steel in India in the past two and a half years is ample testimony to the potential the domestic market holds.

Since the commencement of economic reforms in 1991, the steel industry has gained significant momentum, especially with large scale participation of the private sector in investment. In fact, the steel industry has been in the forefront with decontrol over pricing and distribution, removal of compulsory licensing etc. having been effected within months of commencement of the liberalisation process. The secondary steel sector has been

nurtured into maturity and growth without diluting the importance given to the integrated steel plants. Today, more than 50% of the finished steel produced in the country is from the secondary steel sector.

All the above facts have been duly taken into consideration by the Working Group on Iron and Steel for IX Five Year Plan while making projections of demand and availability for various types of iron and steel during the IX and X Five Year Plan periods and also the expected levels of investment in iron and steel sector, including creation of adequate capacities in the raw materials sector. Export market has been treated, perhaps for the very first time, as a separate and distinct market which should be targeted for exploitation to convert the comparative advantage India has into foreign exchange earnings.

The bold projections of the Working Group are based on realistic assumption of GDP growth rate , industrial development in the country and vast export potential available in our neighbourhood. I am confident that the report of the Working Group will contribute at least in a small way to improving the position of India which today is the tenth largest producer of steel in the world.

Dr. J.K.Bagchi
Secretary to the Government of India

New Delhi

Dated: 2nd December,1996

ACKNOWLEDGEMENTS

Sustained painstaking effort has been put in by the Convenors of the Sub-Groups and Task Forces and the officers of different organisations and Ministry of Steel in the preparation of this Report.

The Ministry of Steel would like to specifically acknowledge the contribution made by the following in the finalisation of the report.

1. Shri B.Mallik, Director, Ministry of Steel
2. Shri Ajay Tyagi, Deputy Secretary, Ministry of Steel
3. Dr.A.S. Firoz, Chief Economist, ERU, JPC
4. Shri T.K. Ghosh, Addl. Director (Operations), S.A.I.L.
5. Shri K.K. Pahuja, Sr.Dy. Director (Operations), S.A.I.L.
6. Shri Sushim Banerjee, Asstt.G.M.(Mkt Research), S.A.I.L.
7. Shri D. Kashiva, Development Officer, Ministry of Steel
8. Shri M.C. Luther, Under Secretary, Ministry of Steel
9. Shri M.P. Rao, Under Secretary, Ministry of Steel
10. Dr.R.K. Nandi, Asstt.G.M., RDCI&S, S.A.I.L.
11. Mrs.S.Sengupta, Dy.Chief Economist, ERU
12. Shri P.Prashant, Dy.Chief Economist, ERU
13. Shri Sunil Saluja, Asstt.Manager (Tech.), ERU

The Ministry of Steel also places on record its appreciation of contribution made by Shri Ravinder Kumar, Shri B.Premi, Smt.Rita Bhatla, Shri D.Basu, officials of the Ministry of Steel, and the NIC Cell of the Ministry of Steel in word processing, formatting and printing of this report.

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INTRODUCTION

In the context of preparation of the Ninth Five Year Plan (1997-2002), the Planning Commission had, vide their Office Memorandum No. I&M-3(30)/95 dated 4.12.1995 set up a Working Group for Iron & Steel under the chairmanship of Secretary, Ministry of Steel, for the purpose of reviewing the performance and present status of the steel industry,assessing category-wise demand for various types of iron and steel over the next 10 years as also making projections upto the terminal years of the IX and X Five Year Plans and to determine availability and gap, if any, in meeting the projected demand.

The Working Group was also assigned the task of assessment of potential for export of steel from India during the next 5 to 10 years by utilising existing capacities and the capacities under implementation. Identification of areas for investment by public sector steel plants and assessment of level of investments up to 2001-02 was also a mandate given to the Working Group, besides recommending measures for making the Indian Steel industry internationally competitive in terms of quality and cost of production. The terms of reference of the Group also envisaged assessment of the requirement of physical inputs and the relevance of new and emerging technologies for iron and steel production in the Indian context and review of the status of R&D work carried out by the steel industry to improve its competitiveness. Review of the present status of production of ferro alloys, refractories etc. and also the broad status of environment protection, pollution control and speedy measures and suggestions for improvement were also among the terms of reference.

The Working Group under the powers delegated to it co-opted some additional members in order to avail itself of the expertise and experience available in the country. The list of members of the Working Group is at Annexure-I.

The terms of reference of Working Group are listed at Annexure-II.

The Working Group divided itself into 4 sub-groups for detailed study, analysis and discussions on the following broad areas :-

i) Demand and supply management for iron and steel.
ii) Raw material inputs and infrastructure.
iii)Financial management and project implementation.
iv) Technology issues.

The list of members of the various sub-groups is at Annexure-III.

In its first meeting held on 5.1.1996, the Working

Group discussed the modalities of the performance of the work assigned to it and numerous suggestions were received from members in this regard. The draft reports prepared by the individual sub-groups were compiled by the Convenor, after necessary editing and rewriting, into a compact draft report of the Working Group. The draft report was discussed in the last meeting of the Working Group held on 12.11.1996 when a number of suggestions were received from the members for modification and improvement of the draft report. These suggestions have been carefully incorporated in the final report. The report generated by Sub-Group-I on Demand and Supply Management provided a focus to the other sub-groups. The strategy adopted by the Sub-Group-I was to make bold projections of demand and availability taking into due consideration the phenomenal growth in production and consumption in the years 1994-95 and 1995-96 and also taking a realistic view of the huge production capacities coming up in the private sector. While import substitution was not a focal area, the approach of the Working Group differed from such studies in the past, by projecting exports as a distinct market which the Indian steel industry should strive to serve fully exploiting its competitiveness in terms of raw materials availability and trained manpower. Throughout the deliberations of the Sub-Groups and also the Working Group, the inadequacy of infrastructural facilities for promoting steel production and consumption and also for facilitating export came in focus. The need for changes in the policies and procedures relating to international trade was also highlighted.

Research and technology have been identified as another focal area for promoting international cost competitiveness of the Indian steel industry and the Working Group has also recommended formation of a Research and Technology Mission, with assured source of funds and with a compact organisational infrastructure, to promote research activities in the steel sector.

For easy referencing, this Report has been organised in eight chapters, which deal with various terms of reference given to the Working Group. The Report as a whole reflects the growing optimism in the Indian steel industry that it can show a very high growth rate and emerge as a leading player in the global steel market in the next ten years, providing a sound platform on which the industrial and economic activities of the country can be based, to make India a truly global economic power.

ANNEXURE-I

COMPOSITION OF THE WORKING GROUP ON IRON AND STEEL FOR THE IX PLAN

MINISTRY OF STEEL

1.	Dr. J.K. Bagchi, Secretary (Steel)	Convenor
2.	Shri A. Prasad, AS&FA, Ministry of Steel	Member
3.	Shri N.K. Raghupathy, Joint Secretary	Member Secretary
4.	Shri Anil Kumar, Joint Secretary	Member
5.	Shri S.S. Saha, Industrial Adviser	do
6.	Shri A.K. Thakur, Director	do
7.	Shri Ashok Bhardawaj, Director	do
8.	Shri B. Mallik, Director	do
9.	Smt. Meenakashi Arora, Deputy Secretary	do
10.	Shri Sujit Gulati, Deputy Secretary	do
11.	Shri Ajay Tyagi, Deputy Secretary	do

OTHER MINISTRIES/ORGANISATIONS

1.	Adviser I&M, Planning Commission	Member
2.	Adviser PPD, Planning Commission	do
3.	Dr. R. Gedam, Deputy Adviser, I&M, Planning Commission	do
4.	Mr. S. Sharma, Joint Adviser, PPD, Planning Commission	do
5.	Secretary, Deptt., of Public Enterprises	do
6.	Shri Sunil Soni, Director, Ministry of Coal	do
7.	Dr. Rajesh Chadha, Senior Consultant, NCAER	do
8.	Shri G.K. Rao, Director IR & Planning Division, Central Electricity Authority	Member
9.	Shri N.M. Katara, E.D., Traffic Transportation (M&S), Railway Board	Member

10.	Shri M.R.R. Nair, Chairman, Steel Authority of India Ltd.	Member
11.	Shri J. Mehra, CMD, Visakhapatnam Steel Project	do
12.	Dr. J.J. Irani, Managing Director, TISCO	do
13.	Shri P.R. Tripathi, Director, National Mineral Development Corporation Ltd.	do
14.	Shri U.K. Mittal, Director (Operations), SAIL	do
15.	Shri B.K. Singh, Director (Projects), SAIL	do
16.	Dr. S. Banerjee, Director (R&D), RDCI&S, SAIL	do
17.	Shri P.K. Mittal, Chairman, Ispat Group	do
18.	Shri Rajesh V. Shah, Chairman, Mukand Ltd	do
19.	Shri S.K. Jindal, Jindal Group	do
20.	Shri S. Ruia, Chairman, ESSAR Group	do
21.	Shri N. Vagul, Chairman, ICICI	do
22.	Dr. L.K. Singhal, CMD, MECON	do
23.	Shri S. Dasgupta, Joint MD, M.N. Dastur & Co.	do
24.	Dr. A.S. Firoz, Chief Economist, ERU, JPC	do

[redacted]

TERMS OF REFERENCE OF THE WORKING GROUP FOR IRON AND STEEL FOR IX PLAN

i. To review the performance and present status and growth of domestic Iron & Steel Industry keeping in view the emerging trends, strength and weakness and changing economic scenario in the country.

ii. To assess categorywise demand, availability, and gap if any, and export potential of steel from India during next 5 to 10 years by utilising existing capacities and the capacity under implementation.

iii. To identify the areas, projects, schemes, etc. where public sector steel plants have to invest and make an assessment of level of investments required year wise upto 2001-02.

iv. To recommend measures for making the Indian Steel Industry internationally competitive in terms of quality and cost of production and recommend year-wise and plant-wise targets of productivity along with measures for achieving the same.

v. To assess the relevance of new and emerging technologies for iron and steel production in the Indian context and make recommendations for introduction of promising technologies both in Public and Private Sector.

vi. To assess the requirements of physical inputs, as well as investments in the complementary sectors like mining, power, transport, refractories etc. during the period.

vii. To assess the requirement of coking coal, likely supplies from indigenous sources and the quantum of imports, year-wise upto 2007-08.

viii. To suggest a policy framework for achieving the targets including increased output from existing steel plants, through modernisation, diversification and addition of balancing facilities, role of mini steel plants and sponge iron plants.

ix. To recommend a policy for production, imports and export of various products of Iron & Steel as well as ferro-alloys e.g. ferro-manganese, ferro-silicon, ferro-chrome, etc. keeping in view of the availability from domestic sources and estimated demand for these items upto 2007-08.

x. To review the present status and future prospects of manufacture and supply of important inputs and raw material including refractories by indigenous producers.

xi. To review the status of present technologies as well as future for emergent technologies, R&D work carried out by steel industry and assess the present and future level of expenditure to improve the competitiveness of Indian Iron and Steel industry.

xii. To review broadly the status of environment protection pollution control and safety measures and suggest measures for improvement.

xiii. To assess the level of direct as well as indirect employment generation during 2001-02 in iron and steel industry if the projected level of investment fructify.

xiv. To recommend such other measures as the Working Group may consider relevant.

COMPOSITION OF SUB-GROUP – I

1.	Shri N.K. Raghupathy, Joint Secretary	Convenor
2.	Shri Shailendra Sharma, Joint Adviser, PPD, Planning Commission	Member
3.	Development Commissioner for Iron & Steel	do
4.	Chief Economist, ERU	do
5.	Chief System Manager, JPC	do
6.	Director (Commercial), SAIL	do
7.	Managing Director, TISCO	do
8.	Chairman, Steel Furnace Association of India Ltd.	do
9.	Director (Commercial), Visakhapatnam Steel Project	do
10.	Chairman, Alloy Steel Producers' Association	do
11.	Chairman, Ispat Group	do
12.	Shri R.V. Shah, Chairman, Mukand Ltd.	do
13.	Chairman, Jindal Group	do
14.	Chairman, Essar Group	do
15.	Chairman, MESCO Group	do
16.	CMD, Metallurgical & Engg. Consultants (India) Ltd.	do
17.	Representatives of CII	do
18.	Shri U.S. Bhatia, Joint Secretary, M/o Commerce	do
19.	Shri T.S. Sundaresan, Secretary, Ferro Alloys Producers' Association	do
20.	Representatives of DGFT	do
21.	Shri A.K. Kashyap, Secretary General, Pig Iron Manufacturers Association	do
22.	Representatives of Sponge Iron Manufacturers' Assoc.	do
23.	Shri R.P. Varshney, E.D., All India Induction Furnaces' Association	do

24.	Executive Director, Alloy Steel Plant	do
25.	Executive Director, Salem Steel Plant	do
26.	Dr. R.P. Sengupta, Professor, Centre for Economic Studies and Planning, Deptt. of Social Science	do
27.	Shri S.L. Rao, Director General, NCAER	do
28.	Representatives of Deptt. of Public Enterprises	do
29.	Shri RSSLN Bhaskarudu, Managing Director, Maruti Udyog Limited	do
30.	Shri P.S. Narayanan, Regional Manager, Engineering Export Promotion Council	do
31.	Chairman, Kirloskar Group	do
32.	Director (Operations), SAIL	do

COMPOSITION OF SUB-GROUP -II

1. Shri Anil Kumar, Joint Secretary, M/o Steel — **Convenor**
2. Representative of Deptt. of Coal
3. Representative of Railway Board
4. Representative of Central Electricity Authority
5. Representative of CII
6. Chief Mineral Economist, Indian Bureau of Mines
7. CMD, Bharat Refractories Limited
8. Chairman, Indian Refractory Manufacturers Association
9. Representative of Ministry of Surface Transport.
10. Executive Director, Maharashtra Electrosmelt Ltd.
11. Representative of Sponge Manufacturers Association
12. Director, Raw Material , SAIL
13. Representative of TISCO
14. Executive Director, VSP
15. Shri Anup Thakur,Director, Ministry of Steel
16. Representative of Federation of Indian Mineral Industries
17. CMD, Kudremukh Iron Ore Company Limited
18. Representative of All India Induction Furnace Association
19. Representative of Pig Iron Manufacturers Association
20. CMD, Metal Scrap Trading Corporation
21. Representative of Indian Ferro Alloys Producers Association

COMPOSITION OF SUB-GROUP – III

1.	Shri A. Prasad, AS & FA, M/o Steel	Convenor
2.	Joint Secretary, (Plan Finance), D/o Expenditure	Member
3.	Shri Shailendra Sharma, Joint Advisor, PPD, Planning Commission	Member
4.	Shri V.S. Jain, Director (Finance), SAIL	do
5.	Shri A. Chatterjee, Director (Finance), VSP	do
6.	Shri U.K. Mittal, Director (Operations), SAIL	do
7.	Representatives of Deptt. of Public Enterprises	do
8.	Vice President, TISCO	do
9.	Shri Tapas Datta, Deputy Director, CII	do
10.	Dr. A.S. Firoz, Chief Economist, ERU	do
11.	Dr. R.P. Sengupta, Professor, Centre for Economic Studies and Planning School of Social Sciences, JNU	do
12.	Shri A.K. Basu, Adviser (I&M), Planning Commission	do
13.	Shri A.K.T. Chari, Chief General Manager, IDBI	do
14.	Shri Sandeep Bakshi, ICICI	do
15.	Shri Anup Thakur, Director, M/o Steel	do
16.	Shri S.N. Mishra, Director (Projects), SAIL	do
17.	Chairman, Jindal Group	do
18.	Shri B. Mallik, Director (Finance), M/o Steel	do

COMPOSITION OF SUB-GROUP -IV

1. Shri S. Banerjee, Director, RDCIS, SAIL **Convenor** nvenor
2. Representative of Deptt. of Science & Technology
3. Representative of M.N. Dastur Co. Ltd.
4. CMD, MECON
5. Representative of Deptt. of Public Enterprises
6. CMD, RINL
7. CMD, KIOCL
8. CMD, NMDC
9. MD, Nippon Denro Ispat Ltd.
10. MD, Jindal Vijaynagar Steel Ltd.
11. MD, Essar Gujrat Ltd.
12. Chairman, SFAI
13. ED, Alloy Steels Plant, Durgapur
14. Chairman, Indian Ferro Alloys Producers Association
15. Chairman, Indian Refractories Manufactuers Association
16. CMD, SIIL
17. Representative of Deptt. of Coal
18. Representative of Federation of Indian Mineral Industries
19. Chairman, All India Induction Furnace Association
20. Shri S.S. Saha, I.A., Ministry of Steel
21. Representative of C.I.I.
22. Adviser, (I&M), Planning Commission

EXECUTIVE SUMMARY

Guidelines to the Sub-groups

1. The Working Group in its first meeting laid down broad parameters for preparation of reports of the four sub-groups, after careful consideration of the trends in development of the Indian iron and steel industry, especially the structural changes which have occurred since commencement of the process of liberalisation of the national economy and the phenomenal growth in production and consumption during 1994-95 and 1995-96. While these parameters differed considerably from the approach followed by the Working Group for VI and VII Five Year Plans, they were similar to the approach of the Working Group for VIII Five Year Plan.

Approach of Working Group

2. In VI Plan, estimate of consumption level and availability of carbon steel and pig iron in 1979-80 was the basic premise. In the VII Plan, projection of future demand was based on global GNP growth rate of 4% to 5%. In the VIII Plan, production plans were worked out considering iron and steel as the basic raw material for the growth, diversification and modernisation of the economy. The Working Group has put aside the traditional conservative approach and has made bold projections based on the premise that the steel industry, being a strategic infrastructure industry, should be the engine for industrial growth, providing an impetus to economic activities and globalisation.

3. Econometric models linking growth in production of steel with growth in GDP may be mathematically precise but do not take into account recent developments. Therefore, the projections of domestic demand based on mathematical models have been revised upward after detailed deliberations taking into account the growth rates of consuming sectors.

4. Export has been identified as distinct market by itself and projections have been made taking into consideration not only the capacities in existence and under creation but also the developments taking place globally and in South-East Asia

5. Export promotion and international competitiveness are closely linked. Measures for building up or improving competitiveness of different segments of the iron and steel industry have been suggested, taking due note of the need for improvement of infrastructural facilities and policy and procedural changes. The emphasis is not on subsidies but on enhancing inherent strengths of various segments.

6. As in the report for VIII Plan, greater emphasis has been laid on technological options, upgradation of quality, research and technology etc. rather than suggesting detailed production programmes of individual plants. This is an obvious corollary to the liberalisation process which lays more emphasis on the market and consumers than on production. Tentative production plans of individual plants have been taken into account for computing gaps in availability of individual categories of iron and steel.

7. The VIII Plan report shifted the emphasis from export of raw materials to semi-finished goods. This report lays greater emphasis on export of finished steel, more specifically value added products such as flat products.

8. This report also takes into account the huge investments being made on creation of capacities for production of steel of higher quality through various technology routes including some of the latest options, and on modernisation of existing integrated plants to improve the competitiveness in terms of quality and cost.

9. The approach followed by this Group has been deliberately bold to ensure that further investment in the iron and steel is facilitated not only to cater to the domestic demand, but also the transnational markets.

Projections

10. The production by the main and secondary steel producers has been estimated by the Working Group as follows :

Crude Steel Production

(in million tonnes)

Source	1996-97	2001-02	Increase during IX Plan period
SAIL	12.10	15.37	3.27
TISCO	3.05	3.40	0.35
VSP	3.00	4.05	1.05
Total (Main Producers)	18.15	22.82	4.67
Secondary Producers	6.10	22.09	15.99
Grand Total	24.25	44.91	20.66

Major new developments

8. Some of the major new developments envisaged in the report are:

i) Massive developments of production capacities in the Secondary Sector (including emerging steel majors) will continue.

ii) Consumption of steel within India will grow to 32.68 million tonnes by 2001-02, the terminal year of the IX Five Year Plan.

iii) The share of flat products in the domestic demand will continue to increase and touch 49.51% (net) by 2001-02 and the growth will flatten out thereafter due to infrastructure development.

iv) The demand for special and alloy steels will grow to 2.15 million tonnes by 2001-02. There will be no capacity constraints in meeting this demand. Export of these products will continue to grow.

v) The domestic demand for pig iron, spurred by growth of the foundry industry and increased use in the Electric Furnace industry, will touch 3.45 million tonnes by 2001-02. There will be an excess capacity in this sector, prompting stand-alone pig iron units to go into steel production. Export of pig iron will be to the tune of 0.9 million tonnes during 2001-02. Forward integration of pig-iron units into steel making may see a further structural change in the steel industry.

vi) The domestic demand for DRI/HBI will touch 7.67 million tonnes by 2001-02 whereas availability will be limited to only 6.18 million tonnes. Constraint of availability of natural gas may not allow further large scale capacity creation in this sector. A major policy change will be called for if large scale metallics import is to be avoided.

vii) Requirement of bulk ferro alloys by the Indian steel industry will be to the tune of 0.97 million tonnes during 2001-02.

viii) Policy initiatives and liberalisation of procedures will be vitally required if the export potential of 6 million tonnes of carbon steel is to be realised by 2001-02. Infrastructural facilities will also need to be developed with the specific objective of promoting exports.

ix) There is an urgent need for creation of Steel Exporters' Forum to devise ways and means of improving international competitiveness of the exporting units.

x) There is a need for augmentation of iron ore mining capacity to meet the expected demand. High grade iron ore should be preserved for value addition within the country.

xi) Evolving of a mechanism for quick environmental clearances for mining projects with adequate care for ecological preservation is essential.

xii) High grade Limestone and Dolomite deposits need to be identified and developed to cater to domestic requirement.

xiii) Steps are necessary for augmenting coking coal production in the country through opening of new mines, commissioning of new washeries , improving operational efficiency of existing washeries and encouragement of captive mining.

xiv) Development of refractory industry through upgradation of existing manufacturing facilities and manufacture of more sophisticated products is an immediate necessity considering that refractories are more of a technological inputs for the steel industry.

xv) Total investment of Rs.20005 crores is envisaged during the IX Plan period by PSUs under Ministry of Steel, with internal generation estimated at Rs.9590 crores.

Research and Technology

9 Research and Technology will play a key role in reduction of cost, improvement of quality and decrease of pollution by the Indian Steel Industry.

10 There is a need for setting up a Research and Technology Mission with an assured corpus of funds and an autonomous decision making body.

11 Adoption of technologies suitable for Indian steel industry is an immediate necessity for improving its competitiveness for Exports.

12 The export potential for different categories of steel has been assessed as 6 million tonnes during 2001-02 and 9 million tonnes during 2006-07. This projection takes into account the huge production capacities coming up in the private sector, some units being 100% EOUs, and the need for serving the transnational markets for fully exploiting the competitiveness of the Indian steel industry.

13 Development of required infrastructural facilities and framing of exporter-friendly policies and procedures are essential if the projected export potential is to be realised.

14 The environment created by the policy initiatives since the onset of the liberalisation process has acted as a

catalyst, especially during 1994-95 and 1995-96, in accelerating production, consumption and investment. Globalisation of the national economy poses the twin challenges of being truly internationally competitive to compete in the export market and competitive enough within the country to withstand the onslaught from imports, consequent to gradual reduction in import tariff barriers. Some of the policy initiatives identified by the Working Group for helping the Indian steel industry to face these challenges are:-

i) Import of coking coal and mining and washing of domestic coal need to be developed in order to facilitate blending of imported and indigenous coal to optimise techno-economic benefits. Captive mining should be encouraged to complement and support availability from coal mining PSUs.

ii) Priority should be given to allocation of Natural Gas for the DRI sector in the context of anticipated huge gap between demand and availability of 2001-02. Due priority should also be assigned to supply of good quality non coking coal from existing as well as new mines to coal based sponge iron plants.

iii) There is a need for further reduction in import duty on non-coking coal to service the requirements of sponge iron units located away from coal mines and to enable blending of imported and indigenous coals.

iv) Proper and adequate infrastructure should be developed for optimum and efficient working of the steel industry, and for facilitating exports.

v) Privatisation, especially in areas such as construction of new berths for ports, warehousing facilities, etc. will help exports.

vi) Development of coastal shipping, with linked road transport arrangements, will help to reduce inland transportation costs, delay in movement, etc.

vii) If export potential is to be realised, procedural formalities will have to be liberalised.

viii) Creation of Steel Exporters' forum to devise ways and means of improving international competitiveness of industry and to take up shortcomings in policies and procedures with Government bodies is an immediate necessity.

ix) In the context of gradual reduction in import

tariff and falling international prices, it is desirable to devise a mechanism of linking tariff levels with international prices.

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CHAPTER I

PERFORMANCE AND STATUS OF INDIAN IRON AND STEEL INDUSTRY

1.0 WORLD STEEL SCENARIO

1.1 After a period of recession, the world steel industry is on the path of recovery since 1993. Global production has gone up by 2.5% in 1995. (Table - 1). A similar trend is observed in the case of consumption also (Table - 2).

TABLE 1

WORLD CRUDE STEEL PRODUCTION, 1991-95

(in million tonnes)

YEAR	PRODUCTION	%CHANGE OVER PREVIOUS YEAR
1990	770	
1991	736	-4.4%
1992	723	-1.7%
1993	731	+1.0%
1994	730	-0.1%
1995	748	+2.5%

Source: International Iron & Steel Institute (IISI), Brussels.

TABLE 2

WORLD FINISHED STEEL CONSUMPTION

(in million tonnes)

YEAR	APPARENT CONSUMPTION	%CHANGE OVER PREVIOUS YEAR
1990	650	
1991	624	-4.0%
1992	613	-1.7%
1993	627	+2.2%
1994	645	+2.8%
1995	655	+1.7%

Source: International Iron & Steel Institute (IISI), Brussels.

1.2 The IISI predicts that total world consumption would reach 717 million tonnes of finished steel by the turn of the century. It has also observed that the growth in consumption will not be uniform across the economic regions. Steel consumption in the developed countries is expected to grow at a rate of only 0.3% per annum upto the end of the century as against 3.25% in the developing countries. The Eastern European countries are expected to achieve a steel consumption growth rate of 2.92% annually.

1.3 International trade in recent years has been marked by a significant increase in the volume traded. The total world trade has gone up from about 220 million tonnes in 1990 to about 281 million tonnes in 1993. The same as a percentage of total world production has increased from 28.6% in 1990 to 38.4% in 1993. The volume of ocean trade outside regional blocks has gone up from 43 million tonnes to about 90 million tonnes over the same period.

1.4 As a result of the emergence of Latin America, South Korea and the CIS countries as major exporters in the global market, the oligopolistic position of the European and the Japanese producers as price-setters has weakened substantially. The international market, as a result, has become highly competitive and volatile.

2.0 CAPACITY, PRODUCTION AND CAPACITY UTILISATION OF CRUDE/INGOT STEEL

2.1 The total crude steel capacity of the Indian steel industry was 27.38 million tonnes in 1995-96, registering an increase of 23.6% amounting to 5.22 million tonnes over 1991-92. The rate of growth recorded by the main producers decelerated from 7.8% in 1991-92 to 1.6% in 1995-96. On the contrary, in the secondary sector the rate of increase in capacity moved up from 1.5% in 1991-92 to 24.0% during 1995-96. In the interim year of 1993-94, the capacity of the secondary sector fell by 9.7% with respect to the previous year due to closure of a large number of existing EAF units. Correspondingly, share of the secondary sector in total crude steel capacity declined from 31.1% in 1991-92 to 28.5% in 1993-94, and then showed an upward trend to register a share of 35.2% in 1995-96. Producerwise distribution of

crude/ingot steel capacity is shown in **Table-3.**

Table 3

PRODUCER-WISE DISTRIBUTION OF CRUDE/INGOT STEEL CAPACITY

(In million tonnes)

Year	Main Producers	% inc-rease	Secondary Producers			% age increase	Grand Total
			EAF	IF	TOTAL		
1991-92	15.26	7.8%	5.40	1.50	6.90	1.5%	22.16
1992-93	16.27	6.6%	4.96	2.50	7.46	8.1%	23.73
1993-94	16.94	4.1%	4.24	2.50	6.74	(-)9.7%	23.68
1994-95	17.45	3.0%	4.95	2.83	7.78	15.4%	25.23
1995-96 (Provisional)	17.73	1.6%	5.26	4.39	9.65	24.0%	27.38

Source: JPC

2.2 The total production of crude/ingot steel in India, during 1995-96, was 21.55 million tonnes as compared to 17.14 million tonnes in 1991-92 showing an increase of 31.6%. The crude steel production figure includes production of special and alloy steel of the main producer plants of ASP & VISL and the secondary producers. It may be noted from **Table 4** that both the main and secondary sector registered an increase of production of around 31% over the considered period (i.e. 1991-96). Out of a total increase of 5.42 million tonnes over the period 1991-96 , addition of 2.17 million tonnes (40%) and 2.79 million tonnes (51.5%) was achieved during the last two years i.e. 1994-95 and 1995-96 respectively.

Table 4

PRODUCER-WISE PRODUCTION OF CRUDE STEEL

(In million tonnes)

Year	Main Producers	Secondary Producers			Grand Total	% share of secondary producers
		EAF	IF	Total		
1991-92	12.95	3.30	0.90	4.20	17.14	24.5%
1992-93	13.66	2.98	1.20	4.18	17.84	23.4%
1993-94	13.90	2.50	1.20	3.70	17.60	21.0%
1994-95	15.20	3.07	1.50	4.57	19.77	23.1%
1995-96	16.06	3.21	2.28	5.49	21.55	25.4%

Source: JPC

2.3 The capacity utilisation of the domestic steel industry during 1995-96 was 82% as compared to 77% in 1991-92. The capacity utilisation rates have been shown in Table - 5. It is evident from the table that the main producers improved their capacity utilisation from 85% in 1991-92 to 96% in 1995-96. On the contrary, in the secondary sector, capacity utilisation declined from 61% in 1991-92 to 57% in 1995-96. In the secondary sector, the EAF units have been operating at higher capacity utilisation rates as compared to the IF units.

Table 5

PRODUCER-WISE UTILISATION OF CAPACITY

Year	Main Producers	Secondary Producers			Grand Total
		EAF	IF	TOTAL	
1991-92	85%	61%	60%	61%	77%
1992-93	84%	60%	48%	56%	75%
1993-94	82%	59%	48%	55%	74%
1994-95	87%	62%	53%	59%	78%
1995-96 (Prov.)	91%	61%	52%	57%	79%

Source: JPC

3.0 PIG IRON AND DRI PRODUCTION

3.1 The total production of pig iron was 2.80 million tonnes in 1995-96 as compared to 1.59 million toones in 1991-92 registering an increase of 76.1%. Earlier pig iron was produced primarily by the integrated steel plants of SAIL and RINL. It may be seen from **Table 6**, that the pig iron producers in the secondary sector increased their production from a meagre 0.10 million tonnes in 1991-92 to 1.06 million tonnes in 1995-96, accounting for 37.9% of the total production. The sector-wise production of pig iron in India during the last 5 years is given in **Table - 6.**

Table - 6

PRODUCER-WISE PRODUCTION OF PIG IRON

(in million tonnes)

Year	Main Producers	Secondary Producers	Grand Total	%age share of the sec. prod.
1991-92	1.49	0.10	1.59	6.3%
1992-93	1.68	0.17	1.85	9.2%
1993-94	1.98	0.27	2.25	12.0%
1994-95	2.01	0.78	2.79	28.0%
1995-96 (Prov.)	1.74	1.06	2.80	37.9%

Source: **JPC**

3.2 There are presently 19 DRI units in the country with a total capacity of 5.62 million tonnes. This substitute for scrap has witnessed tremendous growth in consumption, production and exports. The rapid growth in recent years can be attributed to a significant addition to the DRI capacity, declining scrap imports, intensified DRI exports from India and the overall turnaround in the steel industry. The shortage of metallics world wide and the high prices of scrap created the need for developing alternatives for scrap in India. The Government delicensed this sector as early as in 1985. During the initial years, the DRI manufacturers also received priority allocation of natural gas and coal. The production of DRI has increased from 1.31 million tonnes in 1991-92 to 4.40 million tonnes in 1995-96, registering an increase of nearly 2 1/2 times over the considered period. India has emerged as the second largest producer of DRI in the world after Venezuela. The production performance of this sector has been shown in **Table 7.**

Table 7

PRODUCTION OF DRI

(In million tonnes)

Year	Production	% increase
1991-92	1.31	-
1992-93	1.44	9.9%
1993-94	2.40	66.7%
1994-95	3.39	41.3%
1995-96	4.40	29.8%

Source: JPC

4.0 FINISHED CARBON STEEL PRODUCTION

4.1 The main sources of crude steel are the steel-making facilities of the main producers and the EAF/IF units. The sources of finished steel are as under:

1) Rolling mills of the Main Producers;

2) Captive rolling facilities of the EAF and IF units;

3) Re-rolling units using feed-material consisting of imported semis, saleable semis from other producers and also re-rollable scrap;

4) stand-alone cold-rolling/galvanising units.

5)Pipes and tube making units.

4.2 The total production of finished carbon steel in the country has been 21.4 million tonnes (provisional) in 1995-96 as compared to 14.33 million tonnes in 1991-92, indicating an increase of 49.3%. The production of finished carbon steel by the main producers registered an increase of 33% as compared to 59.5% increase in production of the secondary producers during the period 1991-96. Producer-wise production of finished steel has been shown in **Table 8.** The percentage share of secondary producers in the total production increased from 44.5% in 1991-92 to 49% in 1995-96.

Table 8
PRODUCTION OF FINISHED CARBON STEEL

(In million tonnes)

Year	Main Producers	Secondary Producers	Grand Total	% of share of second. produrs
1991-92	7.96	6.37	14.33	44.5%
1992-93	8.41	6.79	15.20	44.7%
1993-94	8.77	6.43	15.20	42.3%
1994-95	9.57	8.25	17.82	46.3%
1995-96	10.59	10.81	21.40	50.5%

Source: JPC

4.3 The break-up of producer-wise flat and non-flat finished steel production, has been shown in **Table 9.**

Table - 9

PERCENTAGE SHARE OF FLATS IN TOTAL FINISHED CARBON STEEL PRODUCTION

(In million tonnes)

Year	MAIN PRODUCERS			% share
	Non-Flat	Flat	Total	Flat in Total
1991-92	3.02	4.94	7.96	62.1%
1992-93	3.22	5.19	8.41	61.7%
1993-94	3.38	5.39	8.77	61.5%
1994-95	3.80	5.77	9.57	60.3%
1995-96	4.14	6.45	10.59	60.9%

Contd.

Year	SECONDARY PRODUCERS			% share
	Non-Flat	Flat	Total	Flat in Total
1991-92	5.10	1.27	6.37	18.5%
1992-93	5.34	1.45	6.79	21.4%
1993-94	4.81	1.62	6.43	25.2%
1994-95	6.00	2.25	8.25	27.3%
1995-96	6.86	3.95	10.81	36.6%

Year	Grand Total			% share
	Non-Flat	Flat	Total	Flat in Total
1991-92	8.12	6.21	14.33	43.3%
1992-93	8.56	6.64	15.20	43.7%
1993-94	8.19	7.01	15.20	46.1%
1994-95	9.80	8.02	17.82	45.0%
1995-96	11.00	10.41	21.40	48.6%

Source:

5.0 IMPORT AND EXPORT OF IRON AND STEEL

5.1 The import of finished carbon steel has increased from 0.97 million tonnes in 1991-92 to 1.50 million tonnes in 1995-96. Imports stagnated at around 1 million tonne during 1991-1994, but increased by 60% in a single year i.e. 1994-95 in response to general economic recovery. The import-basket has, so far, been dominated by flat products. But this trend may not continue with the commisioning of the new steel projects producing flat products. Another interesting development emerging from **Table - 10** is the increased imports of slabs and other semis in recent years. The import of pig iron declined from 1.52 lakh tonnes in 1991-92 to a negligible quantity of 4 thousand tonnes in 1995-96 due to the increased availability of pig iron from RINL and other mini blast furnace units.

Table - 10

IMPORT OF IRON AND STEEL

('000 tonnes)

Year	Pig Iron	Semis/ Re-rollable Scrap	Finished Carbon Steel	TOTAL STEEL
1991-92	152	27	970	997
1992-93	73	5	1080	1085
1993-94	21	107	1063	1170
1994-95	1	230	1706	1936
1995-96 (Prov.)	4	350	1550	1900

Source: JPC

5.2 Although India started exporting steel way back in 1964, exports were not regular and depended largely on domestic surpluses. However, in the years following economic liberalisation, export of steel recorded a quantum jump as seen in **Table 11**. Export of semi finished and finished steel went up from 0.37 million tonnes in 1991-92 to 1.605 million tonnes in 1993-94. Over the same period, pig iron exports increased to 0.6 million tonnes. The DRI units also started exporting from 1992 onwards. Export of DRI went up from 2 lakh tonnes in 1992-93 to 8.50 lakh tonnes in 1995-96, registering a 325% increase in 4 years.

5.3 Exports, however, declined during 1995-96 because of increased domestic demand brought about by economic revival. Another factor contributing to this downturn was the decline of the Chinese market.

Table 11

EXPORT OF IRON AND STEEL

(in '000 tonnes)

Year	Pig Iron	Semis	Finished Carbon Steel	Total steel	DRI
1991-92	-	5	368	373	-
1992-93	16	154	741	895	200
1993-94	620	585	1020	1605	700
1994-95	466	399	873	1272	660
1995-96	502	395	925	1320	850

Source: JPC

5.4 Export of steel from India consists mainly of semis, bars and rods and plates, constituting 85% of the total quantity. However, the export basket has changed of late to include value- added flat products like hot rolled sheets/coils, cold rolled and coated sheets etc. and substantial quantities of Pig Iron and DRI.

6.0 APPARENT CONSUMPTION OF FINISHED CARBON STEEL

6.1 Apparent consumption (i.e. production + imports - exports +/- variation in stocks) of finished steel, year wise, has been shown in **Table 12.** It has increased from 14.84 million tonnes in 1991-92 to 21.25 in 1995-96.

Table 12

APPARENT CONSUMPTION OF FINISHED STEEL (MILD)

(in million tonnes)

Year	Apparent Consumption of Finished Steel
1991-92	14.84
1992-93	15.00
1993-94	15.32
1994-95	18.66
1995-96	21.65

Source: JPC

7.0 SPECIAL AND ALLOY STEEL PRODUCTION

7.1 India has a high growth industry producing special and alloy steels.

7.2 This sector has witnessed a very rapid growth over the last five years . **Table 13** shows that stainless steel production grew at an annual compound rate of 18% over 1991-92 to 1995-96 while production of other special steels registered a growth rate of 13% per annum over the same period.

Table - 13

PRODUCTION OF SPECIAL AND ALLOY STEEL

(In lakh tonnes)

Year	Stainless steel	Other Special Steel
1991-92	2.28	9.81
1992-93	2.58	10.38
1993-94	2.59	11.32
1994-95	3.17	14.56
1995-96	4.38	16.02

Source: Alloy Steel Producers' Association (ASPA)

8.0 MODERNISATION OF THE EXISTING STEEL PLANTS

8.1 SAIL and TISCO have undertaken massive modernisation of their plants with a view to reduce costs of production and improving quality of steel products. With the improvement in productivity and installation of new facilities, modernisation will also result in expansion of capacities. After completion of the modernisation, crude steel capacity in the SAIL plants is slated to increase from 10.63 million tonnes to 12.28 million tonnes per annum. **Table 14** gives the plant-wise increment in capacities of SAIL and TISCO after

modernisation.

Table 14
CAPACITY CREATION AND MODERNISATION

(in million tonnes)

Plants	Crude Steel Capacity	
	Before Modernisation	**After Modernisation**
BSP	3.92	3.92
DSP	1.15	1.80
RSP	1.40	1.90
BSL	4.00	4.36
SAIL	10.47	11.98
IISCO	0.36	0.36
SAIL, ISPs	10.83	12.34
TISCO	2.16	3.05

Source : ERU, JPC/SAIL

8.2 For TISCO, the increased capacity to 3.05 million tonnes refers to capacity installed after Phase-III of modernisation. The company is now implementing its Phase - IV modernisation after which the crude steel capacity is expected to go up to about 3.4 million tonnes.

CHAPTER-II

A. CATEGORYWISE DEMAND-AVAILABILITY OF FINISHED STEEL (MILD) DURING NINTH FIVE YEAR PLAN (1997-98 TO 2001-02) AND UPTO 2006-07

1.0 INTRODUCTION

1.1 Different quantitative techniques have been adopted in making demand projections by SAIL and Economic Research Unit of JPC . The highlights of these techniques are summarised below:-

i) Demand estimates for Iron and Steel upto 2001-02 by SAIL (1995) are based on prediction of several activity levels within the parameeters laid down by overall macro-economic performance. In other words, sectoral projections have been linked to growth rate of GDP. This has been done by relating sectoral performance levels to important macro-economic indicators such as IIP, GFCF, etc. which in turn are significantly related to the growth rates of GDP.

The SAIL model forecasts for 17 categories of mild steel and pig iron used in 88 market sectors broad-banded in 24 end using market segments. The derived demand levels are then aggregated over categories and sectors to arrive at the total finished steel consumption.

ii) The Economic Research Unit of the JPC has forecast catagorywise demand for steel based on aggregative estimates derived by regressing apparent consumption of steel on the real GDP (i.e., GDP at constant prices), using time series yearwise data over 1969 - 1990. The high value of R2 (i.e., 0.93) implies that the basic hypothesis i.e., changes in demand for steel can be explained by changes in the GDP, is statistically acceptable.

1.2 A broad overview of the two methodologies and also the methodology followed by NCAER in 1988 for making long term Demand Projection for steel was taken by the Working Group. It was decided that it would be more appropriate to compare the forecasts make by ERU and SAIL for each category of steel and adopt a suitable category-wise projection using further judgement taking into consideration current developments in each end-using sector. As a result of this exercise the total projected steel demand aggregated over the categories stands at 32.680 million during 2001-02. The aggregated demand exceeds the estimates of the ERU and SAIL, and takes into account recent developments in the post-reforms era. A note on the quantitative techniques followed by SAIL and ERU and the methodology followed by the Working Group is at Annexure 2.1.

1.3 EXPORT POTENTIAL: Export of Indian steel has been negligible over the past four decades. As a result, it is extremely difficult to project exports based on past trends. The Ministry of Steel, in an earlier report, set an export target of 6 million tonnes of steel by 2001-02. The current levels of export have been much lower. However, assuming better international market conditions as predicted by major international steel research organisations like World Steel Dynamics and the IISI, the target seems achievable. The expected capacity creation in the 100% Export Oriented Units also provides the target with a realistic base. For 2006-07, export of finished steel has been projected to be 9 million tonnes, which is about 20% of the total production of steel projected for that year.

1.4 Export potential of 6 million tonnes and 9 million tonnes for the years 2001-02 and 2006-07, respectively are only indicative. Factors like capacity utilisation, domestic price realisation, international price movements, exchange rate variations etc. would ultimately determine the level of actual exports. Infrastructural constraints like domestic movement, port facilities etc., will also have important bearing on exports.

The projection of demand for finished steel for the terminal years of the IX and X Plans have been arrived at as follows:

(Million Tonnes)

Year	Projected Domestic Demand	Planned Export	Total	Annual Growth rate(%)	Share(%)of Non flat	Flat
2001-02	32.68	6.00	38.88	8.85	50.49	49.51
2006-07	48.80	9.00	57.80	8.25	50.49	49.51

The details of category-wise forecasts are at **Annexure 2.2.**

2.0 ESTIMATION OF DOMESTIC AVAILABILITY OF STEEL

2.1 The domestic availabilty of steel has been arrived at after adjusting for export potential from estimated gross domestic production of steel. For estimating gross availability of steel from domestic producers, the following factors have been taken into account:

(1) The existing steel making capacities in the country,

(2) The ongoing expansion projects of existing producers and

(3) The new units likely to be commissioned by 2001-02.

2.2 The category-wise domestic availability of finished (mild) steel by 2001-02, the category-wise demand-availability of finished steel by 2001-02 and year-wise and category-wise demand for finished steel for 9th Plan period are at **Annexures 2.3 to 2.5** respectively. The availability estimates include finished steel produced from the semis produced by the main and the secondary producers, and from re-rollable scrap.

2.3 The principal assumptions, made for estimating domestic availability of finished steel, are enumerated below:

MAIN PRODUCERS

a). The availability of finished steel from Steel Authority of India Limited (SAIL) is based on its provisional investment plans. Production from wire rod mill of Durgapur Steel Plant (DSP) has been considered only in Xth Plan.

b). It has been assumed that Phase - IV modernisation of TISCO will be completed by 1998-99 and the plant will operate at 100% capacity utilisation by the terminal year of the IXth Plan.

c). The restructuring plans currently under consideration for Indian Iron & Steel Co. (IISCO), if adopted, will be completed only beyond 2001-02. Therefore, only the existing capacity of Indian Iron & Steel Co. has been considered for projecting availability of finished steel in the IXth Plan.

d). The capacity of the Rashtriya Ispat Nigam Limited (RINL) will go up to 4 million tonnes by 2001-02.

ELECTRIC FURNACE INDUSTRY

e). For the existing electric arc furnace (EAF) units, a growth rate of 5% has been applied to the base production level of 1994-95.

f). The production from the IF sector has witnessed a growth rate of nearly 18% in last five years. However, this trend may not continue because of

i) worldwide shortage of scrap and other metallics;

ii) shortage of electric power in India;

iii) competition from large integrated steel plants expected to come up in the IXth Plan;

iv) In the past, the growth of the IF sector has taken place to a large extent at the cost of the EAF sector. However, the rate of this replacement may not continue at the same pace, as the IF sector has already taken a major share in total availability of mild steel. Therefore, a growth rate of only 10% has been assumed for the IF sector.

NEW PLANTS

g). For estimating availability of finished steel from the new units, all the projects approved by financial institutions (FIs) have been considered. For Nippon Denro Ispat Limited and Jindal Vijayanagar, only 75% of the rated capacity has been assumed to be achievable by 2001-02. For other projects in this category, full capacity utilisation has been considered for production.

h). In addition to the projects which have been approved by the financial institutions, some of the proposals of well established industrial houses with high credibility have also been considered. The additional capacity considered is 4.6 million tonnes for projects of i) TISCO (Gopalpur), ii) Nagarjuna, iii) MESCO, iv) L&T and v) Bhusan Steel. Even if these projects do not ultimately fructify, the projected availability of finished steel from them may be replaced by some other projects under conception.

i). For projecting the availability of CR coils/sheets/skelp, 100 % capacity utilsation for integrated HR/CR units has been assumed. However, for stand alone units, the assumed capacity utilisation is 80%. The gross availability of CR coils/sheets/skelp has been estimated to be 4.4 million tonnes by 2001-02.

j). The gross availability of semis from the Main Producers has been estimated to be 2.45 million tonnes. The plant-wise projection of availability of semis will be as follows :

SAIL(including IISCO)	:	1.1 million tonnes
TISCO	:	0.1 million tonnes
RINL	:	1.246 million tonnes

These estimates are based on the tentative production

plans of the main producers

k). The availability of re-rollable scrap by the terminal year of the IXth plan has been estimated to be around 2.00 million tonnes. The likely growth in the generation of re- rollable scrap has been assumed to be low because of expected improvement in material yields in integrated steel plants and inadequate infrastructure which may limit growth of ship breaking industry.

3.0 PROJECTIONS OF DEMAND AND SUPPLY

3.1 The total categorywise net availability of finished steel from domestic producers has been shown in **Annexure 2.3**. Total availability of finished steel in the domestic market by 2001-02 will be in the neighbourhood of 32-32.5 million tonnes. This range has been taken due to indivisibility of capacity. The category-wise shortfall/surplus is presented in **Annexure 2.4**. It can be seen from this table that although the expected domestic supply matches total demand for finished steel, shortfalls and surpluses are evident in individual categories. The largest surplus is noticed in the case of HR coils/skelp/strips. However, these figures should be read with caution because the production facilities allow a large degree of flexibility in the selection of inter-se product-mix of HR coils/skelp, HR sheets and plates.

3.2 The estimated gap between the demand and supply is expected to be met through imports. Moreover, because of the globalisation of the Indian economy, some of the expected domestic supply may also be replaced by imports as dictated by the relative prices.

3.3 Further, a situation of surplus or a small gap in a category should not be taken as an entry barrier to new entrepreneurs, as efficient units with low costs of production and higher quality products, can replace inefficient units. This is more valid in the present economic environment which embodies the spirit of competition.

3.4 The year-wise.category-wise demand for finished steel during the IX plan period is in Annexure 2.5.

B. DEMAND AND AVAILABILITY OF ALLOY AND SPECIAL STEELS

1. INTRODUCTION

1.1 India has a growing sector producing alloy and special steels. This sector witnessed a rapid growth in the last five years. **Annexure 2.6** shows that stainless steel production grew at an annual compound rate of 17.7% between 1991-92 and 1994-95, while production of alloy and special steels registered a growth rate of 13% per annum. **There has been a**

significant shift of production from mild to alloy and special steel in the secondary sector recently.

2. FORECAST OF DEMAND

2.1 Demand forecast for alloy and special steel is based on information provided by the Alloy Steel Producers' Association (ASPA) and the International Data Services (IDS). The higher forecasts of the ASPA have been accepted as this sector has been growing at a fast pace over the last few years. Anticipated expansions in the end-using sectors such as engineering goods, automobiles, utensils and appliances etc., indicate rising future demand for alloy and special steels. A special mention should be made about the vast export potential of stainless steel utensils and appliances. Export of these products has doubled between 1992-93 and 1994-95. The projections of ASPA pertain to total demand for alloy and special steels. For disaggregating the total pro jections, the segment-wise requirement (on the basis of end-use analysis) derived by the International Data Services (IDS) has been used. The resultant projections are shown in **Annexure 2.7**. It has been assumed that the rate of growth assumed for the IXth Plan period will continue during the Xth Plan also.

3. AVAILABILITY OF ALLOY AND SPECIAL STEELS

3.1 At present, the total installed capacity in the IF and EAF sector is about 12 million tonnes. A large number of the EAF units have geared themselves to the production of alloy and special steels. The remaining capacity can also be suit ably modified for the production of such steels by investing in secondary refining facilities, etc.. Therefore, there will be no constraint on the supply side for meeting the emerging demand except for those grades which cannot be produced domestically.

C. DEMAND AND AVAILABILITY OF PIG IRON

1. INTRODUCTION

1.1 Pig iron is the basic input for iron castings. It can also be used in the charge-mix of the electric furnaces (EAF & IF) as a partial substitute of melting scrap. Demand for merchant pig iron arises from iron foundries which manufacture iron castings including grey iron (graded and non-graded), spheroidal graphite (SG) iron, and malleable iron castings.

2. METHODOLOGY FOR FORECAST MODE OF DEMAND FOR PIG IRON

2.1 An overview of demand forecast by regressing technique and also agencies such as SAIL and ERU was taken by the Working Group . Demand for pig iron arises mainly from the engineering goods sector. Therefore, the regression analysis is built on the hypothesis that consumption of pig iron can be explained by changes in the level of industrial production. **However, for increasing the accuracy and reliability of the projections, consumption of pig iron has been related directly to the activity levels (production indices) in specific end-using industrial sub-groups as opposed to the general index of industrial production (IIP).** The identified end-using sectors are enumerated below:

1) Basic Metals and Alloys;

2) Manufacture of Metals except Machinery and Transport;

3) Manufacture of Machinery except Electrical;

4) Manufacture of Electrical Machinery;

5) Manufacture of Transport Equipment.

2.2 As a next step in the analysis, a **composite index** of industrial production has been constructed by taking the weighted average of the production indices relating to the identified sectors. The weights used are proportional to their respective weights in the general IIP. **This Composite Production Index (CI) has been used as the explanatory/casual variable in the regression equation.**

2.3 Examination of the apparent consumption series shows wide and erratic periodic fluctuations even when the general direction of the series definitely establishes an increasing trend. As such, the data call for smoothing out of the spikes and dips before attempting regression analysis. Smoothening of the apparent consumption series has been done by fitting a semi-log trend line to the observed data.

2.4 Regressing the estimated trend values of apparent consumption on the composite production index of gives a good sta tistical fit. The time-series used in tthe analysis spans 1969-70 to 1994-95. The resulting equation has the following form:

$$\text{Log } (ACPI_t) = 5.626 + 0.333 \text{ Log } (CI_t) \quad \ldots\ (1), \quad R^2 = 0.94$$

where, $ACPI_T$ = trend value of apparent consumption of pig iron at time 't'

CI_t = composite production index at time

2.5 On the basis of past data, the elasticity of the CI with respect to general IIP has been computed to be 0.98 (i.e., CI will increase by 0.98% for every percentage increase in IIP). Similarly, the elasticity of IIP with respect to GDP has been estimated as 1.33. Therefore, the assumed rate of growth of 6.02% p.a. in the GDP will generate 8.04% growth in the CI (i.e., 1.33 x 0.0602 x 0.98). Applying the estimated elasticity obtained from equation (1) to the projected growth in CI, it is predicted that demand for pig iron wil increase from 24.18 lakh tonnes in 1996-97 to 2763 lakh tonnes by 2001-02 .

3. FORECAST BASED ON SAIL'S SEGMENTED APPROACH

3.1 In the segment-wise exercise undertaken by SAIL (November 1995), predictions have been made for pig iron upto 2001-02. According to this exercise, demand for pig iron will go up from 2198 thousand tonnes in 1996-97 to 2977 thousand tonnes in 2001-02.

4. FORECASTS BASED ON END-USE AND OTHER METHODS

4.1 A recent study carried out at the ERU estimates the domestic demand for pig iron at about 3.7 million tonnes by 2001-02. The method has been based on the projected growth of the end-using industries and their norms of consumption of pig iron.

5. ADOPTION OF FINAL DEMAND FIGURES

5.1 Although there is correspondence among the three sets of results, year to year divergence exists. In view of the recent spurt in the production of the iron casting units and revival of the engineering goods sector, the figures close to the highest of the estimates for each year were adopted. This position can be further justified by the enhanced ex ports of castings in recent years. Value of the exports of sanitary castings during April-October (1995) has increased by 9.1% over the comparable period in 1994. In the case of industrial castings, the increase has been even more marked with a growth of 68.4% in value terms. The reconciled demand estimates are at **Annexure 2.8**. It is projected that demand will go up from 24 lakh tonnes in 1996-97 to 34.5 lakh tonnes in 2001-02.

3. COMPARISON OF DEMAND AND AVAILABILITY

3.1 Year-wise projection of demand and availability of pig iron during 1996-97 to 2001-2002 and demand upto 2006-07 is indi

cated in **Annexure 2.9.** Major changes forecast include near total cessation of production of pig iron for sale by VSP and substantiallly higher level of production, estimated at 20 lakh tonnes, by the emerging new units in the year 2001-02. During 1995-96, export of pig iron amounted to about 5 lakh tonnes . It is envisaged that exports will reach 9 lakh tonnes in 2001-02. Therefore, net domestic availability at 37.5 lakh tonnes will leave a surplus of 3 lakh tonnes over domestic demand. This may not be a cause for concern as there is a distinct possibility that stand-alone pig iron units may go in for forward integration for steel making at marginal incremental investment, if the pig iron market is not adequately remunerative.

D. DEMAND AND AVAILABILITY OF DIRECTLY REDUCED IRON

INTRODUCTION

Directly Reduced Iron (DRI) is the most important substitute for steel scrap in steel making. DRI is used in electric arc furnaces, induction furnaces and, to a small extent, in integrated steel plants and foundries. Production of DRI has increasd from 27.2 thousand tonnes in 1981-82 to 4.33 million tonnes in 1995-96. Today, India is the second largest producer of DRI in the world, next only to Venezuela.

Demand-Availability

The demand situation in respect of DRI by 2001-02 and year 2006-07 and availability upto 2001-02 is shown in the **Annexure-2.10** Following assumptions have been made in estimating demand and availability.

(1) Production of steel from existing EAF units will grow at 5% annually.

(2) The production from IF units will grow at higher rate of 10% to reach a level of 3.5 million tonnes by 2001-02

(3) The crude steel production from new units following EAF route will reach a level of 5.6 million tonnes by 2001-02.

(4) Due to expected shortage of scrap world-wide, the EAF/IF units will use DRI to the maximum extent, due to techno-economic considerations. DRI in total charge mix has been assumed to be 40% for older existing units while for new units it will be 70%.

(5) Replacement of sponge iron by other alternative iron bearing materials, including pig iron, will not have

significant impact on total demand. Lower demand due to change in the charge-mix in the secondary sector, if any, will be neutralised by higher demand due to possible use of sponge iron in the Integrated steel plants and foundries.

(6) An export potential of 0.5 million tonnes by the year 2001-02 has been assumed . Although export of DRI has increasd substantially in last 5 years (from nil exports in 1990-91 to 8 lakh tonnes in 1995-96), the same trend may not continue because (a) A number of DRI units are going for forward integration which will reduce sponge iron availability for merchant sale. (b) The demand/supply projections show a net shortfall.

Year wise demand of directly reduced iron from 1996-97 to 2001-02 is indicated in Annexure - 2.11.

E. DEMAND AND AVAILABILITY PROJECTIONS OF BULK FERRO-ALLOYS

1. INTRODUCTION

1.1 Ferro-alloys are essential additives in steel making used for imparting desired chemical and mechanical properties to steel products. **The product-mix of the Indian ferro-alloys industry comprises predominantly of bulk ferro-alloys, such as -**

i) **Ferro Manganese (FeMn)/Silico-Manganese;**

ii) **Ferro Chrome (FeCr)/ Charge Chrome, and**

iii) **Ferro Silicon (FeSi).**

1.2 A second category known as **noble ferro-alloys** consists of **ferro vanadium, ferro niobium, ferro titanium, ferro tungsten and ferro molybdenum.** As India is only a small producer of these high-value ferro alloys, the Working Group concentrated on projection for bulk ferro-alloys only.

1.3 India possesses substantial reserves of the basic raw materials needed for production of bulk ferro alloys. The bulk ferro alloys industry came into existence during the Second and the Third Five Year Plans to cater to the growing Indian steel industry. Late seventies saw the advent of 100% export Oriented Units of bulk ferro alloys when this sector was identified as a potential foreign exchange earner due to comparative advantage enjoyed because of substantial domestic availability of the basic minerals.

2. PROJECTIONS OF DEMAND FOR BULK FERRO-ALLOYS

Demand for Ferro Manganese/Manganese Alloys

2.1 Ferro manganese is used in the production of mild steel in both BOF and Electric steel making. Hence, demand for ferro manganese can be directly derived from the projected production of mild steel in the selected bench-mark years of 2001-02 and 2006-07. The projections of demand for manganese alloys required by the mild steel producers have been based on the following assumptions:

1) Specific consumption of ferro-manganese has been taken as 11-13 kgs per tonne of crude steel produced through the BF/BOF route, based on the operational practices of the integrated steel plants. In the case of silico-manganese consumption norm of about 10 kg. per tonne of crude steel is assumed.

2) For Electric furnaces, a specific consumption rate of 8 kgs per tonne of crude steel has been applied.

Domestic demand for ferro-manganese required for domestic steel production has been estimated as 4.9 lakh tonnes by 2001-02 and 6.22 lakh tonnes by 2006-07. (**Annexure 2.12**). Over the last five years, export of manganese alloys (i.e., HC FeMn and SiMn) has been around 50000 tonnes annually. As the world steel industry is expected to experience favourable conditions in the coming years, exports of manganese alloys are expected to touch a level of 1 lakh tonnes by the year 2001-02. Therefore, **the total of export potential and domestic demand for manganese ferro alloys has been estimated as 5.1 lakh tonnes during 2001-02.**

Demand for Ferro-silicon

2.2 Ferro-silicon is used in the production of both mild and special steels. Unlike ferro manganese, however, requirement levels of ferro silicon per tonne of crude steel differ widely between the two types of steel. The assumptions of specific consumption norms of ferro-silicon are as given below:

1) 3 kgs of FeSi per tonne of crude steel for mild steel production.

2) 10 kgs per tonne of crude steel for special and alloy steels.

Demand for ferro-silicon for steel making has been estimated

as 1.66 lakh tonnes by 2001-02 and 2.38 lakh tonnes by 2006-07 as shown in **Annexure 2.13**. Out of all the bulk ferro-alloys, production of ferro-silicon is the most power-intensive. As electrical power is both costly and scarce in India, not much prospect of exports of ferro-silicon is seen over the next 5-7 years. Therefore, the total **demand for ferro-silicon has been estimated at 1.5 lakh tonnes by 2001-02.**

Demand for Ferro-chrome/Charge Chrome

2.3 The end-users of ferro-chrome and other chromium ferro-alloys are -

1) Metallurgical industries, i.e., stainless steel and other chrome-bearing steel;

2) Refractory-making industries;

3) Chemical industries.

2.4 Out of these user-sectors, metallurgical industries account for more than 85% of the total domestic consumption of chromium ferro-alloys. Therefore, future requirement of ferro-chrome will be determined primarily by the anticipated production of stainless and other chrome-bearing steel and the associated specific consumption rates of ferro chrome in these sectors. The assumed norms of consumption are as fol lows:

1) 70% of total stainless steel demand will originate in the utensil sector. Specific consumption of ferro-chrome in this sector has been assumed to be 300 kgs per tonne of crude steel.

2) The remaining 30% of the total stainless steel demand will originate in the industrial sector (i.e., 304 and 316 grades). For such industrial applications, specif-ic consumption of ferro-chrome has been assumed to be 320 kgs per tonne of crude steel.

3) Demand for chrome-bearing steel has been estimated at approximately 30% of the total alloy and special steel excluding stainless steel. A specific consumption norm of 16 kgs of ferro chrome per tonne of chrome-bearing steel has been adopted.

Demand projections derived on the basis of the above assumptions for 2001-02 and 2006-07 are placed in **Annexure 2.14**. However, the estimated demand of 3.119 lakh tonnes of ferro-chrome arising in the steel sec-tor, represents about 85% of the total demand . There-fore, total demand for ferro-chrome can be estimated at

3.69 lakh tonnes taking into account demand in other user sectors. In addition to the ferro-chrome requirement of the domestic industries, this sector has a substantial export potential. Over the last 5 years, exports of charge chrome have ranged between 1 lakh tonnes to 1.2 lakh tonnes per year. According to the assessment of the Indian Ferro Alloys Producers' Association (IFAPA), total charge chrome exports will rise to 1.53 million by 2001-02. Therefore, **total demand for chromium ferro-alloys including export potential will be 3.67 lakhs of ferro-chrome and 1.53 lakh tonnes of charge chrome during 2001-02.**

2.5 Year-wise demand from 1996-97 to 2001-02 and 2006-07 of ferro-manganese, ferro-silicon and ferro-chrome is indicated in **Annexure 2.15.**

3. AVAILABILITY OF FERRO-ALLOYS

3.1 The ferro-alloys industry has a broad-banded capacity of nearly 1.3 million tonnes. These capacities allow the pro ducers enough flexibility to shift from one product to another with relative ease. According to the IFAPA, additional capacities of 2 to 3 lakh tonnes are expected to be generated in the next two years. The total demand for ferro alloys by 2001-02 works out to 1.17 million tonnes. Therefore, there does not seem to be any likelihood of capacity constraints in meeting the projected demand by 2001-02.

LIST OF ANNEXURES

Annexure	2.1	-	Methodologies for demand projection
Annexure	2.2	-	Category-wise demand forecast for 2001-02 & 2006-07
Annexure	2.3	-	Domestic availability of finished steel by 2001-02
Annexure	2.4	-	Category-wise shortfall/surplus of finished steel by 2001-02
Annexure	2.5	-	Year-wise forecast of category-wise demand for finished steel from 1996-97 to 2001-02
Annexure	2.6	-	Production of Special & Alloy Steel during 1991-92 to 1994-95
Annexure	2.7	-	Demand projection of Alloy & Special steels from 1996-97 to 2006-07
Annexure	2.8	-	Projected availability of Pig Iron by 2001-02
Annexure	2.9	-	Year-wise demand-availability of Pig Iron during 1996-97 to 2001-02 & demand upto 2006-07
Annexure	2.10	-	Demand of DRI upto 2001-02 & 2006-07
Annexure	2.11	-	Year-wise demand-avialability of DRI from 1996-97 upto 2001-02
Annexure	2.12	-	Demand for Ferro-Manganese by 2001-02 & 2006-07
Annexure	2.13	-	Demand for Ferro-Silicon for the years 2001-02 & 2006-07
Annexure	2.14	-	Domestic demand for Ferro-Chrome for 2001-02 and 2006-07
Annexure	2.15	-	Year-wise demand from 1996-97 to 2001-02 of ferro-manganese, ferro-silicon & ferro-chrome.

ANNEXURE-2.1

METHODOLOGIES FOR DEMAND PROJECTION

I.0 AGGREGATIVE TECHNIQUE OF ERU

1.1 The Economic Research Unit of the Joint Plant Committee has forecast categorywise demand for steel based on aggregative estimates derived by regressing Apparent Consumption of Steel on the real GDP (i.e., GDP at constant prices). **Apparent consumption of finished steel was regressed on the real GDP, using time-series yearwise data on the two variables over 1969 - 1990.**

1.2 The high value of R^2 (i.e., 0.93) implies that the basic hypothesis, **i.e., changes in demand for steel can be explained satisfactorily by changes in the Gross Domestic Product of the economy**, is statistically acceptable.

1.3 Forecasts of aggregate demand for finished steel have been made for the terminal years of the Eighth Plan (i.e., 1996-97), the Ninth (i.e., 2001-02) and the Tenth Five Year Plans (i.e., 2006-07), on the basis of the estimated elasticity coefficient of 1.32. The exogenously determined explanatory variable i.e., GDP at constant prices, has been assumed to grow at the rate of 6.02% p.a. upto 2001-02 and at 6.5% p.a. beyond that, the growth rates quoted in the Eighth Five Year Plan document. While analysing the data, an element of double-counting of HR feed-material used in the downstream cold-rolling operations was noted. Total finished steel demand on the basis of the fitted equation has been appropriately adjusted to eliminate the effects of double-counting. Total finished steel demand has been predicted to be 21.02 million tonnes in 1996-97, 30.99 million tonnes in 2001-02 and 47.04 million tonnes in 2006-07.

1.4 While estimating the relationship between GDP and apparent consumption of steel, the ERU utilised data relating to a period of 22 years between the terminal years of 1969-70 and 1990-91. The choice of the terminal year of the series (i.e., 1990-91) has been guided by considerations of normal economic activities. The period 1991-1993 was marked by a recession in the domestic economy. The effect was more pronounced in the steel-using sectors as investment and fixed capital formation grew sluggishly. Steel consumption registered an absolute decline during 1991-92, 1992-93 and 1993-94, recovering significantly during 1994-95. Though further rise in the apparent consumption has been recorded in 1995-96 also, firm data on apparent consumption are available only upto 1994-95 - the first year of the general economic recovery. The data series was, therefore, limited upto 1990-91 as total inclusion of the recession years and

only partial coverage of the revival would have distorted the average relationship between demand and GDP.

1.5 The next step in this exercise involved determining the respective shares of flat and non-flat products in the aggregate projected demand as derived above. **While processing past data on consumption of flat vis-a-vis non- flat products, it has been noticed that the HR Coils/Skelps going as feed-material to downstream processing of CR/GP/GC sheets and pipes in the secondary sector, have been double- counted.** This in its turn has artificially inflated the total flat products consumption and hence, the total finished steel apparent consumption of finished steel.

1.6 To eliminate possible sources of double-counting, the figures related to consumption of HR Coils/Skelp were adjusted downwards to account for the input materials utilised for production of CR/GP/GC sheets. The adjusted apparent consumption series now gives the ratios between flat and non-flat products in the total annual production.

1.7 The flat:non-flat ratios for the benchmark years were derived by fitting a trend equation to the actual ratios observed over the past decade and a half. For calculating the trend equation, the movement in the ratios over the last 15 years i.e. 1980 - 1994 was considered. The share of non-flat products in total apparent steel consumption has declined from 66% in 1980 to 56% in 1994. This drop in the share has not been uniform or uni-directional. However, there has not been any unusually large or consistent deviant movement over the last five years.

1.8 Computed proportions of non-flat products for the last 15 years (i.e., 1980 - 1994) were fitted with an exponential time-trend equation. On the basis of this trend equation, flat::non-flat ratio has been projected to be 49::51 by 2001-02 and 52::48 by the terminal year of the Tenth Plan (i.e., 2006-07).

1.9 The broad-banded flat and non-flat products have been allocated among the constituent categories on the basis of the assumption that intra-category product-mix obtained in 1994-95 would also hold good over the entire period of projection.

1.10 The growth rates of different categories of steel will further depend on the relative growth of different end using sectors, that is the industrial structure which will lead to change in structure of demand in the economy. The assumption that the inter category ratio (for demand) will remain unchanged from what has been observed in 1994-95 is weak in respect of certain products like cold rolled sheets/coils and hot rolled coils for pipes and tubes. For example, the auto industry in the recent times is growing at unprecedented pace which has not been captured in the data

upto 1994-95. Also, considering the fact that the pipes and tubes industry is also facing major competition from substitute materials sector and that there is scope for large scale substitution of ERW pipes by seamless pipes, the assumption of constancy of demand mix of 1994-95 over the next few years will not be very realistic. Therefore, recent developments in these products will need to be taken into account to arrive at more realistic forecasts.

2.1 **Disaggregative Model of SAIL.** In this model the sectoral activity levels have been predicted within the parameters laid down by overall macroeconomic performance. In other words, sectoral performances have been linked to the growth rate of the GDP. This has been done by relating sectoral performance levels to important macroeconomic indicators (e.g., IIP, GFCF etc.), which in turn are significantly related to the growth rates of the GDP.

Segmented Approach Adopted by SAIL

2.2 This model forecasts for 17 categories of mild steel and pig iron used in 88 market sectors broad- banded in 24 end-using market segments. The model used by SAIL essentially consists of the steps described below:

(1) **An econometric relationship has been established between the** sectoral consumption of finished steel **and** sectoral performance levels **for each of the 24 identified market segments using time-series information on both the variables. Sectoral performance levels have been measured by output levels, value additions, appropriate indices or capital outlays/expenditures at constant prices. The estimates then relate the consumption of steel in each sector to predicted sectoral activity levels.**

(2) The activity level of each sector has been related to important macro-variables which would determine/explain the sectoral behaviour. Once again, time series data on both the variables have been used to quantify the relationships.

(3) The next obvious step is to determine the elasticity/responsiveness of the chosen macro-indicators to changes in the GDP.

(4) The GDP growth rates are then projected on the basis of an in-house macro-model, assuming a given level of investible resource mobilisation in the economy i.e., the 'resource ratio' expressed as a percentage of GDP. For every projected level of GDP, the corresponding levels of the macro-indicators and sectoral performance levels have been predicted using the elasticities estimated in steps 2 and 3.

(5) Using the derived sectoral activity levels, total fin ished steel requirement in each market segment during the selected benchmark years have been projected on the basis of the relationship developed in step 1.

(6) For category wise projection, the total finished steel consumption of each market segment is pro-rated according to their observed past consumption-mix. This is done separately for each of the 24 sectors. Category-wise total demand is then obtained by summing up sectoral demands at designated time period.

2.3 The macro-economic forecasts of SAIL have been based on an exogenously determined 'resource ratio' (consisting of domestic savings and foreign capital) of 23.4% applied to an in-house macro-model. The results of the forecasting exercise carried out by SAIL hinges crucially on this assumption. It should be noted that the elasticities of sectoral growth with respect to GDP have been based on a data set spanning a time- period of the last ten years (i.e., 1984-1994). The relationships between sectoral finished steel consumption and sectoral activity levels have also been based on data pertaining to the same time-period. The time-period has been chosen to account for the effects of the New Economic Policy initiated in 1991 on sectoral activity levels. The projections of SAIL are upto 2001- 02 and not beyond.

2.4 A survey of the recent performances by the different end-using sectors indicate impending changes in the relative rates of growth i.e., some sectors will grow at an accelerated pace while others will experience slackening of their growth rates. According to SAIL, some of the sectors likely to experience high growth with respect to steel consumption over the next few years are the automobile sector, transportation of petroleum and its products, cold-reducing/cold-forming, coated sheet products and agricutural implements. On the other hand, the sectors which are expected to achieve lower rates of growth have been identified as water supply and sanitary products, wagon/coach/loco manufacturing and packaging.

3.0 METHODOLOGY FOLLOWED BY WORKING GROUP

3.1 GDP- elasticity based forecasts are generally acceptable as no major disturbance is visualised in the overall structural composition of the Indian economy in the next 6 years. A marked shift in the calculated value of the GDP-elasticity of steel consumption can be expected only if the sectoral interrelationships undergo major change.

3.2 Even within the overall parameters set by the computed value of the GDP elasticity, some amount of sectoral shifts are bound to occur in a dynamic economy in the short as well as medium run . This is especially true in view of the wide-ranging changes brought about by the economic reforms initiated since 1991. Some of the end-using sectors are expected to grow at a rate higher than the observed trend (past) rate of growth even over a shorter time-span. Therefore, the Group felt that it would be more appropriate to compare the forecasts of the two agencies for each category of steel and adopt a suitable category-wise projection using further judgement taking into consideration current developments in each end-using sector.

3.3 The basis for adopting the category-wise demand estimation is as follows:

Bars & Rods: The higher projection of the ERU i.e. 11.22 million tonnes has been further escalated by 10% to arrive at an estimated demand of 12.2 million tonnes by 2001-02. The higher figure has been adopted to accommodate the expected upsurge in infrastructural activities by the turn of the century, which will be required to support the expected growth in GDP.

Structurals: The higher estimate of the ERU (i.e. 3533 thousand tonnes) has been rounded off to 3600 thousand tonnes by 2001-02 for the same reason as in the case of bars & rods.

Railway materials: In view of the current resource constraints of the Railways, a demand forecast of 700 thousand tonnes has been adopted. This is lower than the forecasts of both the SAIL and the ERU and is based on expected capital outlay of the Railways by the terminal year.

Plates: The higher forecast of ERU (2995 thousand tonnes for 2001-02) has been escalated in view of higher growth expected in the infrastructural sectors, especially, power, hydro-electric and fertilisers. The adopted figure is 3.14 million tonnes for 2001-02.

HR coils/skelp: The figure arrived at accounts for HR coils and skelp mostly to be used by the tubes and pipes sector. This sector is facing the threat of further substitution by plastics and other materials, including seamless pipes. Considering this, the figure arrived at from the ERU exercise has been further reduced by nearly 5%. The adopted figure is 3.5 million tonnes for 2001-02. It should be noted that the demand for HR coils and skelp quoted in the ERU's exercise is net of downstream requirement of HR feedstock.

HR sheets: Considering the possibility of higher industrial growth which may lead to larger demand for HR sheets, the higher projection of SAIL has been approximated to 1 million tonnes by 2001-02.

GP/GC sheets: The higher demand projection of the ERU has been escalated by approximately 10% to take into account the expected increase in construction activities. The adopted figure stands at 1.7 million tonnes by 2001-02.

Electrical sheets: In view of the recent upturn in the capital goods sector, the higher forecast of the ERU has been further escalated to arrive at an estimated demand of 460 thousand tonnes of electrical sheets by 2001-02.

CR sheets/coils: As the consumer durables, automobile and industrial machinery sectors experienced very healthy growth during the last three years and similar trends are expected in future also, the forecast of ERU has been increased by 20 per cent to present a more realistic growth expected in the coming years. The adopted figure is 5.6 million tonnes.

Pipes: In view of the envisaged high growth rate in the oil and gas sector, the forecast made by SAIL approximated to 0.56 million tonnes, has been retained.

3.4 As a result of this exercise, the total finished steel demand aggregated over the categories stands at 32.680 million tonnes by the year 2001-02, the aggregate demand exceeding the estimates of both ERU and SAIL by approximately 1.7 and 2.7 million tonnes, respectively. In view of the adopted demand forecast of 32.680 million tonnes the projections for 2006-07 have also been revised upwards. Assuming GDP to grow at the rate of 6.5% over 2001-02 to 2006-07 , apparent consumption of steel is expected to grow at the rate of 8.5% per annum. This implies an expected demand of approximately 49 million tonnes of total finished steel by the year 2006-07. The flat::non-flat ratio in total demand for finished steel will be determined by the relative rates of growth in the engineering goods sector (i.e. consumer durables and general machinery) vis-a-vis the growth in construction activities. While forecasting for the year 2006-07, it has been assumed that the flat::non-flat ratio will remain at the level attained in 2001-02. In other words, it is assumed that the continued decline in the ratio of non-flats in the total consumption will be arrested as construction activities will grow at a rate faster than that achieved hitherto.

ANNEXURE 2.2

CATEGORY- WISE DEMAND FORECASTS

(MILLION TONNES)

	ITEMS	2001-02	2006-07
1.	BARS & RODS	12200	18219
2.	STRUCTURALS	3600	5376
3.	RLY. MATRLS	700	1048
4.	TOTAL NON-FLATS	16500	24640
5.	PLATES	3000	4480
6.	HRC/SKELP	3500	5226
7.	HR SHEET	1000	1493
8.	CR COIL/SKELP	5600	8362
9.	GP/GC SHEETS	1700	2538
10.	ELEC. SHEETS	460	687
11.	TIN PLATES	360	538
12.	PIPES	560	836
13	TOTAL FLATS	16180	24160
14.	TOTAL FINISHED STEEL	32680	48800

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DOMESTIC AVAILABILITY OF FINISHED STEEL BY 2001–02

(IN THOUSAND TONNES)

	SAIL	IISCO	RINL	TISCO	ESSAR	LLOYD	JINDAL	NDIL	OTHERS	TOTAL	TOTAL (After adjusting for double counting)	EXPORT POTENTIAL	DOMESTIC AVAILABILITY
BARS/RODS	1335	105	1343	1020	0	0	0	0	10297	14100	14100	1648	12452
STRUCTURALS/SPL. SEC	1181	195	1067	0	0	0	0	0	1803	4246	4246	606	3640
RAILS & RLY. MATERIAL	764	20	0	0	0	0	0	0	110	894	894	54	840
TOTAL NON–FLATS	3280	320	2410	1020	0	0	0	0	12210	19240	19240	2308	16932
													0
PLATES	2304	0	0	150	331	55	280	0	0	3120	3120	602	2518
HR COILS./SKELP/STRIPS	2549	0	0	1655	1555	142	1000	525	4220	11645	7143	1801	5342
HR SHEETS	446	0	0	275	114	11	0	0	0	846	846	132	714
CR COILS/SHEETS/STRIPS	1893	0	0	0	0	217	200	275	3693	6278	5186	849	4337
GP/GC SHEETS	350	0	0		0	131	150	100	847	1577	1577	217	1360
ELECT. SHEETS	92	0	0		0	22	0	0	57	171	171	–	171
TIN PLATES/TFS	85	0	0		0	0	0	0	90	175	175	–	175
PIPES	130	0	0	0	0	22	0	0	400	552	552	91	461
TOTAL FLATS	7849	0	0	2080	2000	600	1630	900	9307	24366	18772	3692	15080
	0	0	0	0	0	0	0	0	0	0	0		0
TOTAL FINISHED STEEL	11129	320	2410	3100	2000	600	1630	900	21517	43606	36012	6000	32012

CATEGORY–WISE DOMESTIC DEMAND AND AVAILABILITY OF FINISHED STEEL BY 2001–02

(IN THOUSAND TONNES)

	DEMAND	SUPPLY	EXCESS DEMAND (+) EXCESS SUPPLY (–)
BARS/RODS	12200	12452	–252
STRUCTURALS/SPL. SEC	3600	3640	–40
RAILS & RLY. MATERIAL	700	840	–140
TOTAL NON–FLATS	16500	16932	–432
PLATES	3000	2518	+482
HR COILS./SKELP/STRIPS*	3500	5342	–1842
HR SHEETS	1000	714	+286
CR COILS/SHEETS/STRIPS	5600	4337	+1263
GP/GC SHEETS	1700	1360	+340
ELECT. SHEETS	460	171	+289
TIN PLATES/TFS	360	175	+185
PIPES	560	462	+98
TOTAL FLATS	16180	15080	+1100
TOTAL FINSHED STEEL	32680	32012	+668

Note * This category includes HR coils/skelp/strips going mainly to the production of pipes and tubes. The supply projection of this category and the estimated gap have to be read with caution. This supply figure is residual, after the HR coils going for cold rolled and other downstream products and HR sheets have been accounted for. Since as of now, one expects cold rolling capacity to fall short of demand, the figure for residual HR coils is high. However, as cold rolling capacity grows further, the gap in the case of HR coils/skelp/strips will decrease. It is always advisable to consider the overall HR equivalent demand and supply for arriving at a more realistic view.

Annexure 2.5

FORECAST OF CATEGORYWISE DEMAND FOR FINISHED STEEL, 1996–97 TO 2001–02

(ADOPTED ON THE BASIS OF REGRESSION ANALYSIS AND SEMENTED APPROACH)

(IN THOUSAND TONNES)

	1997–98	1998–99	1999–00	2000–01	2001–02
Bars and Rods	8883	9616	10410	11270	12200
Structurals	2737	2931	3139	3362	3600
Rly Materials	676	682	688	694	700
TOTAL NON–FLATS	12308	13244	14231	15334	16500
% SHARE IN TOTAL					50.49
Plates	2104	2299	2512	2745	3000
HR Coils/Skelp *	2751	2922	3103	3296	3500
HR Sheets	677	746	823	907	1000
CR Coils/Sheets	3174	3658	4216	4859	5600
GP/GC Sheets	1110	1235	1374	1528	1700
Electrical Sheets	299	333	371	413	460
Tin Plates	822	331	341	350	360
Pipes	327	374	428	489	560
TOTAL FLATS	10813	11980	13227	14629	16180
% SHARE IN TOTAL					49.51
TOTAL FINISHED STEEL	23139	25225	27499	29978	32680

NOTE: HR Coils/Skelp has been adjusted to exclude feed–material used in downstream processing of finished steel.

Note.2: * This category includes HR coils/skelp/strips going mainly to the production of pipes and tubes. The supply projection of this category and the estimated gap have to be read with caution. This supply figure is residual, after the HR coils going for cold rolled and other downstream products and HR sheets have been accounted for. Since as of now, one expects cold rolling capacity to fall short of demand, the figure for residual HR coils is high. However, as cold rolling capacity grows further, the gap in the case of HR coils/skelp/strips will decrease. It is always advisable to consider the overall HR equivalent demand and supply for arriving at a more realistic view.

Annexure 2.6

PRODUCTION OF SPECIAL AND ALLOY STEEL

(IN '000 TONNES)

YEAR	STAINLESS STEEL	ALLOY & SPECIAL STEEL
1991–92	228	981
1992–93	258	1038
1993–94	259	1132
1994–95	317	1456

NOTE: 1) DATA INCLUDE ASPA UNITS, NON–ASPA UNITS AND IF UNITS.

2) PRODUCTION BY NON–ASPA MEMBERS IS ESTIMATED AT 15% OF ASPA PRODUCTION

DEMAND PROJECTIONS OF IDS AND ASPA

(IN '000 TONNES)

	IDS			ASPA
YEAR	ST. STEEL	ALLOY & SP. STEEL	TOTAL	ALLOY & SP. STEEL
1996–97	659	1373	2032	1680
2001–02	1005	1916	2921	2154

Annexure-2.7

DEMAND PROJECTIONS FOR ALLOY & SPECIAL STEEL

('000 TONNES)

ITEM	1996-97	1997-98	1998-99	1999-00	2000-01	2001-02	2006-07
1. Alloy constructional steel	562	585	608	633	658	685	879
2. Carbon constructional steel	682	725	771	820	872	927	1189
3. Spring steel	280	286	292	298	304	310	398
4.Free cutting,Ball Bearing and others	156	169	183	198	215	233	299
Sub Total	**1680**	**1765**	**1854**	**1949**	**2049**	**2155**	**2764**
5. Stainless steel	659	717	780	849	924	1005	1693
TOTAL ALLOY,SPECIAL & STAINLESS STEEL	*2339*	*2482*	*2634*	*2798*	*2973*	*3160*	*4457*

Annexure-2.7

PROJECTED AVAILABILITY OF PIG IRON, 2001 – 02

Annexure 2.8

(LAKH TONNES)

SAIL	10.45
IISCO	4.05
VSP	–
OTHER 13 MERCHANT PI UNITS (INCL. KALINGA IRON WORKS)	12.00
TOTAL EXISTING UNITS	26.50
NEW UNITS UNDER IMPLEMENTATION	20.00
TOTAL AVAILABILITY	46.50
EXPORT	9.00
NET DOMESTIC AVAILABILITY	37.50
DOMESTIC DEMAND	34.50
NET SURPLUS	3.00

Annexure 2.8

DEMAND AND AVAILABILITY OF PIG IRON, 1996–97 TO 2001–02

('000 TONNES)

	1996–97	1997–98	1998–99	1999–00	2000–01	2001–02
1. DOMESTIC DEMAND	2400	2500	2700	2950	3200	3450
2. TOTAL AVAILABILITY	3224	3469	3733	4016	4322	4650
3. EXPORTS	562	618	679	746	819	900
4. DOMESTIC AVAILABILITY:(2)–(3)	2662	2851	3054	3271	3502	3750
5. EXCESS DEMAND (+) EXCESS SUPPLY (–) : (1) – (4)	–262	–351	–354	–321	–302	–300

Annexure 2.9

YEAR-WISE DEMAND OF PIG IRON UPTO 2006-07

	2002-03	2003-04	2004-05	2005-06	2006-07
Domestic Demand	3703	3993	4307	4645	5009

ANNEXURE-2.10

DEMAND OF DRI BY 2001-02 & 2006-07

	Projected Prod.of crude steel		Reqd.of Metallics		Share of Sponge Iron		Reqd. of Sponge Iron	
	2001-02	2006-07	2001-02	2006-07	2001-02	2006-07	2001-02	2006-07
Existing EAF Units	4.3	8.5	4.7	9.4	40%	40%	1.87	3.79
Existing/ New IF Units	3.5	7.0	3.8	7.7	40%	40%	1.53	3.10
New Major (EAF Route)	5.6	11.2	6.1	12.3	70%	70%	4.27	8.64

ANNEXURE-2·11

YEAR-WISE DOMESTIC DEMAND AND AVAILABILITY OF DRI

UNIT : MILLION TONNES

YEAR	DEMAND	AVAILABILITY	EXCESS DEMAND (+) EXCESS SUPPLY (-)
1996-97	3.68	4.19	-0.51
1997-98	4.26	4.56	-0.4
1998-99	4.93	5.08	-0.15
1999-2000	5.72	5.30	+0.42
2000-01	6.62	5.53	+1.09
2001-02	7.67	6.18	+1.49

ANNEXURE 2.12

DOMESTIC DEMAND FOR FERRO-MANGANESE BY 2001-02 & 2006-07

SOURCES	2001-02		2006-07	
	Crude Steel Production (in MT)	FeMn Demand (Lakh Tonnes)	Crude Steel Production (in MT)	FeMn Demand (Lakh Tonnes)
BF/BOF	33.20	3.65	46.79	4.63
EAF/IF/NEW MAJORS	15.68	1.25	20.69	1.59
TOTAL	47.88	4.90	67.48	6.22

ANNEXURE 2.13

DOMESTIC DEMAND FOR FERRO-SILICON BY 2001-02 & 2006-07

TYPES OF STEEL	2001-02		2006-07	
	Crude Steel Production (in MT)	FeSi Demand (Lakh Tonnes)	Crude Steel Production (in MT)	FeSi Demand (Lakh Tonnes)
MILD STEEL	44 72	1.34	62 36	1.87
ALLOY AND SPECIAL STEELS	3 16	0.32	5 12	0.51
TOTAL	47.88	1.66	67.48	2.38

ANNEXURE 2.14

DOMESTIC DEMAND FOR FERRO-CHROME BY 2001-02 & 2006-07

TYPE OF STEEL	2001-02 Production (in MT)	2001-02 FeCr Demand (Lakh Tonnes)	2006-07 Production (in MT)	2006-07 FeCr Demand (Lakh Tonnes)
STAINLESS STEEL				
1) UTENSIL GRADE	0.705	2.115	1.39	4.18
2) INDUSTRIAL GR.	0.3	0.9	0.64	1.91
CHROME-BEARING STEEL	0.65	0.104	0.81	0.13
TOTAL	1.655	3.119	2.84	6.22

ANNEXURE-2.15

DOMESTIC DEMAND FOR BULK FERRO-ALLOYS BY 1996-97 TO 2001-02 & 2006-07

(In '000 Tonnes)

ITEM	1996-97	1997-98	1998-99	1999-00	2001-02	2001-02	2006-07
1.FERRO-MANGANESE	342.368	354.923	367.939	381.432	395.419	490 00	622.000
2.FERRO-SILICON	108.098	114.638	121.574	128.928	136.728	166.000	238.000
3.FERRO-CHROME	164.738	187.171	212.658	241.617	274.518	311.900	622.00

CHAPTER III

MEASURES FOR MAKING THE INDIAN STEEL INDUSTRY INTERNATIONALLY COMPETITIVE IN TERMS OF QUALITY AND COST OF PRODUCTION

The actual crude steel production in 1994-95 and 1995-96 by major steel producers is as follows:

CRUDE STEEL PRODUCTION

(In Million Tonnes)

Plant	1994-95 Actual	1995-96 Actual	1996-97 Plan
BSP	4.05	4.07	4.17
BSL	3.66	3.68	4.00
RSP	1.18	1.21	1.61
DSP	0.94	1.02	1.60
IISCO	0.34	0.33	0.36
ASP & VISL	0.30	0.35	0.36
SAIL :	10.47	10.66	12.10
TISCO	2.79	3.02	3.05
VSP	1.94	2.38	3.00
TOTAL : (main producers)	15.20	16.06	18.15
Secondary EAF producers IF	3.07	3.21	3.50*
	1.50	2.28	2.60*
Grand total :	19.77	21.55	24.25

*Estimated

The gap between projections made earlier for 1994-95 which was considered as terminal year for original VIII Five Year Plan and actual production is mainly attributable to project delays and/or subsequent slower stabilisation of production. The industry also went through a period of recession from 1991-92 to 1993-94 where steel consumption remained stagnant. The impact of liberalised economic environment was felt from 1994-95 onwards with sharp rise of finished steel consumption and production pick up. In the secondary sector, there has been steep rise in the production from induction furnace units.The trend has continued in 1995-96 also. The beginning of IX Plan period will mark completion of a

number of major projects by main producers and creation of capacity in private sector based on alternative technological routes and wider geographical dispersal of the industry.

The assessment of future produdction levels for crude steel, saleable steel are at Annexure 3.1 , 3.2 and 3.3 respectively. These assessments show following growth rate projections, as compared to growth obtained for the period 1990-91 to 1994-95.

Item	Average annual growth rate %		
	1990-91 to 1994-95	VIII Plan	IX Plan
Crude Steel	3.3	7.9	8.3
Saleable Steel			
Sponge Iron	31.6	30.0	12.0

The World Steel Dynamics global steel production outlook calls for a 4% rise in crude steel to 748 MT in 1995 and for an 4% rise to 779 MT in 1997. The growth in Indian steel industry will, therefore, outstrip the global growth rate.

3.0 COMPETITIVENESS

3.01 The competitiveness of Indian steel industry has been considered on the following parameters:

i) Cost of major inputs.

ii) Usage of major inputs i.e. productivity and yields at different stages.

iii) Capital investment - Specific investment and cost of capital.

3.2 The information obtained in these areas for major steel producing countries and Indian steel plants is placed at Annexure-3.4. The status is as under:

a) Main competitive advantage available to Indian steel industry is cheap and good quality iron ore. This is available at about $ 10/t for plants with captive sources and $ 20/t in other cases, which is in sharp contrast to CIF price of about $ 30-40/t paid by advanced countries.

b) Next major advantage to Indian steel industry is in terms of labour cost. The labour cost in India is $

1-1.5 per hour against $ 30-40 per hour in advanced countries. This advantage is off-set to a great extent by lower labour productivity, which ranges from 80 t/man year to 190 t/man year in India against 300-500 t/man year in developed countries. The newer plants, with greater automation and sub-contracting of certain activities, are aiming for nearer to international labour productivity levels.

c) Indigenous coking coal is currently available to the industry at about $ 50-55/t. However, its limited availability and poor quality have led to import of coking coal at about CIF $ 70/t. Indian steel plants are using imported coal in the range of 20-70% in the blend. The prices of indigenous coking coal have gone up sharply by about 27-28% in about last six months, subsequent to its deregulation. The higher price of indigenous coking coal has not, however, led to any improvement in quality, which has only deteriorated. The benefits of higher imported coking coal has, therefore, been neutralised by adverse impact of poor quality of indigenous coking coal.

The arbitrary and steep price rise of indigenous coking coal is disproportionate to general price situation and should be avoided. It is also notable that the prices of coal viz., D, E, F & G Grades have not been increased, indicating thereby that lower price of other grades of coal has been sought to be subsidised by increasing price of coking coal. Steel industry cannot be forced to subsidise other coal consumers.

Coking coal is, therefore, emerging as the most critical input for growth of steel industry in view of its stagnant availability, poor quality and rising prices. Urgent measures need to be taken to improve indigenous coking coal supplies and reconsider the recent price increases to maintain the competitive advantage available to steel industry.

d) The new mini blast furnace units are importing coke at CIF $ 110/t. Imported coke presently attracts 20% customs duty. The same should be rationalised to 5% level as in case of imported coking coal.
Similarly, customs duty on PCI coal for Coal Dust Injection in Blast Furnaces needs to be brought on par with that of imported coking coal.

e) The cost of fluxes and ferro-alloys is high in India mainly due to non-availability of good quality fluxes near the steel plants and high cost of power for ferro-alloys. Fluxes are currently available at average price of $ 15 /t and ferro alloys at $ 1000/t.

f) Other sources of energy like power and natural gas, which are also controlled by State monopolies, cost dear to Indian iron and steel industry. Power which is available at $ 0.03-0.05/kwh in other countries (including China) is available at $ 0.06-0.08/kwh in India and the power tariff is going up continuously. Natural gas is available at $ 7.7/G.Cal. against international price of $ 2.6/G.Cal. This is further compounded by uncertain supply, trippings and quality deficiencies which affect competitiveness of the end use industry.

g) The competitive advantages in iron ore and labour cost get wiped out for older plants still operating on obsolete technologies. A detailed cost pattern as per BICP report of 1995 is as follows:

Year 1994 (US $/tss)

Item	USA	UK	FRANCE	GERMANY	INDIA (SAIL)
Energy	99	81	91	96	135
Iron Ore	63	52	52	57	22
Fluxes & Alloys	24	31	31	28	35
Others	105	113	112	111	90
Total Material cost	291	277	286	292	282
Labour	167	111	150	178	57
Misc. Taxes	8	8	17	10	27
Works Cost	466	396	453	480	366
Dep. & Interest	37	27	51	50	44
Total Cost :	503	423	504	530	410

Main conclusions from this model are :

i) Energy cost which is about 33% in India constitutes only 20% of the total cost abroad. Reasons are attributable to obsolete technology and inefficient operations. Newer steel plants adopting latest technology are not likely to suffer from this handicap. Details of technological aspects are left to the subgroup on Technology.

ii) Miscellaneous taxes are much higher in India than other countries. Progressive reduction in customs duties and levies is putting the industry at a disadvantage vis-a-vis imported steel. Import prices of flat products, both from CIS and European Mills, have shown a continuous downward trend. The trend is likely to continue in the coming months also. As a result, the landed cost some categories of imported materials have become much cheaper than the domestic prices. As more

than adequate domestic capacity has already been created for production of Plates, Coils and Sheets, the likely inflows of imported materials due to declining international prices and reduction in duties have already aggravated the marketing of these products by indigenous producers and have adverse impact on their bottom line. It is, therefore, imperative that the domestic producers are given matching tax relief in order to market the products at a rate compared to the landed cost of imports.

h) Indian steel industry is characterised by over capitalisation leading to increase in the fixed cost and low return on investment. New less capital intensive technologies, faster project implementation and reasonable cost of capital are necessary for long term competitiveness of steel industry.

.3 To quote Paine Webber, WSD (Steel Strategist #21), "Steels' technological revolution will continue to create winning opportunities for the aggressive. When combined with the 'competitive' pricing structure, this means steel companies can only succeed if production costs are trimmed and product quality upgraded at a rapid rate. Otherwise, no matter how good the macro environment, they will be leap-frogged by others".

.4 It may not be feasible to fix plant-wise target of productivity when industry is going through far reaching structural changes. Different plants operating on different technologies with varying age are expected to have different competitive strengths.

.5 Other specific recommendations in the areas of technology and infrastructure having impact on competitiveness are as follows:

a) Proper and adequate infrastructure should be developed for optimum and efficient working of the industry.

b) To overcome the inconsistency the quality of available raw materials and to minimise fluctuations, an effective and elaborate bedding and blending system has to operate in each plant. This will help in blending of variety of material for desired quality and consistency. Linkages of sources of raw material for each plant should be planned.

c) All plants should have sufficient agglomeration facilities. Use of sinter/pellets in blast furnaces has to be maximised to around 75-80%. Measure should be adhered to improve existing sinter plants productivity and availability. All projected green field plants have provision of combined mixing and modulizing drum,

improved design of sinter machines, energy efficient furnaces and base blending system for raw material mix to achieve this end. Use of serpentine/dunite in sinter making process can provide flexibility in producing desired quality of sinter.

d) Use of low insoluble flux for blast furnaces will help in cutting down alkali input.

e) Efforts can be made for desired beneficiation of iron ores. Mixing of blue dust/concentrates with ore fines can be considered to counter the adverse effect of Al_2O_3/SiO_2 ratio.

f) It is desirable to consider importing of larger quantity of coking coals for integrated steel plants. The imported coking coals have ash content of around 8%. It is also seen that there is wide fluctuation in ash content in the domestic coals from different mines. By blending imported low ash coking coal with indigenous coking coal, the coke quality can be improved. All new projected plants are being planned now with 100% imported coking coal/coke. Benefits which may be derived by way of improvement in the efficiency of operation of blast furnaces, cutting down on coke rate, and improvement in the much needed productivity and quality of hot metal may ultimately lead to reduction in the total cost.

g) Use of oxygen and coal injection:- With the successful commercialisation of various coal injection technologies in many countries, it is possible to adopt coal injection in existing and new blast furnaces. This will provide opportunities to replace coke with certain amount of indigenous non-coking coals of suitable quality.

h) In the area of steel making and processing, Basic Oxygen Furnace (BOF) mainly based on liquid iron charge alongwith secondary steel making operation can be effective to meet the stringent technical requirements for achieving quality products from continuous castings. Conventional primary rolling practices have to be replaced by continuous casting technology as far as possible. This should include latest commercialised thin slab casting.

i) Use should be made of good quality of refractories which give longer life and in turn better productivity.

j) Waste heat energy should be recovered wherever possible.

k) Implementation of automation in the process routes, full capacity utilisation, improved maintenance prac-

tices, extensive mechanisation in all possible areas, and pollution control measures will help in better plant availability, utilisation and in improving labour productivity.

l) Introduction of quality monitoring, inspection and control measures at all stages of operation and technical discipline will further help in achieving the objectives.

m) Technically superior facilities for bundling and packaging of the finished products, must be introduced so that materials reach the destination in good condition.

3.6 Constant efforts are to be made towards development of human resources to absorb new technologies and improve work practices. Upgradation of skills, multi-skilling and continuous training form thrust areas for steel industry.

4.0 Policy for Exports & Imports

4.1 The steel exports from the country have not gained the momentum that they should have - primarily because of the image that has been perceived by the foreign buyers on the basis of our actual performance in the past. Exports have also been influenced by conditions in the domestic market.

4.2 Experience shows that the delivery schedules offered by India are too long; there are inadequacies in the quality of the material and their packaging. There is also a tendency to withdraw or cancel contracts at short notices. Still a lot of red tapism exists which takes a long time to finalise and execute any deal.

4.3 On the order booking side, the systems/procedures are lengthy; it takes 3 months and some times even upto 6 months to book orders. Then again, amendments follow at regular intervals.

4.4 Suggestions to improve export performance are as follows:

a) <u>Fixation of Vessels for Exports</u>

As per existing guidelines, PSUs have to charter ships through Ministry of Surface Transport (Transchart). Being commercial organisations they should be allowed the freedom to avail of the best possible freight rates that may be offered from all sources.

b) <u>Export Incentives</u>

The following incentives are currently available for

exports:

i) Value Based Advance Licences (VABAL)

ii) Packing credit at concessional rate of interest.

iii) Special import licence which permits import of restricted items.

Out of the above, the major benefit is available from VABAL. This benefit is quite low due to several restrictions imposed on utilisation of advance licences under input/output norm.

It is, therefore, suggested that certain percentage of export should be allowed for import on actual user basis.

c) Government of India allows additional credit facility at concessional interest rate for processing export materials. Due to wide fluctuation in foreign currency, steel companies prefer credit in Indian rupees. The rate of interest for credit in Indian rupees should be on par with interest rate on credit in foreign currency.

d) **Customs clearance for exports to Nepal against freely convertible currency**

Exports to Nepal have picked up in recent years. There are procedural hurdles restricting and delaying exports. The following syggestions need adoption:

i) Appropriate authority may be provided to all these land customs stations at the border to clear export consignments.

ii) In terms of the existing procedure, export goods from the stockyard can be despatched for export only under the supervision of the Central Excise Officials. In many cases this is time consuming.

To simplify the procedure specially for exporters Permission may be granted to remove the materials for export under self declaration without case by case supervision by Central Excise officials. This is permitted by the policy. DGFT is empowered to issue such relaxation to individual companies.

e) <u>Separate Storage Yards</u>

As per the Central Excise procedure goods which have been removed without paying excise duty for the purpose of exports are to be kept in a separate storage place

(and also in separate lots within such separate storage place) . Such restrictions should be removed.

f) Pass Book Scheme

The pass book facility is available only for four major metros. This should be extended to other export centres also.

g) Infrastructure

One of the major constraints faced by all the exporters has been in the area of infrastructure. Aspects like inadequate port capacities & storage facilities, long waiting time for berthing of ships and resultant demurrage charges all lead to Indian ports not being preferred by international shipping companies.

The loading system and the equipments available at ports also are not suitable for faster loading/unloading which again acts as a disincentive to shipping lines.

The capability of Indian railways to cope with ever rising demand of movement has come to a saturation point. Moreover, Railway provides for minimum chargeable distance which adversely affects port based manufacturers. Roads also are not having adequate capacity to handle heavy Steel traffic passing through congested areas. Availability of big trailers is also limited.

The telecommunication system at the ports/plants, though has improved considerably in the recent years, should be made more reliable to meet the changing requirements.

As such, in order to meet the projected export target of about 6 MT by 2001-02 AD, which will be a four-fold increase over the present level, following action needs to be taken urgently:

i. Existing Railway network at the ports should be upgraded, to handle extra freight from the various producing units.

ii. Special road network linking ports with the shore based producing units may be considered.

iii. Joint Sector/Pvt Sector participation for " own your own port facility " for augmenting the port capacities and modernising loading systems need to be encouraged in a big way. Such proposals should be considered on a fast

track basis for clearance.

iv. Privatisation may provide relief in the following areas:

- Construction of new berths with latest state of the art technology for handling steel.

- Developing warehousing facility near ports on land provided by the ports. The ports should be asked to provide space for storing steel material for exports of iron and steel.

v. Another related area to be considered is development of coastal shipping (with linked road transport arrangements) which would reduce the inland transportation costs (by rail/road), delay in movement and will allow shipment in bigger lots from main ports.

vi. Crane capacity has an effect on the rate of loading cargo. The present methods lead to improper stowage and also slow handling rate. Currently steel is loaded in unitised and pallatised condition abroad. Billets, bars, structurals, etc. are loaded in bundles while sheets and coils are pallatised.

The port cranes are very old and their capacity is also low. Special cranes of 25/30 tonnes capacity should be installed. Ports like Vizag, Paradeep, Haldia and Bombay should have this facility as they are major ports handling steel export. The rate of loading has to be increased from 1500 to 4000 tonnes per day.

vii. Handling of steel in the Indian ports is still a labour intensive method. The present labour practices at ports are not conducive to efficient/economical operations, even if there are specialised equipments at ports. There are labour demands such as demand for payment for "opportunities lost". While installing equipment,necessary steps should be taken to evolve a policy for port labour on the following lines:

- Training labour continuously to familiarise them with correct methods of handling of iron and steel items.

- Multi-skilled labour training for smooth flow of traffic.

- For training of dock/port labour, investment should be shared by the exporters, Steel Ministry/DLBS/Ports etc.

- Financial assistance/contributions should come from the Government of India for port handling.

- Attempts should be made for having long term settlement with the labour so as to avoid labour strikes, etc.

- A well thought out incentive programme should be planned.

- Amendments to labour laws may be considered, if necessary.

h) **Other Issues**

Load in motion weighbridges for railway wagons and automatic computerised road weighbridges should be installed.

The priorities of the port/dock labour board and other associated bodies working within the port area should be reconsidered and a list should be drawn out immediately. The priority list can be reviewed from time to time. Separate lists of priority should be prepared for:

- Allotment of storage space.

- Allotment of equipment and gear.

- Allotment of berths.

- Allotment of labour.

The ports should also expand the railway yards in such a way that increased export traffic can be accommodated. Such expansion should provide for bigger yards, quicker acceleration diesel engines for shunting, right type of wagons for internal movement and also other mechanical equipment required.

Adequate and suitable powered barges/floating cranes, etc. should be made available by the port for delivery overside.

Bunching of ships due to slow out-turn at ports should be studied by the ports. Such bunching arising out of slow out-turn at ports leads to fall in the export operations and more time is taken.

Development of the port in the context of present and future

national needs with special reference to the changing shipping and port technology needs to be done.

Rationalisation of the port and cranage charges on the basis of what the traffic can bear should be done immediately.

In case of multi-port loading of the same ship, certain priorities have to be given by second ports of loading especially when these ships go on charter basis.

i) **Clearance of coastal cargo**

In normal procedure, on arrival of the vessel, custom officials will board the vessel and after completion of the boarding formalities the Export General Manifest of the loading port will be converted into Import General Manifest and then the preventive officer allows discharge of the cargo.

It is suggested that the coastal cargo can be discharged without completion of boarding formalities on arrival of the vessel.

Port clearance for ships which are sailing in costal water

Normally the ships which are sailing between the coastal ports within the country require port clearance for each and every voyage. It causes delay in sailing of ship to other ports and also in heavy demurrage.

It is suggested that there should be port clearance from one loading port for the period of one year for the coastal trade ship so that the ship can freely sail to any port within the country.

5.0 FINANCE AND BANKING PROCEDURES

5.1 To focus attention from all relevant service sectors including financial institutions and commercial banks, steel industry needs to be brought under priority sector of Commerce Ministry as the volume of exports envisages foreign exchange earning potential of 2 Billion US Dollars by the end of 9th Plan.

5.2 Rules and regulations in the banking system need to be simplified to match international standards, for example -

a) De-centralization of L/C opening authority with appropriate enhancement of delegated powers needs to be considered.

b) The delays in document availability, fund remittance etc., related to transactions with foreign buyers/banks are to be minimized.

c) The present system of reconfirmation of L/C by a foreign bank may be replaced by insurance coverage which may be financially attractive for exporters.

6.0 IMPORTS

6.1 To minimize the impact of fluctuation in the steel prices in the international market, it is necessary to formulate a mechanism to link customs tariff to international prices. Chelliah Committee has also recommended that where international prices dip steeply (not due to dumping), say by as much as 25% or so, a regulatory duty may be imposed for a specified period of time so that the domestic industry is given an opportunity to adjust itself. This is immediately required to be implemented for steel products where prices fluctuate by as much as 35-40%.

6.2 Adequate safeguards against dumping are still not in place in India and the procedures are time consuming.

6.3 The following simplification is suggested for clearance of imported cargo :

Green channel facility for clearance of import cargo of repetitive nature is suggested as simplification of existing procedure.

7.0 STEEL PRODUCERS EXPORT FORUM

7.1 To attain the targeted levels of export it is also felt that a formal body as indicated below, is constituted at the earliest by the producers themselves.

7.2 This forum will serve as a platform for exchange of information and views on -

* international market intelligence and pricing
* possibility of export funding
* pooling of resources for warehousing facilities abroad.
* sharing of information w.r.t availability of Ships and utilization in pooled fashion if necessary.
* Building up of image of " INDIAN STEEL " abroad.
* any other information of common cause.

7.3 All steel exporters should strive to obtain ISO-9000 accreditation to assure international buyer of reliability of quality of products.

7.4 Also, the forum may be activated to ensure reliability of execution of commercial deals. Over and above the constraints and policy changes, that may need to be considered in the dynamic world steel trade environment, can be identified by the forum to focus the attention of appropriate agencies.

8.0 ROLE OF D.R.I. INDUSTRY

9.0 Export of DRI

9.1 The severe recession witnessed in the early 90's made the Indian sponge iron industry to look towards the overseas markets and a beginning was made by exporting 2 lakh tonnes of sponge iron in 1992-93. Though the export of sponge iron was about 8.5 lakh tonnes in 1995-96 , 5 lakh tonnes may be exported during 2001-02 due to increase in domestic consumption.

9.2 Measures

The policy on export of high grade iron ore should be such that the requirements of the domestic gas-based sponge iron plants are fully met before exporting the surplus.

9.3 As an incentive for units exporting sponge iron, natural gas should be supplied at international prices. This will enable the domestic sponge iron industry to become competitive with respect to their overseas counterparts.

9.4 The minor Ports located near the locations of sponge iron plants should be upgraded as major ports and infrastructural facilities at these ports should be upgraded at the earliest.

10.0 International Competitiveness

10.1 With regard to international competitiveness, the Indian sponge iron industry is at a disadvantageous situation as the details given below indicate :

(landed costs)	India	Venezuela
1. Natural gas ($ per G.Cal)	7.7	2.64
2. Iron ore ($ per MT)	37.0	20.0
3. Iron ore pellets ($ per MT)	50.0	32.0

For cost comparison, Venezuela has been chosen as it has the largest sponge iron capacity (gas-based) and its production level is very close to that of India. The cost of natural gas, iron ore and iron ore pellets are higher in India.

10.2 In the case of non-coking coal also, the Indian sponge iron industry is at a disadvantage considering the poor quality, although the price may appear to be little lower.

	India	Indonesia
Landed cost of non-coking coal ($/T)	40	45

In the case of India, these coals generally contain high ash levels in the range of 25-40% leading to a significant loss of production and revenue of the sponge iron units. On the other hand, the Indonesian coal, though priced high, contains very low ash in the region of 4-10% maximum, which will lead to a substantial increase in the plant productivity and hence higher sales revenue.

10.3 **Policy measures**

i) Looking at the emerging scenario in the steel sector, it is obvious that the sponge iron manufacturing capacity needs to be augmented to a level of around 10 million tonnes towards the later half of Ninth Five Year Plan.

For achieving the above objective, additional gas allocation will have to be earmarked for the sponge iron sector.

iii) Simultaneously, due priority should be assigned to supply good quality non-coking coal from the existing as well as new mines to the sponge iron units. The custom duty on non-coking coal which is 25% at present should be brought on par with that on coking coal (i.e. 5%). This singular step will also trigger fresh investments in the coal based sponge iron sector. The imported coal will be blended with local coal so that the quality of coal feed is improved and the productivity of the kilns also get enhanced.

iv) Utilisation of off-gas/plant wastes

Efforts are required for increasing the thermal efficiency of the process including use of kiln waste gases and rejected coal fines for preheating the charge and generation of power.

Coal based 150,000 tpy DRI plant consumes around 3.0 to 3.5 MW of power, where as on an average 10 to 11 MW power can be generated from kiln off gases. Further, char generated

during DRI production and coal fines generated during crushing and screening of coal can also be utilised in CFB boilers to generate additional 10-12 MW.

Power generation from above schemes should be made mandatory for all sponge iron manufacturers. This will not only mitigate power situation in the country but also lessen pollution. In addition, if required, this power can be utilised for downstream steel making and metal making facilities. Government of India should finalise policies regarding buy back of this power. Certain concessions may also be given for purchase of plant and equipment for DRI industries utilising power generation facilities.

10.4 The world steel production through electric furnace route has increased more than that through the BF-BOF/OHF route during last decade. World production of crude steel has gone up from 710 million tonnes during 1984 to 731 million tonnes during 1993 i.e. by about 21 million tonnes. But the crude steel production by electric furnace route has increased from 178 million tonnes to 228 million tonnes during the same period i.e. an increase of 50 million tonnes.

10.5 In India, contribution of electric steel making units to the total crude steel production is around 30%. The trend of crude steel production in India from the main steel plants and electric furnaces is given in Table-3.

TABLE-3

CRUDE STEEL PRODUCTION IN INDIA BY DIFFERENT ROUTES

Year	Integrated steel plants (Mt)	EF route (incl. ASP and VISL) (Mt)	Total (Mt)	Share of Electric furnace units (%)
1990-91	11.20	4.94	16.14	30.6%
1991-92	12.95	4.20	17.14	24.5%
1992-93	13.66	4.18	17.84	23.4%
1993-94	13.90	3.70	17.60	21.0%
1994-95	15.20	4.57	19.77	23.1%
1995-96 (Prov.)	17.07	5.49	22.56	24.3%

The electric furnace units are generally concentrating in production of non-flat products only, except for Essar Steel, Lloyd Steel, Rathi Alloys and Jindal Strips.

10.6 Some of the Indian plants have adopted modern technologies but in general there is wide gap in the technology pursued by Indian electric furnaces as compared to the foreign plants, which needs to be bridged.

11.0 SUGGESTIONS FOR GROWTH OF ELECTRIC FURNACE UNITS

11.1 a) Electric power constitutes 15-20% of the total production cost and about 55-60% of the conversion cost (production cost excluding metallics) in the electric furnace industry. Improvement in quality and quantity of supply of power and the power tariff will greatly help it to cut down cost and be more competitive. If State Electricity Boards (SEBs) can be persuaded to ensure uninterrupted power supply and to charge differential tariff for power consumed during night time, it will be of big help.
Electric furnace units may coordinate with other industrial units in the region for installing power plants.

b) It is observed that there is big difference in the operating parameters of Indian plants when compared with globally efficient units with reference to tap to tap time, power consumption, electrode consumption, etc. EFS should try to adopt modern technologies for becoming more competitive in domestic and global market.

Annexure 3.1

CRUDE STEEL PRODUCTION PROJECTIONS

UNIT'000T

YEAR/PRODUCT	BSP	DSP	RSP	BSL	IISCO	VISL	ASP	VSP	TISCO	ESSAR	USHA SATARDA	USHA/ MALVIKA	MIDEAST	NIPPON	JINDAL	SFAI *	AIIFA (INGOTS)	TOTAL
1990 - 91 ACTUAL	3511	875	1246	2806	324	89	189	112	2294							3800	1800	17046
1994 - 95 ACTUAL	4051	936	1178	3656	344	88	209	1940	2788	53						3070	2300	20559
% GROWTH	15.4	6.9	-5.5	30.3	6.2	-1.5	10.6	1632.1	21.5							-19.2	27.8	20.6
AVR. ANN. GROWTH	2.9	1.4	-1.1	5.4	1.5	-0.3	2.0	76.9	4.0							-4.2	5.0	3.8
1995 - 96 ACTUAL	4073	1023	1205	3680	329	101	231	2381	3010	730						3800	2800	22633
1996 - 97 PLAN	4200	1800	1700	4250	360	124	246	3000	3050	1200						4600	3500	26830
VIII PLAN																		
TARGET	20320	7190	8060	19421	2082			11700										68773
EXPECTED	20264	4854	6398	18637	1718			10347	13802									76020
IXth PLAN																		
1997 - 98	4300	1800	1786	4200	360	124	260	3000	3050	2100		276		1020		5600	4000	29776
1998 - 99	4300	1800	1945	4360	360	124	279	4050	3180	2100	184	675		1531	550	6000	4500	33838
1999 - 2000	4400	1980	1945	4360	660	124	307	4050	3400	2100	492	1107	923	2551	1000	6300	4700	38299
2000 - 2001	4550	2120	1945	4700	925	124	316	4050	3400	2100	615	1230	977	3061	1300	6600	5200	41113
2001 - 2002	4700	2220	2080	5043	1322	124	326	4050	3400	2100	615	1230	1086	3061	1500	6800	5700	43257
TOTAL	22250	9920	9701	22663	3627	620	1488	19200	16430	10500	1906	4518	2986	11224	4430	31300	24100	186283
Xth PLAN																		
2002 - 2003	4850	2300	2150	5100	1400	124	326	4050	3400	2100	615	1230	1086	3061	1500	6800	6000	43992
2003 - 2004	5100	2400	2350	5150	1500	124	326	4050	3400	2100	615	1230	1086	3061	1500	6800	6000	44692
2004 - 2005	5300	2500	2400	5200	1600	124	326	5000	3400	2100	615	1230	1086	3061	1500	6800	6000	46142
2005 - 2006	5450	2600	2450	5300	1700	124	326	5500	3400	2100	615	1230	1086	3061	1500	6800	6000	47142
2006 - 2007	5600	2700	2500	5400	1800	124	326	6000	3400	2100	615	1230	1086	3061	1500	6800	6000	48142
TOTAL	26300	12500	11850	26150	8000	620	1630	24600	17000	10500	3075	6150	5430	15306	7500	34000	30000	64000

* SFAI has stated that there figures includes ESSAR production.

Annexure - 3.1

Annexure 3.1

CRUDE STEEL PRODUCTION PROJECTIONS

UNIT'000T

YEAR/PRODUCT	BSP	DSP	RSP	BSL	IISCO	VISL	ASP	VSP	TISCO	ESSAR	USHA SATARDA	USHA/ MALVIKA	MIDEAST	NIPPON	JINDAL	SFAI *	AIIFA (INGOTS)	TOTAL
1990 - 91 ACTUAL	3511	875	1246	2806	324	89	189	112	2294							3800	1800	17046
1994 - 95 ACTUAL	4051	936	1178	3656	344	88	209	1940	2788	53						3070	2300	20559
% GROWTH	15.4	6.9	-5.5	30.3	6.2	-1.5	10.6	1632.1	21.5							-19.2	27.8	20.6
AVR. ANN. GROWTH	2.9	1.4	-1.1	5.4	1.5	-0.3	2.0	76.9	4.0							-4.2	5.0	3.8
1995 - 96 ACTUAL	4073	1023	1205	3680	329	101	231	2381	3010	730						3800	2800	22633
1996 - 97 PLAN	4200	1800	1700	4250	360	124	246	3000	3050	1200						4600	3500	26830
VIII PLAN																		
TARGET	20320	7190	8060	19421	2082			11700										68773
EXPECTED	20264	4854	6398	18637	1718			10347	13802									76020
IXth PLAN																		
1997 - 98	4300	1800	1786	4200	360	124	260	3000	3050	2100		276		1020		5600	4000	29776
1998 - 99	4300	1800	1945	4360	360	124	279	4050	3180	2100	184	675		1531	550	6000	4500	33838
1999 - 2000	4400	1980	1945	4360	660	124	307	4050	3400	2100	492	1107	923	2551	1000	6300	4700	38299
2000 - 2001	4550	2120	1945	4700	925	124	316	4050	3400	2100	615	1230	977	3061	1300	6600	5200	41113
2001 - 2002	4700	2220	2080	5043	1322	124	326	4050	3400	2100	615	1230	1086	3061	1500	6800	5700	43257
TOTAL	22250	9920	9701	22663	3627	620	1488	19200	16430	10500	1906	4518	2986	11224	4430	31300	24100	186283
Xth PLAN																		
2002 - 2003	4850	2300	2150	5100	1400	124	326	4050	3400	2100	615	1230	1086	3061	1500	6800	6000	43992
2003 - 2004	5100	2400	2350	5150	1500	124	326	4050	3400	2100	615	1230	1086	3061	1500	6800	6000	44692
2004 - 2005	5300	2500	2400	5200	1600	124	326	5000	3400	2100	615	1230	1086	3061	1500	6800	6000	46142
2005 - 2006	5450	2600	2450	5300	1700	124	326	5500	3400	2100	615	1230	1086	3061	1500	6800	6000	47142
2006 - 2007	5600	2700	2500	5400	1800	124	326	6000	3400	2100	615	1230	1086	3061	1500	6800	6000	48142
TOTAL	26300	12500	11850	26150	8000	620	1630	24600	17000	10500	3075	6150	5430	15306	7500	34000	30000	64000

* SFAI has stated that there figures includes ESSAR production.

Annexure - 3.1

SALEABLE STEEL PRODUCTION PROJECTIONS

Annexure-3.2

UNIT'000T

YEAR/PRODUCT	BSP	DSP	RSP	BSL	IISCO	VISL	ASP	SSP	VSP	USHA	MESCO	TISCO	NIPPON	JINDAL	ESSAR	TOTAL
1990 - 91 ACTUAL	2795	727	1087	2426	329	59	145	41	37			1944				9591
1994 - 95 ACTUAL	3409	852	1200	3168	332	58	154	56	517			2446				12193
% GROWTH	22.0	17.2	10.4	30.6	0.8	-1.9	6.2	34.8	1297.3			25.8				27.1
AVR. ANN. GROWTH	4.1	3.2	2.0	5.5	0.2	-0.4	1.2	6.2	69.5			4.7				4.9
1995 - 96 ACTUAL	3495	947	1148	3330	302	63	187	48	2136			2691			700	15047
1996 - 97 PLAN	3627	1467	1266	3405	448	86	215	80	2656			999		80	1200	15529
VIII PLAN																
TARGET	16480	6125	6270	16215	2141				10308							57539
EXPECTED	16690	4505	5957	15955	1736				8935			12183				65961
IXth PLAN																
1997 - 98	3695	1585	1350	3630	405	86	229	80	2656			2770	1000	880	2100	20466
1998 - 99	3590	1587	1630	3790	405	86	246	80	3656	179		2920	1500	1000	2500	23169
1999 - 2000	3673	1788	1650	3790	705	86	263	80	3656	480	850	3200	2500	1220	2500	26441
2000 - 2001	3776	1960	1650	4254	849	86	270	80	3656	600	900	3210	3000	1400	2500	28191
2001 - 2002	3750	1994	1743	4740	1226	86	280	80	3656	600	1000	3230	3000	1500	2500	29385
TOTAL	18484	8914	8023	20204	3590	428	1288	400	17280	1859	2750	15330	11000	6000	12100	127650
Xth PLAN																
2002 - 2003	3900	2050	1800	4800	1300	86	280	80	3656	600	1000	3230	3000	1500	2500	29782
2003 - 2004	4100	2200	1900	4850	1350	86	280	80	3656	600	1000	3230	3000	1500	2500	30332
2004 - 2005	4400	2300	2000	4900	1400	86	280	80	4276	600	1000	3230	3000	1500	2500	31552
2005 - 2006	4600	2400	2100	4950	1450	86	280	80	4726	600	1000	3230	3000	1500	2500	32502
2006 - 2007	4800	2500	2200	5000	1500	86	280	80	5133	600	1000	3230	3000	1500	2500	33409
TOTAL	21800	11450	10000	24500	7000	428	1400	400	21447	3000	5000	16150	15000	7500	12500	157575

Annexure-3.2

PIG IRON PRODUCTION PROJECTION

UNIT'000T

YEAR/PRODUCT	BSP	DSP	RSP	BSL	IISCO	VISL	VSP	JINDAL	NIPPON	USHA REDI	MESCO	PIMAOI	TOTAL
1990 - 91 ACTUAL	96	87	50	332	308	3	521						1397
1994 - 95 ACTUAL	278	181	35	257	403	4	848					114	2120
% GROWTH	190.8	108.2	-30.0	-22.6	30.8	15.2	62.8						51.8
AVR. ANN. GROWTH	23.8	15.8	-6.9	-5.0	7.7	2.9	10.2						10.4
1995 - 96 ACTUAL	272	104	44	154	421	78	771					148	1992
1996 - 97 PLAN	170	100	80	150	420	101	301			240	197	370	2129
VIII PLAN													
TARGET	1332	1037	304	2142	1709	0	3678						10202
EXPECTED	1155	438	236	916	2079	0	3651						8475
IXth PLAN													
1997 - 98	350	185	47	115	470	92	493	8	1500		418	160	3838
1998 - 99	474	250	71	200	470	92	395	55	1800	169	464	160	4600
1999 - 2000	505	225	71	428	405	92	395	100	2000	122	164	160	4667
2000 - 2001	550	70	71	280	450	92	395	130	2000	160	174	180	4552
2001 - 2002	600	70	85	290	405	92	395	150	2000	196	193	535	5011
TOTAL	2479	800	345	1313	2200	460	2073	443	9300	647	1413	1195	22668
Xth PLAN													
2002 - 2003	600	70	85	290	405	92	395	150	2000	196	193	535	5011
2003 - 2004	600	70	85	290	405	92	395	150	2000	196	193	535	5011
2004 - 2005	600	70	85	290	405	92	395	150	2000	196	193	535	5011
2005 - 2006	600	70	85	290	405	92	395	150	2000	196	193	535	5011
2006 - 2007	600	70	85	290	405	92	395	150	2000	196	193	535	5011
TOTAL	3000	350	425	1450	2025	460	1975	750	10000	980	965	2674	25054

Annexure 3.3

COST COMPETITIVENESS

S. NO.	ITEM	UNIT	USA	CHINA	BRAZI	S.KOR.	GER.	JAPAN	BSP	DSP	RSP	BSL	IISCO	VSP @	TISCO	ESSAR	NIPPON	JINDAL	MESCO	MIDEAST	USHA * MALVIKA
1.	**COST OF MAJOR INPUTS**																				
	Iron ore lumps	us$/t CIF			17.5	29.5			9.14	12.00	8.86	10.00	9.71	23.40		34.29	34.29	10.00	11.97	9.34	28.57
	Iron ore fines	us$/t CIF	28		14	23	62	51						16.57					8.31	8.20	
	Pellet	us$/t CIF														46.57		25.71			
	coal																				
	- coking coal	us$/t	56	36	71	64	41	35									71.43		78.43	45.29	
	- Indigenous								51.43	41.43	45.71	42.86	42.86	58.80							
	- Imported								85.71	81.43	81.43	90.00	81.43	68.06	71.00						
	- Non coking coal	us$/t	32						24.29	30.00	20.00	15.71		19.83			60.00	62.86	57.66		
	coke	us$/t	117	80-85	107	90		100-140				110.00		92.11	112.00		157.14		117.46		137.14
	Major Fluxes (Lime)	us$/t							15.57	18.03	19.63	21.40	17.66	27.26	19.50		71.43	5.71	87.86	32.86	3.14
	Scrap	us$/t	135	155		185			123.46	132.83	108.09	121.57	108.29	148.57			214.29	171.43			
	Refractories	us$/t												460.34			1288.57	714.29			
	Power(1994)	US$/KWH	0.049	0.048			0.066	0.115	0.07	0.05	0.08	0.04	0.04	0.03			0.77	0.07			
	Natural Gas	(US$/GJ)/$/NCu.M	2.3		3.3	3.5										0.06					
	Mn ore	us$/t																21.43			
	Cr. ore	us$/t																			
	Ferro alloys - FeMn	us$/t							496.71	520.06	517.06	588.77	523.74	510.26			714.29	571.43			
	- Fesi								1005.14	965.23	978.34	1046.20	851.66	824.34							
	Labour cost	US$/MAN HRS	34.5	0.87	9	12.87	40.2	38	1.46	1.31	1.49	1.49		0.92	2.20		2.00	0.34	1.43	0.71	
2.	**PRODUCTIVITY**																				
(i)	Specific raw material consumption																				
	- Iron ore	(t/tcs)/(t/t of hbi)	1.639				1.601	1.528	1.570	1.640	1.580	1.606	1.558	1.581	1.726	1.640	1.600	0.850	1.544	1.850	1.630
	- Pellets	(t/thm)																0.620			
	- Coal	(t/tcs)	0.789				0.729	0.664	1.014	1.278	1.115	1.054	1.326	1.722	0.955		700.000	1.100	0.761	1.090	
	- Fluxes	(t/tcs)							0.196	0.188	0.243	0.233	0.241	0.217	0.470		350.000	0.300	0.080	0.150	0.210
(ii)	Specific energy consumption	(Gcal/tcs)/(Gcal/t							8.000	9.800	10.300	8.700	12.500	7.770	8.583	2.790			5.500	7.420	6.100
(iii)	Yields																				
	- Liquid steel to crude steel	Ratio							0.956	0.947				0.940	0.968	0.960	0.985	0.970		0.960	0.960
	- Crude steel to finished steel	Ratio	1.196		1.235	1.185	1.196	1.168	0.809	0.826	0.809	0.848	0.828			0.940	0.980	0.970	0.965	0.960	0.975
	*Long products	Ratio							0.805	0.797	-	-	0.828	0.960	0.882						
	*Flat products(HR & CR)	Ratio							0.821	0.888	0.809	0.848	-		0.960			0.965			
(iv)	Refractory consumption	(Kg/tcs)/(kg/tls)							35.900	38.900	47.300	31.200	59.200	30.000	0.208	16.000	7.000	25.000	11.143	NA	
(v)	Ferro alloys consumption	(Kg/tcs)/(kg/tls)							15.700	7.800	25.300	9.500	14.600			9.200	12.000	5.000			
	(For alloy & stainless steel)																				
(vi)	power consumption	kwh/tcs							443	603	855	612	584	600	441	710	243	100	345	332	585.00
(vii)	Labour productivity (1995)	T/manyr	500		272	996	243	704	121	49	53	108	30	189	107	1667	500	500	750	326	
3.	**CAPITAL INVESTMENT**																				
(i)	Specific investment per tonne of crude steel.																				
	- Green field	US$/t		1500										800		450	86	754	556	439	608.57
	- brown field	US$/t													285.71						
(ii)	Cost of financing separate for steel ** plant & supporting facilities (three months euro dollar interst rates, % as on May 95)	% p.a	6.06				4.5	1.31													
		** m $												2286		1124			128	46	
														143							

* USHA Group has indicated Malvika steel plant (at Jagdishpur) figures for cost and specific cosumption of inputs Where as production figures are given for Satarda plant in Maharashtra

** For Indian steel plants total investment in million dollars is given

@ VSP reports all the figures w r t Liquid Steel

Dollar rate : Rs 35

TISCO is not reporting cost of Iron Ore & Coal due to the reason these raw materials are produced from its capative sources & cost is not comparable

CHAPTER - IV

RAW MATERIALS, DEMAND-SUPPLY CONSTRAINTS

There is a need for assessing, in broad overall terms, the requirements and availability of various raw materials* and infrastructure to support the levels of outputs of the iron & steel sector in the light of projections contained in the earlier chapters with a view to providing a proper direction for efforts to augment availability of the raw materials and also build up necessary infrastructure. Such assessment has been done for :

* each of the major mineral raw materials viz. iron ore,limestone,dolomite,manganese ore and coal,coking and non coking;

* raw material for ferro alloys;

* raw material for refractories;

* metallics, including sponge iron.

Each of the above has been discussed in a simple framework : reserves in the country,existing production levels,including exports/imports,likely availability by the end of the Plan period and finally,comments and suggestions,wherever necessary on constraints and possible remedial actions.This simplistic approach has the merit of easy comprehension.

A. IRON ORE

2.1 Reserves

India is blessed with abundant reserves of iron ore,both in terms of quantity as well as quality.Thus,as on 1.4.90,the total recoverable reserves of iron ore have been estimated at 12,745 million tonnes (9602 million tonnes hematite and 3143 million tonnes magnetite). State-wise break-up of reserves is given at **Annexure 4.1.**

2.1.1 A closer scrutiny of this break up reveals that while the reserves at 9.6 billion tonnes is truly and comfortably enormous,the reserves of high grade ore are not quite so abundant. Thus,high grade lumps (65% Fe & above) reserves are only 0.77 billion tonnes of which only 0.56 billion tonnes are proven reserves.Similarly,high grade fines are only estimated at 0.33 billion tonnes of which 0.23 billion tonnes are proven.The vast majority of iron ore reserves are thus of medium and low grades suggesting a policy orientation aimed at conservation of the limited high grade ores in order to make them last as long as possible.

PRODUCTION & EXPORTS

2.2 This would become clear by taking a look at the the production and export figures for iron ore over the period 1990-91 to 1994-95 as given in tables 1 ,2 & 3 below:

Table-1
Production of iron ore and concentrates

('000 tonnes)

	1990-91	1991-92	1992-93	1993-94	1994-95
Lumps (Total)	**23157**	**23599**	**22743**	**23852**	**25278**
Above 67% Fe	1224	1437	3193	3351	3433
65-67%	9038	9567	7542	8695	8908
62-65%	10214	8869	9600	8669	8881
60-62%	1890	2598	1644	2221	2275
Below 60%	791	1128	764	916	938
Fines (Total)	**25829**	**27498**	**27664**	**28259**	**29442**
Concentrates(Total)	**6532**	**6368**	**5411**	**6559**	**6019**
Total	**55518**	**57465**	**55818**	**58670**	**60739**

Source: IBM, Nagpur

Table-2

Exports of iron ore and concentrates

(million tonnes)

Year	Exports			
	Goa	KIOCL	MMTC	Total
1	2	3	4	5
1990-91	11.88	5.53	14.23	31.64
1991-92	13.35	5.61	12.95	29.91
1992-93	12.44	4.73	10.63	27.80
1993-94	14.75	6.09	10.61	31.45
1994-95	14.08	5.26	12.01	31.35

Source: Goa Mineral Ore Exporters Association, Kudremukh Iron Ore Co. Ltd., and MMTC

Table-3

Year	Production	Exports	%age production exported
1	2	3	4
1990-91	55.52	31.64	56.99
1991-92	57.46 (3.49)	29.91 (-5.47)	52.05
1992-93	55.82 (-2.85)	27.80 (7.05)	49.80
1993-94	58.67 (5.11)	31.45 (13.13)	53.64
1994-95	60.74 (3.53)	31.35 (-0.32)	51.61

Note: Figures in parenthesis in cols. 2 and 3 indicate rise/fall over previous year

2.2.1 The data captured in Tables 1 to 3 reveal that:

(i) the production of iron ore,save for 1992-93,has been rising to cater to both domestic and export demand;

(ii) production of lumps and fines has risen from 55.52 mt to 60.73 mt,during the five year period (a percentage increase of 9.3%) while exports have remained relatively stable,at around 30 - 31 mt,implying a steady increase in domestic consumption;

(iii) at the rate of expolitation of approximately 61 mt per annum,there are sufficient reserves of haematite,in overall terms,to last over 150 years,and therefore there can

be no cause for worry on the ore availability front in overall terms;

(iv) however,reserves of high grade ore may be a cause of concern;thus,at the current levels of expolitation (approximately 12 mt per annum),the reserves would last only around 60 years,and at the expected higher levels of exploitation even less.

From the above, it would have to be appreciated that the scenario of iron ore reserves while comfortable calls for patterns of exploitation consistent with the goal of stretching out the reserves of high grade ores over a longer period through various measures such as blending of very high grade ores with medium grades for both domestic consumption as well as exports,encouraging technologies in the iron & steel sector dependent on iron ore fines appropriately beneficiated,developing technologies for mining that minimise losses through generation of fines,adopting modern transportation techniques such as slurry pipelines to minimise losses of valuable ore etc.

AVAILABILITY

2.3 As per our estimates of this Group, the projected production capacity of **existing** iron ore mines in the country is as under:

Table-4

PRODUCTION CAPACITY - IRON ORE : 2001-02

(million tonnes)

	Fines	Lumps	Concentrate/ Pellet-feed	Pellets	Total
NMDC (Bailadila + Donimalai)	17.68	11.52	---	---	29.20
SAIL	16.00	8.00	---	---	24.00
KIOCL	---	---	4.00	3.50	7.50
TISCO	3.30	4.54	---	---	7.84
ESSAR Gujarat	---	---	---	3.00	3.00
Bihar-Orissa	1.50	5.00	---	---	6.50
Bellary-Hospet (including Chitradurga)	1.50	6.00	---	---	7.50
Mines in Maharashtra	1.50	0.50	---	---	2.00
Goa	13.00	4.00	---	2.75	19.75
Total :	54.48	39.56	4.00	9.25	107.29

.ls

PRODUCTION CAPACITY - IRON ORE : 2006-07

(million tonnes)

	Fines	Lumps	Concentrate/ Pellet-feed	Pellets	Total
NMDC (Bailadila + Donimalai)	17.68	11.52	---	---	29.20
SAIL	22.30	10.88	---	---	33.18
KIOCL	---	---	4.00	3.50	7.50
TISCO	3.30	4.54	---	---	7.84
ESSAR Gujarat	---	---	---	3.00	3.00
Bihar-Orissa	2.00	7.00	---	---	9.00
Bellary-Hospet (including Chitradurga)	1.50	6.00	---	---	7.50
Mines in Maharashtra/A.P.	3.00	1.00	1.00	---	5.00
Goa	13.00	4.00	---	2.75	19.75
Total	62.78	44.94	5.00	9.25	121.97

2.3.1 In addition to above, it is expected that new mines will be opened to cater to the requirements of the proposed new steel plants of TISCO, L&T and MESCO in Orissa, Jindal Vijayanagar Steel in Karnataka and expansion of Chiria mines in Bihar and Rowghat development as new mines to feed SAIL. This will add a further capacity of around 18 million tonnes of run-of-mine ore giving around 15 million tonnes of lumps and fines by 2001-02.

EXPECTED REQUIREMENT OF IRON ORE

2.4 Iron and steel manufacture is essentially about removing oxides from the ore and adding various fluxes and additives to obtain desired qualities. While the Blast Furnace route uses iron ore in lumps or lumps in combination with sintered ore (utilising iron ore fines), the Electric Furnace route utilises steel scrap or scrap in varying combinations with Sponge Iron. Sponge Iron ,in turn,uses iron ore in combination with iron ore pellets.Again while gas based Sponge Iron plants need iron ore of very high grades,coal based units can use relatively lower grades. In fact, various technologies exist in which iron ore of various grades can be used in different combinations for iron & steel manufacture,making the task of prescribing

consumption norms for each group onerous and difficult. Therefore, an overall norm of 1.6 tonne of iron ore per tonne of crude steel and Sponge Iron has been used to assess total requirement of iron ore during the 9th Plan.

2.4.1 The production targets of various categories of iron and steel sector in 2001-02,along with expected process technologies, are indicated below:

Table-5

(Qty.: million tonnes)

Crude Steel Process	Qty.	D.R.I. Process	Qty.	Pig iron Qty.
BF/BOP	27.52	Coal based	2.93	4.65
Corex	1.10	Gas based	3.75	
Electric steel	13.40			
Total	42.02	Total	6.68	Total 4.65

2.4.2 While BF/BOP, pig iron and coal based sponge iron processes require various grades/specification of iron ore, corex and gas-based sponge iron need a certain percentage of pellets in addition to iron ore. The electric arc furnaces depend on the supply of scrap and/or sponge iron. To meet the above projected requirements, the requirements of various grades/specifications of iron ore are estimated to range from 65 to 70 million tonnes per annum by 2001- 02, assuming a proximate norm of 1.6 tonnes of iron ore per tonne of Hot Metal/DRI. The requirements of high grade Calliberated Lump Ore (CLO) (+66% Fe) for gas-based sponge iron plants would range from 2 to 2.5 million tonnes while that for coal-based sector would be 4.75 to 5 million tonnes. It would, therefore, appear that as far as iron ore is concerned, no major problems are anticipated on overall, gross requirement of iron ore to satisfy domestic demand.

2.4.3 There is some concern over the availability of high grade CLO (+66% Fe). Presently, it is limited to around 2 million tonnes from Bailadila Deposit-5 of NMDC and some small quantity is also supplied to the coal based sponge iron units. It is felt that after 11-B project comes into operation sometime by 1999-2000, an additional 2.2 million tonnes of the calibrated lump ore would be available which will take care of high grade iron ore requirements of existing gas based sponge iron units. Till then, some iron ore in the form of CLO or pellets will continue to be imported."

As for the coal-based sponge iron units,the requirements of iron ore ranging from 4.75 to 5 million tonnes per annum are being completely met from domestic sources and would continue to be so met during the 9th Plan.

The requirements of pellets for gas-based sponge iron sector range from 3.50 to 3.75 million tonnes per annum. The situation is likely to ease with the commissioning of ESSAR Gujarat's pellet plant of 3 million tonnes by 2000 A.D.

Constraints for Growth and Remedial Measures

2.5 The chief constraint to the envisaged growth in consumption of iron ore may come from the transport sector. Steel, pig iron and sponge iron plants have to depend heavily on rail transport for movement of iron ore. The existing railway infrastructure is already under strain. To meet the increased requirements, it would be necessary for the Railways to take urgent steps to augment their linkage capacity. Measures which need to be taken are listed below:

(a) Creation of new/additional line capacity;

(i) Banspani-Barajamda

- The construction of a third line on the Tata-Durg section and a by-pass line at Rajkharswan to connect the main line at Dongaposi line.
- Early completion of the Banspani-Daitari rail link.
- New railway line from Manoharpur to Bano in S.E. Rly to facilitate smooth movement via Hatia.
- Additional railway line from CKP to Rourkela as existing double line is already saturated.
- Doubling of Chandil-Bokaro route
- Doubling of Kiriburu - Meghahatuburu to Bandamunda sector as the iron ore movement from Kiriburu/Meghataburu and Barsua/Kalta will increase substantially.

(ii) Dalli-Rajhara

- Upgradation of Dalli-Rajhara and Bhilai railway line
- New railway line from Rowghat-Bailadila and expansion of the Rowghat-Jagdalpur line.

(iii) Bellary-Hospet

- Early conversion of the Bellary-Goa railway line and early completion of the Konkan railway line.

(iv) Point-to-point rail transportations from mine to users

- In view of the existing constraints in upgrading of the various lines, it would be essential to develop point-to-point rail transportation system between the mines and the user plant(s) which could be developed by the private sector to minimise the bottlenecks.

(b) Schemes to facilitate flow of private investment in the rail sector e.g. BOLT, BYOW schemes are to be reviewed in order to make them attractive to private investors since the interest shown so far has not been very encouraging.

2.6 The discussions in foregoing paras thus enable the realistic conclusion that based on assessments of likely requirement and availability, there may not be any major problem for the country's iron ore sector to meet the demands of both the domestic and the export sector during the ninth plan if all the new capacities/expansions presently under contemplation are completed. An additional production capacity of 18 mt of iron ore has been projected and this is expected to come from development of new mines. Assuming an average investment of Rs.200 crore per mt of additional mining capacity, an investment of the order of Rs. 3,600 crore is indicated.Investment in railways has not been estimated separately.

B.LIMESTONE

Present status and future prospects

2.7 Limestone is the main flux material used in the blast furnace. As in the case of iron ore, India is well endowed with both BF and SMS grades limestone.However, stringent quality requirements of new technologies demand very low silica content with high CaO and supplies of such lime stone are limited from the known sources.

2.8 Reserves

The total recoverable reserves of BF and SMS grades of limestone as on 1.4.90 are given in table-6 below:

Table-6

(Million tonnes)

Grade	Recoverable reserves			
	Proven	Probable	Possible	Total
S.M.S.(O.H.)	272	1,098	2,919	4,289
S.M.S.(L.D.)	141	79	62	282
S.M.S.(OH+LD mixed)	4	-	134	138
B.F	1,593	1,123	2,828	5,544
S.M.S.& B.F. mixed	52	111	1,150	1,313
Total	2,062	2,411	7,093	11,566

Source : IBM, Nagpur

State-wise break up of reserves is given at Annexure 4.2.

2.8.1 It may be mentioned that the above reserves have been classified based on the earlier nomenclature used by the steel industry. However with the improved technologies in steel making, different specifications and nomenclatures are now sometimes being used by the primary manufacturers of steel such as **iron making limestone** with silica content up to 5% and **steel making limestone** with silica content maximum up to 2.5% (but preferably up to 1.5%) . If these classifications are utilised, the above reserve figures will get reduced. A more realistic picture of resources would, therefore, be available only later after the data are classified under the new nomenclature.

2.8.2 It is expected that import of SMS grade limestone will increase.Reserves of high grade (low silica i.e. 1-1.5% SiO2) limestone are very limited,especially since the closure of mines in the Dehradun area.The other areas identified for low silica high grade limestone are as under :

(a) Nagaur-Jaisalmer districts of Rajasthan

(b) Solan/Sirmur districts of Himachal Pradesh

(c) Meghalaya

Meghalaya, due to its distant location,is presently considered unviable as a source of supply for low silica limestone.It is therefore essential that attention is focussed on developing mines of Rajasthan and Himachal.

PRODUCTION AND IMPORTS

2.9 Limestone of various categories are suitable for different end uses.Table 7 below shows the production of different categories of limestone from 1990-91 to 1994-95 and Table 8 shows the imports made during the years 1992-93 to 1994-95:

Table-7
Production of limestone

('000 tonnes)

	1990-91	1991-92	1992-93	1993-94	1994-95
Cement	60931	67836	66826	72807	75015
Iron & Steel	3566	3678	3831	4387	4539
Chemical	2731	2819	2895	2953	3073
Others	2854	3042	3065	3558	3567
Total	70082	77375	76617	83705	86194

Source : IBM, Nagpur

Table-8

Imports of limestone

Year	Qty. (In tonnes)
1992-93	567452
1993-94	424254
1994-95	631918

Source : DGCIS, Calcutta

The data reveal a steady growth in limestone production for the iron and steel sector, from 3.56 mt in 1990-91 to 5.089 mt in 1995-96. No problems for Blast Furnace grade of Limestone are expected in the future either,the country's reserves being vast.As for imports,most of these are of SMS grade and are necessary both because adequate quantities are not available as well as for reasons of economy.The VIII th PLan working group had in fact estimated that SMS grade limestone imports would be to the tune of around 1 million tonne.As against this,imports have been somewhat lower.

EXPECTED REQUIREMENT AND AVAILABILITY

2.10 Large quantities of BF grade limestone are required for steel production.The present consumption norm is around 200 Kg per tonne in sinter plant/Blast Furnace and around 150 kg per tonne of crude steel. This translates into a requirement of over 11 million tonnes during 2001-02 for the envisaged level of crude steel production and merchant pig iron by the Blast Furnace route.

While no problem is envisaged as far as supply of BF grade limestone is concerned, adequate supplies of SMS grade limestone would not be available,necessitating larger quantum of imports than hitherto.

CONSTRAINTS AND REMEDIAL MEASURES

2.11 Despite the apparently comfortable position of limestone reserves,the fact is that superior grades with low silica content are in short suply accounting for the present level of imports. Imports are also resorted to by steel plants on grounds of economy, internal freight being large. Recently, due to favourable foreign exchange variations, the limited indigenous production, has become somewhat competitive. This situation can further improve if suitable railway lines are established in the major production centres of limestone such as the Sanu-Jaisalmer area. Broad gauge linkage has been established up to Jaisalmer and the completion of the remaining 60 km railway link upto the Sanu limestone mine is under active consideration. It is possible that if there is a firm commitment for the production resulting from enhanced capacity, with pre-despatch analysis premise, then RSMML would be keen to consider additional investment for setting up of the railway link from Jaisalmer to Sanu.

2.12 It would be also necessary to plan for increase in movement of limestone from Central India sources to the various upcoming steel plants. For this, it would be necessary to extend the railway siding from Kuteswarmines to Khanabanjan siding as well as at Satna.

DOLOMITE

Present status and future prospects

2.13 Reserves
The total recoverable reserves (all grades) of dolomite as on 1.4.1990 are placed at 4967 million tonnes. An idea of the grade-wise reserves of dolomite can be had from the table-9:

Table-9

('000 tonnes)

Recoverable reserves Grades	Proved	Probable	Possible	Total
BF/Sintering	292175	527807	1186980	2006962
SMS(OH)	3488	47257	125076	175821
SMS(LD)	14468	48000	-	62468
SMS(OH & LD mixed)	68296	49684	129645	247625
BF & SMS Mixed	61548	95387	151631	308566
Refractory	54710	60516	960	116186
BF, SMS & Refractory	1797	3674	4410	9881

Source : IBM, Nagpur

2.13.1 BF Grade dolomite : India is well endowed with BF grade dolomite resources which are of the order of 1 billion tonne. The existing mines are more than capable of meeting the requirement of steel plants for a long time to come.

2.13.2 SMS grade dolomite : SMS grade dolomite can tolerate up to a total of 4% impurities.This grade of dolomite, particularly with low silica, is scarce in the country. The steel plants are at present buying this grade of dolomite from Jayanti mines in West Bengal and Baradwar mines in Madhya Pradesh which yield dolomite with a silica content of 1-3%.

OUTLOOK

2.14 An interesting development taking place in the steel industry is the attempt to substitute dolomite by dunite. This will mean that any problem on account of dolomite will disappear since dunite is abundantly available.

As for low silica dolomite,this is scarce. Save Bhutan and Jayanti mines, which supply around 2 - 3 lakh tonnes per year,there is no other source.Some areas have been located eg. Rupa area in Arunachal Pradesh and Panthal area in J & K and these would need to be developed.

D.MANGANESE ORE

Present status and future prospects

2.15 Reserves

The total all-India geological resource of manganese ore have been estimated by IBM at 372 million tonnes as on 1.4.1990 (Table-10):

Table-10

(Million tonnes)

	Proved	Probable	Possible	Total
i) Insitu reserves	64.7	102.5	203.0	369.8
ii) Conditional resources	---	0.4	1.8	2.2
Total	64.7	102.5	204.8	372.0

Source : IBM, Nagpur

Out of this, the recoverable reserves have been estimated in Table-11:

Table-11

(In '000 tonnes)

Grade	Recoverable reserves
i) Unclassified/Not known/other	71,510
ii) Blast furnace	58,083
iii) Medium	22,507
iv) Ferromanganese	21,381
v) Battery/chemical	2,996
Total	176,477

Source : IBM, Nagpur

2.16 The state-wise reserves of manganese ore have been shown in Annexure 4.3. It may be mentioned that despite the concerns raised from time to time, the reserves of manganese ore have been steadily increasing with every five-yearly revision of the national mineral inventory by IBM. Thus,despite production of 8.05 million tonnes from 1.4.85 to 31.3.90, recoverable reserves of manganese ore has gone up from 154 million tonnes as on 1.1.1985 to 176 million tonnes as on 1.4.1990.

PRODUCTION AND EXPORT

2.17 The production and export figures for the last five years are given below in Table-12.

Table 12

('000 tonnes)

	1990-91	1991-92	1992-93	1993-94	1994-95
MnO2	31	33	32	31	30
above 48% Mn	182	189	234	205	200
46-48%	179	186	224	201	196
44-46%	36	38	47	41	40
42-44%	76	79	94	65	63
40-42%	65	68	85	74	72
38-40%	156	162	195	261	254
35-38%	51	54	60	57	55
30-35%	457	476	573	482	469
25-30%	216	224	270	214	208
below 25%	41	43	56	46	45
Total	1490	1552	1870	1677	1632

Source: IBM, Nagpur

Exports of manganese ore

(in lakh tonnes)

Year	Grades			
	38/46(L)	26/28(L)	Fines	Total
1990-91	0.94	1.72	0.29	2.95
1991-92	0.83	1.72	0.06	2.61
1992-93	0.25	0.98	1.00	2.23
1993-94	-	1.81	0.68	2.49
1994-95	0.12	2.88	1.16	4.16

Source : MMTC

2.18 SAIL has projected an average consumption of manganese ore per tonne of hot metal of about 46kg in 2001-02 and 45 kg in 2006-07. This figure is rather high and it is expected that specific consumption of manganese ore would be much lower in the coming years.For instance,the Japanese steel plants use manganese ore directly in the ladle and consume only 4-5 Kg per tonne of hot metal. The new steel plants which are proposed to be set up in India will also similarly require much lower quantity of manganese ore.However, as many of the new steel plants are coming with convertor route, the consumption of manganese alloys may increase during the coming years.

2.19 On the basis of above,it may be safely concluded that as far as manganese ore is concerned,the production in India is sufficient to take care of any additional demand on

account of requirement by pig iron/steel plants. It may be mentioned here that the manganese ores mined in Goa, Bellary- Hospet sector of Karnataka, and Vijayanagaram district of Andhra Pradesh are basically of low grade and therefore transportation to the steel plants is uneconomical because of long haulage. Exports are an option but even here the international market is limited.

COAL

Present status and future prospects

2.20 Reserves

The country's total coal reserves in seams up to 0.9 m in thickness and down to 1,200 m depth have been estimated to be of the order of 2,00,029 million tonnes as on 1.1.95. These are categorised as per table-13.

Table-13

Categorisation of coal reserves into coking/non-coking

(million tonnes)

Type of coal	Proved	Indicated	Inferred	Total
Coking	15,072.89	13,348.79	1,511.61	29,932.29
Non-coking	53,524.71	76,405.21	40,165.78	1,70,095.70
Total:	68,597.60	89,754.00	41,677.39	2,00,028.99

Source : Ministry of Coal

Out of the total coal reserves of 200 billion tonnes, about 15% constitute coking coal and the balance non-coking coal.

Indian coals are high in ash content but low in sulphur content. The ash or dirt is intermixed with coal making it difficult to remove unlike coals of Europe and other countries. This characteristic is inherent in Indian coal on account of their very formation through the drift process.

PRODUCTION AND IMPORTS OF COKING COAL

2.21 Total coal production and raw coking coal production over the period 1989-90 to 1994-95 are given below in Table-14.

Table-14

(million tonnes)

Year	Total production	Raw coking coal production	%age of total production
1989-90	200.89	44.43	22.12
1990-91	211.73	45.56	21.52
1991-92	229.28	45.72	19.94
1992-93	238.26	45.40	19.05
1993-94	246.03	45.07	18.32
1994-95 (Prov.)	253.80	41.97	16.54

Source : Ministry of Coal

CIL produces about 40-41 mt. of raw coking coal of all varieties of which about 26-27 mt. is of steel and washery grades. Against this the actual supplies of washed and direct feed (including blendable variety) to steel plants have been as in table-15:

Table-15

(million tonnes)

Year	Washed coal	Direct feed	Total
1992-93	9.26	1.23	10.49
1993-94	9.24	1.07	10.31
1994-95 (Prov.)	8.94	1.90	10.84

Source : Ministry of Coal

It may be noted that the production of coking coal as also the coking coal supplies to the steel plants has been declining or at best stagnant. It may also be noted that the existing supply of coking coal from domestic sources is not enough to meet the demand of even the existing steel plants,necessitating imports.Table 16 below shows the level of imports for 1992-93 to 1994-95 for each integrated steel plant:

Table-16

Name of company	Year	Quantity (in mt)	Approximate value (Rs.crores)
Steel Authority of India Ltd. (SAIL)	1992-93	4.248	779.6
	1993-94	4.754	889.1
	1994-95	5.385	1023.8 (Prov.)
Rashtriya Ispat Nigam Ltd.(RINL)	1992-93	1.658	321.25
	1993-94	1.884	357.23
	1994-95	2.270	440.16 (Prov.)
Tata Iron & Steel Co. (TISCO)	1992-93	0.85	216.71
	1993-94	0.44	106.95
	1994-95	0.82	185.00

Source : SAIL, RINL and TISCO

It would be seen that imports till 1994-95 have been of the order of 8.4 million tonnes.Total import during 1995-96 has been reported to be around 10 mt.It is worth recalling that it was only in 1979-80 that imports were first resorted to.Since then,they have been increasing for essentially two reasons :

i) To bridge the gap between the requirement and indigenous availability;

ii) To improve the quality of overall blend for technological reasons for improving blast furnace productivity.

Recognising the inevitability of imports of coking coal,two policy decisions to facilitate the same have already been taken viz. import of coal is permitted under OGL and import duty on coking coal is a minimal 5%.

PROBLEMS AND REMEDIAL MEASURES FOR COKING COAL

2.22 The average ash of Indian coking coals is in the range of 20-35% whereas metallurgical coal should contain 17% $\pm$ 0.5% ash. Beneficiation thus becomes imperative not only to reduce ash but also to enhance the coking properties to enable production of better quality coke for improved efficiency in blast furnace operation. Presently almost all the coking coals supplied to steel plants are being washed excepting some quantities (below 10%) of direct feed and blendable varieties.

2.23 Washing of coking coal thus assumes tremendous importance.Performance of the existing coking coal washeries in the country, company- wise, has been shown in Table-17 below:

Table-17

Company	No. of washeries	Capacity (mtpa)
BCCL	9	12.55
CCL	5	11.47
WCL	1	1.20
CIL	15	25.22
SAIL	2	3.00
TISCO	2	3.94
TOTAL	19	32.16

Source : Ministry of Coal

Performance of washeries

Washery	Operable capacity (mtpa)	% Utilisation		
		1994-95	1993-94	1992-93
Dugda I & II	3.80	61.53	62.80	58.90
Bhojudih	1.70	92.66	88.40	87.60
Patherdih	1.60	62.67	61.80	59.40
Lodna	0.40	85.10	87.50	57.50
Sudamdih	2.00	50.90	40.50	45.00
Borora	0.42	81.48	78.60	66.70
Moonidih	2.00	53.93	52.30	45.50
Mohuda	0.63	52.92	57.10	63.50
BCCL	12.55	63.97	62.43	59.62
Kargali	2.72	80.77	91.20	93.00
Kathara	3.00	58.17	60.70	64.00
Swang	0.75	130.93	131.90	141.30
Gidi	2.00	85.90	89.50	88.00
Rajrappa	3.00	56.63	56.80	58.00
CCL	11.47	72.73	76.56	78.73
Nandan WCL	1.20	57.08	51.40	50.50
CIL(Total)	25.22	67.62	68.33	67.84

2.24 The overall utilisation of washeries remains in the region of 68%. While the utilisation of BCCL washeries and Nandan washery have shown some improvement, there has been a decline in case of CCL washeries from around 79% to 73%. Further,more disturbingly, the ash percentage in the clean coal remains in the region of 20-21% in case of BCCL and 17.5-18.5% in case of CCL and WCL ie.higher than the desired level of 17%.

2.25 It is therefore absolutely necessary to focus attention on the washery sector to improve its efficiency. Their main problems have been identified and are as under:.lm18

i) Quality of raw coal feed has deteriorated over the years due to depletion of good quality upper seam reserves in Jharia coalfields;

ii) Introduction of large scale opencast mining has resulted in admixture of extraneous materials along with the coal;

iii) Delay in executing long term measures of modernisation/modification as recommended by Altekar Committee has resulted in poor capacity utilisation and quality of washed coal;

(iv) Many of the existing washeries of BCCL and CCL were originally designed to process raw coal feed of 22-24% ash content. The increase in ash in the present raw coal feed has affected the performance of washeries considerably.

v) Frequent power interruption has had its own deletirious impact on capacity utilisation.

2.26 There is therefore little doubt that the coking coal scenario is a cause for major concern in the coming years when the demand in terms of raw coking is expected to escalate as per projections in Table 18 below:

Table-18
(million tonnes)

1995-96 (Target)	38.70
1996-97 (Target)	40.50 (Prov.)
2001-02	*50.00 (Prov.)

* Including private sector steel plants and pig iron plants.

Supply augmenting steps are most obviously necessary. The steps required inter-alia include:

i) Increasing raw coking coal availability and development of new mines;

ii) Modification of the existing coking coal washeries to improve the capacity utilisation as well as the quality of washed coking coal;

iii) Increasing raw coal feed to washeries by supplying low volatile medium coking coals of suitable quality;

iv) Early commissioning of two new washeries under construction at Madhuband (2.5 mtpa - BCCL) and Kedla (2.6 mtpa - CCL) for increasing existing washing capacity.

(v) Encouraging private sector participation in establishing coal washeries. Legal hurdles in the way have already been removed by an amendment of the Coal Mines (Nationalisation) Act, 1973 on 9.6.1993 and initial steps have also been taken to invite the private sector to establish washeries on **Build-Own-Operate** basis. What is now required is to evaluate the reasons for the rather poor response and to come up with more attractive schemes;

(vi) Intensification of effort to increase production of coking coal; 14 projects with a total capacity of about 9 million tonnes per annum already under implementation need to be commissioned on schedule as also the 15 projects under-formulation, representing a possible 12.64 million tonnes of additional coking coal, need to be expedited (details of these projects are given in Annexure 4.4 & 4.5).

2.27 The discussions above clearly reveal that during the 9th Plan period,the iron & steel sector would face shortfalls in supplies of indigenous coking coal,in terms of both quantity and quality.And for both these reasons,large scale imports would become necessary.Present supply of washed coking coal,including direct feed coal,is around 11 million tonnes.This is not expected to go up substantially in the next five years.Dependence on imports would therefore necessarily increase,from the present level of 8.5 million tonnes to almost 19-20 million tonnes,to cater to the requirements of the existing integrated steel plants and the new steel and pig iron plants that are expected to come up.Planning for this enhanced level of exports is a must and would call for priority attention to the ports as well as associated rail movement from ports to the steel plants.

2.28 Equally importantly,this calls for an adequate policy response from the Government in the Ministry of Coal. Pragmatic, investor friendly policies to attract investment in the coal mining sector need to be put in place on a priority.It is unlikely that the Government would be able to provide adequate budgetary support to Coal India Ltd. or to the Steel majors in the Public Sector for developing new coal mines.

RAW MATERIALS FOR FERRO ALLOYS

Introduction

2.29 The important mineral raw materials for the ferro alloy industry are the ores of manganese for ferro-manganese and silico- manganese, chromite for ferro-chrome/charge chrome, quartzite for ferro silicon, ilmenite and rutile for ferro-titanium, concentrates of tungsten and molybdenum for ferro tungsten and ferro-molybdenum; vanadium pentoxide for

ferro-vanadium, ores of nickel for ferro-nickel etc.Besides,the industry uses coal, coke, charcoal as reductants and fluxes viz. limestone and dolomite for impurities removal in the alloys.

2.30 (a) **Non Coking Coal for Metallurgical Purposes**

Currently, India is the largest coal based sponge iron producer in the world. Some of the coal based sponge iron units have expressed concern over the qualiy and the quantity of non coking coal being supplied to them. It is, however, expected that CIL will be able to meet their requirements. CIL have informed that there are difficulties transporting coal from CIL mines to Raigarh area where there is a concentration of sponge iron units. The situation can be further improved with the appropriate allocation of captiave coal mining block to sponge iron producing units.

In addition, good quality non coking coal would also be required for Corex technology based iron plants, one of which is under implementation. In view of inferiior quality of indigenously available non coking coal, it is imperataive that such coal is washed either by the producer or user before use in the Corex plant.

Customs duty on non coking coal is 20%+2% at present, which is considered too high to make imported coal a viable option for use in the metallurgical plants. The group feels that there is a need to reduce the custom duty on non coking coal for metallurgical operations at par with duty on impored coking coal so that non coking coal could be imported by the actual users for blending with domestic coal.

2.31 In addition, this industry being highly energy intensive,power has to be seen as a vital and critical input.

PROBLEMS, CONSTRAINTS AND OUTLOOK FOR THE FERRO ALLOY INDUSTRY

Manganese Ore

2.32 Reserves of manganese ore [Annexure 4.3], already discussed earlier, are abundant, in overall terms. However,the reserves of ferro manganese grade of manganese ore are depleting and need to be watched carefully. Indian Bureau of Mines has estimated that as on 1.4.90, the reserves of ferro grade ore were 21.381 million tonnes and medium grade ore, 22.507 million tonnes as against the reserves of 24.868 and 43.698 million tonnes respectively as on 1.4.85. Out of this 21 million tonnes of ferro grade ore, the proved reserves as at present are hardly 9.7 million tonnes. According to IFAPA, for meeting the requirements of steel industry, the ferro-manganese industry would need

880,000 tonnes and 1303,000 tonnes of ferro and medium grade ore during 1996-97 and 2001-02 respectively (Annexure-4.6). This would mean that the proven reserves would be sufficient for only around 7 to 9 years,certainly a cause for concern.

Chrome Ore

2.33 Coming to the other major raw material,chromite ore,the overall reserves stand at 186 million tonnes as on 1.4.90.Of this,the various grades of mineable reserves are around 125 million tonnes as shown in Tables 21 and 22 below:

Table-21

(Million tonnes)

Particulars	Proved	Probable	Possible	Total
Total Reserves (in situ and conditional resources)	36.73	83.8	65.51	186.04

Out of this, the mineable reserves have been estimated as under in Table-22:

Table-22

Grade	Mineable Reserves
Refractory	3.96
Chemical/Metallurgical	52.54
Charge chrome	38.09
Beneficiated	27.69
Unclassified	3.55
	125.83

2.34 Out of the reserves which can presently be exploited,the actual production and exports of various grades of chromite ore,from 1990-91 to 1995-96 can be seen in Tables 23 and 24 below:

Table-23
Production of chrome ore

('000 tonnes)

		1990-91	1991-92	1992-93	1993-94	1994-95
Above 47%	lumps	67	61	45	30	20
	fines	375	406	300	487	468
40-47%	lumps	103	125	155	147	141
	fines	183	259	266	140	134
Below 40%	lumps	130	114	130	126	121
	fines	43	44	55	26	25
Concentrates		38	78	120	99	131
Total		939	1087	1071	1055	1049

Source: IBM, Nagpur

Table-24

Exports of Chrome Ore (Lakh tonnes)

Year	52/50%	50/48%	48/46%	46/44%	38/36%	30/28%	Conc. Total
1990-91	1.03	0.25	-	1.00	-	-	-	2.28
1991-92	0.90	0.50	-	1.66	-	0.33	0.28	3.67
1992-93	0.44	0.63	-	1.58	-	0.16	-	2.81
1993-94	-	0.77	-	1.64	-	-	-	2.41
1994-95	0.05	0.65	0.17	2.37	0.11	0.05	-	3.40

Source : MMTC

The data above reveal the following:

(i) production of lumps (above 47% grade) has been declining rapidly while that of fines(above 47% grade) has more than doubled during the same period;

(ii) for above 47% grade,exports have declined from 1.28 lakh tonnes in 1990-91 to 0.70 lakh tonnes in 1994-95;

(iii) overall,production after remaining at around 10 lakh tonnes has sharply jumped to 16 lakh tonnes in 1995-96;the largest increase has been in fines of all grades;

(iv) in overall terms,exports have gone up from 2.28 lakh tonnes to 3.40 lakh tonnes;significantly,most of the increase has been in ores of below 46% concentration.

2.35 Chromite, used for producing ferro chrome/charge chrome, silico chrome and LC ferro chrome, etc., which, in turn are consumed by the producers of stainless steel and chromium based alloys and special steels,is abundantly available in overall terms.It has been estimated that the requirement of chromite would be 854,000 tonnes during 1996-97 and 1,327,000 tonnes during 2001-02 for supporting the production of steel.What again,as in the case of manganese ore,needs careful attention is the availability of high grade chromite ore,in lumpy and fines form.

2.36 In addition to domestic requirement of manganese and chromite ores for production of ferro alloys for the steel sector,demand for these alloys also arise from the massive potential that exists for their exports.An idea of exports of ferro-alloys over the last five years can be had from the following table-25 :

Table-25
Ferro alloy exports (Tonnes)

	1990-91	1991-92	1992-93	1993-94	1994-95
Ferro manganese	19574	19656	11181	752	4306
Ferro silicon	1470	39	111	1370	6349
Ferro silico manganese	---	2564	14229	29077	35281
Ferro chromium	4949	16376	19906	27506	58734
Ferro titanium & Ferro silico titanium	---	---	26	---	1
Ferro silico magnesium	---	4	482	19	4532
Charge chrome	58670	91480	113261	101175	90282
Ferro silico chromium	---	---	---	3036	---
Ferro molybdenum	---	---	---	---	180
Ferro vanadium	---	---	---	---	19
Ferro niobium	---	---	---	---	1
Others	505	54402	10953	15971	75
Total	85168	184521	170149	178906	199760

Source: DGCIS, Calcutta

It is clear from the table above that exports,especially of ferro chrome and charge chrome,are increasing every year. Given the potential that also exists for other ferro alloys,there is a need to carefully look at the potential for exports,the requirements of high grade chromite and manganese ores for meeting both the indigenous requirements as well as requirements for export.

Quartzite

2.37 Quartzite, used for producing ferro silicon,is available in abundance,and is no cause for concern.

Reductants

2.38 Ferro alloy industry uses coal, coke, charcoal as reductants for producing bulk ferro alloys. Generally, these reductants are available in the country with high ash and volatile metal contents. Therefore, some of the ferro alloy units import some quantity of low ash coal, coke etc.As the quantities involved are small,no problems are anticipated on their account.

Power

2.39 Ferro alloy industry is highly power intensive. Power constitutes 35% to 75% of the cost of production, depending on the ferro alloys produced. The industry's requirement of power, during the Ninth Five Year Plan (Annexure-4.6) is expected to escalate from 3.6 to 5.5 billion units.This is only one aspect of the problem, in terms of energy requirement.The other aspect that is even more a cause for serious

concern is the quality of power supply,subject as they are to power cuts and interruptions.Taken together with the high and increasing tariffs for power,energy costs for this industry has become a very serious matter and the situation is only likely to get worse.

RECOMMENDATIONS

2.40 The availability of ferro grade manganese ore is limited,accounting for only 30% of total production of this ore every year. Since the domestic ferro manganese requires low phos,low silica ore,and the export demand is also for ore displaying the same qualities,there is a conflict of interest between the ferro alloy producers - who would like all the good quality ore to be reserved for domestic use,and the ore producers,who would prefer to supply a blend of very high quality ore with inferior ore,in order to make mining remunerative. A similar situation prevails for high grade chromite ore also. Unbridled exports, on one hand, would deplete good ore quickly and completely; on the other hand, not permitting any export would leave the producer of ore with no market in a fairly short time.What is therefore needed is a pragmatic policy framework that protects the interest of both.

There is no doubt that ferro alloys sector, representing value addition to the domestically produced ores, deserves to be encouraged to become internationally competitive and exploit fully the export potential. Towards this end, the following measures suggest themselves:

(i) need to step up exploration activities for identifying new mines of high grade manganese ores;

(ii) establishing mine head plants for manganese/chromite ores beneficiation and agglomeration;

(iii) supply of power at internationally competitive rates;

(iv) reduction in import duties on coking coal with more than 12% ash content;

(v) technology upgradation especially to bring down energy intensity of this sector;

(vi) priority in allotment of railway wagons;

(vii) creation and upgradation of ports.

As far as mineral inputs viz. manganese and chromite ores are concerned, it needs to be ensured that their mining is an attractive commercial proposition, and towards this end, it would not perhaps be feasible for this sector to be seen as purely a feedor sector for the ferro alloy producers. This calls for a pragmatic policy whereby mining offers reasonable returns and is able to fully satisfy the domestic demand. The present policy which puts high grades of ore on

the restricted list and permits exports subject to ceilings of lower grades provides a reasonable policy framework where the policy objective of ensuring adequate supplies to domestic ferro-alloys sector as well as reasonable returns to ore producers can be achieved and should therefore continue.

2.41 Power, a major input,as noted earlier,is certainly a problem area. The **effective tariff,** that is tariff after taking into account the poor quality of power supply, is much higher than the power tariff in other competing countries.This increases the cost of ferro alloys produced in the country.The problem here is one of huge investments in the power sector and not merely a matter of subsidising the ferro alloys sector.As investments in the power sector fructify,it can reasonably be expected that effective rates would come down.To overcome this problem,some ferro alloy units may consider setting up captive power plants.

2.42 Non availability of of wagons is also becoming an area of concern. One tonne of ferro alloy, requires nearly four tonnes of various raw materials, most of it requiring transport by rail. Similarly, despatch of ferro alloys, both in the country and for exports, requires the use of railways.As per IFAPA, nearly 40% of annual production of ferro alloys is moved to major steel plants by railway wagons/train loads. While, 20 to 25% is transported by wagons/train loads from different plants to various ports in the country for exports. Ferro alloy industry is now facing problems of non- availability of wagons for both inward and outward, a problem likely to get worse in the coming years. Most of the ferro alloy units are situated in the Central, Eastern and Southern Region of the country and the availability of raw materials are also from these regions. Moreover exports also take place from the ports in the Southern, Eastern and Western Region. Transport problems have been experienced by ferro alloy industry mostly in the South-Central, Central, South-Eastern and Western Railways.

Similarly,Port facilities in the country are proving to be a constraint.It takes a long time for ships to get berth and a longer time for loading as compared to other ports in the world.

Both the railways and the port sectors are planning augmentation of their capacities for meeting the increased requirements of the iron and steel sector and it can be expected that the ferro alloy units would be adequately taken care of.

IRON ORE (HAEMATITE) Reserves as on 1-4-1990

Unit: Thousand Tonnes

STATES	PROVED	PROBABLE	POSSIBLE	TOTAL
ANDHRA PRADESH	3322	5771	37647	46740
BIHAR	1386581	1228875	351506	2966962
GOA	362560	200258	199412	762231
KARNATAKA	510639	252531	165251	928421
MADHYA PRADESH	900836	463229	681246	2045311
MAHARASHTRA	83935	35951	56463	176349
ORISSA	1441405	631739	593619	2666763
RAJASTHAN	20	5962	3161	9144
ALL INDIA TOTAL	4689298	2824316	2088306	9601920

IRON ORE (MAGNETITE) Recoverable Reserves as on 1-4-1990

Unit: Thousand Tonnes

STATES	PROVED	PROBABLE	POSSIBLE	TOTAL
ANDHRA PRADESH	37870	380000	---	417870
BIHAR	936	2427	1792	5066
GOA	64865	3881	95810	164556
KARNATAKA	1662614	371323	484300	2518237
KERALA	---	24194	11263	35457
RAJASTHAN	4	10	461	475
TAMIL NADU	---	---	1074	1074
ALL INDIA TOTAL	1766290	781835	594611	3142735

Annexure - 4.2

LIMESTONE Recoverable Reserves as on 1-4-1990

Unit : Thousand Tonnes

STATES	PROVED	PROBABLE	POSSIBLE	TOTAL
ANDHRA PRADESH	1283692	915897	12095419	14295009
ARUNACHAL PRADESH	-	-	125459	125459
ASSAM	166198	48550	488425	703173
BIHAR	222192	39372	443485	705049
GUJARAT	100797	942454	7511414	8554664
HARYANA	18458	1555	27391	47404
HIMACHAL PRADESH	1428265	39456	2135479	3603201
JAMMU & KASHMIR	35305	10095	695907	741307
KARNATAKA	679627	7165939	9407598	17253164
KERALA	412	18434	6850	25697
MADHYA PRADESH	4444912	1902167	3102906	9449986
MAHARASHTRA	739172	774665	1264597	2778435
MANIPUR	472	6195	8118	14785
MEGHALAYA	68061	634454	3819437	4521952
NAGALAND	825	-	308250	309075
ORISSA	433150	252530	526462	1212142
PONDICHERRY	5260	-	4180	9440
RAJASTHA	1310579	3272122	5210568	9793269
SIKKIM	-	-	1785	1785
TAMIL NADU	267556	295570	311217	83834
UTTAR PRADESH	261173	168150	908120	1337443
WEST BENGAL	6400	12147	16605	35153
DAMAN & DIU	90069	-	-	90069
ALL INDIA TOTAL	**11562578**	**16463756**	**48419672**	**76446006**

Annexure - 4.3

MANGANESE ORE Recoverable Reserves as on 1-4-1990

Unit: Thousand Tonnes

ALL INDIA/STATES/DISTRICTS Grades	PROVED	PROBABLE	POSSIBLE	TOTAL
ALL INDIA	28567	41794	106116	176477
ANDHRA PRADESH	7	4157	3368	7532
BIHAR	---	---	2298	2298
GOA	2151	11432	9976	23559
GUJARAT	---	---	1477	1477
KARNATAKA	2262	10427	51858	64548
MADHYA PRADESH	9216	2510	4818	16544
MAHARASHTRA	10138	5662	3373	19173
NAGPUR	2325	1937	1531	5794
ORISSA	4793	7605	28438	40836
RAJASTHAN	---	---	409	409
WEST BENGAL	---	---	100	100

Annexure-4.4

ON-GOING COKING COAL PROJECTS

SL. NO.	PROJECT	COMPANY	CAPACITY (MTY)
1.	Pootki Balihari (UG)	BCCL	1.00
2.	Bhalgora (UG)	BCCL	0.70
3.	Block-III (OC)	BCCL	0.45
4.	Ghonudih Expn. (OC)	BCCL	0.56
5.	Khas Kusunda (OC)	BCCL	0.24
6.	Block-IV (OC)	BCCL	0.50
7.	Ara (OC)	CCL	0.41
8.	Parej East (OC)	CCL	1.75
9.	Parej (UG)	CCL	0.30
10.	Bokaro Barmo Seam (OC)	CCL	0.80
11.	Jhirki (OC)	CCL	0.50
12.	Uchitdih (OC)	CCL	0.40
13.	Jaridih (OC)	CCL	0.60
14.	Tandsi (UG)	WCL	0.90
	Total		9.11

Source: Ministry of Coal

Annexure-4.5

COKING COAL PROJECTS UNDER FORMULATION/APPROVAL IN CIL

SL. NO.	PROJECT	COMPANY	CAPACITY (MTY)
1.	Topa OC RO	CCL	1.20
2.	Kathara OC RO	CCL	1.80
3.	Jharkhand OCP	CCL	1.00
4.	Kedla EPR OC	CCL	2.00
5.	Tapin Integrated	CCL	2.75
6.	Pundi EPR OC	CCL	1.20
7.	Montico OC	CCL	0.40
8.	North Kathara Ph-I	CCL	0.18
9.	Amlo UG	CCL	0.15
10.	Bermo OC	CCL	0.50
11.	Chano-Rikba Ph-I	CCL	0.50
12.	Golukdih Augmentation	BCCL	0.30
13.	Kharkharee Mechn.	BCCL	0.12
14.	Parbatpur UG	BCCL	0.18
15.	Pindra SDL UG	CCL	0.36
Total			**12.64**

Source: Ministry of Coal

STATEMENT SHOWING REQUIREMENT OF RAW MATERIAL/INPUTS FOR PRODUCING BULK FERRO ALLOYS FOR THE PERIOD 1996-97 AND 2001-02

S. No.	Particulars	Unit	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-02
I.	1. **Demand of steel**	Million tonnes	25.00	27.40	29.80	32.20	34.60	37.00
II.	**Availability of:**	Thousand tonnes						
	2. Manganese Alloys	"	345	378	412	444	477	511
	3. Ferro Silicon	"	105	115	125	135	145	155
	4. Ferro Chrome	"	185	212	239	267	294	321
	5. Charge Chrome	"	120	126	132	139	146	153
III.	**Raw Materials/Inputs Requirement**							
	6. Manganese Ore (Ferro Grade Ore)	"	880	964	1050	1132	1216	1303
	7. Quartzite	"	299	328	358	387	416	446
	8. Chrome Ore	"	854	946	1039	1137	1232	1327
	9. Coke	"	528	582	636	690	743	798
	10. Charcoal	"	74	81	88	95	102	109
	11. Lignite Coal/Coke	"	61	68	74	81	88	95
	12. Limestone & Dolomite	"	173	189	206	222	239	256
	13. Carbon Paste	"	25	27	30	32	35	38
	14. Power	Million KWH	3629	3992	4361	4729	5098	5470
	15. Furnace Oil/ LSHS (Approx.)	Thousand Tonnes	250	275	300	325	350	375
	16. Wagons (Approx.)	Nos.	30000	33000	36000	39000	42000	45000

Source: Indian Ferro Alloys Producers' Association, Bombay

CHAPTER-V

RAW MATERIALS FOR REFRACTORIES

2.43 Refractories are vital for the iron and steel manufacturing sector impacting directly the productivity of the Blast Furnace,LD converter etc.(superior quality refractory leads to lesser frequency of replacement,higher number of heats etc.) as well as the cost of manufacture. The common refractories used in iron & steelmaking are fire-clay, high alumina, silica, magnesite and chrome magnesite, magnesia carbon, zircon and so on.

Present Status of Refractories in India

2.44 Total production capacity for refractories in the country(including captive manufacturing units in some of the major integrated steel plants) and the production(in MT) in the last 4 financial years are as follows :-

Table 26

Item	Capacity(MT)	Production(MT)			
		1991-92	1992-93	1993-94	1994-
Fireclay	600000	234347.00	214568.00	222852.00	265756.00
High Alumina	300000	138710.00	152380.00	136985.00	182962.00
Silica	60000	19051.00	26925.00	22316.00	27615.00
Basic	285000	211574.00	190262.00	176456.79	207268.00
Dolomite(including captive production)	70000	na	na	na	na
Electrocast	6000	1400.00	1539.00	1628.00	1620.00
Slidegate plates	10000	4747.00	5546.00	5145.21	4102.66
CC Refractories	6000	n.a.	1052.00	1272.00	2168.00
Ceramic Fibres	8000	1336.00	1620.00	2325.00	3191.16
Zircon/Zircon Mullite	12000	2099.00	1670.00	1470.00	1203.14
Others	125000	73450.00	71286.00	79614.00	81221.00
TOTAL	1482000	686714.00	666848.00	650064.00	777106.96

The table above reveals the following:

(i) overall production of refractories,after declining during 1992-93 and 1993-94 (recessionary conditions in the steel sector) has again picked up in 1994-95;

(ii) nevertheless,the overall capacity utilisation has remained low,ranging from a low of 44% to 52.4 %;

(iii) thus,the excess capacity situation,noted in the VIIIth Plan working group report,continues to prevail,with

one important difference viz. sophisticated refractories eg. sldegate plates,concast refractories are now being produced.

2.45 Presently,the Indian refractory industry can be said to have the technological capacity to produce fairly sophisticated categories of refractories.However,further improvements in quality and adaptation to Indian conditions (which are already under way) would be expected of this sector,in order that it can keep pace with the increasingly sophisticated requirements of the steel industry.Fuller capacity utilisation,with quality improvements,involving continuous technology upgradations,rather than capacity enhancement per se,seems to be the obvious prescription for the refractories sector.

Imports and Exports

2.46 An encouraging development in the nineties has been larger exports of refractories against the stagnant exports noticed at the time of formulation of the VIII th Plan.In value terms,they have risen from about Rs.5 crores in 1990-91 to Rs.30 crores in 1994-95 and are expected to reach about Rs.45 crores in 1995-96.Table 27 below provides a detailed picture of exports for various refractories based on information available with the DGCIS:

Table 27

EXPORTS(Tonnes)

ITEMS	1992-93	1993-94	1994-95
HIGH ALUMINA BRICKS & SHAPES	2555.000	1053.000	1385.000
MULLITE BRICKS	5.000	0.000	0.000
FIRE CLAY BRICKS & SHAPES	1027.000	1100.000	1717.000
SILICA BRICKS & SHAPES	103.000	61.000	1939.000
MAGNESITE BRICKS & SHAPES	1276.000	2155.000	6094.000
CHROME MAGNESITE BRICKS & SHAPES	724.000	616.000	794.000
MAGNESITE CHROME BRICKS & SHAPES	1688.000	740.000	37.000
MAGNESIA CARBON BRICKS & SHAPES	2055.000	3892.000	1783.000
DIRECT BONDED BASIC BRICKS & SHAPES	60.000	40.000	518.000
MAG CARB BRKS & SHAPES AND GRAPHITISD ALUMINA	257.682	466.440	99.972
OTHERS(CONTG.BY WT>50% GRAPHITE/CARBON)	300.953	439.236	457.723
ALUMINA CARBON BRICKS & SHAPES	0.000	296.000	128.000
GRAPHITE CARBON BRICKS & SHAPES	0.000	53.000	19.000
CLAY GRAPHITE STOPPER HEADS	2.000	1.000	25.000
OTHERS(REFRACTORY BRICKS,BLOCKS,TILES,ETC)	1605.000	1037.000	800.000
SILICON CARBIDE BRICKS & SHAPES	62.000	0.000	143.000
SILICON CARBIDE CRUCIBLES	52.483	21.702	76.957
OTHERS(GOODS CONTG.>50%AL203 OR AL203 & SI02)	172.844	126.317	88.202
ZIRCON/ZIRCON MULLITE REFRACTORIES	0.000	7.280	33.542
CERAMIC FIBRES	0.000	224.297	328.963
MLITHCS/CSTBLES(FCLAY/BASIC/SILIC/HIAL INSUL)	389.250	112.061	637.160
OTHERS(REFRACTORY CERAMIC GOODS)	67.791	112.190	238.603
TOTAL	**12403.003**	**12553.523**	**17343.122**

Imports of refractories,for all sectors,including steel,have also registered an increase during the same period as Table 28 below will show:

Table 28

IMPORTS(in Tonnes)

ITEMS (in Tonnes)	1992-93	1993-94	1994-95
HIGH ALUMINA BRICKS & SHAPES	77.000	7.000	126.000
MULLITE BRICKS	43.000	24.000	28.000
FIRE CLAY BRICKS & SHAPES	176.000	82.000	404.000
SILICA BRICKS & SHAPES	625.000	865.000	65.000
MAGNESITE BRICKS & SHAPES	559.000	1175.000	1393.000
CHROME MAGNESITE BRICKS & SHAPES	0.000	35.000	0.000
MAGNESITE CHROME BRICKS & SHAPES	145.000	135.000	4.000
MAGNESIA CARBON BRICKS & SHAPES	2.000	0.000	405.000
DIRECT BONDED BASIC BRICKS & SHAPES	1786.000	671.000	982.000
MAG CARB BRKS & SHAPES & GRAPHITISD ALUMINA	19.150	71.311	11.671
OTHERS(CONTG.BY WT>50% GRAPHITE/CARBON)	242.577	335.321	169.252
ALUMINA CARBON BRICKS & SHAPES	1.000	0.000	24.000
GRAPHITE CARBON BRICKS & SHAPES	0.000	0.000	50.000
CLAY GRAPHITE STOPPER HEADS	113.000	0.000	122.000
OTHERS (REFRACTORY BRICKS,BLOCKS,TILES,ETC.)	4082.000	4468.000	7249.000
SILICON CARBIDE BRICKS & SHAPES	0.000	6.000	35.000
SILICON CARBIDE CRUCIBLES	0.000	12.337	7.665
OTHERS(GOODS CONTG.>50%AL2O3 OR AL2O3 & SIO2)	0.000	1019.356	909.686
ZIRCON/ZIRCON MULLITE REFRACTORIES	32.812	35.421	82.145
CERAMIC FIBRES	0.000	0.467	22.196
MLITHCS/CSTBLES(FCLAY/BASIC/SILIC/HIAL INSUL)	2.242	13.987	2.870
OTHERS(REFRACTORY CERAMIC GOODS)	576.490	836.852	1002.071
TOTAL	**8482.271**	**9793.052**	**13094.556**

(Some further imports are likely to have taken place together with the import of capital goods and/or under EPCG licences for which details are not readily available.)

The overall picture that emerges is a mixed one - on one hand, increasing exports certainly reflect a certain maturity in the capability of the refractory manufacturers and suggests that the producers are taking steps for technology upgradation;on the other hand,increasing imports indicate that there are gaps in product specifications and perhaps in quality parameters which need to be addressed by the indigenous manufacturers.

Demand and Availability Projections

2.47 Demand for refractories in both quantitative and qualitative terms depends entirely on the projected produc-

tion trends of major consuming industries such as steel (which accounts for almost 75% of the total refractory demand in the country), cement, non-ferrous metals, glass and so on. Discussions here relate primarily to the demand from the steel sector which is poised for tremendous growth: in terms of crude steel production, from about 22 million tonnes in 1995-96 to about 42 million tonnes by 2001-02. According to available information, the present rate of specific consumption of refractories in the integrated steel plants is 24-26 kgs. per tonne of liquid steel. With the modernisation of the existing plants and with additional capacities likely to be based on latest technologies,it would be reasonably safe to assume a decline in the specific consumption of refractories to around 18 kgs. per tonne.

On the above assumption,for the levels of production of crude steel by BF-BOF route(27.52 mt),by Corex route(1.10 mt),by EAF route(13.40 mt);DRI and merchant pig iron (11.23 mt),the expected demand for various categories of refractories has been estimated and is given in Table 29 below:

Table 29

2001-02 AD

	Specific consumption (kg/tonne)	Estimated Production by route (mill.tonne)	Projected Operational Requirement (Tonnes)
a) Blast Furnace & Cast House:			
- Fireclay based	1.10	27.52	30272
- High Alumina	1.20	27.52	33024
- Alumina Carbon	1.00	27.52	27520
b) DRI/SR/EAF process:			
- High Alumina	2.50	25.73	64325
- Basic	3.75	25.73	96488
c) Steel Melting(BOF):			
- Basic (Magnesite & Dolomite)	4.00	27.52	110080
d) Steel Ladles :			
- High Alumina	2.50	42.02	105050
- Basic	0.50	42.02	21010
e) Tundish & CC:			
- High Alumina	0.60	21.00	12600
- Basic	1.25	21.00	26250
- Alumina Carbon	0.50	21.00	10500
f) Others(Electrocast, Ceramic fibres, Monolithics)	1.50	42.02	63030

Put differently, the requirement in Steel Industry in 2001-02 for estimated 42 million tonnes of crude steel would be approximately :

Fireclay -	30272 MT
High Alumina -	214999 MT
Silica (for IF) -	7000 MT
Basic -	253828 MT
Alumina Carbon -	38020 MT

Assuming that the steel industry as a whole accounts for about 75% of the total refractory production in the country, the additional requirement for other sectors may be as under:

Fireclay -	9082 MT
High Alumina -	64500 MT
Basic -	76148 MT
Alumina Carbon -	Nil

To this may be added the constructional requirements :

Blast Furnace	: Fireclay	10,000 MT
	High Alumina	12,000 MT
	Silica(stoves)	1,000 MT
Coke Ovens	: Silica	25,000 MT
	Fireclay-shapes	16,000 MT

Therefore the overall projections for refractory requirements in the country for steel and non-steel industries for 2001-02 AD is estimated to be as follows:

a) Fireclay -

Operational (Steel)	30272	MT
Constructional (Steel)	26000	MT
Constr./Oper. (Non-steel)	9082	MT
Total -	65354	MT

b) High Alumina -

Operational (Steel)	214999	MT
Constructional (Steel)	12000	MT
Constr./Oper. (Non-steel)	64500	MT
Total -	291499	MT

c) Silica -

Operational (Steel)	7000	MT
Constructional (Steel)	26000	MT
Constr./Oper. (Non-steel)	2000	MT
Total -	35000	MT

d) Basic -

Operational (Steel)	253828 MT
Constructional (Steel)	Nil
Constr./Oper. (Non-steel)	76148 MT
Total -	329976 MT

e) Alumina Carbon -

Operational (Steel)	38020 MT
Constructional (Steel)	Nil
Constr./Oper. (Non-steel)	Nil
Total -	38020 MT

Thus,in overall aggregate terms,expected demand for all categories of refractories in 2001-02 works out to around 7.6 lakh tonnes.As against this,the available aggregate capacity stands at 14.8 lakh tonnes per annum; and total production recorded in 1994-95 has been 7.7 lakh tonnes.This corroborates the observation made earlier in the report that the need for this sector is to concentrate on quality aspects and R & D; capacity enhancement seems unnecessary.

Status of Raw Materials

2.48 The major raw materials,recommended specifications for the refractory industry,current as well as projected requirement with remarks on the availability situation of the raw materials is given below :

Major Raw Materials	Specifications	Curr./Proj. req.('000T)	Remarks
Fireclay	Al2O3 35%(min); Fe2O3 1.5%(max)	Curr. 371 Proj. 500	Adequate availability
Bauxite(Calcined)	Al2O3 84%(min); Fe2O3 3.5%(max); TiO2 4%(max); CaO 1.5%(max); BD 3.1 gm/cc	Curr. 218 Proj. 190	Shortages being madeup by imports
Kyanite/Sillimanite /Andalusite	Al2O3 58%(min); Fe2O3 1.5%(max); PCE(OR) 37	Curr. 45 Proj. 80	Shortfalls in supply some imports
Fused/Sintered Alum.	Al2O3 96%(min); SiO2 0.35%(max); Fe2O3 0.2%(max); CaO 0.25%(max); BSG 3.2 gm/cc(min)	Curr. 15 Proj. 20	Adequate availability; some imports
Zircon sand	ZrO2 65%(min); Fe2O3 0.5%(max); SiO2 32%(max);	Curr. 5 Proj. 10	In short supply; exports may be curbed

	TiO2 0.5%(max);			
	BSG 4.6 gm/cc(min)			
Quartzite	SiO2 95%(min);	Curr.	50	Adequate availability
	Al2O3 0.75%(max);	Proj.	60	
	Fe2O3 0.75%(max)			
Chromite	Cr2O3 52%(min);	Curr.	36	Shortages in lumpy ore;
	SiO2 5%(max);	Proj.	48	exports may be curbed
	Fe2O3 20%(max);			
	CaO 1%(max)			
Dolomite(Raw)	CaO 35%(min);	Curr.	150	Adequate availability;
	MgO 21%(min);	Proj.	180	low silica material
	SiO2 1%(max);			should be reserved
	Al2O3 1%(max);			for refractories
	Fe2O3 0.5%(max)			
Magnesite(Dead Burnt) (natural)	MgO 89%(min);	Curr.	80	In short supply;
	SiO2 6.5%(max);	Proj.	56	required MgO silica
	CaO 2%(max);			levels not available;
	Fe2O3 1.2%(max);			demand likely to
	BD 3.20 gm/cc			decline
Magnesite(Dead Burnt) (natural)	MgO 92-94%(min);	Curr.	40	Not available
	SiO2 2.5%(max);	Proj.	70	indigenously;
	CaO 1%(max);			about 50,000 MTPA
	BD 3.25 gm/cc			being imported
Magnesite(Sea water)	MgO 97%(min);	Curr.	100	One unit of 50,000 MTPA
	SiO2 0.5%(max);	Proj.	140	under construction
	BD 3.35 gm/cc			
Magnesite(Fused)	MgO 94%(min);	Curr.	15	Not available
	SiO2 2%(max);	Proj.	25	indigenously;
	CaO 1%(max);			about 15000 MTPA
	Fe2O3 1%(max);			being imported
	BD 3.45 gm/cc			
Graphite	Free C 94%(min),	Curr.	10	Reserves adequate;
	Flakey type	Proj.	16	requires beneficiation
Silicon Carbide	SiC 97%(min);	Curr.	3	Adequate availability
	SiO2 1%(max);	Proj.	6	
	Al2O3 0.25%(max);			
	Free C 0.5%(max);			
	Free Si 0.5%(max);			
	Surface Fe2O3 0.1%(max);			
	BSG 3.2 gm/cc			

(In addition to the above, certain additives and binders are also required, e.g. Boron Carbide, Resins, Special high alumina binders, etc., which are largely imported as the quantity involved and purity levels are not available in-

digenously or are prohibitively priced.)
The remarks against each of the raw materials indicate the status of current availability and suggest action that is recommended .

PROBLEMS AND SUGGESTIONS

2.49 As brought out in the discussions so far,the refractories sector has sufficient capacity and save for certain raw materials eg. zircon,lumpy chromite ore,DBM with MgO 90 - 92 %, there is also adequate supply of raw materials. The challenges facing this sector stem not from considerations of capacity constraints or from lack of raw materials but from the rapidly changing demands being placed on this sector by the increasingly sophisticated requirements of the steel industry and for this, continuous product improvements by technology upgradation is the only answer.Some suggestions in this regard are discussed below.

2.50 (i) The VIIIth Plan Working Group had identified some specialised refractories for development.Of these the following require to be pursued:

(a) Re-bonded fused silica bricks for coke oven doors and for continuous casting of certain types of steel.

(b) Improved porous plugs for long duration purging of steel.

(c) Nitride bonded silicon carbide for blast furnaces.

(d) Carbon blocks for blast furnaces hearths.

(ii) **Research and development is called for in respect of:**

(a) High purity synthetic aggregates such as magnesia-zirconia sinter, magnesia spinel sinter, sintered mullite, sintered alumina, etc .

(b) Process technology involving use of new types of binder and additives together with their characterisation.

(c) Application engineering for optimisation of refractory performance in the consuming industries.

(iii) The product development needs necessarily be left to the individual refractory plants to take up with inhouse R & D or otherwise. R & D in application engineering is urgently called for and the cooperation and support of the consuming industries would be essential in this respect. Specifically, the following R & D projects may be considered for suitable funding:

(a) Finite element analysis for optimising refractory performance in basic oxygen furnaces and steel ladles.

(b) Computerised "virtual reality" programmes for zoned lining developments and computer-aided designs.

(c) Pilot scale simulative tests for errosion/corrosion of refractories in various applications, such as hot metal ladles, BOF, ladle furnaces and so on.

2.51 Some other problem areas identified by the industry need to be mentioned :

(i) Historically,the sluggish steel sector of the 80's has been responsible for low growth observed in the refractories;this need no longer be a major concern as the steel sector is poised for rapid expansion;

(ii) Raw materials constitute about 60-70% of the factory price of most sophisticated refractories based on synthetic raw materials. Therefore it is imperative that the customs duty on imported raw materials should be reduced to about 10-15% from the current level of 50%.

(iii) Raw material quality and availability is a major factor for the refractory industry. Numerous reports and research projects on beneficiation of indigenous raw materials have been under taken, but have not progressed owing firstly to the high capital investments involved and secondly the uncertainties of the market situation. For instance,it would be necessary to carefully appraise the research projects undertaken for the beneficiation of magnesite and bauxite.

(iv) The availability of zircon sand and sillimanite sand from Indian Rare Earths Ltd. also require urgent augmentation for the development and production of high creep resistant and corrosion resistant refractories for steel and glass industries.

(v) Adequate power supply,in terms of energy requirement and quality,is a factor that inhibits continuous production,especially for certain synthetic aggregates eg. fused/sintered alumina,fused magnesia.

(vi) The refractory industry depends upon raw materials from different sources which need to be mixed and blended together.Availability of rail transport is a problem since the railways for their operational reasons require rake load movements.This is difficult for the refractory units as many do not have railway sidings of their own nor is it usually possible to take rake-load quantities for financial and operational reasons. Multi modal transport planning would need to be looked at seriously.

(vii) A concern has been expressed about the loading and unloading facilities at the ports.The refractory industry relies substantially on import of certain raw materials

which are not available indigenously (1,00,000 tonnes of DBM and SWM, 20-25,000 tonnes of calcined bauxite and so on).

As for exports,a view has been expressed that the existing port and railways regime do not permit factory stuffing of containers.This means that the exporting refractory units have to arrange for transport to the approved customs ware houses at the port where accredited stevedores stuff the containers.This system does mean extra costs and inherent inefficiency and it may be worthwhile examining whether factory stuffing of containers to be made available by the railways and container movement thereafter to the port for final destination may not be better.

(viii) Human resource development for the ceramic and refractory industries and up-dating the ceramic curriculum has not received due attention or emphasis.Ceramic engineering is touching new horizons and is poised to revolutionise applications in refractories,electronics,automobiles,defence,nuclear,space sectors.This area needs to be given due attention in consultation with major institutions such as College of Ceramic Technology, Calcutta; Benaras Hindu University;Regional Engineering College, Rourkela and others.

CHAPTER – VI

METALLICS – Steel Melting Scrap and Direct Reduced Iron

INTRODUCTION

2.52 Steel Melting Scrap and Direct Reduced Iron (DRI) are two major inputs in electric steel making through electric arc furnace and induction furnace routes. In the integrated steel production route, some quantity is also used in LD converter as a coolant. The usage of steel melting scrap is preferred (better yield); however, because of its limited global availability, the consumption of DRI is continuously increasing. The ratio of the scrap /DRI used in the charge mix depends on various factors such as the technology adopted, demand-supply scenario, locational aspects etc., all of which together would determine the precise contribution for a plant.

Rapid technological changes are also taking place in the integrated steel sector. From scrap availability point of view, as far as the integrated steel plants are concerned, due to the increasing adoption of concast technology, the internal generation of scrap is coming down. It is expected that in future these plants will emerge as net purchasers of scrap/DRI.

DEMAND AVAILABILITY

2.53 Demand availability projections for finished steel and DRI have already been dealt with in this report earlier. To recapitulate source wise crude steel production in 2001-02 has been projected as below:-

(Million tonnes)

	Existing (1995-96)	**Projected (2001-02)**
BOF	15.71	27.50
Corex		1.10
Electric Steel	5.84	13.40
Total	**21.55**	**42.01**

Based on the above projections, the requirement of steel melting scrap and DRI will be as under:

(million tonnes)

Existing EAF	4.7
Existing IF/New IF	3.8
New EAF units	6.1
Integrated steel plants	5.5
	20.1

2.54 As stated earlier the combination of scrap and DRI depends on various factors. For the purpose of calculating their requirments, it has been assumed that 40% DRI will be used in the existing EAF as well as existing and new IF units and 70% DRI in the new, large EAF units. It has also been assumed that Integrated Steel plants will use 20% scrap/DRI as coolant in steel making. On these assumptions, requirement of the steel melting scrap and DRI in 2001-02 is expected to be of the order of 12.43 million tonnes of scrap and 7.67 million tonnes of DRI. Against this, the availability (discussed in paras below) and the expected shortage is as below:-

	Steel Melting Scrap	**DRI**
Demand	12.43	7.67
Availability	4.50	6.18
Surplus/Gaps (-)	7.93 (-)	1.49 (-)
Total Scrap/DRI shortage	**9.42**	

2.55 The following paragraphs discuss the emerging scenarios for steel melting scrap and explain the basis fo assuming their availability projections made above.

Steel Melting Scrap

2.55.1 Traditionally, steel melting scrap has been the major input for steel making in the secondary steel sector. Due to its limited availability from indigenous sources, the requirement of steel scrap had to be supplemented by imports. The imports of steel melting scrap during last 4 years have been as follows:-

(unit: Million Tonnes)

1992-93	**1993-94**	**1994-95**	**1995-96**
2.57	0.75	1.42	0.97

International market in Steel melting scrap is characterised by wide fluctuations. This directly impacts quantum of imports. Various world agencies have forecast shortages in global scrap availability due to various reasons such as shift in steel making from conventional blast furnace route to electic arc furnace route in the developed countries, improved machining technologies and so on. Therefore, import option would always be a little uncertain.

As regards indigenous availability, it may be mentioned that as far as integrated steel plants are concenred, they are expected to become net purchasers in view of increasing adoption of concast technology. Indigenous availability from other sources is also not expected to go up substantially in the near future. Whie precise estimates of indigenous scrap availability have eluded researchers/planners, given the diverse sources which generate scrap, other indirect methods of estimation make it reasonable to conclude that indigenous availability of scrap for melting purposes will be around 4.5 million tonnes in 2001-02.

Strategies to meet the metallic requirements

2.56 As stated above, serious shortage of metallics to the extent of 9.3 million tonnes is projected by 2001-02. In order to meet this metlallics shortage, follwing actions are suggested:-

(i) There is a need to augment natural gas allocation for sponge iron sector. It must be recognised that gas for sponge iron is a process necessity and represents high value addition; and unless more gas based sponge Iron Plans come up, the metallic shortage would continue making the iron and steel industry import dependent and therefore subject to external shocks on account of projected high prices and worldwide shortage of metallics.

(ii) Presently duty free import of raw material is permitted against the committed export under the Advance Licensing System. Gas based sponge iron units engaged in exports are not able to make use of this facility since natural gas cannot be usually imported. In order to encourage these units to export and be cost competitive, they may be provided natural gas from domestic sources at international prices.

(iii) The existing coal based plants are facing quality problems in the matter of non coking coal. In order to enable these units to blend imported coal with local supplies for better performance, customs duty on non coking coal shold be low and may be considered at par with duty on coking coal. Besides improving performance of the existing plants, this singular step will also trigger fresh investments in the coal based sector especially near the ports.

(iv) To encourage investment, grant of captive coal mine blocks of known explorable reserves should be liberally considered.

(v) As brought out previously there is likely to be shortage of about 2 million tonnes of high grade iron ore required by this sector which is likely to persist unless the Bailadila 11-B mine start producing. To meet this projected gap and to meet the emerging demand of sponge iron sector it is desirable that the policy on export of high grade iron ore should be such that the requirement of this sector is met first. The surplus quantities of high grade iron ore alone should be premitted to export.

(vi) In view of the growing importance of the sponge iron sector and in the national interest, this sector should be treated at par with the existing integrated steel plants for allocation of wagons under the preferential traffic schedule of railways.

(vii) Govt. should encourage the production of alternative virgin iron units without the use of coke or the use of the blast furnace. One such technology namely Corex is already under implementation. Other promising technologies some of which are at the thresold commercialisation like Hismelt, Dios, Ausmelt, Fastmelt etc. may be given due consideration for the development in the country.

(viii) Part of scrap/DRI can also be substituted by use of pig iron in electric steel melting, though it cannot be used substantially because of higher carbon, phosphorous & sulphur contents. Likewise, efforts should also be made to use hot metal in electric arc furnaces to substitute Scrap/DRI and to reduce power consumption.

CHAPTER - VII

FINANCIAL MANAGEMENT, INVESTMENT PROJECTIONS AND PROJECT IMPLEMENTATION

1. INTRODUCTION

1.1 The projections with regard to investment and financial requirements for the IXth Plan depend upon the projected levels of production of steel, requirement of raw/input materials and other associated infrastructural facilities. In addition, the projections take into consideration the requirements for R&D activities. The estimated IXth Plan investments in the steel sector is, thus, a sum total of the investment projections made by the Public Sector Undertakings and the anticipated investments by the private sector.

2. VIIIth PLAN OUTLAY - PROJECTION AND ACHIEVEMENT

2.1 The Working Group constituted for VIIIth Five Year Plan for Iron and Steel Sector had projected an aggregate investment of Rs.29.591 crores as under:

	(Rs. In crore)
SAIL (including R&D and its subsidiaries)	14,497
VSP	2,356
NINL	1,000
VNSL	1,000
TISCO	2,200
Complementary Investment in other Undertakings of Ministry of Steel	1,758
National Mission	200
Secondary Sector	6,580
Total	29,591

2.2 Subsequently an outlay of Rs.14,579 crores with a Budgetary support of Rs.774 crores was set aside by Planning Commission for Public Sector Undertakings under the Ministry of Steel. The remaining investment of Rs.15,012 crores was expected to come up from the private sector. Taking into account investment actually made upto 31.3.96 and approved outlay for the terminal year 1996-97 of VIIIth Plan, a total investment of Rs.15,321 crores by Public Sector companies is anticipated.

2.3 Although authentic details of actual investment made in the private sector (integrated and secondary) upto 31.3.1996 and during 1996-97 are not available, as per latest avail-

able information, the major domestic financial institutions have already sanctioned as on 31.8.96, 20 steel projects in private sector involving an investment of Rs.20,095 crores. Out of these, 7 projects covering an investment of Rs.6,238 crores have already been commissioned during the current VIIIth Plan period. Other 13 projects involving an investment of Rs.13,857 crores are at various stages of implementation. In addition to this, another 8 projects involving an investment of Rs.12, 698 crores are pending with the financial institutions, which are not expected to come up during the 8th Plan period, since the terminal year 1996-97 of the Plan is almost over. In other words, a major portion of remaining investment (i.e. Rs.13,857 crore) in respect of projects, which have been sanctioned by the financial institutions, is expected to be made during the balance period of VIIIth Plan itself. It is estimated that Rs.11,813 crores would be invested by 31.3.97. Thus the total estimated investment in private sector steel plants during VIIIth Plan is Rs.18,051 crores. In addition, there has been an investment of approximately Rs.2,630 crores in merchant pig iron plants and Rs.2,750 crores in sponge iron plants. There has also been investment in cold rolling mills, rerolling units, ferro-alloys production, etc., the detailed information in respect of which is not available.

2.4 From the above, we can assume that total investment in iron and steel sector during VIII Plan period will be exceeding Rs.38,752 crores including actual outlay of Rs.15,321 crores for the public sector. Therefore, the total investment likely to be made during the VIII Plan will be substantially in excess of the original projections made by the Planning Commission.

3. DEMAND SUPPLY PROJECTIONS FOR THE IXth PLAN

3.1 Domestic demand for finished carbon steel in the country would touch 32.68 million tonnes (net) during 2001-02. In addition, the country may have an export potential of 6 million tonnes of steel. Thus, the total demand for finished carbon steel would be 38.68 million tonnes (net). In gross terms, this would amount to about 44.5 million tonnes. In response to such steep increase in demand expected, the production of finished steel is expected to be a little over 44 million tonnes in gross terms and 38 million tonnes in net terms. (Table-I given below)

3.2 The forecast of demand made by the Working Group in respect of pig iron, direct reduced iron (DRI), alloy and special steel and ferro alloys envisages substantial increase in demand. The Working Group, in addition, has identified the need for development of the raw materials sector to support the anticipated growth of the iron and steel sector.

3.3 Domestic production of steel is expected from the following sources:

a) Existing steel making capacities in the country,

b) Upcoming additional capacities in the existing plants, and

c) New plants to be commissioned by 2001-02.

New investment will be required mainly in areas (b) and (c) above.

3.4 It is expected that by 2001-02, the output of different categories of producers would be as shown in **Table-I** below. It may be observed from these figures that production of finished carbon steel almost matches with the expected demand during IXth Plan period.

TABLE-I

PRODUCTION OF FINISHED STEEL BY VARIOUS CATEGORIES OF PRODUCERS

Category	(In Million Tonnes) Output of Finished Steel
MAIN PRODUCERS	
Steel Authority of India Ltd.	11.129
IISCO	0.32
RINL	2.41
TISCO - Jamshedpur	3.1
NEW MAJORS(Essar Steel, Lloyed Steel, Jindal Vijay Nagar Steel, Jindal Strips and Nippon Denro Ispat Ltd.)	5.55

Category	(In Million Tonnes) Output of Finished Steel
OTHER SECONDARY PRODUCERS(Including EAF and IF units and other major units under conception/implementation)	21.517
TOTAL GROSS OUTPUT IN 2001-02	44.026

Note: Gross output includes double counting on account of HR Coils used for production of cold rolled coils and other downstream products.

4. INVESTMENT IN THE PUBLIC SECTOR

4.1 The total projected investments to be made in the public sector and National Mission for Iron & Steel during the IXth Plan would be of the order of Rs.20005 crores. Of this, Rs.16,468 crores would be for the Integrated Steel Plants of SAIL & VSP, Rs.2,787 crores for other PSUs and Rs.750 crores for the National Mission on Iron & Steel. Break-up of proposed investment pattern in IXth Plan is given in **Table-2** below:-

TABLE-2

(Rs.in crores)

I.	**SAIL.**	**9th Plan Outlay**
	- Schemes completed during 8th Plan (Project related expenditure to be spilled over the 9th Plan)	179.00
	- Schemes to be completed during 8th Plan (Project related expenditure to be spilled over the 9th Plan)	1966.00
	- Continuing Schemes (spill over)	2806.00
	- Additions & Modifications	2902.00
	- Replacements	1582.00
	- Expansion	5525.00
	- Township	40.00
	Sub Total	15000.00
II.	**VSP (RINL)**	**9th Plan Outlay**
	- Continuing Schemes	265.00
	- New Schemes (including expansion to 4.05MT)	1029.00
	- AMR Schemes	176.00
	- R&D feasibility studies	12.00
	Sub Total	1482.00
	Total SAIL & VSP	16482.00
III.	- Complementary investment by other PSUs	2787.00
IV.	- Investment in the National Mission for Iron & Steel	750.00
	GRAND TOTAL (TABLE-2)	20005.00

STEEL AUTHORITY OF INDIA LTD. (SAIL)

4.2 The detailed investment plan of Steel Authority of India Limited (SAIL) for the IXth Five Year Plan period is discussed in detail at **Appendix-A(I to III)**. Statements in

regard to scheme/project wise details on total costs, expenditure, outlay and expected dates of completion have also been included in this Appendix. Details of method of financing the proposed schemes and resource mobilisation for the IXth plan, year-wise, upto 2001-02 have also been included in this note.

4.3 It may be seen from **Table-2** above that out of the investment of Rs.15,000 crores envisaged during the IXth Plan, the outlay of Rs.4,951 crores accounts for spill over from the VIIIth Plan. Thus, the net amount envisaged for investment on new projects during the IXth Plan works out to Rs.10,049 crores. Major investments are being planned towards modernisation and expansion of Bhilai (BSP) and Bokaro (BSL) steel plants, each accounting for Rs.4,551 crores and Rs.4,705 crores respectively. Here also, one has to note that 27.22% in case of BSP and 25.12% in case of BSL of investment are spill over from the VIIIth Plan. The modernisation of Rourkela (RSP) and Durgapur (DSP) steel plants, which constituted a large part of investment during VIIIth Plan, will have 68.11% and 38.85% of the investment respectively as spill over from the VIIIth Plan. SAIL will direct 37% of the total investment outlay towards expansion and diversification. While 33% of it accounts for spill over from VIIIth Plan, AMR schemes will involve about 21% of the total investment planned. They have also envisaged investment of Rs.1,129 crores towards quality control and improvement and Rs.256 crores towards pollution control.

4.4 Of the amount of Rs.4,951 crores proposed as spill over from the VIIIth Plan, an amount of Rs.684 crores is yet to be sanctioned. The cost of all the schemes envisaged to commence during IXth Plan has been estimated at Rs.15,349 crores. The total new investment proposed for the IXth Plan period is Rs.10,049 crores (excluding spill over from VIIIth Plan).

4.5 It has been estimated that SAIL will have a retained profit of Rs.5,914 crores during 1997-98 - 2001-02 (Post depreciation, interest, taxes and dividend). The projection of profitability of SAIL seems to be conservative considering the performance of the company in the last few years and the prospects of the steel industry in the coming period. After taking into account depreciation, write offs, loan repayments, increase in working capital and non-plan capital requirement, SAIL will have about Rs.6,788 crores as net internal resources available for the IXth Plan. To meet this plan outlay, in addition to Internal Resources of Rs.6788 crores, the SAIL shall raise remaining funds of Rs.8212 crores through raising of Bonds/Debentures (Rs.4779 crores), ECB/Suppliers' credit (Rs.678 crores) and market borrowing including Steel Development Fund of Rs.2750 crores. SAIL has proposed a Budgetary Support of Rs.5.00 crores for IISCO modernisation.

RASHTRIYA ISPAT NIGAM LTD (RINL)

4.6 Details of schemes/projects proposed by Rashtriya Ispat Nigam Ltd (RINL\VSP) for modernisation of the plant, expansion of capacity and installation of balancing facilities are at **Appendix-B**.

4.7 VSP was designed to meet the requirement of pig iron in the country in the past. However, as pig iron capacity has been developed in the private sector in merchant plants equipped with mini-blast furnaces, there is no national compulsion for VSP to produce pig iron for sale. Also considering the overall economics, VSP will be much better placed in terms of profitability to produce steel rather than pig iron. To achieve this, however, the company will have to make substantial investment in the downstream steel making and casting areas. The VSP, therefore, proposes to increase the liquid steel capacity of the plant to 4.05 million tonnes from the present 3.00 million tonnes by adding a slab caster, a ladle furnace and two additional LD converters at a cost of Rs.918 crore. In addition, VSP proposes to invest Rs.25 crores on incorporating facilities for coal dust injection, Rs.86 crores for Turbo Generator, Rs.176 crores for AMR schemes, Rs.12 crores towards R&D and Feasibility Studies and Rs .265 crores for other continuing schmes towards modernisation and expansion. Thus, the total investment proposed for the IXth plan by VSP works out to Rs.1482 crore. Out of this proposed outlay, Rs.265 crores are accounted for by continuing schemes which will be spilled over from to VIIIth plan and Rs.1217 crores by new schemes.

4.8 The RINL, however, proposes to generate Rs.1136 crores as internal accrual, out of which Rs.1019 crores will be utilised to finance its capital expenditure during the IXth Plan period. The company, thus, is likely to mobilise remaining resources from borrowings from financial institutions for funding the above mentioned investment proposals. Internal resource generation of Rs.1136 crores has been worked out assuming the approval of Government to the pending capital restructuring proposal and expected improvement in its operations during this period.

Complementary Capital Investments by other PSUs

4.9 During the IX plan period, complementary capital investments would be required to be made by other Public Sector undertakings (NMDC, KIOCL, MOIL, SIIL, MECON, HSCL, MSTC, FSNL, Bird Group of Company and BRL) under the administrative control of the Ministry of Steel. The details of projects envisaged by the above companies are summerised in **Appendix-C**.

NATIONAL MINERAL DEVELOPMENT CORPORATION (NMDC)

4.10 The proposed investments of National Mineral Development Corporation (NMDC) will be mostly towards increasing capacity in iron ore production as it can be seen from **Appendix-C**.

4.11 The major among the projects in hand are Kumaraswamy Iron Ore Project (Rs.239.84 crores), Bailadila 13 (Rs.300 crores), Bailadila 11B (Rs.24.76 crores as a joint venture), Blue dust and mining scheme (Rs.24.28 crores) and Bailadila 4 (Rs.0.45 crore) all of which are related to development of iron ore mines and iron ore utilisation. In addition, NMDC has plans to invest on Deposit 10/11A (Rs.341.36 crores), Development of Limestone in HP (SS) (Rs.18.14 crores), Ultra Pure Ferric Oxide Plant (Rs.22.53 crores), Baildila-14 Modification (Rs.6.91 crores), Ramandurg (Rs.2.00 crores), Development of Lime Stone in HP (LS)(Rs.272.63 crores), Kotmisonar (Rs.4.38 crores), Beach-sand (Rs.99.90 crores) and Panna Diamond Project Expansion (Rs.20.13 crores). The company expects to invest Rs.155.21 crores towards AMR schemes, Rs.25 crores on development of township and another Rs.28.05 crores on R&D and feasibility studies, JMDC Ltd. DBM Project (Rs.0.28 crores) and Joint Venture Company with KIOCL and MECON (Rs.1.20 crores). An amount of Rs.1,604.70 crores (say Rs.1605.00 crores) is the proposed outlay for the IXth Plan.

4.12 The NMDC plans to support these investment schemes largely from internal accruals. During the IXth Plan period, NMDC has forecast a total of Rs.1,146.00 crores as total internal resources available for investment for the entire Plan period out of which Rs.1105 crores will be utilised for plan expenditure. In order to support the full investment requirement of the company scheduled for the IXth Plan, the company proposes to mobilise Rs.320.00 crores as bonds/market borrowings and remaining amount of Rs.180 crores from other sources during 9th Plan period.

KUDREMUKH IRON ORE COMPANY LTD. (KIOCL)

4.13 KIOCL's proposals for the IXth Plan are detailed in **Appendix-C**. The schemes, which will be taken up and completed during IXth Plan period including certain projects as spill over from 8th Plan include second Pellet Plant (Rs.20.00 crores), Recovery of Iron Ore from Tailings (Rs.41.00 crores), Pig Iron Plant (KIOCL's share of equity Rs.15.00 crores), Coke Oven Project (Rs.45.00 crores), Gangrikal Mine Development (Rs.6.00 crores), Nellibeedu Mines Development (Rs.100 crores), AMR (Rs.366.47 crores), R&D and Feasibility Studies (Rs.7.50 crores). The total outlay for the IXth plan, thus, stands at Rs. 600.97 crores **(say Rs.601.00 crores)**. Out of this proposed investment KIOCL will spend Rs.76 crores for the continuing schemes spilled over from

the 8th Plan period and remaining shall be utilised for the new schemes.

4.14 The KIOCL plans to finance the investment projects largely through internal accruals, which has been projected at Rs.347.00 crores for the entire IXth Plan. The balance of the fund requirement of Rs.254.00 crores is to be met from ECB/Suppliers' credit.

MANGANESE ORE INDIA LTD.(MOIL)

4.15 The details of plan schemes and outlay proposed of Manganese Ore (India) Limited (MOIL) for the period till 2001-02 are given at **Appendix-C**.

Manganese Ore India Ltd.(MOIL) has drawn up a plan to invest Rs.76.00 crores during the IXth plan period. Of this, Rs.3.05 crores is accounted for by continuing schemes and Rs.72.95 crores by AMR and new shemes during the IXth Plan period. New schemes are mostly towards investment in the existing facilities. Important among the new facilities planned are a 10,000 tonne per year capacity ferro manganese plant (Phase -II) at an estimated cost of Rs.4.90 crores, Renovation and Deepening of production shaft at Balghat Mine-Phase-I (Rs.4.00 crores), Sinking a new vertical Shaft at Gumgaon Mine (Rs.4.00 Crores), Installation of advanced upgradation facilities for 25 mm Ore by Jigging (Rs.4.50 crores), sinking a pair of foot-wall incline shaft at Ukwa Mine (Rs.3.00 crores), High Intensity magnetic separation plant at Dongri Buzurg (Rs.1.40 croes), Electrolytic manganese Dioxide plant 1200 TPA (Rs.1.00 crore), R&D and Feasibility studies (Rs.3.00 crores). The company plans to generate the entire fund needed for investment during the IXth plan through internal generation.

Sponge Iron India Limited (SIIL)

4.16 The details of the proposals are at **Appendix-C**. The Sponge Iron India Limited (SIIL) proposes to put up a 60,000 tonnes per year capacity sponge iron plant at an estimated cost of Rs.50 cr., steel making facilities and R&D activities at Rs. 17 crores during the IXth plan period. The company has indicated that it will not be able to generate internal resources to support its proposed 9th Plan investment and will require government support for funding its projects costing Rs.67.00 crores, which are meant for its turn around during Ixth Plan period.

HINDUSTAN STEELWORKS CONSTRUCTION LTD.

4.17 The details of proposals are at **Appendix-C**. The Hindustan Steelworks Construction Ltd. (HSCL) is a loss making company at present and is expected to remain so during the IXth plan period also. It has, however, planned to invest Rs.42.00 crores for procurement of new construction equipment and

revamping of old ones for its construction activities. The company has not indicated any alternative mode of mobilising the needed resources and therefore is expected to depend on government support for investment during the IXth plan.

MSTC Limited

4.18 The details of proposals are at **Appendix-C**. MSTC Limited plans to invest Rs.68.00 crores on various schemes and expects to have sufficient internal accrual of Rs.181 crores to meet this capital expenditure. The company is a trading organisation and its performance is going down especially after the decanalisation of the import of shredded scrap. Because of this, it has a plan to diversify its operations for which the above outlay of Rs.68.00 crores has been proposed for IXth Plan.

Ferro Scrap Nigam Ltd. (FSNL)

4.19 The details of proposals are at **Appendix-C**. The Ferro Scrap Nigam Ltd. (FSNL) proposes to invest Rs.91 crores on AMR and modernisation during the IXth plan. This proposed outlay is meant for revamping its existing equipment and procurement of new equipment for proposed modernisation. They expect to mobilise an internal accrual of Rs.58 crores and the remaining amount of Rs.33 crores from bank borrowings.

BIRD GROUP OF COMPANIES

4.20 The details of the investment proposal of the Bird Group of Companies for the IXth Plan are given in the **Appendix-C**. The Group proposes to set up a sinter plant and a small blast furnace (Rs.80.00 crores). Development of Mines and Mining equipment (Rs.12.00 crores), Railway Electrification (Rs.5.00 Crores), AMR (Rs.7.00 crores) and Tribal Sub-plan for BSLC in Birmitrapur (Rs.6.00 crores). The total outlay thus comes to Rs.110.00 crores. The Group expects to generate Rs.55 crores internally provided their pending turn around proposal is approved. The company has no plan for mobilising resources from other sources. Thus, it will face a shortfall of Rs.55 crores for investment. The company expects government budgetary support of Rs.55 crores, since it has no strength to mobilise funds from other sources.

Metallurgical Engineering Consultants India Ltd.(MECON)

4.21 Of the remaining PSUs under the control of the steel ministry, MECON is not involved in manufacturing and is only an engineering consultancy organisation. The IX Plan projections of the company in respect of proposed expenditure and resource position are also incorporated in **Appendix-C**. MECON may need Rs.74 crores during Ixth Plan period as capital outlay. The company has projected internal accrual of Rs.299.00 crores during the 9th plan period, out of which it proposes to finance the projected outlay.

Bharat Refractories Limited (BRL)

4.22 The Bharat Refractories Limited (BRL) is a sick company and the revival package recommended by BIFR suggesting certain reliefs has been accepted by Government. The same has been finally accepted by the BIFR alongwith other measures for revival of the company. It is expected that with reliefs granted by Government, BRL shall improve substantially during IXth Plan period. The company has planned for implementation of certain new schemes and AMR schemes with an outlay of Rs.39 crores during the IX Plan period. Obviously, the company will need budgetary support of Rs.39 crores to meet this capital expenditure, since it is not expected to generate sufficient internal surpluses during the plan period.

5. R & D EFFORTS AND EXPENDITURE

5.1 Obsolescence of technology, low productivity and inability to improve product-quality and a high cost structure have been the major deficiencies in our steel industry. The production continues to be based on low grade raw materials, limited level of automation in process control and energy input remaining higher than international norms. While the modernisation programmes in respect of the integrated steel plants are directed towards overcoming the deficiencies and other problems by suitable technology upgradation, sustained R&D efforts will, however, be needed to ensure that the benefits of modernisation continue to become available to the economy over the years.

5.2 Research and development call for our immediate attention if the steel industry is to achieve its goals and make concrete progress. The Government and the industry - both in public and private sectors - should be willing partners in the efforts required and also in funding the expenditure on research and development.

5.3 The restructuring of Iron and Steel Mission is under progress. In addition to the investment being made by integrated steel plants (private and public sectors) in the R&D fields, Ministry of Steel have prepared a note for consideration of the Cabinet Committee on Economic Affairs for spending some part of the interest accrued on the Steel Development Fund. The proposal is still under consideration of Government. On receipt of necessary approval, the National Mission for Iron & Steel may also be restructured and depending upon the nature of activities proposed to be taken up by this Mission, the requirement of funds would need to be worked out. Tentatively, an amount of Rs.750 crores out of the interests (at the rate of Rs. 150 crores a year) accrued on SDF has been proposed, which will be available for utilisation on R&D during IX Plan period.

6. TOTAL INVESTMENT EXPECTED DURING Ixth PLAN BY PSUs UNDER THE MINISTRY OF STEEL INCLUDING NATIONAL MISSION FOR IRON AND STEEL

6.1 The **Table-3** given below suggests the mode and area of investment projected in iron and steel sector during IXth Plan period in public sector, which comes to Rs.19,959.00 crores.

TABLE-3

(Rs. in Crores)

Sl.	Name of the PSU	Continuing Schemes and spill over from earlier Plan	New Schemes	AMR Schemes	Others	Total
1.	Steel Authority of India Ltd.(SAIL)	4951.00	5525.00	4484.00	40.00	15000.00
2.	Rashtriya Ispat Nigam Ltd.(RINL)	265.00	1029.00	176.00	12.00	1482.00
3.	National Mineral Development Corp.(NMDC)	436.00	968.00	155.00	46.00	1605.00
4.	Kudremukh Iron Ore India Ltd (KIOCL)	61.00	151.00	386.00	3.00	601.00
5.	Manganese Ore India (MOIL)	3.05	26.95	41.00	5.00	76.00
6.	Sponge Iron India Ltd. (SIIL)	0.00	64.00	3.00	0.00	67.00
7.	Metallurgical Engg. Conslt. Ltd.(MECON)	0.00	0.00	0.00	74.00	74.00
8.	Hindustan Steel Cons. Ltd. (HSCL)	0.00	0.00	0.00	42.00	42.00
9.	MSTC Ltd.	0.00	68.00	0.00	0.00	68.00
10.	Ferro Scrap Nigam Ltd.(FSNL)	0.00	0.00	91.00	0.00	91.00
11.	Bird Group of Companies (BGC)	0.00	70.00	40.00	0.00	110.00
12.	Bharat Refractories Ltd. (BRL)	0.00	20.00	19.00	0.00	39.00
13.	National Mission for Iron & Steel (NMIS)	0.00	750.00	0.00	0.00	750.00
Total for all Companies in Public Sector		5716.05	8671.95	5395.00	222.00	20005.00

6.2 The proposed method of resource mobilisation by Public Sector Undertakings during the 9th Plan period is exhibited in

the Table-4 below:-

TABLE-4

PROPOSED METHOD OF RESOURCE MOBILISATION BY PUBLIC SECTOR UNDERTAKINGS DURING NINTH PLAN PERIOD

[Rs. in Cr

SL. NO.	NAME OF THE PUBLIC SECTOR UNDERTAKING	INTERNAL RESOURCES	BONDS/MARKET BORROWINGS	ECB/SUPPLIERS CREDIT	OTHERS	TOTAL (IEBR)	BUDGETARY SUPPORT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1.	Steel Authority of India Limited (SAIL)	6788.00	4779.00	678.00	2750.00 *	14995.00	5.00
2.	Rashtriya Ispat Nigam Ltd.(RINL)	1019.00	0.00	104.00	359.00	1482.00	0.00
3.	National Mineral Development Corpn. (NMDC)	1105.00	320.00	0.00	180.00	1605.00	0.00
4.	Kudremukh Iron Ore India Ltd. (KIOCL)	347.00	0.00	254.00	0.00	601.00	0.00
5.	Manganese Ore India Ltd. (MOIL)	76.00	0.00	0.00	0.00	76.00	0.00
6.	Sponge Iron India Ltd. (SIIL)	0.00	0.00	0.00	0.00	0.00	67.00
7.	Metallurgical Engineering Consultants India Limited (MECON)	74.00	0.00	0.00	0.00	74.00	0.00
8.	Hindustan Steel Construction Ltd. (HSCL)	0.00	0.00	0.00	0.00	0.00	42.00
9.	MSTC Ltd.	68.00	0.00	0.00	0.00	68.00	0.00
10.	Ferro Scrap Nigam Ltd. (FSNL)	58.00	0.00	0.00	33.00	91.00	0.00
11.	Bird Group of Companies (BGC)	55.00	0.00	0.00	0.00	55.00	55.00
12.	Bharat Refractories Ltd. (BRL)	0.00	0.00	0.00	0.00	0.00	39.00
13.	National Mission for Iron and Steel (NMIS)	0.00	0.00	0.00	750.00	750.00	0.00
	TOTAL FOR ALL COMPANIES.....	9590.00	5099.00	1036.00	4072.00	19797.00	208.00

* SDF = Rs.2966 Crores Equity = Rs.2750 Crores

7. INVESTMENT IN THE PRIVATE SECTOR-INVESTMENT IN STEEL PLANTS

TISCO

7.1 Details of investment planned by TISCO towards modernisation of its existing plant at Jamshedpur, scheme-wise, along with indicative costs, are at Appendix-D. This investment is mainly for modernisation of its plant with introduction of modern technology, to add balancing facilities for improvement in productivity and to ensure better utilisation of the facilities, for changing product mix for improved response to market demand and also to increase capacity of the plant by investment on balancing\additional facilities. TISCO is expected to consolidate its position by the envisaged investment of Rs.2,425 crores in the fourth phase of its modernisation which has already started with an outlay of Rs.325 crores during 1995-96 and 1996-97. TISCO will be spending Rs.2,100 crores during the IXth Plan period on

Phase-IV modernisation, the foreign exchange component estimated at Rs.670 crore. TISCO plans to mobilise the needed financial resources through external commercial borrowing, loan from Steel Development Fund (SDF), bonds and private placement of shares.

NEW MAJORS

7.2 Although there is a very long list of greenfield projects in the steel sector, the future of many of these is uncertain as these are at stages of conception and planning. The actual position of investment will depend a lot on the market, availability of financial resources and the ability of the promoters to handle such projects. However, some of the projects are in the process of implementation. Five projects have been identified as new majors.These are Essar Steel Ltd., Nippon Denro Ispat Ltd., Lloyds Steel , Jindal Strips and Jindal Vijay Nagar Steel Ltd., are expected to add an annual capacity of 5.55 million tonnes. Essar Steel, Lloyds Steel and Jindal Strips Limited have almost fully commissioned their plants and capital investment in these three projects would be over during the VIII Plan period itself. The other two plants are in the process of being installed and the capital investment expected for the IXth plan is estimated at Rs. 2522 crores for the IXth Plan.

Other New Projects

7.3 In addition to the new steel majors, a number of projects has been approved by the financial institutions, some are under their consideration and some others have not yet approached the financial institutions for support as on 31st August, 1996.

7.4 As the phasing of investment in the case of these projects has not been firmed up, the total investment likely to be made during this plan has been estimated after taking into account an overall view of the estimated size of investment needed and estimated periods of construction of these projects. It is possible that some of the projects considered may get delayed further and some others may not at all take off. In such an eventuality, the overall size of investment will be reduced. But such reduction may also get neutralised by other projects, not included in the list and are under conception.

7.5 In the specific cases of projects under consideration, although the financial institutions have committed their support, the final implementation of the projects will depend on the ability of the promoters to mobilise finance from other sources.

7.6 Although it is difficult to estimate accurately the investment that will take place during the IX Plan on these projects considering the progress of the projects, it has

been estimated that this category of plants will involve an investment of only Rs. 27036 crores during the Ixth Plan. This includes major projects like TISCO-Gopalpur, L&T, Nagarjuna, MESCO Kalinga, Bhushan Steel, Neelachal Ispat etc. with Rs. 2522 crores to be invested on the ongoing new major projects, the total expected private sector investment in plants is likely to be Rs.31,658 crores during the IX Plan period including invest proposed by TISCO proper.

INVESTMENT IN ELECTRIC ARC AND INDUCTION FURNACE UNITS

7.7 High levels of capacity utilisation of both EAF and IF sectors, if there is no addition to the present capacity of 9.65 million tonnes of crude steel, will need to be achieved if the estimated availability of semi-finished steel from these sectors is to be ensured. The question arises if the EAF and IF sector will be able to achieve such high capacity utilisation, especially in view of high costs of raw materials and power. The current capacity utilisation in these two sectors has been quite low as noted earlier. Whereas, increased demand is expected to be met from additional production obtained from improved utilisation of capacity and which should be the desired response from the industry considering the need for better utilisation of national resources, such a situation may not come through as new entries may completely alter the picture. Since this industry, in particular the IF sector, allows for reasonably low break even point, new entries are expected, not only to take care of the closed capacities, but also to take advantage of the emerging markets. The new investment that may come about in this sector may not be easily forecast due to diverse mix of technology and products. Since a large number of EAF based units will have to install secondary steel refining facilities to produce alloy and stainless steel, some investment will be required for this. There is, however, no reasonable basis for estimation of the investment requirement in the EAF & IF sectors.

INVESTMENT IN MERCHANT PIG IRON PLANTS

7.8 It has been estimated that during 2001-02, 4.65 million tonnes of pig iron will be produced in the country. The above projection includes 2.00 million tonnes of production from new capacities which would be in production by then. Most of the investments in the pig iron sector are envisaged during the VIIIth Plan period itself. As of now, there is no project envisaged for the IXth Plan. Investment, however, is likely to spill over to the IXth Plan period in certain cases due to delay in project implementation. Further, many of the pig iron units have plans to go for further value addition to produce steel. The IXth Plan period may see some investment in this area. In the case of any operational improvement in the public sector Integrated

Steel Plants and if there is investment for forward integration by pig iron plants, pig iron production in the secondary sector may become attractive enough to draw further investment.

INVESTMENT IN DIRECT REDUCED IRON (DRI)

7.9 The present capacity of both gas and coal based DRI plants is 5.62 million tonnes. It has been projected that there could be an expansion of 1.41 million tonnes in capacity by 2001-02.

7.10 Among the major new units, Prakash Industries Limited are slated to commission their plant around mid 1996. The Jindal Group could be commissioning their new capacities by 1996-97 though Lloyd's plant could start production in the first year of the ninth plan period. Monnet Ispat, Ipitata and OSIL's plans are in preliminary stages and no major investment is yet to be made. OSIL is even likely to put up a 0.40 million tonne plant as per present indications. Essar Steel is not so certain of its Module IV expansion due to difficulties in regards to availability of additional gas.

7.11 The industry is well aware of the shortages of metallics, but no other plan of expansion or new capacity seems to be on the cards for the present.

8. INVESTMENT PROJECTION FOR THE IX PLAN: SUMMING UP

8.1 The overall investment scenario for the IX th Plan period, thus, emerges as follows:

TABLE - 5
INVESTMENT PATTERN IN IX TH PLAN

(Rs. In crore)

AREA	PUBLIC SECTOR	PRIVATE SECTOR	TOTAL
Steel	16482.00	31658.00	48140.00
Sponge Iron	0.00*	635.00	635.00
Pig Iron	0.00	200.00	200.00
Raw Materials and Others	3523.00	0.00**	3523.00
Total	**20005.00**	**32493.00**	**52498.00**

* Investment projected by SIIL for expansion of sponge iron capacity, addition of steel making capacity and for other related matters are being considered in the category raw materials and others'.

** Investment likely to be made in the private sector in this area could not be estimated due to paucity of information.

8.2 It may be noted that the information in respect of the private sector is not complete not only in respect of major projects related to production of iron and steel , but also in the areas related to raw materials, particularly mining. It has been estimated on a thumb rule basis that the iron and steel industry will require about Rs. 51,000 crores towards additional capacity excluding the investment needed in raw materials and other allied sectors. It may be noted that of the required capacity addition in iron and steel for the IX Plan, a substantial part of it will be accounted for by investments made during the VIII Plan itself as most of the projects started during the VIII Plan will ultimately come to production during the IX Plan. Taking a overall view of investment scenario during the VIIIth and IX th Plan, any shortfall over and above the investment planned by the public sector, investment made by the private sector in the continuing projects and investment to be made in the projects during the Ixth Plan as considered, will be met out by the additional investment in the private sector.

8.3 As the government further liberalises investment policies, the private sector will be expected to play a much more significant role in the overall development of the iron and steel sector in the coming years.

Source-wise outlay proposed for PSUs under Ministry of Steel during IXth Plan.

8.4 The total outlay proposed for Public Sector Undertakings of the Ministry of Steel for IX Five Year Plan has been indicated in Table-3 and 4 earlier. It would be of interest to note that the investment in the integrated steel plants of SAIL, Rashtriya Ispat Nigam Ltd., National Mineral Development Corporation, Kudremukh Iron Ore India Limited, Manganese Ore India Limited, Metallurgical Engineering Consultants India Limited, MSTC Limited and Ferro Scrap Nigam Limited, is proposed to be wholly financed by the respective undertakings from their internal accruals and other sources without depending on Governmental support. Similarly, the outlay for National Mission for Iron and Steel is proposed to be met from the Steel Development Fund. The other PSUs such as sponge Iron India Ltd. (SIIL), Hindustan Steelworks construction Ltd. (HSCL) and Bharat Refractories Ltd. (BRL) would require entirely Government support. While Bird Group is expected to meet Rs.55.00 crores from its internal accruals, it will require a budgetary support of Rs.55.00 crores. SAIL has asked for Rs. 5.00 crores for IISCO modernisation. Thus, total budgetary support comes to Rs.208.00 crores, which constitutes only 1% of a total projected outlay of Rs.20005.00 crores in the 9th Plan.

8.5 With the proposed investments and build up in production capacities discussed in the foregoing paragraphs, it would

be reasonable to assume that the supply position should be satisfactorily tuned to the demand forecast of steel in the country during the IX Plan. All efforts should ,however, be made in all sectors to ensure consistent and adequate availability of raw materials and inputs and infrastructural support so that optimum capacity utilisation would be feasible.

9. ISSUES RELATED TO INVESTMENT AND FINANCING

9.1 It will be interesting to note that with the ongoing and proposed modernisation of the existing integrated plants, India will have a very young and modern steel industry by the end of the IX Five Year Plan. It is important to note that with the above mentioned investments, the plants under SAIL and TISCO are slated to achieve substantial gains in capital, labour and material productivity. The integrated plants of SAIL,TISCO and also RINL should strive for maximum possible expansion in their existing sites. However, such decisions will further have to be examined in the context of markets in proximity, scope of introduction of modern technology and the economies of scale.

9.2 There is scope for capacity expansion in SAIL Plants, particularly in Bokaro and Bhilai.

9.3 TISCO will continuously strive for increasing output from its plants through productivity gains and modernisation.

9.4 Rashtriya Ispat Nigam Limited (RINL) is slowly overcoming its initial teething problems and its capacity is getting stabilised. RINL is still a cash starved company and has only recently started making profits in operation. Its huge interest liability and depreciation have not yet allowed for recording net profit. Therefore, the company will continue to depend on outside funds (other than internal accruals) for any major investment for quite some more time. Because of this factor, the prospects of any large investment at RINL will remain under a cloud of uncertainty. In the event of a solution to the resource problem, RINL can look forward to invest on the existing plants for full realisation of its capacity and make its product mix more profitable.

9.5 The recent investments including those in the pipeline in the steel sector have mainly been in large plants for flat products. Investments are not flowing to long products' production. In the event of unfavourable conditions related to raw materials and energy, the capacity in the electric steel making sector may remain idle. In such circumstances, capacity may be added in large integrated plants producing non- flat products. This would call for additional investment and thus increase the requirement of investment resources in the steel sector much beyond what has been estimated.

9.6 Eventually, a cautious approach will need to be adopted for selecting product mix, technology and location before any major investment decision is taken in the steel sector, so as to avoid industrial sickness on account of lack of market demand and inappropriate technology choice.

9.7 The loans, which are obtained from the financial institutions, go through two stages. In the first stage, the financial institutions study the viability of the project and on being convinced, sanction the loan based on several factors such as funds available, exposure to a particular industry, loans already granted to the group/company, etc. In the next stage, the actual disbursement of the loan takes place. Here again, the financial institutions adopt a cautious approach and ensure that the company has been honouring all its commitments on flow of funds from other sources etc. The disbursement is spread over a period of time to ensure safety of funds belonging to the institutions.

9.8 For large steel projects in the private sector, the financial institutions have envisaged an ideal debt equity ratio of about 1:1. Although, the actual ratio may vary depending on the specifics of the project under consideration, the financial institutions are opposed to very large ratios like 3:1, as required by many of the promoters. The financial institutions expect the core promoters to have an exposure at least of 15% of the total capital outlay in the form of holding equity shares. If that is so, the promoters should be holding about 30% of the total equity shares. The domestic financial institutions are to abide by the RBI guidelines which restrict the exposure of the financial institutions to 15% to any industry group. In case of specific projects, the norm for maximum exposure is 25% - 30% of the total capital outlay. In case the funding from the above sources is not adequate, the companies may resort to external commercial borrowing, support from foreign financial institutions, etc. These sources are not residual and if the same is tied up, the need for support from foreign equipment suppliers, commercial banks and domestic financial institutions will be limited. If loans are available from multiple sources at reasonable cost, debt equity ratio may be increased accordingly in specific cases.

9.9 Table-6 below exhibits the capital structure as suggested by financial institutions for providing assistance to the steel

sector companies.

TABLE - 6

Capital structure as suggested by Financial Institutions for providing assistance to Steel Sector Companies.

(Rs. in Crores

Description	Small Projects	Medium Projects	Large Projects	Very large Projects
Total Projects Cost	1400.00	2500.00	4500.00	6000.00
A. **Equity Capital**				
Core Promoters	210.00	375.00	675.00	900.00
Public	490.00	875.00	1575.00	2100.00
Total (A)	700.00	1250.00	2250.00	3000.00

(Rs. in Crores)

Description	Small Projects	Medium Projects	Large Projects	Very large Projects
B. **Borrowed Capital**				
Foreign Suppliers	168.00	300.00	540.00	720.00
Commercial Banks	182.00	325.00	585.00	780.00
Financial Institutions	350.00	625.00	1125.00	1500.00
Total (B)	700.00	1250.00	2250.00	3000.00

It can be seen from the above table that, if the basic norms of financing as envisaged by the financial institutions are considered, for any large project, the contribution of the promoters in absolute terms, turn out to be so large that mobilising that much of funds from existing business may become extremely difficult. The private sector entry in major investment along with liberalisation in the policy related to capital issues and foreign investment and borrowing have brought in a sea change in the way investments are taking shape in this sector. New methods, hitherto unused, have been utilised to mobilise funds for steel projects. The issue of GDRs, for example, was unknown, in the past. As the financial markets and institutions develop, there will be more and more opportunities for mobilisation of funds for steel projects.

9.10 In spite of strong financial position of the PSUs, the investment needs of these units, are not likely to be fully

met by the proposed resource mobilisation efforts. Therefore, the government may have to continue to support some of the PSUs during the IXth plan in a limited way.

Issues with regard to sick PSUs of Ministry of Steel

9.11 Out of 12 Public Sector Undertakings eight are profit making and paying dividend to Government of India in a substantial manner. The remaining four companies (RINL, BRL, HSCL and SIIL) are incurring losses. As regards Bharat Refractories Limited (BRL) and its subsidiary India Firebricks and Insulation Company Limited (IFICO), these companies were referred to BIFR in May, 1992. On the basis of recommendations of BIFR, a draft scheme for revival of the company has been considered and approved by Government. The Bench of BIFR has also accepted the same. It is expected that with substantial financial reliefs granted by Government and other measures being initiated, the company shall make profits in its operation during the 9th plan period.

9.12 HSCL, though technically not sick under the SICA, is not in sound health at present. HSCL can be revived through a complete package involving financial restructuring of the capital base and a turn around strategy. HSCL has submitted a revival plan comprising essentially a financial restructuring package, involving conversion of loans into equity and preference shares, waiver of interest accrued and due, writing off as well as deferment of some loans and strategy for increased business turn over. The turn around proposal of the company is under consideration of the Government.

9.13 As regards RINL, the company is still in process of stabilisation and progressing satisfactorily in direction of achieving its rated capacity. Although because of heavy interest burden, the plant continues to incur net loss, its performance in terms of gross margin/cash profit is improving steadily. The company has made a cash profit of Rs.225.50 crores during 1995-96. However, its accumulated net loss is likely to exceed 50% of the equity capital and therefore, despite improvements in its performance, it may technically become a sick company and shall have to be referred to BIFR. In view of this, a turn around proposal has been prepared and is under consideration of the Government.

9.14 With regard to Sponge Iron India Limited, it may be highlighted that this was established as a demonstration plant with the help of UNDP/UNIDO in 1980 for production of 30,000 tonnes of sponge iron per year. The capacity of this plant was later enhanced to 60,000 tonnes. The company was running well upto 1992-93 and was paying dividend to the Government. However, because of certain developments, such as non stabilisation of new technology called Submerged Arc

Furnace (SAF) technology and cost of production and sales of Sponge Iron being marginally higher than the selling price, the company is not in a position to service the accumulated loan and interest. The total loan component outstanding against the company as on 31.3.1996 stood at Rs.5.84 crores and interest portion of this period at Rs.6.60 crores making a total outstanding (loan instalments and interests put together) of Rs.12.44 crore. In order to bring the company back to health, a turnaround package is being worked out with technical advice/consultation of M/s M.N. Dastur & Company. It is, however, encouraging that, working results for 1995-96 have been satisfactory with an anticipated marginal profit of Rs.29.36 lakh as against a loss of Rs.198 lakh in the preceding year. Therefore, with some more management effort, the company has the potential of becoming profitable once again.

9.15 The above mentioned PSUs under Ministry of Steel are important both from point of view of their strategic position in the steel sector as well as their inherent strength and capability to contribute to the national economy. From above consideration, it is imperative that full support of Government is extended to these companies to enable them to come back to their financial health.

10. SCOPE OF EMPLOYMENT GENERATION IN THE IRON AND STEEL INDUSTRY

10.1 Steel is a crucial industrial input and the steel industry has very strong backward and forward links with the rest of the economy. It has been estimated that a unit value of steel produced and consumed leads to about five units of value of output in the economy. This multiplier effect is true in the case of employment generation as well. The steel industry provides enormous scope for employment generation in the upstream areas related to raw materials, more particularly in mining. Further, the steel industry requires very extensive infrastructure like railways, roadways, shipping, aviation, communication, etc. It also needs an extensive marketing network for storage and distribution. Then there are the capital goods manufacturers, design engineers and consultants to support the efforts of steel production. Every steel plant opens up a township which provides ample employment opportunities in the service areas.

10.2 It has been found out in a recently conducted study by a premier institution that every tonne of steel capacity created leads to creation of a job directly or indirectly. This is so in respect of greenfield capacity. According to the projections made in this report in respect of likely addition to greenfield capacity in steel, pig iron and sponge iron sector, total employment generation potential through the impact of the greenfield plants is about 11.117

millions. It may be mentioned that the existing majors are unlikely to expand their workforce directly in their modernisation and expansion related investments. However, the impact will be positively appreciated in the other related sectors. It may be noted that as technology of production is upgraded with increased automation, scope of direct employment reduces. But the same is generally taken care of through proportionate increase of the same in the allied areas.

APPENDIX-A

A1: INVESTMENT PLAN OF SAIL DURING 9TH PLAN (Excluding IISCO Modernisation)

PLANT	8TH PLAN SPILL OVER			REQUIREMENT OF FUNDS FOR SCHEMES TO BE SANCTIONED IN 9TH PLAN						TOTAL WITH SPILLOVER	Cost of Schemes IN 9TH PLAN	Spillover to 10TH PLAN
	Total	Sanctioned	Unsanctioned	Replacement	Pollution	Quality	A/M	Expansion	TOTAL			
BSP	1239	1133	105	284	65	535	648	1780	3312	4551	4640	1328
DSP	647	615	33	74	8	8	72	855	1017	1665	1223	206
RSP	1538	1093	445	434	46	139	101		720	2258	1446	726
BSL	1182	1154	28	524	87	329	450	2133	3523	4705	4888	1365
ASP	56	20	36	26	11	10	45	68	160	215	184	24
SSP	22	22	0				15	87	102	125	617	515
RMD	34	22	12	209	39	108	101	251	708	742	1508	800
CMO	42	42	0	17			30	111	158	200	336	178
CO	43	18	24					176	176	219	251	75
CET	6	6	0					13	13	20	43	30
RDCIS/MTI	19	19	0				30	50	80	99	100	20
TOTAL	4828	4145	684	1568	256	1129	1492	5525	9970	14799	15235	5265
VISL	29	29	0	13	0		49		62	91	92	30
MEL	1	1	0				16		16	17	22	6
IISCO	90	90	0						0	90		
IISCO(K)	3	3	0						0	3		
TOTAL Incl. Subsidiaries	4951	4268	684	1582	256	1129	1557	5525	10048	15000	15349	5301

APPENDIX - A

A-II: UNIT INVESTMENT PLANTS - MAJOR PROJECTS PLANNED TO BE TAKEN UP DURING 9TH PLAN ALONG WITH OUTLAY ENVISAGED FOR THE PERIOD.

Bhilai Steel Plant

Coke oven battery No.11- Rs.150 crore
Power & Other utilities-Rs.150 crore
Rowghat Mines (Stage-II)-Rs.300 crore

Converters in SMS-3 - Rs.450 crore

New CCP - Rs.250 crore

Universal Beam Mill - Rs.550 crore

Total 9th plan outlay envisaged-Rs.4551 crore inclues spill from 8th plan - Rs.1239 crore

The investments of BSP will be mainly in the New SMS shop with continuous casting facilities. Under SMS-2, investments will be done for modification of Converter vessels and vacuum degassing and Ladle furnace facilities. Upgradation of casters will be done including automatic width adjustment, electro magnetic stirrers and dynamic spray cooling.

In mills, the investments are for a new Universal Beam Mill estimated to cost of Rs.650 crores, plate mill towards quality improvement schemes such as quenching and tempering facilities, furnace modification etc. Rail & Structural Mill for finished facilities for 39 meters rails, Wire Rod Mill and Merchant Mill for modernisation of A&D strands and replacement of strand 11-12 respectively.

In the primary areas, the investments will be put in COB # 11 at an estimated cost of Rs.225 crore and various schemes in the blast furnace area such as CDI in BF 4 & 5, Torpedo ladles, stove modification etc. Expansion of Rowghat Mines Stage-II has been planned to be taken up during the period at an estimated cost of Rs.744 crore.

APPENDIX - A

Durgapur Steel Plant

Rebuilding of batter-2 - Rs. 40 crore

Blast Furnace-3 reconst-Rs.90 crore

CDI in two furnaces - Rs.60 crore

Medium Structural Mill - Rs.500 Cr.

Bloom Caster with ladle -Rs.185 Cr. furnace

Total 9th plan outlay envisaged-Rs.1665 crore includes spill from 8th plan - Rs.647 crore

The spill over is mainly in modernisation to the tune of Rs.507.58 crore. To reap the benefits of the Modernisation fully and installed capacity utilisation, some improve ment areas have been earmarked for invest-ments during the 9th five year plan.

Rourkela Steel Plant

Replacement of guage -Rs. 48 crore control system in CRM

Turbo-blower in BF-3-Rs.70 Cr.

CRM Priority-I schemes-Rs.75 Cr.

CRM Phase-II - Rs. 50 crore

Total 9th plan outlay envisaged-Rs.2258 Cr. includes spill from 8th plan - Rs.1538 Cr.

The spill over of the modernisation schemes will amount to Rs.915.02 crore in the 9th plan.

During planning the schemes for 9th plan, emphasis has been given towards quality and replacement schemes in Mill areas. Invest-ments for revamping of CRM (Ph.2) at a cost of Rs.480 crore and upgradation of pipe plant at Rs.100 crore will be initiated in the end of the 9th plan and expenditure will largely be incurred in the 10th plan only.

Bokaro Steel Plant

2x1 stand slab caster- Rs.400 crore in SMS-1

Addl.caster in SMS-2 - Rs.300 crore

Modernisation of HSM Ph.2-Rs.300 Cr.

CDI in BF-1,2,3 - Rs.150 crore

2 Nos.MP Boiler - Rs.150 crore

Addl.Oxygen plant - Rs.140 crore

Total 9th plan outlay envisaged-Rs.4705 crore includes spill from 8th plan - Rs.1182 crore

Modernisation spill over is estimated at Rs.657.87 crores. Under primary areas New COB # 9&10 has been planned to be sanctioned during 8th plan at an estimated cost of Rs.740 crore for which around Rs.400 crore has been planned to be invested during 9th plan and Rs.340 crore will spill over to 10th plan.

Under 9th plan new investments, quality improvement schemes will acount to Rs.329 crores of which Rs.130 crores are for vacuum degassing with desulphurisation.

APPENDIX - A

Raw Materials Division

Total 9th Plan outlay -Rs.742 crore envisaged

Including spill from -Rs. 34 crore from 8th plan

The replacement schemes including replacement of dumpers, shovels, dozers and drills etc. account for Rs.209 crores. The capacity addition schemes for iron ore and flux include provision for Chiria or Taldih and Bolani, Barsua upgradation, mechanisation of Kuteshwar and mechanisation of Baraduar dolomite mine.

Central Marketing Organisation

Total 9th Plan outlay- Rs.200 crore envisaged

Including spill from - Rs. 42 crore 8th Plan

Investment for the Central Marketing Organisation will aggregate to Rs.200 crores for the 9th Plan of which the spill over from the 8th Plan will account for Rs.42 crore

Alloy Steels Plant

Total 9th Plan outlay - Rs.215 crore envisaged

Including spill from - Rs.56 crore 8th plan

New AOD Convertor (Rs.31.4 crore) and introduction of High Power Transformer by EAF would ensure capacity of liquid steel to increase from a present level of 2,60,000T to 3,55,000 T in 2001-02. Introduction of Billet Caster (Rs.50 crore) would reduce ingot route to ensure better yield and quality.

Salem Steel Plant

Total 9th Plan outlay - Rs.125 crore envisaged

Including Spill from - Rs.22 crore 8th Plan

Apart from full utilisation of existing hot and cold rolling facilities, introduction of backward integration of SSP at Rs.600 crore (investment in 9th plan-Rs.87.4 crore) would start from the end of 9th Five Year Plan. The major envisaged facilities of this backward integration are :

- Electric Arc Furnace
- Converter
- Argon Rinsing Station
- Slab Caster

APPENDIX - A

M.E.L.

Total 9th Plan outlay - Rs. 17 crore envisaged	SAIL plants would continue to meet its major ferro-manganese requirement from the plant.
Including spill from - Rs.1 crore 8th Plan	

V.I.S.L.

Total 9th Plan outlay - Rs. 91 crore envisaged	To have better benefits from recently installed Blast Furnace, plant would introduce new facilities like New Sinter Plant (Rs.50 crore), new pig casting machine and new stand at NRM.
Including spill from - Rs.29 crore 8th Plan	

A.III FINANCING OF CAPITAL EXPENDITURE DURING 9TH PLAN

The proposed plan for financing the capital outlay of Rs.15,000 crores planned for 9th Plan period is as under :-

	Rs.crores
i) Internal Resources	
- Net Profit	11400
- Add: Depreciation	5700
- Total Resource Generation	17100
- Less: Tax payable	3420
- Less: Dividend	2066
- Gross Internal Resource	11614
- Less: Loan Repayment (net of SDF)	4115
- Less: Increase in Working Capital etc.	1000
- Net Internal Resource	6499
ii) Extra Budgetary Resources	
- Addl. Equity including premium	2750
- ECB/Suppliers' credit	600
- Bonds/Market Borrowings	5151
- Total EBR	8501
Grand Total (i)+(ii)	15000

2. Internal Resource Generation

2.1 The gross internal resource projected to be generated during the Ninth Five Year Plan is estimated at Rs.11,614 crores. The net internal resource estimated after providing for loan repayment, increase in working capital etc. is Rs.6499 crores as per details furnished below :-

Parameters	Amount(Rs/cr.)
Gross Margin	24600
Interest	7500
Depreciation	5700
Net Profit	11400
Total Resource Generation (Net Profit + Depreciation)	17100
Less: Tax Payable	3420
Dividend	2066
Gross Internal Resource	11614
Less: Loan repayment (Net of SDF)	4115
Increase in Working Capital etc.	1000
Net Internal Resource	6499

RASHTRIYA ISPAT NIGAM LIMITED
VISAKHAPATNAM STEEL PLANT

NOTE ON PHYSICAL AND FINAINCIAL TARGETS SET WITH REFERENCE TO THE TERMS OF REFERENCE OF THE SUB-GROUP

1. Presently VSP has the capacity to produce 3.4 million tonnes of Hot metal, 3 Million tonnes of liquid steel, 0.56 million tonnes of pig iron and 2.656 million tonnes of saleable steel in the form of long products only.

Keeping in view the productivity potential of its various production units, the Companny has planned to introduce certain new technologies for productivity improvement with the resultant rise in the production of both hot metal and liquid steel. The idea is to attain change in the product mix of the Company by using the increased output of liquid steel to produce finished steel of flat products which will help enlarging its market share by offering attractive package consisting both long and flat products to the customers in comparison to its other market competitors. The present facilities available with the Plant enables the Company to produce only finished steel in form of long products. The total capital outlay required to be made for attaining above over the years has been estimated at Rs. 1034 crores, the particulars of which, scheme-wise, are as under:-

SNo.	Descriptin	Cost Rs. Cr.	Tear of commence-ment	Year of commissioning
1.	Coal Dust Injection	40	Early 1996	Sept.1998

2. Combined blowing-off	10	Early 1996	March,1997	
3. Expansion to 4.05 MT Liquid steel				
a) Slab caster and Ladle furnace (Phase-I)	259	1996-97	Sept.1998	
b) Addl.Two Converters (Phase-II)	725	April,1999	Sept.2001	

The table appended below gives the particulars regarding phasing of above capital outlay required for the schemes, year-wise:-

(Rs. Crores)

S.No.	Description	Total Investment	1996-1997	1997-1998	1998-1999	1999-2000	2000-2001	2001-2002
1.	Coal Dust Injection	40	15	18	7	--	--	--
2.	Combined Blowing	10	9	1	--	--	--	--
3.	Expansion to 4.05 MT							
	a) Slab Caster	259	33	118	96	12	--	--
	b) Converters	725	--	--	--	66	323	302*

*Balance Rs.34 crores to be spent in the year 2002-03.

3. Apart from above RINL also proposes to go ahead with the project for setting up one more Turbo generator (TG-5) to attain self sufficiency towards its requirements for power. This TG-5 is estimated to cost around Rs.100 crores and the scheme is proposed to commence in 1996-97

subject to obtaining necessary approvals for that. Yearly investment on above Capital outlay of Rs.100 crores shall be distributed as under:

1996-97	Rs.14 crores
1997-98	Rs.77 crores
1998-99	Rs. 9 crores

4. The present 3 million ton plant of RINL started its commercial operation in 1992-93. Since then the varous production units of the Plant have been in continuous operation. Besides incurring expenditure on carrying out regular repairs and maintenance of these units to keep them in proper working order, certain investments are also required to carry out a few schemes of Additions, Modifications and Replacements (AMR) in the equipments available in different productive units in order to either improve the operational efficiency of the Plant or to increase their production capacity, attaining cost reduction etc. Total investments required for implementing the various AMR schemes in phases between 1995-96 and 2001-2002, as identified by RINL, have been estimated at Rs.235.96 crores, to be distributed yearly as under:

1995-96	Rs.25 crores
1996-97	Rs.35 crores
1997-98	Rs.35 crores
1998-99	Rs.35 crores
1999-2000	Rs.35 crores
2000-2001	Rs.35 crores
2001-2002	Rs.36 crores

The particulars of major items to be covered under the aforesaid AMR scheme are given in a separate list marked with letter 'A' attached.

5. The need for introducing technology improvements in the various operational and manufacturing processes

involved in the integrated steel manufacturing sector in order to render them more and more cost effective and cost competitive in the context of present globalisation of country's economy, has assumed paramount signifiance and importance. It is in this background the work in the field of Research and Develpment work must gain momentum with required investments in this area. Accordingly RINL has planned to invest Rs. 20 crores for carrying out Research and Development work between 1995-96 and 2001-02 of which Rs. 12.00 crores will be spent during the 9th Plan period. The yearly break up of above invesment of Rs.20 crores are as under:

1995-96	Rs.3 Crs
1996-97	Rs.5 Crs
1997-98	Rs.3 Crs
1998-99	Rs.3 Crs
1999-2000	Rs.2 Crs
2000-2001	Rs.2 Crs
2001-2002	Rs.2 Crs

6. Summarised position regarding implementation of all the projects/schemes referred to herein above at paras 1 to 5 with size on investments required for each, yearwise, have been given in a separate statement marked with letter 'B' attached. Excepting on implementing the scheme for Capacity expansion of the existing plant to 4.05 million tonnes of liqud steel from 3 Million tonnes and setting up of one slab caster with two additional converters, no extra manpower requirement is envisaged on implementing any other project/scheme listed in the enclosed statement marked with said letter "B". With the implementation of said scheme of capacity expansion to 4.05 million tonnes of liquid steel, the additional manpower requirement has been projected to go up by about 600 Nos. in all.

MAJOR ITEMS OF AMR SCHEMES PROPOSAL

(Based on approval given in August 1995)

Sl. No.	Proposal	Dept.	Category	Cost (Rs.in crores)
1.	Innstrumentation in BF export system	BF 2	Tech Requirement	10.00
2.	Gega cutting machines (6 Nos.)	SMS	Tech Requirement	12.78
3.	Automation of CCD	SMS	Tech Requirement	60.00
4.	Billet marking/ stamping machine	LMMM	Tech Requirement	20.00
5.	Modification for 6 m 320 y 250 for MMSM	MMSM	Tech Requirement	15.00
6.	Hydraulic mudguns	BF	Tech Requirement	10.00
7.	Third HFL line	SMS	Tehc Requirement	15.00
8.	Installation of 2nd stream of boiler coal system	TPP	Prodn. Requirement	20.00
9.	Mines	OMQ	Mines	18.29
10.	Others	--	---	54.88
			Total:	235.95

SUMMARY OF PROJECTS & SCHEMES PROPOSED TO BE IMPLEMENTED UPTO 2001-2002

(RS.CRS)

SL.NO.	NAME OF THE SCHEME	APPROVED COST	ANTICIPATED COST	EXPENDITURE UPTO 31.3.95	IX FIVE YEAR PLAN 1995-96	1996-97	1997-98	1998-99	1999-2000	2000-2001	2001-2002	TOTAL FOR IX PLAN
A.	CONTINUING SCHEMES	8594	8763	8040	264	186	183	82				265
B.	NEW SCHEMES											
	a) COAL DUST INJECTION IN B.F.-1		40			15	18	7				25
	b) COMBINED BLOWING OF L.D. CONVERTERS		10			9	1					1
	c) EXPANSION TO 4.05m.T. OF LIQUID STEEL-TOTAL		984			33	118	96	78	323	302	917
	-SLAB CASTER		259			33	118	96	12			226
	-CONVERTER		725						66	323	302	691
	d) TURBO GENERATOR-V		100			14	77	9				86
C.	A.M.R. SCHEMES		236		25	35	35	35	35	35	36	176
D.	R&D AND FEASIBILITY STUDIES		20		3	5	3	3	2	2	2	12
	TOTAL	8594	10153	8040	292	297	435	232	115	360	340	1482

Approved Cost: Main Plant (Base: II Qtr 1992) - Rs. 8529 crs
Mines: (Base: IV Qtr 1987) - Rs. 65 crs
Total: Rs. 8594 crs.

Anticipated Cost: Main Plant - Rs. 8696 crs.
Mines (under revision) - Rs. 67 crs.
Total: Rs. 8763 crs.

APPENDIX-B

APPENDIX-C

WRITE UP ON SCHEMES/PROJECTS TO BE TAKEN UP DURING IX PLAN

Name of PSU/Scheme	Proposed Outlay (Rs./Crores)	Details
(1)	(2)	(3)
N.M.D.C.	Rs.1605 Crs	Rs.351 Crores outlay is on account of continuing schemes which is spill over from the 8th Plan. A major portion of this is for Bailadila 10/11A (Rs.295 crores). Other schemes include ultra-pure ferric oxide, value added products of blue dust and Arki Limestone scheme. Rs.150 crores is the outlay for additions, modifications and replacement (AMR). The new schemes proposed to be taken up during the 9th plan period have an outlay of Rs.1049 crores of which the major products are Kumarswamy Iron Ore Project (Rs.300 crore), Arki Limestone Project (Rs.275 crore) Bailadila-13 (Rs.300 crores). Other smaller projects include beach sand project and deposit 11-B joint venture, blue dust mining scheme etc. An outlay of Rs.22 crores is for R&D and feasibility studies.
K.I.O.C.L.	Rs.601 Crs.	Rs.61 crores outlay is on account of continuing schemes which spill over from the 8th Plan. These include second pellet plant and recovery of iron ore from tailings. New schemes envisaged in the 9th plan have an outlay of Rs.151 crores which include Nellebeedu Mine Development Project (Rs.100 Crs.), coke oven project (Rs.45 Crores) and Gangrikal Mine Development Project (Rs.6 Crores). The outlay for AMR is Rs.386 crores and outlay for R&D is about Rs.2.5 crores
M.O.I.L.	Rs.58 crores	Rs.4.75 crores spill over from 8th plan which includes megnetic separation plant at Dongri Buzurg Mine, mechanisation of ore handling in underground mines, mechanised upgradation of lumpi ore at Balaghat Mine etc. Outlay for new schemes is Rs.23 crores which include Ph.II of ferro manganese plant, renovation of Balaghat Mine, new vertical shaft at Gumgaon mine, installation of advance upgradation facilities for -25mm ore. Sinking of shaft

		at Ukwa Mine etc. An outlay of Rs.25 Crores is for AMRs and an outlay of Rs.2.50 crores and Rs.3 crores is proposed for townships and R&D respectively.
S.I.I.L.	Rs.67 Crores	There are no continuing schemes. However, Rs.2.50 crores is the proposed outlay for AMR schemes and Rs.64 crores for new schemes which include 60000 tonne sponge iron plant (Rs.50 crores), steel making facility (Rs.10 crores) and coal beneficiation plant (Rs.4 crores). There is no proposed outlay for townships or R&D.
B.R.L.	Rs.39 Crores	The company has planned for implementation for some new schemes and AMR schemes with an outlay of Rs.39 crores which will require budgetary support. No other schemes are engisaged.
H.S.C.L.	Rs.39 crores	The proposed outlay for the 9th plan is meant to be used for AMR schemes and will require budget support. No other schemes are envisaged.
M.S.T.C.	Rs.15 crores	The proposed outlay for new schemes likely to spill over to 9th plan is Rs.5 crores, while an outlay of Rs.10 crores is envisaged for new schemes in the 9th plan.
F.S.N.L.	Rs.59 crores	The proposed outlay of Rs.59 crores is for AMR schemes. No other schemes are envisaged.
Bird Group of Companies	Rs.110 Crores	An amount of Rs.40 crores is for AMR schemes while an amount of Rs.70 crores is proposed outlay for new scheme i.e. for sinter plant and small blast furnace project.

INVESTMENT PLAN BY TISCO FOR JAMSHEDPUR PLANT

Modernisation Phase IV : Total Cost Rs 2425 Crores

Phasing of Expenditure

TotalRsCr	95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03
2425	12	313	719	444	523	304	110	0

Phasing of Foreign Exchange (included above)

Sl. No.	PROJECT	F.E. COMPONENT Rs. Cr.	PHASING OF EXPENDITURE							
			95-96	96-97	97-98	98-99	99-00	00-01	01-02	02-03
1	Sinter Plant 1 & 2	800		100	440	200	60			
2	L.D.Shop # 1									
	CC Upgradation	300		100	100	100				
	VADR Splitting	100			100					
3	Bloom Caster	6300			600	0	3000	1800	900	
4	L.D.Shop # 2	8000		1250	2900	1950	1900			
5	3 rd Slab Caster	6000		1200	2300	1500	1000			
6	Hot Strip Mill	22500		4700	11300	4000	2500			
7	B.R.M. # 2	8200		1000	2500	2200	1800	700		
8	H.L.S.M.	10500				2920	1950	4560	1070	
9	Information Tech. Facilities	1000			200	300	300	200		
10	Other Infrastructure Facilities	3300		360	2640	300				
	TOTAL	67000	0	8710	23080	13470	12510	7260	1970	0

CHAPTER- VIII

Technology Issues

1 INTRODUCTION

1.1 The Indian steel industry has grown over the last four decades, using the following five technological routes in the two different sectors :

Primary Sector

1. Coke ovens - blast furnace - basic oxygen furnace:

Secondary Sector

2. Scrap based EAF steelmaking ;
3. DRI based EAF Steelmaking ;
4. Mini BF based plants ; and
5. Induction Furnace based plants.

1.2 State of Technology

A cursory examination shows that the performance of the Indian steel industry using four of these five routes, is much below the current international norms due to the inferior state of technology of the Indian steel industry. For example, India stillproduces 26% of its steel through OH route which is obsolete in other advanced countries. Only 20% of India's steel is secondary refined whereas it is much higher in the advanced countries. A meagre 16% of India's steel is continuously cast . Indiansteel plants generate 2 times more slag and dust , 20 times more waste water and 5 times more waste gases compared to developed countries . Energy consumption is 8 to 13 Gcal/tcs in India whereas it is only 4 to 6 Gcal/tcs abroad . Indian steel production incurs 31% of its cost on energy whereas it is much lower elsewhere . Advanced instrumentation and automation are extensively used abroad to achieve quality and cost reduction. But their use in India is meagre.

1.3 However, in spite of the inferior state of technology used to produce the Indiansteel, its cost is low due to the unusually low cost of our primary raw material and also of our labour . The indications are that these two advantages would be rapidly eroded in future, making the Indian steel less competitive, unless our technology improves significantly.

The technological performance of Indian steel plants , in terms of specific energy or power consumption , specific consumption of raw materials and consumables, environmental and pollution norms and cleanliness, is significantly lower than that of the advanced countries. On the other hand, the newly commissioned DRI plants particularly the gas based ones, compare favourably but they too are yet to fully establish good norms of perform-

ance and of quality in their steel products.
The inferior performance of the Indian steel plants is often due to the inefficient use of technology, mismatch between the imported technology with the indigenous situation, obsolete technology and technological indiscipline. Further, the Indian steel industry, until recently, has been engaged in production-driven marketing' instead of the market-driven production' as it should be. As a result, bulk of the tonnage steel made in India belongs to the garden variety, with very little appreciation of what specific steel one should use for a given application.

1.4 Challenges

An analysis of the past patterns of steel consumption over the last four decades in India shows that the consumption of steel in India has grown at a steady rate , The current indications and projections are that during the next three or four decades, the growth rate in consumption would be higher. To match this consumption, the production in the Indian steel industry has to grow phenomenally. While organizing such a growth, the environmental issues which over the last several decades have not received the requisite attention, will need carefully focused technological inputs.

1.5 The customers are now free to obtain the steel produced abroad, through state-of-the-art technology route which is less expensive , delivered on time , packed nicely and customized in respect of shape, size, quality and specification. Thus, if, the Indian steel industry is to survive, it has to reduce cost improve quality , and produce new and value added product which the customer needs. The survival of the Indian steel industry requires that this be done immediately. To beat the twin challenge of growth and global competitiveness, the Indian steel industry has to improve the technological performances of its existing plants -starting from raw materials to finished products - either through adoption of improved technological practices or through the modifications of plant equipment and facilities or alternatively, through the selection of new emerging technologies for new plants in the green field sites.

The performance status of integrated steel plants in India vis-a-vis their international counterparts is at Annexure 8.1 and comparative analysis of performance of EAF and DRI industry in India and their international counterparts is at Annexures 8.2 and 8.3.

2. NEW AND EMERGING TECHNOLOGIES

2.1 An assessment of the current use of technology

A comparison of performance characteristics of the steel plants abroad and in India (Annexures 8.1,8.2, 8.3) show that our performance in all the technological activities of steel making is considerably inferior. This inferior performance is due to inefficient use of technology, obsolete technology, the mismatch of Indian input materials with the imported technology, technological indiscipline and lack of proper work culture- all leading to low productivity of capital and labour.

Area of technological concern

While assessing and adopting any technology to the Indian scene, the following limiting factors should be kept in view :

First, most of our raw materials are adequate in quantity to sustain and expand the steel sector. Except for the quality of our coal, the quality of the other raw materials are by and large satisfactory. Our coals (both coking and non coking) are of inferior quality (in terms of ash content and coking properties) which has significant influence in the iron making operations.

Second, our poor infrastructure like power, transportation and communication and their poor reliability aggravate the whole process not just of selection of a technology, but also its adoption and scope of utilization.

Thirdly, the recent introduction of global competition in our steel industry, has forced the industry to improve the product quality, cost competitiveness and customer satisfaction amongst which the prime concern is product quality today.

2.2 Technological Improvement Schemes and their Scope

Improvement of the technological performance of an industry is a continuous process. While adopting any given technology, one has to select one or more of the four broad schemes :

1. Incremental Improvement Schemes - Incremental improvement of the technological operations to reduce costs, improve quality, and to produce new value added product, with no or marginal investments (immediate measures).

2. AMR Schemes - Improvements in the performance of the existing units with comparatively less investment through addition, modification and replacement of minor supporting equipment (short term measures).

3. Modernisation Schemes - Introduction of improved technologies that call for large scale modifications of major plant and equipment and of the facilities requiring substantial investment. This can be generally taken up during modernisation programmes (medium term measures).

4. Emerging Technology Adoption Schemes - Selection of new and emerging technologies in green field sites. This calls for large investments (long term measures).

Which strategic one from one of these four schemes should be chosen is a very complex decision one has to make while acquiring any modern technology. An informed decision making in this matter, requires a comprehensive expertise in technology management, which is yet to be developed in our country.

2.3 New and Emerging Technologies in the Horizon- Status and Relevance

A large number of new technologies currently available can be introduced in our steel plants.

Annexure 8.4 lists major technologies available for the different areas of iron and steel making. It also indicates the most appropriate one of the four schemes mentioned above , which could be used to introduce or adapt a given technology. While many of the technologies mentioned in Annexure 8.4 are sometimes practiced in India, others are yet to be introduced; and yet some others are still under development..

In order to facilitate the assessment of the technologies in the Indian context, the new and emerging technologies have been categorized based on the stage of their development or adoption in India :

Category A: New technology which is either at an advanced stage of development or very recently introduced in a commercial or demonstration scale.

Category B: New technology which has been established abroad, but is yet to be introduced in India.

Category C : New technology which has been introduced in India but is not practiced widely.

Annexures 8.5, 8.6 and 8.7 contain details of the technologies belonging to the categories A, B and C respectively. Based on the above categorization, technologies have been classified according to their technological areas such as:Mineral Beneficiation, Coal & Chemicals , Alternate Iron Making Processes, Direct Reduction, Steel Making, Shaping & Rolling, etc. and they have been examined with regard to their basic technical features, relevance to India, feasibility of their introduction and their current status.

2.4 Assessment of a few Promising Technologies & Recommendations

Beneficiation of raw materials

Major producers like SAIL & TISCO, wash and beneficiate their raw materials such as iron ore or lime stone. The Coal India washes its coking coal to bring down the ash content from around 25 % to about 17 to 18%. However, at present 40 to 45% of the coking coal required in the country is being imported. Coal based DR industry uses indigenous non coking coals of ash content 25% and above. The VM content of these coals are also higher than desired. With the advent of new iron smelting technology like Corex, we need superior quality low ash low VM coals (ash less than 10% and VM less than 20%) from indigenous sources if large scale import of such coal is to be avoided. The information available from Coal India sources indicate that with the deregulation of coal import, it may be possible to provide superior quality coal by adopting large scale washing of non coking coal obtained from selected deposits. This possibility should be explored.

The standard well established beneficiation technologies available, such as Jigs, Froth Flotation, Mozeley Separator, Cyclones,Whims,etc.,could be adopted for the beneficiation of coals and other minerals. These technologies can be introduced under addition, modification, replacement or modernisation schemes as applicable to the specific coal deposit.

The beneficiation of coal fines using Carpco's Flotex Density Separator is a recent innovation. It has shown highly promising success in the upgradation of fine coal (100 mesh and below). A clean coal product with a very high recovery of combustible material, has been established in pilot scale test with a high efficiency of the circuit. The technology is not yet available in commercial scale. The potential use of Flotex Separator and other beneficiation techniques to reduce ash in our coking coals, should be immediately explored.

Direct Reduction Technologies

Direct Reduction (DR) Technology is well established in the country. Two promising, new technologies under development at present are likely to reach commercial stage soon : FASTMET (coal based) and Iron Carbide (natural gas based). These technologies have reached demonstration stage and may be available in 3 to 5 years' time. A brief assessment of the two processes is at Annexure 8.8. These technologies can be introduced in the green field site plants as well as during modernisation.

New Iron Smelting Technologies

Intense efforts made in the last two decades to develop alternate iron smelting technologies based on non coking coals, resulted in the development of quite a few processes. These technologies fall under two distinct groups :

.Smelting Reduction Process

.New Technologies Based on Blast Furnace Concept

Most of the smelting reduction processes (except Corex Process) are still under development and are unlikely to be available before 2000 AD. The important features of these processes are :

- **Elimination of Coke**
- **Minimum preparation of the charge**
- **Lower economies of scale**
- **Flexibility of accepting wider variety of raw materials and quick turn down**
- **Much less environmental impact.**

Major technologies in this field are : Corex, Romelt, Hismelt and DIOS. Annexure 8.9 gives the status and assessment of these technologies.

While Corex process is already commercialised, others are still under development and may be available by 2000 AD. Romelt process has been tested in a fairly large scale and is ripe for commercialisation. Romelt process is simple, requiring much less space, and could be fitted well within the existing building structures of a plant in the primary sector.Hismelt and DIOS processes are being operated in large scale pilot plants since 1994. These technologies are more appropriate for green field site plants though existing old blast furnaces may be replaced by a unit of Corex or Hismelt.

The new technologies based on the BF concept are the oxy-fuel process and the nitrogen-free blast furnace. The oxy-fuel process holds immense potential in eliminating the dependence of coke to a great extent. The processes are still under development and may take a few years to reach commercial stage.

Direct Steel Making technologies

Most of the technologies mentioned above are designed to produce liquid hot metal. Research is also being carried out to develop processes to make steel directly from ore. One such attempt is the Resiness Process where non-coking coals are used to pre-reduce iron ore fines in an externally heated retort. The resulting DR rod is then smelted in an electrically heated slag bath to produce steel. A large scale bench testing facility to try out the Resiness process is being planned. The initial preliminary work to test the concept was carried out at NML, India.

Coke Making

New technologies that are available in this area are being practiced in a commercial scale abroad. However, they have not been widely introduced in India. Stamp charging particularly offers significant improvement in productivity and coke quality under Indian conditions as has been established by TISCO. Non recovery ovens, which operate on a small scale and do not produce pollutants like the conventional by product ovens, have become particularly significant with the establishment of mini blast furnaces.

A brief write up of these two technologies is given in Annexure 8.10. It may be noted that both the technologies can be adopted during modernisation or in green field locations .

Blast Furnace Process

Expert systems and B.F. control using mathematical models hold promise of significantly improving the performance. Use of these systems offer better process control, improves hot metal quality and BF productivity and provides diagnosis during troubleshooting. They could be introduced in most of the existing blast furnaces with least modification and are highly recommended.

BOF Steel Making

Pretreatment of hot metal, dynamic control of BOF process, production of high alloy steels are some of the modern technologies in BOF based steel making. These technologies can be introduced in existing setups providing additional benefits. More details are presented in Annexure 8.11. For producing quality steel, pretreatment of hot metal is a pre-requisite. Adequate attention has not been given to this area so far. Suitable system compatible with the individual plant's needs must be introduced in all the steel plants.

EAF Steel making

Almost all the technologies in this area have been well established abroad and are being continuously refined. Details are in Annexure 8.11.

Many of these technologies such as Foamy slag practice, UHP transformers, EAF bottom stirring, scrap pre-heating, DC EAF, oxygen assisted melting etc. are yet to find wide acceptance in India. These techniques are basically productivity enhancement tools or energy saving measures, and can be introduced under AMR or modernisation schemes .

Steel Casting and Rolling

The major technologies in this area are: thin slab casting, thin strip casting and continuous rolling. These are breakthrough technologies which would provide immense benefits in terms of the cost, quality and productivity. Thin strip casting and continuous rolling have been briefly described in Annexure 8.12. Thin strip casting is still under development in some of the advanced countries. In Japan, it is expected to become commercial very shortly.

Continuous rolling technology with sophisticated instrumentation and control systems have already been demonstrated in advanced countries and as such may be considered for introduction in existing as well as in new mills, under the modernisation programmes .

Recommended list of New Technologies

Based on the assessment of the various technologies presented above and in Annexures 8.8 to 8.12, a short list of recommended technologies for adoption in the Indian steel industry has been prepared . This list includes those technologies which appear to be more relevant to our general needs.

The list has been divided into two groups :

The first group (presented in Annexure 8.13) includes technologies which would be introduced as short term measures with minor modification of existing systems and with less investment.

The second group (shown in Annexure 8.14) includes major new technologies ,some of what which would only be available in future, which can be introduced only as a long term measure since they require substantial investments.

The prospect of introduction of each of these technologies in the first and the second group and their techno-economic viability, should be assessed for each specific project, while evaluating different technological alternatives.

2.5 Energy Conservation Measures in Steel Plants

Steel industry by its very nature is highly energy intensive. Since energy accounts for about one third of the cost of production in Indian integrated steel plants, top priority should be given for its conservation. Main energy input to steel plants are coking coal, steam coal, petro-fuels and purchased electricity.

Due to various measures adopted, specific energy consumption in SAIL plants has reduced from 11.27 Gcal/tcs (1986-87) to 8.84 Gcal/tcs (1995-96). Annexure 8.15 shows specific energy consumption of different integrated steel plants which shows a downward trend in energy consumption during the last 10 years. More investment in technologies, superior input materials, and strict adherence to technological norms are required to lower it to the international level.

Annexure 8.16 shows various energy conservation schemes which are being increasingly adopted by the steel industry to reduce energy consumption. The possibility of adopting them by the individual Indian steel plants should be explored.

3. RESEARCH & DEVELOPMENT

3.1 Current Status of : Research, Technology and R&D Expenditure

Research Status

The status of steel research in the country had been extensively studied and analyzed in a recent report, which concludes that the steel research :

- . is very small in volume;
- . is pursued in isolated pockets, without an overall integration on a national level to pursue a given mission,goal or objective;
- . is not using well-defined procedure or criteria to select a project or a programme;
- . is unconnected to the users;
- . does very little in the vital area of major technology development ; and
- . has hardly any impact in the world scenario (no major technology has ever been exported from the country).

Yet considerable expertise, a large number of qualified scientists and research engineers, reasonably good experimental facilities and capabilities exist in the various institutes, laboratories, and the in-house R&D of the industry, for pursuing steel research.

Technology Status

The position on the technology front is even worse. No major technology for the steel industry has been developed indigenously. Almost all the major technologies have been purchased off the shelf from abroad. The purchase of such expensive technology or even its use or retirement, have not been accomplished through a properly institutionalized pursuit nor is it based on the careful analysis, methodology or plan, such technology purchase requires.

The result is that it takes long time to stabilize the operation of the technology after the commissioning of the new plant. Besides, the performance of such technology when used in the country is below the international norm (see section I). What is equally disconcerting is that the compatibility of these technologies with Indian raw materials and with our work culture and technology discipline environment has remained a nagging problem. The net result is that the payback and return on the investment made on the new technology are much less than what they could be.

These problems have stayed with us for the last four decades since there is no organized pursuit of technology management in the country. Thus, the technology management in the steel industry needs to be organized and used for the growth of the steel industry.

Dissemination of information related to technology is vital for improving the technological base in the country. Today, organized technology dissemination within the steel industry is negligible in our country. A proper mechanism for the collection, storage and dissemination of technological information needs to be defined and created.

The expansion and promotion of steel usage depends significantly on satisfying both the expressed and perceived needs of the customer or user. This is achieved abroad through systematic Application Engineering service. Unfortunately, this specialized activity is yet to gain any foothold in our country.

Expenditure in Steel R&D

India spends a meagre Rs.55 crores annually on steel research which is very low, 6 to 8 times lower than that in any advanced country in the world . In fact, the country's R&D expenditure on steel research is limited to a few companies like SAIL, TISCO, Mukand, Usha & Mahindra etc. The other primary producers and the secondary sector hardly spend money in an organized manner on steel research.

This disappointing picture can be corrected only if the government makes funds available to selectively support, in some instances fully and in other instances partially, - either as a matching investment or as a matching expenditure. This is the only way to stimulate the pursuit of steel research and technology development by the steel producers and users, who at present see little merit in such activities. The government must plan for an additional expenditure of Rs.150 crores per year in steel research and technology development.

3.2 A New Approach to the Organization & Management of Research: Partnership Model

R&D in our country quite rightly has often been accused of being theoretical or academic - without any concern for or a linkage with, the customer or user. Therefore, it is often referred to as a waste of money by the steel industry. In this context , the unique R&D system developed at RDCIS,SAIL is relevant .If the approach and model are adopted in the organization & management of all the projects selected, organised and funded by the proposed mission, it can overcome the traditional limitations experienced in the past in pursuing a R&D project.

3.3 Research & Technology Mission

The Indian government together with the R&D establishments and

the steel industry did define a mission in mid eighties. But it did not succeed due to the lack of :

- a proper organization, direction and clarity ;
- its linkage with different institutions and industries;
- well defined methodology of selection, execution and utilization of projects or programmes ;
- an authority who was to be fully responsible for accomplishing the mission (the responsibility was entrusted to a committee) ;
- definition of programmes ; and
- the source of fund etc.

The purpose of instituting a mission is valid even to-day but the concept and the content of mission needs a total redefinition. Also it needs a proper policy and mechanism for its operation. Equally important is the definition of a strategy to apportion the resources at the command of the mission .

To accomplish the purpose , the government should set up a Steel Research & Technology Mission fully empowered, and entrusted with the responsibility to accomplish it ; and fully answerable for failing to do so. The government should institute a corpus of funds and entrust it to the mission. The annual funds required could be provided by the annual interest earned by the accumulated interest of SDF. The first job of such a mission would be to define the policy, mechanism, strategy and most important of all its Programme - in consultation with industry, academia and laboratories.

3.4 Thrust Areas of Research & Technology

The mission must bring together the industry, academia and laboratories to evolve a national policy and generously fund the pursuit of Research and Technology Development activities in the following thrust areas :

- adoption of new and emerging technologies to the indigenous situation ;
- incremental improvement of the current plant performance to international levels ;
- solution to our long standing problems of raw materials etc.
- minimization of energy consumption in our steel plants;
- minimization of pollution levels and better utilization of wastes ;
- development of new and better refractories ;
- introduction of automation, instrumentation and computerization in all spheres ;
- development of major technologies ;

- pursuit of good quality fundamental research ;
- Pursuit of carefully selected R&T Programmes ;
- development of new products with improved properties, better cleanliness and easy applicability;
- forestalling of inter-material competition ; and
- Organization and Management of Research & Technology to meet the needs of customer and user.

4. ENVIRONMENT PROTECTION

4.1 Present Status of Environment Protection in Indian Steel Industry

The manufacture of steel consumes substantial resources and leads to complex environmental problems. The processes are energy-intensive with coal as the main energy source. The consequent release of large amounts of carbon dioxide has global implications. On the global level, the steel manufacturing process ranks second among industrial carbon dioxide emitting sources, next only to thermal power plants. The unit carbon dioxide emission per ton of crude steel from a Japanese steel plant like Mizushima works stood at 268 kg carbon equivalent per TCS in 1987, whereas the level for a typical present day Indian steel plant would be around 500 kg carbon equivalent per TCS.

Origin of Indian Environmental Problem

The Indian steel industry generates 4 to 5 times more waste water and gases and almost double the BF and BOF slags and other solid wastes compared to international levels . Energy consumption is also about two times higher. The associated environmental problems, therefore, need to be addressed suitably with a view to minimise their impacts. The recent intervention of the Supreme Court of India for the timely implementation of recommended pollution control schemes reflects this growing concern and urgency.

4.2 Current Environmental Issues

Indian emission norms are generally less stringent when compare to the international standards. Various emissions from different processes are shown in Annexure 8.17. The Indian steel industry currently faces the following major environmental issues which need immediate as well as long term attention:

- control of secondary emissions mainly from coke ovens, sintering plants, blast furnaces etc.
- control and utilisation of solid wastes generated from various operations
- reduction in water consumption
- reduction of the noise levels and of the release of hazardous fine dust containing Zn & Pb in mini steel plants using EAF
- low efficiency of pollution control equipment due to the lack of priority on their maintenance and operation schedules

- adoption of cleaner technologies or processes for reduced energy consumption resulting in minimisation of CO_2 emissions
- long term plant-specific plan and its progressive implementation to respond to the increasingly stringent pollution norms which are likely to be enforced in our country, in future.

4.3 Approach Towards Improvement

In order to meet the environmental challenges ahead, Indian steel plants need to plan and introduce the appropriate technologies in the next five years as also in the subsequent years and the suitable scheme to implement it. These are indicated in Annexures 8.18 to 8.20. The ultimate objective of producing "green" steel can be achieved to some extent by adopting new and emerging ironmaking technologies which are in the various stages of development or implementation. These technologies are found to be more environment friendly and energy efficient. One recent tool for comprehensive evaluation of environmental impacts is Life Cycle Assessment (LCA), which analyses both "direct" and "indirect" environmental, energy and resource impacts associated with the various stages of the life cycle of a product or process.

Besides, the implementation of ISO-14000 (applicable to Environmental Management Services) being developed by International Standards Organisation, addresses aspects like environmental audit covering material, energy, water, quality, health and safety audits. This can provide another powerful system for assessing the environmental quality in steel plants. SAIL, for example, has developed its Environmental Policy keeping in view the requirements of ISO-14000.

However, the transition from the existing technologies to environment friendly or clean technologies in many cases cannot be effected quickly, as major replacements or modifications can be carried out often, only at the cost of production. Hence the implementation of environment related programmes needs to be prioritised so that these could be economically integrated with plant upgradation or replacements.

4.4 Safety Measures

The maintenance of safe operating standards for plant equipment and personnel is a key requirement along with a clean environment. All the steel producing units which do not follow these standards, should implement them as soon as possible.

Recommended measures include :

- Comprehensive instructions on specific hazardous jobs,with written protocol and defined responsibilities,
- Safety Audit of gas pipe lines and process equipment, conducting job safety analysis of dangerous operations, etc. and
- A Safety Management System, with a concept of "Total Safety" to be introduced in all plants and units.

4.5 Recommended Measures

- The sporadic adoption of improved process control technologies have reduced environmental impacts in Indian steel plants. However, this has to be progressively implemented in all relevant units uniformly.

- The adoption of appropriate technologies for utilisation of solid wastes in conventional steel making processes will produce almost 80% utilisation and will also reduce waste dumps.

- Some major water conservation schemes can reduce water consumption in various processes to a level of 10 to 12 m3/TCS.

- To ensure increased availability and efficiency of pollution control equipment, a rigorous maintenance and operation schedule and the automation and computer control of pollution control systems are essential.

- A number of clean technologies which are alternatives to the conventional BF route and eliminate coking and sintering, save energy. These technologies need to be examined and adopted in future.

- Hydrometallurgical processes like caustic leachelectrowinning can be adopted to recover Zinc and Lead from fine mini steel EAF dust, followed by use of residual waste as landfill.

- Emerging technologies like Plasma melting has demonstrated several benefits including reduced noise. Its potential to replace the EAF melting should be explored.

- A combined implementation of both LCA and ISO 14000 could bring about enormous benefits to any steel industry in terms of awareness and maintenance of environmental measures.

- Safety function should be reinforced to give special emphasis on occupational-health aspects.

- Analysis and investigation of work area toxicity should be undertaken.

- Transition from existing technology to more environment friendly technology, in many cases, cannot be immediate because of constraints in shop lay out and the nature of existing plant and equipment. Moreover, the level of expertise available for effecting swift changes are lacking in the country in terms of engineering consultancy as well as manufacture and supply of the required equipment.

4.6 INVESTMENT IN STEEL SECTOR FOR ENVIRONMENTAL PROTECTION

There will be substantial additional production by 2001-02 to meet the projected demand from integrated steel plants already under operation or under erection in Public and Private sector, namely, Steel Authority of India Ltd. (SAIL), Rashtriya Ispat Nigam Ltd.(RINL), Tata Iron and Steel Company Ltd.(TISCO), Jindal Vijaynagar Steel Ltd. (JVSL), MALVIKA, USHA ISPAT, Neelachal Ispat Nigam Ltd. (NINL), ESSAR Steel and other units including Induction Furnaces and Re-rolling Units. In addition, a few new steel plants in private sector will also be set-up in the States of Orissa, Karnataka and Maharashtra. SAIL is planning to invest about Rs. 15,000 crores for moderanisation of existing units during the IXth Five Year Plan. All these plants will have to set-up environmental control units in line with stipulated norms. Also all the new units may be required to comply with "Clean Coal Technology" requirement which is under finalisation by the Central Pollution Control Board. In line with these requirements, substantial investment will be required for environmental control in steel sector, broadly covering the following fields:

- Air pollution /water pollution control
- Waste management
- Clean technology in coke making
- Environmental Impact Assessment Studies
- Green belt development and other environmental management requirements.

According to MECON, the investment required for the purpose could be to the tune of Rs. 3500 crore during the IXth Plan period.

4.7 HIGH LEVEL OF CARBON EMISSION BY THE STEEL SECTOR

Carbon in the form of Carbon Dioxide and Carbon Monoxide is emitted in the atmosphere in various processes during manufacturing of steel. This causes imbalance in the quality of air. The prime cause of further warming of the earth is CO2 component of

the atmosphere, which is at present a mere 0.03% of the atmosphere by volume. Carbon monoxide however has special influence on climate because unlike atmospheric oxygen and nitrogen, it absorbs radiant heat. This special characteristic means that an increase in the carbon dioxide content of the atmosphere will increase the amount of sun's energy retained in the atmosphere.

It is estimated that before the industrial revolution, the CO2 content of the atmosphere was 195 - 260 ppm. The current CO2 content is about 334 ppm. It is rising at about 1.5 ppm every year. Due to high carbon dioxide emission from the steel plants, it is observed that in most of the steel plant towns, the atmospheric temperature has risen by 2 to 5 deg. C.

As emission of carbon dioxide and carbon monoxide from the steel plant is unavoidable , it is necessary to develop a thick green belt in and around the steel plant. The width of green belt suggested is from 100 m to 500 m. Technologies with low rate of coal consumption also need to be adopted. Segregating power generation and steel plant will help in reduction of concentrated CO2 emission in the steel plant area.

5. REFRACTORIES IN STEEL INDUSTRY

5.1 Role of Refractories

Even though the refractory constitutes only a small (about 4%) input into the cost of steelmaking, an improvement in the quality of refractory can dramatically reduce cost and improve quality of the steel produced.

High quality refractory product is essential not only for the growth but for the very survival of the Indian Iron & Steel industry, which is experiencing the impact of global competitiveness right at its door steps. Besides, emerging developments in the steel technologies require increasingly higher performance refractories.

To cope with these, the Indian refractory industry should take recourse to improved or new technologies to produce refractories of superior quality and sophisticated special products in order to :

- improve the productivity and the life of the steel plant units
- reduce steel making cost ; and
- improve the quality of the steel produced.

5.2 Present Status

Refractories are mainly used by industries like, iron & steel, cement, glass, non-ferrous, hydrocarbons and fertiliser. The relative consumption in Annexure 8.21 shows that the steel industry is the predominant consumer of refractories in India. The present installed capacity of refractory plants in India is around 15 lakh tonnes, spread over almost 60 non-captive units and captive plants of SAIL. Only 40 to 50% of this rated capacity has been utilised over the last decade. The production of refractories in India has been steadily increasing with the steel production (Annexure 8.22). This shows that the Indian refractory quality has not correspondingly improved.

Shaped Versus Unshaped

Annexure 8.23 shows that the quantity of 'Unshaped and Special Shaped Products' has doubled in India but with a corresponding increase in the production of 'Shaped Products'. In Japan, the global leader in refractories, the production of 'Unshaped and Special Refractories' has also increased but with a corresponding fall in the production of 'Shaped Products' during the same period. The use of monolithic (unshaped) in a steel industry is a good measure of state of refractory technology. India compares very poorly with the advanced countries, as regards the use of monolithic.

Specific Consumption of Refractories

The projected growth vis-a-vis the specific consumption of refractories of the major Industries is shown in Annexure 8.24. The specific consumption of refractories in the Indian steel plants has been steadily decreasing since 1985 and is expected to be around 20 kg/t of steel by the turn of the century. However, in Japan the specific consumption had reached a level of 12 kg/t of steel in 1990, which has been maintained since then.

In the secondary sector at present, the specific refractories consumption in EAF is 10 to 26 kg/tcs as compared with 2 to 15 kg/tcs in developed countries . In case of induction furnaces, it is reported that the specific refractory consumption with acid lining is around 7 kg/t and with basic lining, 4 to 5 kg/t respectively.

Customer Satisfaction and Application Engineering

Customer satisfaction is today a minimum requirement in the steel industry. Therefore, only way a supplier of a steel industry,such as the refractory industry, can develop and prosper, is by adopting the culture of satisfaction, of its customer and also of its customer's customer. To develop and produce tailor made refractory product with guaranteed quality and performance, the refractory industry must be organised to interact with its customers. A few refractory industry are equipped to do these and even still less number use the approach of application engineering, which the steel industry extensively uses in interacting with their customer. Yet this remains as the only means of developing the superior, customised refractories.

There is a critical need to produce high quality and customised refractory products for the selected areas of steel making activities. The Indian refractory industry has to respond to these needs.

5.3 Future Prospects

The requirement of the consuming industries is envisaged to increase by 40 to 80% by the year 2000 AD. This will not generate enough demand, to utilise the spare capacity already available in the Indian refractory industry.

An examination of the current Indian status and the target set for 2000 AD vis-a-vis the existing international norms (Annexure 8.25), reveals the obvious gaps. To overcome these gaps, the performance of the refractories in the following five areas are very critical.

- BF proper and Cast house
- Steel ladles
- EAF and IF
- Converters
- Continuous casting

During the next decade, the consumption of refractories will go up by only 26% if the steel production increases by 83% in view of the envisaged reduction in the specific consumption of refractory. The stringent demand on quality of steel will in turn call for a new product mix (a definite shift towards monolithic) in refractory industry and better quality refractories.

The total installed capacity of the Indian refractory plants is adequate enough to produce additional tonnage of refractories. But only 50% of the existing refractory plants are equipped with the modern infrastructure facilities to produce the 'quality refractories', which alone can meet the stringent metallurgical needs of the steel industries.

In addition, the availability of high quality raw materials for the refractory industry in India has also been a long standing acute problem area identified long since. This will be even more acute in future.

The measures which would enable the refractory industry to meet the above challenges are indicated below :

5.4 Recommended Measures

Blast furnace proper & cast house, converters, EAF, IF, steel ladles and continuous casting are the prime areas of concern, in which the refractory performance has to be improved significantly. To improve quality of and to develop new and value added refractory product, the technological inputs required in the prime areas of concern are identified in Annexure 8.26. The technological inputs have to follow one of the four strategic schemes which were identified earlier.

1. Incremental Improvement Schemes (IIS) ;
2. Addition, Modification & Replacement of plant equipment (AMR) ;
3. Modernisation of Existing Plants and Facilities (MEP) ; and
4. New Technology Adoption Schemes at green field site (NTS).

The overall matrix of the refractory developmental work required in several application areas will consist of :

- technological routes followed for steel making ;
- the multiplicity of units using refractories in a steel plant ;
- the five different critical areas as identified in section 5.3 ;
- various constraints the individual groups of refractory makers face; and
- the four schemes described above.

A combination of some or all these variables produce a large number of complex customer-specific, supplier-specific and application specific problems many of which are rather critical for the Indian steel industry.

Developmental Work in Partnership Mode

The large number of these critical technological problems that the refractory manufacturer and the steel plant face in the wake of global competitiveness, can be solved only if the suppliers and customers continuously interact to pursue developmental work in a partnership mode.

To overcome the complex problems indicated above, the recommendation for technology development is made in the following six activity areas as given below.

Development And Beneficiation Of Refractory Raw Materials

The availability of high quality raw materials for the refractory industry has to be rapidly improved by simultaneously pursuing all the three approaches as given below :

1. Beneficiation of Magnesite, Bauxite, Chrome, Kyanite or Sillimanite and Graphite:

   - Today, none of these minerals except graphite, are beneficiated. Even graphite beneficiation currently followed, needs extensive improvement.

   - The refractory industry should invest around Rs. 75 to 120 crores (depending on whether it is MEP or NTS) in the beneficiation plant, since it is estimated to yield adequate return.

   - The expertise and facilities available at IBM, NML and other National R & D Centres and refractory manufacturers, should be pooled to develop mineral-specific,deposit-specific beneficiation flow sheet. The R&D work for such development should be commissioned and supported by the industry.

2. Production of Synthetic High Purity Raw Materials : Spinel; Mullite; abular Alumina; Mullite-Zirconia; Sea Water Mgo-Sinter; and Pure Calcium Aluminate Cement (cf. CA 25):

   - Refractory manufacturers should join hands with the R & D centres and undertake development work for the commercial production of these special products and investment in AMR schemes.

- Some of these materials are now imported, the notable amongst these is sea water magnesia for which the import dependence must be eliminated as soon as possible.

3. Production of Fused Grains of MgO and Spinels :

- The producers of fused alumina grains, should diversify, plan and invest in AMR scheme to produce fused grains of MgO and spinels.

Development of High Performance Newer Refractories

To meet the demands of refractory, with improved quality and performance in the steel industry, the refractory manufacturers should undertake IIS scheme and wherever required AMR scheme, in a partnership mode with the steel plant to:

- develop sophisticated products;
- assimilate technology already imported; and
- develop new technology

New Generation Monolithic with appropriate Application Engineering

The refractory manufacturer with appropriate facilities and developmental capabilities, should join hands with a R & D Centre and involve also a steel plant in a partnership mode to :

- develop new generation monolithic ;
- perfect the appropriate application engineering of the monolithic ;
- upgrade its operation and maintenance to achieve state-of-the-art technology ; and
- increase production of monolithic.

A refractory industry having relatively modern facilities must diversify to produce at least 20% more monolithic and prefabricated shapes made thereof.

Up-Gradation of Manufacturing Facilities

The manufacturing facilities of some of the refractory manufacturers should be upgraded as indicated below :

1. The prime refractory manufacturers in the public and the private sectors should invest in AMR or MEP schemes described earlier, to meet the future demand and challenges imposed by increased productivity or improved quality required in consuming industries.

2. These manufacturers should import more of the contemporary facilities depending on the products in

which they want to specialize : isostatic press; high pressure briquetting press; tar impregnation eqipment; high temperature batch type kilns; mills for microfines and vibrocasting facilities. All of these would require a total investment of about Rs. 60 crores. The return on investment would be significant.

Implementation of Modern Designs and Improvement in Repair Techniques

To prolong the refractory life, steel plants in collaboration with their R & D Centres should take the supplier of refractory as a partner and pursue IIS and AMR schemes to develop new design and repair techniques using :

- state-of-the art repair technology;
- a programmed maintenance schedule; and
- indigenously manufactured equipment, tools, tackles and hardware

Innovation of Specific Products to meet the needs of the Specific Operating Practices

The R&D Centres of the steel or refractory industry, either alone or together with the other national R & D Laboratories, should undertake developmental programmes in the following areas (the technological improvement schemes under which they could be introduced have also been indicated within brackets):

- improve the quality of the existing products (IIS)
- manufacture tailor-made refractories to meet customer-specific needs (IIS) ;
- salvage wastes to make value added products (IIS) ;
- develop New Generation Monolithic like, ULCC, CLC, Pumpables, Plastics, Self-flowing and Sol-Gel bonded castables (Basic Research, IIS & AMR) ;
- demonstrate viability of beneficiation flow sheet for the refractory minerals to facilitate investment decision (IIS) ;
- develop Spinels, Tabular Alumina, Fused or Sintered pure MgO and Mullite and Non-oxide refractories (IIS) ; and
- design and develop refractory lining of EAF and IF to enable the use of a large percentage of DRI in the charge on a regular basis (IIS).

6. Summary and Recommendations

- The technological performance of almost all the activity areas in the Indian steel plants is significantly lower than the corresponding international norms due to : inferior or obsolete technology ; inefficient use of technology ; mismatch between the imported technology with the indigenous situation ; and the lack of technological discipline in our country.

- To survive the global competition produced by the gov ernment's new economic policy during the last five years,the Indian steel industry must improve the cost, quality and delivery of its steel product. Only then it can experience the phenomenal growth which awaits it in the next three or four decades.

- For all that, the Indian steel industry has to choose, acquire, absorb and utilize modern technologies and practices.

- New and modern state-of-the-art technologies can be adopted using a strategic mix of the four schemes discussed.

- The new and emerging technologies for the steel industry have been reviewed and assessed and based on this, a few selected technologies have been recommended for adoption in the Indian steel industry.

- Steel industry is highly energy intensive. Several new technologies are assessed to make recommendations for the adoption of energy conservation measures and use of energy efficient technologies.

- To face and survive the challenge of growth and global competitiveness, the Indian steel industry should reduce cost, improve quality & decrease pollution. It can do so only in a mission mode. Under the circumstances, an appropriate mission for the Indian steel industry is :

  "Emerge within the next two decades, as the producer of best quality steel at lowest cost, with least damage to our environment"

- Research and Technology will play the key role in accomplishing such a mission.

- Accordingly the Government should appoint a Steel Research and Technology Mission (SRTM) to organise, pursue and accomplish meaningful programmes in: Basic & Generic Research; Incremental Improvement of Performance; Major Technology Development; Technology.

Management: Technology Dissemination ; and Application Engineering.

- The R&D expenditure in Indian steel sector is very low compared to any advanced country in the world. It would increase 6 to 8 fold to come upto the international norm.

- Steel research in the country is very small in volume ;pursued in isolated pockets without an overall integration on a national level. SRTM should network the considerable expertise, capabilities, facilities and human resource which exist in academic institutes, national laboratories and industries in our country and work with them in partnership mode to solve the long standing problems of the Indian steel industry.

- RDCIS,SAIL has developed an approach and a model which is termed as partnership model', for the organization and management of research and technology development. These have aroused worldwide interest since it produced excellent results in terms of monetary benefit and satisfaction to the customer of R&D which are presented through figures, tables and annexures. This approach and model should be widely adopted for steel research and technology development in our country.

- SRTM should ; be an autonomous body and be provided with funds to the extent of Rs.150 crores per annum.

- The first job of SRTM should be to define the policy, mechanism,organisation structure, strategy and most important of all, its programmes

- The Indian steel industry generates almost double the total solid wastes, consumes 4 to 5 times more water and generates about 4 time more gases compared to those in the advanced countries. This is due to poor quality of our input material, continuation of old equipment or obsolete technology and improper implementation of pollution control measures.

- Efforts made by steel plants in the last decade has helped in controlling air & water pollution and noise emissions to a significant extent. However, more needs to be done. Also, secondary emissions and waste management are the main areas of concern right now.

- The unsolved environmental issues mainly relate to control of secondary emissions, minimization of solid waste generation and water conservation. The future

pollution control norms are expected to be more stringent even in our country.

* To meet these challenges, the industry must adopt in future:
  - Improved process control technology uniformly
  - Effective solid waste utilization schemes
  - Water conservation measures
  - Automation and computer control of pollution abatement
  - Clean technologies
  - ISO 14000 and LCA
  - Total Safety Management System particularly for occupation health aspects.

The SRTM will play a key role in encouraging and directly supporting some of these activities.

* Refractory is a vital technological input to iron and steel industry. In India only around 50% of the present installed capacity of the refractory plants (1.5 Mtpa) is utilized and hardly 50% of the existing plants are equipped with modern facilities. In the next decade, the capacity utilization of the refractory industry will increase much less when compared to the large anticipated increase of steel production. This is because the specific consumption of refractories will decrease significantly from its current level of 26-32 kg/t of steel in the integrated steel plants ; 10-26 kg/t in EAF; and 4-7 kg/t in IF sectors respectively. Therefore, the priority for the development of the refractory industry is not so much to increase the production, as much as, it is to modify the product mix and to significantly improve the product quality. The major thrust of refractories are to be in the areas of BF, converters,ladles and continuous castings. Recommended measures to be adopted are :

  - beneficiation of raw materials
  - development of high purity input materials
  - development of high performing quality refractories
  - increase in productivity and use of new generation monolithics
  - improvement in repair techniques

Several problems mentioned in the thrust areas stated above can be solved only through a partnership between the steel and the refractory industry. The SRTM will play the nodal role in this task if one adopts the model described earlier.

ANNEXURE 8.1

PERFORMANCE STATUS OF INTEGRATED STEEL PLANTS : INDIAN AND INTERNATIONAL

PARAMETER	INDIAN	INTERNATIONAL
Sinter Plant($t/m^2/hr$)	0.7-1.2	1.5 - 1.8
Blast Furnace($t/m^3/day$)	0.46 - 1.54	2.2 - 2.8
Steel Making(blows/year/ working convertor)	4400 - 4700	11000 - 12000
BOF Lining Life (No. Of Heats)	120 - 470	800 - 3000
Continuous Casting (meters/minute)	0.6 - 1.0	1.5 - 2.0
Rolling Mills		
* Hot Strip Mill		
Mill Utilisation(%)	64 - 66	80 - 85
Yield from Slab(%)	95.5 - 96.9	98.5
* Cold Rolling Mill		
(Tandem Mill)	48 - 50	75 - 80
Mill Utilisation(%)	98 - 98.6	99.5
Yield (%)		
Energy Consumption (Gcal/tcs)	8 - 13	4 - 6
Steel Cleanliness(S,P,O,N) (ppm)	600 - 1000	250 - 300

ANNEXURE 8.2

PEFORMANCE STATUS OF EAFs : INDIAN AND INTERNATIONAL

PARAMETER	INDIAN	INTERNATIONAL
Furnace size, ton	20 -70	30 -160
Specific transformer capacity, MVA/t	0.4 - 1/0	0.6 - 1.0
Oxygen consumption,NM^3/t	5 - 10	10 - 30
Tap to tap time, minutes	100 - 200	70 - 120
Specific productivity, t/hour/MVA	0.5 - 0.9	0.8 - 1.2
Power consumption,KWh/t	550 - 650	360 - 500
Electrode consumption, Kg/t	3.5 - 6.5	1.5 - 4.5
Refactory consumption, Kg/t	10.0 - 26.0	2.0 - 15.5

* Majority of the furnaces belong to the size 20 to 70 t. But there are furnaces of size below 20t and above 70t.

ANNEXURE 8.3

PERFORMANCE STATUS OF DRI PLANTS: INDIAN AND INTERNATIONAL

PARAMETER	INDIAN	INTERNATIONAL
COAL BASED		
Module Size, Mt	0.03 - 0.15	0.09 - 0.15
Coal Consumption, t/t DRI (~25% Ash)	1.2 - 1.3	0.75 - 0.8
S, P in DRI, %	S : <0.05 P : 0.06 - 0.08	S : 0.01 - 0.025 P : 0.04 - 0.06
Ore type	Lump	Lump & Pellets
Usage in EAF, %	30 -70	>50
C_m/Fe ratio	~0.5	~0.45
GAS BASED		
Module size, Mt	0.44 - 1.0	0.4 - 0.6
Nat, gas consumption, Nm^3/t	~300	~300
Ore type	Lump+pellets	Lump+pellets
Fe, in ore, %	+65	+65
Metallization, %	+92	+92

Steel Casting

41	Thin Strip casting	Scheme 4
42	Thin Slab Casting	Scheme 4

Rolling & Shaping

43	Cold Strip Mill - Continuous pickling, tandem rolling and annealing line	Scheme 3 or 4
44	Strip profile & flatness Control	Scheme 2 & 3
45	Hot Strip Mill - Integrated thick - thin strip caster	Scheme 4
46	Hot Strip Mill - Coil Box Heat Conservation Panels	Scheme 2 & 3

A large number of new technologies are available for adoption.

Endnote (explanation of scheme numbers)

Scheme 1: Incremental improvement schemes - Incremental improvement of the technological operations to reduce costs, improve quality, and to produce new value added product.

Scheme 2: AMR schemes - Improvements in the performance of the existing units with comparatively less investment through addition modification and replacement or minor supporting equipment (short term measures).

Scheme 3: Modernisation schemes - Introduction of improved technologies that call for large scale modifications and substantial investment. This can be generally taken up during modernisation programmes (medium term measures).

Scheme 4: Emerging Technology adoption schemes - Selection of new and emerging technologies in green field sites. This calls for large investments (long term measures).

Direct Reduction Processes

20	Fastmet	Scheme 4
21	Iron Carbide	Scheme 4
22	FIOR II	Scheme 4
23	Combismelt	Scheme 3 or 4

Steel Making - EAF

24	Use of special fluxes / process for impurity removal	Scheme 1
25	Ultra high power transformer	Scheme 2
26	Oxy-fuel burner	Scheme 2
27	Scrap pre heating	Scheme 2 or 3
28	Eccentric bottom tapping	Scheme 2
29	EAF bottom stirring	Scheme 2
30	Foamy slag practice	Scheme 1
31	Use of HM from BF/MBF/Cupola	Scheme 1

Steel Making - Secondary Refining

32	RH / RH-OB	Scheme 2
33	AOD	Scheme 2
34	Ladle Furnace	Scheme 2 or 3
35	VOD / VOD - C	Scheme 3

Steel Making - BOF

36	Pre Treatment of Hot Metal	Scheme 2 or 3
37	Dynamic Process control	Scheme 2
38	Slag Stopper	Scheme 1 or 2
39	Production of High alloy Steel	Scheme 1
40	Slag Splashing	Scheme 1

List of Emerging Technologies in Iron and Steel Industry

		Technology Improvement Scheme
	Mineral Beneficiation & Agglomeration	
1.	Floatex density separation.	Scheme 3
2.	Ferrous Wheel	Scheme 4
3.	Taller bed sintering (bed height> 500mm)	Scheme 2 or 3
4.	High Suction Sintering	Scheme 2 or 3
5.	Use of Slit burners for ignition of sinter mix	
6.	PELSIN (Hybrid Pellet Sintering)	Scheme 3 or 4
	Coke & Chemicals	
7	Stamp Charging of coal	Scheme 4
8	Tall & Wide ovens	Scheme 3 or 4
9	Non Recovery Ovens	Scheme 3 or 4
10	Production of Impregnating Pitch	Scheme 2
	B.F. Process	
11	Oxy- Fuel Processes	Scheme 4
12	Use of Math. Models for Burden Distribution	Scheme 1 or 2
13	Use of Expert System	Scheme 1 or 2
	Alternate Route to Liquid Iron	
14	Corex	Scheme 3 or 4
15	DIOS	Scheme 4
16	Hismelt	Scheme 4
17	Romelt	Scheme 3 or 4
18	AISI	Scheme 3 or 4
19	Ausmelt	Scheme 3 or 4

Technology Area	Steelmaking			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Very Low Impurity steel production - Use of special fluxes / process for impurity removal	De-nitrogenation, de-phophorisation using special fluxes	For making steels for special applications		Under development abroad

Technology Area	Casting			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Thin Strip casting	Single or twin roll type. Direct casting of strips (<10 mm thick). Require no or less hot working.	Only 25 % of capital and operating costs of conventional concast. Less energy requirement. Product flexibility and possibility to cast stainless & silicon steels.	Still under development. Can be adopted in mini mills. Should be considered after stabilization of the technology	Pilot / Semi commercial technologies are under development abroad.

Ausmelt (Australia)	A single stage bath smelting process. Uses lump ore, Coal and flux. Oxygen enriched coal are injected through top lance. This process is already established commercially in non-ferrous extraction industry.	Little raw material preparation, simple process steps using conventional equipment expected high productivity and low capital cost.	Can be introduced in new installations.	A 1 tonne per day pilot plant at Dandenong, Victoria, Australia, where a large variety of ore and coal have been tested. A 2 t/h demonstration plant is under construction. A 2.5 mtpa has been planned by 1998-99.

Technology Area	**Direct Reduction Processes**			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Fastmet	Uses non coking coal impregnated pellets in Rotary hearth furnace. Charging hot pre reduced pellets in EAF for making Steel. Require low ash coals.	Does not depend upon Natural gas; Improved Environment compatibility.	Lower power consumption (~200 kW).	A 2.5 t/h demonstration Plant at Kobe Steel's Kakogawa works. Two 0.09 MT plant planned by US gulf coast.
Iron Carbide	Uses Fine ore in a fluid bed furnace. require natural gas, High efficiency; Low temperature reduction. Product (Fe_3C) can be used either hot or cold. Not prone to re-oxidation.	Eliminates Coke ovens & sintering plants. Could be scrap substitute in EAF or BOF	Lower scale of operation; could be economical at smaller scale (60,000 - 90, 000 tpy) in gas based locations.	A 300,000 tpa plant has been commissioned by Nucor in Trinidad and Tobago
FIOR II	Uses fine ore in fluid beds. Natural gas. High pressure (~ 10 bar) operation.	Use of fine ores. Depends on natural gas	Only in new installations.	Plant design stage.
Combismelt	Pre reduction in rotary kiln followed by hot charging of DRI in SAF	Reduced power consumption in EAF. Based on integration of standard technologies	Could be suitable at Coal based locations	No commercial plant

Technology Area	**Alternate Ironmaking (Smelting Reduction) Processes**			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Corex (Voest Alpine)	Uses non coking coal & oxygen. Lump ore & Low ash(ash < 12%, FC > 55%) & low VM(< 25 %), coals required	Does not depend upon Coke; Environmentally superior; may need blending with Low ash, low VM Coals	Viability depends upon cost of oxygen and economic use of off gas for power generation or DRI production	Two commercial plants; a few under construction, including India; scale : up to 1 MT
DIOS (Japanese National Project)	Uses non coking coal & oxygen. Fine ore & low ash(< 25 %) coals. Low Si HM. Quick stop & start capability.	Eliminates Coke ovens & sintering plants;	Lower scale of operation; oxygen cost is an important factor; could be better suited for mine based location.	Under development. A demonstration plant of 150,000 tpy at NKK's Keihin works. Likely to be available by 2000 AD.
Hismelt (Hismelt Corp, Australia & Midrex, USA)	Uses non coking coal . Fine ore & low ash(< 25 %) coals. Hot blast (~1200 C). Low Si HM. Power generation from off gas	Eliminates Coke ovens & sintering plants; Environmentally superior.	Lower scale of operation; oxygen cost is an important factor; could be better suited for mine based location.	Under development. A demonstration plant of 0.1 MT near Perth, Australia. Plans for commercial imple-mentation by 2000 AD.
Romelt (Russia)	Uses a mix of Lump and fine ores and coals. Suitable for low grade ores or wastes. Simple and conventional equipment. Power generation from off gas. Low S, low Si HM. Quick start & stop capability.	Little raw material preparation. Eliminates Coke ovens & sintering plants; but oxygen intensive. Environmentally superior.	Low scale of operation (0.3 MT). Simple in design and operation. Oxygen cost is the decisive factor in determining viability.	A 0.3 MT pilot plant at Novolipetsk Steel works. HM has been used in BOF. Ripe for commercial exploitation.
AISI (USA & HYL, Mexico)	Uses Lump ore or pellets. Low ash coals and Oxygen required. Plans to extend as a direct steel making process	Eliminates Coke ovens & sintering plants; Environmentally superior.	Require heat hardened pellets	Under development. A 8 t/h pilot plant (Pittsburgh). Likely to take longer time to reach commercial stage.

NEW TECHNOLOGIES UNDER ADVANCED STAGES OF DEVELOPMENT

Technology Area	Mineral Beneficiation			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Floatex density separation.	It is a hindered bed classifier. The lighter/finer particles leave as overflow; the coarser/heavier particles are collected as underflow. Concentrates up to 68% Fe can be obtained with 90% yield. Wide fluctuations in feed rate and grain size tolerated.	Nearly 5 Mt. slimes are generated in beneficiation plants of SAIL alone with Fe content varying from 55 to 61%. Mineral conservation & ecology preservation. The technique is applicable in coal washing also.	Lower capital and operational costs compared to other processes. Extensive test of the slimes are required before selecting this technology.	Industrial trials are being conducted in India and abroad for implementation.

Technology Area	Coal & Chemicals			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Non Recovery Ovens	Sole heated, modified beehive type ovens. Operates under suction. Byproducts not recovered. Uses pre heated air	Smaller scale of operation. Much better pollution control. Lower investment cost.	Can be coupled with mini B.F..	A few plants have been set up. MBF at Sesa Goa is operating a battery with imported coal

Technology Area	Blast Furnace Processes			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Oxy-fuel Process (Two variants : Oxy-coal and Oxy-gas)	Bulk injection of non coking coal or natural gas and Oxygen. Coal : 200-250 kg, Oxygen: 75-100 Nm3 (oxy-coal). Nat. gas : 140-160 Nm3 Oxygen : 90-100 Nm3.	Much reduced coke consumption. Require large quantity of oxygen. Improved Environment compatibility.	Can be introduced in smaller furnaces to start with. Expected Productivity increase 25 - 35 % and coke rate decrease by 20 - 30 %.	Trials conducted in BSC blast furnace by BSC, Ilba and Hoogovens .

TECHNOLOGIES ESTABLISHED ABROAD BUT NEW IN INDIA

Technology Area **Mineral Beneficiation**

Technology / Process	Basic Features	Relevance under Indian Context	Feasibility of Introducing	Status
Ferrous Wheel	Employs magnetic concentration of iron values using permanent magnet. Both rougher and cleaner operations can be done simultaneously. Higher yield and quality of concentrate.	Nearly 5Mt. slimes are generated in beneficiation plants of SAIL alone with Fe content varying from 55 to 61%. Mineral conservation & ecology preservation.	Can be adopted in SAIL mines after carrying out bench and pilot scale tests.	Developed by M/s Eriez recently. Being used commercially in Brazil. In India M/s Sesa Goa has plans for procurement of a unit.

Technology Area **Sintering**

Technology / Process	Basic Features	Relevance under Indian Context	Feasibility of Introducing	Status
Taller bed sintering (bed height > 500 mm)	Bed height to be increased to > 500 mm from the conventional level of 350-480 mm.	Higher yield, and productivity; low energy consumption and better quality.	Feasible with modifications in the existing system (exhauster capacity, drive etc.).	Current bed height 350-500 mm in SAIL plants. Japanese plants operating at 600 mm or above.
High Suction Sintering		Sintering with high suction (>1500 mm w.c) leads to higher productivity and utilization of finer fractions in ore.	Feasible in existing units. Sealing systems to be changed.	Undergrate suction at present varies from 450 to 900 mm wc in SAIL plants & elsewhere it is around 1500 mm wc.
Use of slit burners for ignition of sinter mix	Slit / Line burners replaces conventional burners in the ignition hood.	Reduction of gaseous fuel energy by 50-60% (from 0.062 to 0.02 Gcal per tonne of sinter).	Feasible to adopt in existing units. The know-how will have to be imported.	Being used in Kawasaki Plant in Japan
PELSIN (Pellet Sintering)	Combination of palletizing and sintering. Mini pellets of 5-8 mm are coated with coke fines and sintered.	The product is of high yield and superior quality.	Major modification to be brought in our steel plants.	Pilot scale process developed at RDCIS. Hybrid palletized sinter being used in NKK Japan.

Annexure 8.6

Technology Area **Coal & Chemicals**

Technology / Process	Basic Features	Relevance under Indian Context	Feasibility of Introducing	Status
Tall & Wide ovens	Oven width increased from 400 - 450 mm to 550-600 mm. Higher throughput	Significant improvement in productivity. Better pollution control.	Possible in new installations	Being considered for BSL (battery # 9)
Production of impregnating pitch	Impregnating pitch has low softening point(75-80 C) and low quinoline insoluble(1-5%).	Being imported at present. Main use in electrode industry.	Can be introduced with low investment.	Being implemented in BSP(1440 t/yr Capacity).

Technology Area **Blast Furnace Processes**

Technology / Process	Basic Features	Relevance under Indian Context	Feasibility of Introducing	Status
Use of Mathematical Models for burden distribution & Control	Prediction of burden profile.	Achievement of consistent high efficiency, increase in productivity (4-5%) , reduction fuel rate by (4-5 %), high HM quality.	Require installation of below burden probes and profilometer	Already in use in modern BF's abroad
Use of Expert System	Diagnosis of irregularities. Better operational control		Needs development for specific conditions	Already in use in some BF's abroad.

Technology Area **Steel Making (EAF)**

Technology / Process	Basic Features	Relevance under Indian Context	Feasibility of Introducing	Status
Scrap Pre-heating	Furnace off gases are utilised to preheat the scrap to 300-400 C. Benefits : Power saving. Improved productivity.	In furnace where fume extraction exists this concept can be utilised.	Can be installed in shops where space is available.	Possibly no installation.
EAF Bottom Stirring	Faster melting. Low gas content in steel. Better alloy recovery. Higher yield.	Can be installed in existing furnaces.	Easy to introduce	Not installed in any plant.

Annexure 8.6

Technology Area Casting				
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Thin Slab Casting	Casting Thickness : 40 - 70 mm Casting speed 3.0 - 6.0 m/min. Slab width : 1300 - 1500 mm. Throughput : 1.0 - 2.75 t/h	Lower capital and operating costs(~ 70 %). Low energy requirement.	Possible in mini mills. Setting up of a new thin slab caster at ASP and conversion of existing slab caster at BSP	Already in operation in Europe(W. Germany) and USA (Nucor).

Technology Area Rolling and Shaping				
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Continuous Rolling	Continuous operation from pickling to annealing	Improvement in productivity, yield and quality	Existing plants can be modified to adopt this technology.	No installation exists in India. Technology available from SMS, Wean-Danieli, NKK
Strip profile & flatness control	6 - Hi mill, continuous variable crown rolls, Roll shifting, Roll crossing. Shape meter	High accuracy rolling, Flexible manufacturing (schedule free rolling) to meet auto body, white goods demand.	Existing mills can be modified	A few mills in India have 6-Hi configuration. Technology available from SMS, Wean-Danieli, NKK
Integrated Thick/Thin Strip Caster	Eliminates Reheating furnace, Roughing mill	Reduces mill cost	Suitable for new mills	No installation with thin strip caster. Technology available from SMS.
Coil box Heat Conservation panels	Installed on the delay table	Improves quality; conserve energy	Can be integrated with existing mills	RSP would install coil box. No installation for H.C panels. Technology available from Davy, Stelco

TECHNOLOGIES INTRODUCED IN INDIA BUT NOT WIDELY PRACTISED

Technology Area	Coal & Chemicals			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Stamp Charging	Coal is stamped to form a cake before introduction to ovens from the pusher m/c.	Significant improvement in M10 and CSR. Increased charge bulk density (by ~ 35 %) leads to high productivity.	can be introduced in new battery installations	Introduced at TISCO. Being considered for RSP

Technology Area	Steel Making (BOF)			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Pre-treatment of hot metal.	Removal of Si, S & P outside BOF.	Must for quality enhancement and reduction in cost.	Can be put-up in all BOF Shops.	Partial desulphurisation at RSP & Tata Steel.
Dynamic Process Control	Static model & dynamic measure-ment	Better operation predictability, improvement in yield. Process automation.	Can be installed in BOF Shops.	Static model available at DSP, TISCO & BSP.
Slag stopper	Prevents slag entry to subsequent operations.	Reduction in ferroalloys consumption & quality improvement.	Feasible in existing units.	Only at DSP, BSP and VSP.
High alloy steel through BOF	High productivity & low cost.	Increasing demand for high quality high alloy steels.	Feasible with combined blowing.	Being adopted in VISL.
Slag splashing	Improvement in lining life.	For BOFs with low lining life.	Feasible in existing units.	Being used in USA (LTV)

Technology Area	Steel Making (EAF)			
Technology / Process	**Basic Features**	**Relevance under Indian Context**	**Feasibility of Introducing**	**Status**
Ultra high power transformer	Power rating greater than 500 KVA/ton. Benefit : For improved productivity.	Productivity of most furnace is low due to lack of UHP operation. EAF with UHP facilities in India is almost negligible.	Under existing configuration transformer capacities can be marginally enhanced.	UHP power rating in EAF in advance countries is 500-1000 KVA/T as against 300-500 in India

Oxy - fuel burners.	Additional input of heat to EAF by auxiliary fuels. Benefits : Energy saving 5-10%. Improved productivity.	Overall techno-economic benefit will depend upon relative cost of power and fuel.	Can be introduced at medium cost input.	Most furnace do not have oxygen fuel burners.
Eccentric Bottom Tapping	Bottom tap hole. Carry over slag control. Clean steel production. More furnace areas can be water cooled. Less tapping temp. loss.	For successful secondary refining, control of carry over slag is necessary.	May be difficult in existing furnaces.	Most furnaces without EBT.
Foamy slag practice	Faster melting. Increased productivity. Power saving.	Inexpensive.	Can be easily introduced in any EAF.	Some plants are using in India.
Use of hot metal from BF/MBF/ Cupola in EAF.	Faster melting. Power saving. Increased productivity. Scrap substitute.	To combat scrap shortage problem. Reduced power consumption.	Depends on logistics, infrastructure.	One or two plants in India are using. HM from mini BF.
DC Arc Furnace	A single electrode from top and anode at the bottom. Better bath stirring due to electro magnetic effects. Can be run with higher MW level more reliably.	Lower electrode consumption compared to AC EAF. Fewer parts to maintain. Lower electrical losses.	Large modifications needed in the furnace as well as the power system. More appropriate for new installations.	Adopted in ESSAR, Gujrat.

Technology Area **Steel Making (Secondary Refining)**

Technology / Process	Basic Features	Relevance under Indian Context	Feasibility of Introducing	Status
Hydrogen Sensors	On line hydrogen measurement.	Very useful for H2 sensitive grades	Easy	Almost non existent.
RH/RH-OB	Relevant for Low C, N, H, O steels and ultra low 'C' or I.F. steels.	Useful for producing ultra low C, clean steels.	Can be introduced due to future needs for such grades.	No installation at SAIL plants. ASP had a unit earlier. Planned at TISCO. BSL also planning to introduce.
AOD	For stainless and low 'C' steels without vacuum. Flexible in respect on input carbon.	Not taken up earlier due to high Ar cost and refractories.	Can be introduced if argon at reasonable cost is available.	Few plants have. ASP is planning.
LF	Ladle heating and refining facility (without vacuum)	Highly useful and relatively low cost refining facility.	Can be duplexed with BOF, OH or EAF.	Several plants have installed. No ladle refining in SAIL plants except VISL. Planned in ASP, BSL & RSP. Most popular secondary refining.

DIRECT REDUCTION PROCESSES

FASTMET Process

Process developer : Midrex Corporation, USA

Process : The Process steps comprises preparation of ore-coal pellets, drying and charging the green pellets to rotary hearth furnace pellets are reduced at 1250-1350 °C. Pre-reduced pellets are hot briquetted at about 1000 °C to produce HBI or can be hot charged to an adjacent steel making unit.

Raw Materials : Iron ore concentrate or fines (size range : 80% < 74 μ). Pulverised coal (size : 80% < 74 μ). Since coal ash remains embedded in the final product, low ash coals are preferred Wide range of ore and coal have been tested. Coal requirement ~ 400 kg/t.

Product : Metallization ~ 95%; C < 2%.

Fuel & reductant : Coal is the main reductant. Coal, gas or oil can be used as supplementary fuel depending on availability.

Status : A 2.5 t/h demonstration plant is under commissioning at Kobe Steel's Kakogawa Plant, Japan.

Critical assessment: The process would require low ash coals. Most of our non coking coals would require blending or beneficiation. Strength of the process lies in use of iron ore fines, high energy efficiency and possibly lower capital investment compared to gas based DR processes.

Iron Carbide

Process developer : Nucor, USA

Process : Reduction of ore fines in a fluid bed furnace using reformed natural gas at about 600 °C and pressure 1.8 atm.

Raw material : High grade ore fines or blue dust.

Fuel/reductant: Reformed natural gas (mostly H_2).

Status : A 300,000 tpa plant has been commissioned by Nucor in Trinidad, West Indies.

Critical Assessment : At low temperature operation the process is highly energy efficient (~ 13 GJ). The product Fe, C (~ 93% Fe & 7% C) is rich in Carbon and thus ideal for steel making. The product is non pyrophoric, free flowing and can be easily transported. The process is also environmentally superior, water being the only by product. If natural gas is available, this process should have bright prospect of adoption and could be a competitor to other gas based DR process.

SMELTING REDUCTION PROCESSES

Corex Process

Process Developer / promoter Voest-Alpine AG Austria

Process A 2-stage process (involving pre-reduction, gasification and melting). Equipment involved include reduction shaft and melter gasifier. Pressurised operation (3 - 5 bar)

Current status A commercial scale plant of 300,000 tons/year capacity at ISCOR, South Africa operating since December 1987. Next generation plant of 600,000 tons/year capacity has been commissioned at POSCO, South Korea in Nov. 1995. COREX modules are now offered in 3 commercial sizes, namely C-1000, C-2000 and C-3000 with capacities varying between 300,000 tons/year and 1.2 million tons/year, depending on module size and iron oxide feed used. New Corex plants are being constructed at Vijaynagar Steel ltd, India (0.6 Mtpy module) and at HANBO, South Korea (2xC600 module with integrated Midrex DRI plant)

Raw material High quality ore of 8 to 20 mm size preferred. Can accept pellets and sinter also. Screening for separation of undersize necessary.

ii) Energy/reductant Non coking coals (Max ash + VM < 50 %.) Size range 5 to 40 mm. Indian coals(high VM and ash) would require blending with coke breeze or imported coals.

Critical Assessment Process is extremely sensitive to coal blend analysis (VM) and size distribution.Undersize separation and drying of coal is essential. The process is also oxygen intensive and generates large quantity of surplus gas. Viability of the process depends on gainful utilisation of this by-product gas e.g. in power generation.

Direct Iron Ore Smelting (DIOS)

Process Developers / promoters Japan Iron and Steel Federation, Centre for Coal Utilisation and eight leading Japanese steelmakers.

Raw materials	High grade ore fines preferred. Quality and size not specified. Blend of non-coking coal and high fixed carbon, low ash coal preferred. Size range 5-40 mm.
Energy/reductant	a) Use high temperature air blast at 1200 ^{0}C instead of oxygen.
Critical assessment	The process uses iron ore fines and should be able to treat variety of coal. Report on the demonstration plant operation is encouraging. Being a two stage process with high degree of post combustion, overall gas utilisation is better and oxyen consumption is lower compared to Corex or Romelt process. The technology would be available for commercial use by year 2000.

Romelt Process

Process/developer	Moscow Institute of Steel and Alloys and Novolipetsk Steel Works, Russia.
Process	A single stage bath smelting process with high degree of post combustion. Iron ore and coal are reacted in a rectangular reactor when O_2 and air are blown through two rows of tuyeres. Power generation from the off gas.
Raw materials	Any type of iron material e.g. lumps ore, pellets, fines wastes etc. can be used. Lime or lime stone is used as flux.
Energy/reducant	Lump coal size (6-20 mm). Low ash and VM coal preferred.
Status	A 0.3 tpy pilot plant working at Novolipetsk Works. Commercial plant design have been developed by Gipromez. SAIL is planning to form a joint venture company with the process developers for marketing this technology.
Critical assessment	Simple equipment using standard design - less space requirement; may be possible to adopt in existing units with minimum modification, also the main process unit expected to be less capital intensive. Process is capable of treating any type of ore or coal and no preparation is required. Produces high quality hot metal with very low Si. Hwever, O_2 consumption is high (~ 750 - 800 Nm^3/t for our coals) and its cost is the most critical factor for viability of the process.

Process	This is a two or three stage process with high degree of post combustion (~ 50 %). Also incorporation of third stage as reforming step.i) The process steps involve : -preheating of sinter feed/pellet feed and pre-reduction in circulating fluidized bed pre-reduction furnace (PRF). -generation of reaction gas (CO) in gas reforming furnace (GRF). -production of hot metal in smelting reduction furnace (SRF) with top injection of oxygen and bottom purging of nitrogen.
Current status	Construction of 500 tons/day pilot plant at Keihin Works of NKK commenced in May 1991. Reported to be commissioned by October 1993.
Raw materials	High grade ore fines preferred. Feed size depends on type of fluidised bed (bubbling or circulating) employed.
Energy/reductant	Both medium and high volatile coals/coke tested. Input coal size to SRF depends on type of fluidised bed; - 1 mm coal is used in GRF.
Critical assessment	The process utilises iron ore fines and should be able to process wide variety of coals. Being a two stage process with high degree of post combustion, overall gas utilisation is better and oxyen consumption is lower compared to Corex or Romelt process. It is still under development.

Hismelt Process

Process Developers/ promoters	CRA Ltd. Australia and Midrex Corporation, USA in co-operation with Central Steel and Iron Research Organisation (CSIRO) of Australia, Klockner Stahlwerke of Germany and Davy Mckee of UK.
Process	A two stage Process with high degree of post combustion. The process steps are : - Pre-reduction (< 30 %) of ore fines in circulating fluidised bed pre-reduction system (PRS) utilising off-gas from smelter reduction vessel (SRV) - Bottom injection of coal and natural gas in SRV. Preheated air (1200 ^{0}C) blast used for coal gasification in SRV. - Steam generation utilising PRS off-gas - High pressure operation.
Current status	The 0.1 Mtpy demonstration plant at Kwinana successfully commissioned in 1993 and experimental work is being done. Future plans include design of a commercial plant by 1996 and installation of first commercial plant of 500, 000 tpa in year 2000.

COKE MAKING

Stamp Charging of Coal

Process : Formation of a stable coal cake from finely crushed coal by stamping it mechanically. Introduction of the cake into the oven from the pusher side.

Status : The technology is in operation in Germany, France and other European countries for a long time. One battery at TISCO(# 6 & 7) and another one is under installation (# 5).

Critical Assessment : Benefits of the technology include :
Increased bulk density of the charge by 30 to 40 %. and productivity by 10 to 12 %. M10 & M40 values improve by 4 to 5 points Capability to treat inferior grade coals and other operational advantages. Since large modifications are required in the ovens and equipment, the technology has been introduced only in new batteries.

Non Recovery Ovens

Process The gases evolved during carbonization are burnt, part of the energy is used in the coke making process and the balance is exhausted through the waste gas system. The process operates under suction conditions and no condensable by-products are generated.

Status Only a few non recovery ovens are in operation in USA, Australia and Kumbhraj ovens in India. M/s Sesa Goa is operating such an 82 ovens battery (Kembla, Australian technology) with imported coal for their mini blast furnaces.

Critical Assessment Generally these ovens have lower production rate compared to conventional ovens. With setting up of many mini blast furnaces, this technology have assumed importance. Lower scale of operation, low capital investment and greater environmental advantage are the important factors in favour of this technology.

Scrap Pre-heating

Process :	Scrap pre-heaters could be batch or continuous. Heating agent could be an external fuel, waste gases or combination of both. In continuous pre-heaters, scrap is changed by vibrating conveyors or gravity fed.
Status :	Batch pre-heaters are employed in many places abroad. No installation exists in India. Japanese steel makers are using this technology since 1970s and American steel makers started using this technology recently.
Critical Assessment :	Approximately 25% of the total energy input is lost to the waste gases. Pre-heating of scrap reduces energy consumption and furnace cycle time by 5-10%. Logistics and space constraints restrict use of this technology in existing shops.

EAF Bottom Stirring

Process Developers :	Union Carbide, USA and Radex, Austria
Process :	Provides extensive movement of the bath by bottom inert gas stirring.
Status :	Since 1980, 70 EAF's has been equipped with this technology. No installation exists in India.
Critical Assessment :	Reported benefits are : saving in power (~ 5%), decrease in electrode consumption (~ 1%), increase metallurgical (~ 1%) and alloy yield (~ 2%). Possible to introduce in existing furnaces.

Production of high alloy steels in BOF

Critical Assessment — Chromium bearing steels can be made by injection of sufficient quantity of oxygen though bottom blowing. Productivity improvement is around 100% compare to conventional EAF - secondary metallurgy route. High quality can be ensured in combination with ladle furnace treatment which is becoming a common feature in all SMS shops. Existing BOF's can be fitted with bottom blowing equipment with marginal investment.

EAF Steel Making

Ultra High Power Transformer

Process : Achieves faster melting rate by increased energy input of 500 KVA/t of power or more. Most of the furnaces abroad operate in the range of 500-1000 KVA/t range.

Status : In India only a few furnaces are equipped with UHP transformer.

Critical Assessment : The technology is significant in achieving higher productivity (tap to tap time : 60-80 min.). In some instances, the existing transformers may be augmented to some extent depending upon the secondary circuit limitations.

Oxy-Fuel Burners

Process : Oxygen assisted burning augments the supply of energy to the furnace. There may be one to three burners per furnace using either natural gas or oil.

Status : Oxy-Fuel burners are widely used abroad. No installation is known in India. ASP, Durgapur is installing Oxy-Fuel burners in one of the furnaces.

Critical Assessment : Improves productivity and power saving to the extent of 5-10% or more. The furnace system should be able to handle additional quantity of gases generated due to fuel burning. Techno-economics would depend upon relative cost of fuel vis-à-vis electricity.

BOF STEEL MAKING

Pretreatment of hot metal

Process	Pretreatment of blast furnace hot metal using special reagents e.g. calcium carbide for removal of sulphur and silicon. The treatment is generally done in a hot metal ladle or a transport vessel (e.g. torpedo car). Extent of removal of each component may vary depending on their concentration in hot metal and other operating parameters.
Status	Not practiced widely in India. Partial dephophorisation is done at RSP and Tata Steel.
Critical Assessment	Reduction of sulphur to low level reduces blowing time, flux consumption and lead to low residuals and gases in steel. Blowing time is reduced by 20% and productivity increase could be of the order of 7%. The unit is independent of blast furnace or BOF and can be located in between these two shops.

BOF Control

Process	Uses computer assisted process models along with sensors for continuous determination of exhaust gas analysis and bath temperatures etc. In corporation of facilities like slag stopper further improves quality of steel and gives higher recoveries of alloying additions.
Status	Yet to be adopted in India.
Critical Assessment	The BOF process is automated to dynamic process control. Optimum bath oxidation leads to lower alloying addition and quality improvement. Also there could be some improvement in yield (approximately ~ 1%); can be fitted in most of the BOF's with low investment; though some modifications necessary.

THIN STRIP CASTING & ROLLING

Process — The continuous casting of strips in the thickness range of 1 to 5 mm by direct solidification of molten metal on chilled moving surfaces. The strips can be processed directly in the cold rolling mill.

Status — Developmental works have been carried out by various steel companies abroad for strip casting of steel. Pilot and semi commercial plants have come up for casting of stainless steel by various steel companies, viz., Voest Alpine-Allegheny Ludlum (USA), CSM (Italy), NSC (Japan), Hitachi (Japan), Usinor Sacilor (France) and others. In India, Research and Development Centre for Iron and Steel, SAIL has been putting significant effort in the laboratory investigation of thin strip casting. Stainless strips of thickness 1 to 2 mm and width 100 mm have been successfully cast in the laboratory scale unit, cold rolled and characterised.

Critical Assessment — Considerable benefits have been envisaged out of the technology, viz., saving in energy due to elimination of slab cooling, conditioning, stocking, reheating and roughing operations of continuously cast slabs, production in smaller tonnages of various grades of steel with improved properties, production of strips of steel grades which have poor hot deformation properties, lower operating costs and capital investment in the production of flat rolled products and less space requirement.

Continuous Rolling

Process Developers — NKK, Dofasco and BSC

Process — Combination of rolling and pickling lines in sequence. Dofasco has built a cold mill complex coupling pickling line with a 5 stand, 4 - high cold mill. Similar concepts have been demonstrated by other developers.

Critical assessment

Primary benefits over conventional system are: increase in productivity (~ 40 %), higher yield and enhanced quality.Cost reduction is effected by elimination of several items like tandem mill entry coveyor system, pickled coil handling and storage etc.The system can be introduced in existing mills (e.g., Llanwern, BSC) or new mills (Dofasco, Canada).

Status

The concept of continuous tandem cold rolling mill was first introduced by NKK, Japan in their 5-stand tandem mill. A few more such mills are in operation in Japan, Canada and England.

NEW TECHNOLOGIES THAT CAN BE INTRODUCED WITH MINOR MODIFICATIONS/LESS INVESTMENT

Technology Area	Process/Technology
Coal & Chemicals	Impregnating Pitch
Mineral Beneficiation	Ferrous Wheel
Sintering	Taller Bed Sintering High Suction Sintering Slit Burners for sinter bed ignition
Blast Furnace	Use of Mathematical Model for Burden Distribution Expert system for BF
BOF Steel Making	Pre treatment of Hot Metal
EAF Steelmaking	Bottom Stirring UHP Oxy-fuel Burner
Secondary Refining	VOD AOD RH

EMERGING TECHNOLOGIES THAT WOULD REQUIRE LARGE SCALE MODIFICATIONS / HIGH INVESTMENT

Technology Area	Process/Technology
Direct Reduction	Iron Carbide * Fastmet *
Coal & Chemicals	Tall & Wide Ovens Non-Recovery Ovens
Mineral Beneficiation	Floatex
Sintering	Pelsin (Hybrid Pellet Sintering)
Blast Furnace	Oxy-fuel Process *
Alternate Iron Smelting	Romelt * Ausmelt * Hismelt * DIOS * Corex
EAF Steel Making	DC Arc Furnace
Casting	Thin Slab Casting Thin Strip Casting *
Rolling and Shaping	Continuous Rolling *

* Corex is already commercialised and Romelt is ripe for commercialisation. Others are yet to be established on commercial basis, but are likely to be available by 2000 AD.

SPECIFIC ENERGY CONSUMPTION IN INTEGRATED PLANTS

Gcal/tcs

Plant	1986-87	1991-92	1994-95	1995-96
BSP	10.51	8.36	7.98	7.79
BSL	10.61	8.86	8.71	8.70
RSP	11.65	10.00	10.26	10.72
DSP	12.03	10.67	9.77	9.89
IISCO	17.17	13.89	12.49	12.84
TISCO	9.33	9.30	8.94	8.68
ASP	6.62	5.79	5.97	5.54
RINL	–	10.10(1992-93)	7.82	7.59

ENERGY CONSERVATION SCHEMES

Incremental improvement schemes

- Optimization of coal blend, improved design of coke oven doors and sealing of cross walls for minimizing the leakages of gas.
- Improvement of blending of raw materials in sinter plant, introduction of improved design burners, sealing system and grate bars etc.
- Optimization of operational parameters and charged materials in the blast furnaces.
- Optimization of operation of open hearth furnaces.
- Introduction of improved design of burners in open hearth furnaces and ladle heating stands.
- Introduction of improved insulation of water cooled skid pipes and walls in the reheating furnaces.
- Use of water cooled panels in EAF's.
- Introduction of oxy-fuel burners.
- Foamy slag practice
- Induction furnace automation using computers.
- Ceramic fibre lining in batch type/re-heating furnaces.
- Solid state and dual output power supply.

Improved technologies with significant addition of new equipment

- Partial briquetting of coal charge, stamp charging in coke ovens and introduction of 7 m tall coke ovens.
- Bell less top burden distribution system in blast furnaces.
- Increase in % of sinter in blast furnace charge.
- Improved design of blast furnace stoves.
- Conservation of open hearth furnaces to better productive and energy efficient twin hearth furnaces.

- Larger Production through BOF-Continuous casting routes.
- Recovery of BOF gas.
- Computerized operation of reheating furnaces and mills.
- Introduction of ceramic fibre lining in batch type heat treatment furnaces.
- Coal dust injection in Blast Furnaces.
- Scrap pre-heating in EAF.
- Use of ultra high power transformer.
- Use of new technologies for charging hot DRI or HM in EAF.
- Use of W.H. recovery systems wherever possible.

Annexure 8.17

MAJOR EMISSIONS FROM VARIOUS PROCESSES IN INTEGRATED, MINI AND MIDI STEEL PLANTS

Processes	Water	Stack Emission	Fugitive or Secondary Emission	Solid Waste generation
Blending and Bedding	Suspended solids, run-off water	---	Iron oxides, coals, recycled dusts	Dust from baghouses, cyclones etc.
Sinter & Pellet Plants	Scrubber waters. suspended solids, lime, acids	SO_x, No_x, F, CO, particulates.	Dusts from sinter plant coolers, transfer points, noise	Baghouse (etc) dusts with alkalies, filter cake
Coke Ovens	Phenols, cyanides, tars, ammonia, thiocyanates, sulphides, chlorides	Smoke, SO_x, NO_x steam, gas flare.	Coal or coke dusts, sulphurous or PAH emissions, smoke, steam	Carbonaceous solids from baghouses, pitch, tar, refractories
Blast Furnace (both medium & large)	Suspended solids, phenols, cyanides, fluorides, lead and zinc compounds, chlorides, heat	H_2S, SO_2, steam from slag cooling beds	Iron oxides H_2S, cast house fume, CO, coke dust, noise	Baghouse (etc) dusts, blast furnace slags, refractories, filter cakes
Hot metal Treatment	Alkalies, suspended solids	Particulates, alkalies, fluorides	Na_2O, K_2O, lime dust, iron oxide fume	Baghouse dusts with high lime, corrosive slags
Steel Making (BOF & EAF based)	Scrubber waters, suspended solids, zinc compounds	CO flare, CO_2, fluorides, iron oxides	Fine iron oxides, alloy fume, noise	Skimmer, EAF, BOF & ladle slags; refractories, baghouse dusts
Casting	Oil, fluorides, suspended solids, heat	---	Fume; lead; SO_x; fluorides	Slag from exothermic compounds, refractories, filter cake
Rolling	Oils, suspended solids, chromates, acids, alkalies	SO_x, NO_x, CO_2, smoke	Scarfing fume and noise	Mill scale, oily mill scale, filter cake, ferrous sulphate
Coating	Chromates, phosphates, alklies, acids, oils, suspended solids	----	----	----

Annexure 8.18

IMPROVED PROCESS TECHNOLOGIES FOR ENVIRON-MENT PROTECTION

Process Area	Technologies	Impact on Environment	Status
Coke making	On-main charging	Reduction in gas emission from Coke Oven doors.	DSP BSL BSP
	New generation of Oven doors.	Prevention of gas leakage.	BSP BSL RINL
	Modified wet quenching or dry quenching of coke	Reduction/prevention of emission from quenching tower.	RINL
	High capacity ovens partial briquetting (PBCC)	Reduction in dust & gaseous emissions.	BSP RSP
	Stamp charging technology.	Elimination of emission.	TISCO
Sintering	Improved Sinter mix preparation, increased bed height & better pellet sealing	Reduction in dust emission	BSL, BSP, TISCO, RINL
Iron Making	Cast house slag granulation	Reduction in solid waste generation	BSP, BSL, DSP, RSP, RINL, TISCO
	High top pressure operation	Reduction in flue dust generation	BSP, BSL, DSP,RINL, TISCO
	Other process improvements like burden distribution, high blast temperature, auxiliary fuel injection etc.	Reduction in input consumption Reduction in slag generation	BSP, BSL, RSP, RINL, DSP, TISCO
Steel Making	Adoption of basic oxygen furnace & suppressed combustion system	Reduction in dust emissions	BSP, DSP, TISCO, RINL
	Continuous casting of steel	Elimination of intermediate process generating waste gases & solids	BSP, DSP, RINL, TISCO
EAF steel making	Plasma melting	Reduction in noise level and energy consumption	

APPLICATIONS OF STEEL PLANT SOLID WASTE

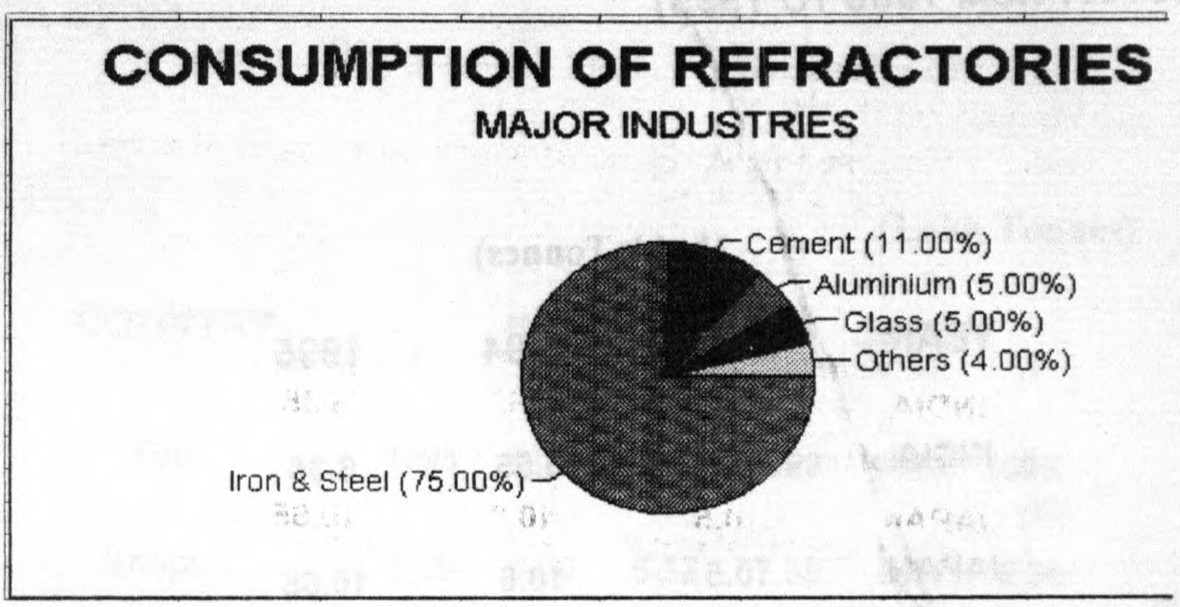
Type of Waste	Uses
BF slag	Cement making; road making (as aggregates, pavement and high density-heavy duty roads,
SM (BOF) slag	Rail ballast, road making, soil conditioner, filling material (with fly ash), cement making, recycled to BF to replace lime stone (20-30%)
Fly ash	Brick making, portland pozzolana cement, concrete making, road making (soil stabilisation) ceramic tiles, soil amendment
Ferrugenous waste	Recycled to blast furnace, micro and other palletisation, (oxidised, reduced, cold bonded)
Lime/dolomite fines	Briquetted and recycled, sinter making (to improve granulometry); blending in raw materials
Refractories	Reusable parts recycled, broken pieces recycled/sold, as ramming mass and mortar

WATER CONSERVATION MEASURES

1. Reducing wastage and minimising consumption
2. Modification of processes to reduce water generation
3. Increased recycling within shops, elimination of once through process.
4. Recycling water from outfalls
5. Reclamation of water from ash or sludge ponds
6. Pollution control at source
7. Upgradation of existing treatment facilities

Water, being a scarce resource, needs special attention for conservation.

ANNEXURE 8.21



Iron ***& Steel Industry is the major consumer of Refractory***

Annexure 8.22

CONSUMPTION OF REFRACTORIES IN STEEL INDUSTRIES (INDIA VS JAPAN FROM 1993 TO 1995)

(Lakh Tonnes)

YEAR	1993	1994	1995
INDIA	5.25	5.55	6.35
JAPAN	10.5	10.6	10.65

Annexure 8.23

REFRACTORY PRODUCTION IN INDIA VS. JAPAN DURING 1993-95

(Lakh Tonnes)

COUNTRY	INDIA			JAPAN		
Year	1993	1994	1995 (E)	1993	1994	1995 (E)
Shaped	5.10	5.20	5.32	7.39	6.91	6.50
Unshaped & Special Products	1.25	1.55	2.44	7.82	8.20	8.60
Total Estimated	6.35	6.75	7.76	15.21	15.11	15.10

Annexure 8.24

GROWTH OF CONSUMING INDUSTRIES VIS-A-VIS SPECIFIC CONSUMPTION OF REFRACTORIES

Industry	Production in MT		Specific Consumption in Kg/T	
	1995	2000 (E)	1995	2000 (E)
Steel	18	33	26-32	18-22
Glass	1.5	2.5	50-60	38-42
Cement	60	100	1.5-2.0	1.2-1.4
Others	42	65	6.5-7.5	4.5-5.5

E : Estimated

Annexure 8.25

MAJOR TECHNOLOGICAL ISSUES IN STEEL INDUS-TRIES : ROLE OF REFRACTORIES

TECHNOLOGICAL ISSUES	INDIAN		INTERNATIONAL
	1995-96	2000	Current
Steel Cleanliness (ppm S,P,O & N)	600 - 1000	400 - 600	225 - 275
Sp. Consumption of Refractories (Kg/ts)	26 - 32	18 - 22	11 - 15
Sp. Refractory Cost Input (Rs./ts)	425 av.	395 av.	345 av.
Consumption of Monolithic (% of total Refractories used)	8 - 12	16 - 24	45 - 55

Annexure 8.26

TECHNOLOGICAL INPUTS TO IMPROVE PERFORMANCE PARAMETERS OF INDIAN STEEL PLANTS

Prime areas of Focus	Current Status	Target (2000AD)	International Standard	Technological Inputs To Achieve Targets
· **B.F Proper & Cast House**				
* 1st repair of B.F proper	5 years	8 years	10 years	Si_3N_4 bonded SiC refractories. Remote controlled maintenance
* No. of Casts/day	5 - 8	10 - 12	10-12	Resin bonded tap hole mass. Soak bar practice
* Cast house throughput (in lakh t)	0.5 - 1.5	4.0	4 -5	SiC based ULCC with perfected Application Engineering
· **Converters**				
* Life in Heats	150 - 900	1500	800 - 3000	Fused MgO based MgO-C Programmed repair
· **Steel Ladles**				
* Life in Heats	20 - 30	60 - 100	80 - 250	Zoned lining, NCC/ Spinel based Cast-ables and Endless Casting
· **Continuous Casting**				
* No. of Ladles / Sequence	1- 5	3 - 8	8 - 20	New generation monolithic and Application technique
· **EAF**				
* Sp. consumption of Refractories kg / tcs	10 - 26	8 - 20	2 - 15	Better quality roof & side wall bricks. Appli-cation of Monolithic Effective Cooling
· **IF**				
* Sp. consumption of Refractories kg / tcs	7 (acidic) 4 - 5 (basic)	5 - 6 3 - 4	5 - 6 3 - 4	Application of need-specific monolithic

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