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IRON & STEEL INDUSTRY: CHANGING TRENDS

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Contents

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EXECUTIVE SUMMARY

Steel has become one of the most widely used materials across the global industries. It is an alloy of iron and carbon containing less than 2% carbon and 1% manganese and small amounts of silicon, phosphorus, sulphur, and oxygen. It is made from iron ore which is mined in about 50 countries and almost 98% of global iron ore is used in steelmaking.

Global Scenario: Iron and Steel

The world's crude iron ore reserves have fluctuated between 170 and 190 billion metric tons (BT) over the past decade. The average iron content of the total iron ore reserves in the world has been in the range of 47%-49%. With respect to the countries, Australia accounts for over 28% of the global crude iron ore reserves, followed by Brazil (18.9%), and Russia (13.9%). India's reserves of crude ore are around 5.5 BT with a global share of 3.1%, which is the seventh highest in the world.

While the global iron ore reserves[1] are around 180 BT, the global resources[2] are estimated to be greater than 800 BT of crude ore containing more than 230 BT of iron. Australia is the largest producer of iron ore in the world with a share of almost 35% in 2021. It is followed by Brazil (14.6%), China (13.8%), and India (9.2%).

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[1] Reserve is the economically mineable part of a measured and/or indicated mineral resource

[2] A resource is a concentration or occurrence of solid material of economic interest in or on the Earth's crust for which there are reasonable prospects for eventual economic extraction

With respect to the steel, the global crude steel production increased from 1562 MT in 2012 to 1951 MT in 2021, recording an AAGR of 2.5%. A major chunk of the global crude steel production comes from China which has a share of almost 53%. India is second in rank with a share of over 6%. As compared to a decade ago, China's share has increased by almost 7% in 2021.

Indian Scenario: Iron and Steel

India has a highly developed steel manufacturing sector, capable of manufacturing crude steel to value added steel products. It is the second largest producer of crude steel in the world currently as it surpassed Japan in 2018. Being one of the core industries, steel contributes to slightly more than 2% of India's GDP.

India's crude steel production was registered at 120 MT in FY 22, up from 78.4 MT, a decade ago. The Indian steel industry has registered an impressive performance by growing at an average of 5% every year, during FY 13 to FY 22.

The growth of Indian iron and steel industry is largely dependent on the supply and availability of suitable iron ore, given that it is an important raw material for the industry.

India's reserves of crude iron ore decreased from 7 BT in 2012 to 5.5 BT in 2021. With respect to the resources, India had 33.3 BT of crude iron ore resources in 2015. Out of these, 22.5 BT were of iron ore haematite while the rest were of iron ore magnetite. Between the two categories of iron ore, haematite is considered to be a superior quality because of the higher grade.

On the production front, the iron ore production in India reached 204.5 MT in FY 21, up from 168.6 MT in FY 12, thereby recording an AAGR of 3.4%. The production trends in iron ore have been erratic during the last decade, due to various reasons. The production fell by over 16% in FY 21 due to the pandemic. In FY 13, the production fell by 19% due to the cancellation of mine leases in Goa.

It may be noted that the iron mines in India are either captive (owned by SAIL, Tata Steel, JSW Steel, JSPL, etc.) or non-captive (owned by mining companies who sell merchant iron ore to steel makers such as National Mineral Development Corporation (NMDC) and Odisha Mining Corporation (OMC)). The share of captive iron ore production has increased from 26% in FY 12 to 41% in FY 21. The AAGR registered by the captive iron production during the last decade has been 8%, as compared to the non-captive production where the AAGR has been 2%. The increase in captive iron ore output is attributable to steel companies' aggressive bids on iron ore mines following the passage of the MMDR Act, 2015.

With respect to the states, Odisha remains the largest producer of iron ore in India with a share of over 51% in FY 21 (from 40% in FY 12); followed by Chhattisgarh (18.1%), and Karnataka (16.9%). It is vital to note that Goa was amongst the top states in FY 12 with a share of almost 20% in India's iron ore production.

Trade in Iron and Steel

Iron ores and concentrates (HS 2601)

The global exports of iron ore and concentrates were registered at over US$ 218 billion in 2021, up from US$ 128 billion in 2012. The exports registered an AAGR of 10%, owing to a growth of over 55% in 2021. The reason for the high growth in 2021 was that the iron ore prices reached a decade high in 2021.

Further, exports are heavily concentrated with over 50% of the exports coming from Australia. However, the import demand is even more concentrated with China importing 70% the global iron ore and concentrates.

With respect to India's trade in iron ore and concentrates, it commands a surplus in the trade of iron ore. The country's exports were recorded at over US$ 4 billion in 2021 with imports being close to US$ 0.4 billion. During the last decade, India registered a trade deficit in only 2015 as there were various bans and production caps in states such as Karnataka and Goa.

India's 80% exports went to China in 2021 because of the size of the China's steel industry and its demand for raw materials. On import front, Brazil was the top import source for India in 2021. However, the pattern has been erratic, given the nature of India's domestic industry and policy changes. Overall, South Africa, and Australia have been the major sources for iron ore imports of India.

Iron and Steel (HS 72)

The global exports of iron and steel have grown from US$ 425.9 billion in 2012 to US$ 557.5 billion in 2021, registering an AAGR of 5.7%. The exports registered a growth of almost 70% in 2021 over 2020. China, Japan, Germany, Russia, and South Korea have remained the major exporters during the last decade. China also remains the top importer of HS 72.

India's exports of iron and steel have registered an impressive growth during the last decade, increasing from US$ 7.7 billion in 2012 to US$ 21.2 billion, thereby recording an AAGR of over 18%. On the other hand, imports grew much slower at an average of 1.7%, during 2012 to 2021. India's share in the global exports of iron and steel increased from 1.8% in 2012 to 3.8% in 2021.

With respect to India's trading partners, India's exports in 2021 majorly went to Italy, Belgium, China, Nepal, and Vietnam while one-fifth of its imports were from South Korea. The share of South Korea was 12%, a decade ago.

Articles of Iron or Steel (HS 73)

The global exports of articles of iron or steel (HS 73, hereafter) have grown from US$ 306.1 billion in 2012 to US$ 359 billion in 2021, registering an AAGR of 2.3%. During the last decade, the highest growth for exports of HS 73 was recorded in 2021, when the exports grew by 25.8%. The top five exporters contribute to half of the global exports with China alone contributing to more than 25% of the global exports.

India has consistently maintained a surplus in the trade of articles of iron or steel, during the last decade. Further, India majorly relies on China (34%) for the imports of HS 73, while almost 30% of India's exports of HS 73 go to the USA. The biggest gainer in India's import sources of HS 73 has been Vietnam whose share increased from 0.4% in 2012 to 5.1% in 2021.

Policy Changes in the Iron and Steel Industry in India

Iron Ore

The exports of iron ore, which is a key mineral required to produce iron and steel, were increasing during FY 02 and FY 10. To protect the domestic steel industry, an export levy on iron ore lumps (10%), fines (5%), and pellets (10%) was implemented in FY 10. In the next fiscal year, the export tariff on iron ore lumps, pellets, and fines was increased to 20% across all grades. After making various modification in the rates during the next decade, the GOI hiked the export duty on iron ore lumps and fines to 50% and the same on pellets was increased to 45% in FY 23. In November 2022, the GOI withdrew the export duty on iron ores lumps & fines below 58% Fe content, and iron ore pellets. For the exports of iron ore lumps and fines > 58% Fe, duty was set at 30%.

Further, there have also been state specific policy changes. In 2011, the Supreme Court of India banned mining in Ballari, Chitradurga and Tumakuru and banned the exports of iron ore pellets from Karnataka. In 2013, some mines were allowed to restart with a cap of 30 MT production per year. This cap was raised to 35 MT in 2017 and further to 50 MT in 2022.

The Supreme Court also banned iron ore mining in Goa in 2012. The ban was partially lifted in 2014 with a production cap of 20 MT per year. In addition, 88 mining licenses that the government had renewed in 2014 and 2015 were revoked by the Supreme Court in 2018. As a result, output in Goa has been almost non-existent since FY 19.

An important policy change has been the introduction of MMDR (Mines and Minerals Development and Regulation) Act, 2015. Under the MMDR Act, 2015, the earlier process of Reconnaissance Permits (RPs) on first come first serve basis was replaced with non-exclusive RPs. The Act also allowed for the mine lease to be non-renewable 50-year lease and at the end of it, the same could be re-auctioned. Another important provision was that the captive players were allowed to bid for the mines previously held by non-captive players.

Post this, there were amendments introduced in 2021 which came to be known as MMDR Amendment Act, 2021. In accordance with the Act, the central government may set aside any mining (apart from coal, lignite, and atomic minerals) for leasing for a specific end-use. In short, no mine will be reserved for a specific end-use. The amendments also allowed that the captive mines could sell up to 50% of the production to external buyers.

Steel

In 2012-13, Government of India decided to enhance the customs duty on flat rolled products of non-alloy steel from 5% to 7.5%. In August 2015, when China devaluated its yuan against the US dollar by nearly 3%, Government of India increased the customs duty by 2.5% on flat and long steel products. Further, there have been instances of imposing safeguard duties and anti-dumping duties on products such as hot-rolled coils, hot rolled flat sheets and plates, cold-rolled flat products, steel wire rods, etc.

In February 2021, due to the rising steel prices, the Government reduced import duties on a host of steel items. In February 2022 also, the GOI announced revoking of anti-dumping duties on certain steel products imported from countries including China.

During 2020 to 2022, international steel prices witnessed a relentless rally with prices more than doubling to an all-time high in April 2022 from March 2020 levels. As a result, in May 2022, GOI levied a 15% duty on the export of steel. However, in November 2022, GOI withdrew the export duty on steel products.

It may be noted that currently the steel industry is being driven by the National Steel Policy, 2017 which targets crude steel capacity of 300 MTPA by 2030-31. The policy also projects consumption of the finished steel to reach 158 kg by 2030-31, from the current 61 kg.

Climate Change and Steel

Globally, the total CO_2 emissions have increased from 24.3 GT in 2000 to 36.3 GT in 2021. China's emissions currently are the highest in the world and increased by more than 3 times, in the last two decades. It may also be noted that the contribution of industry was 16.7% in the total CO_2 emissions of the globe, a couple of decades ago, and is now over 17%.

Particularly, with respect to the iron and steel industry, the energy intensity (GJ/tonne crude steel) has increased from 19.81 in 2011 to 20.62 in 2020. The crude steel is usually manufactured through two processes - blast furnace-basic oxygen furnace (BF-BOF), and direct reduced iron-electric arc furnace (DRI-EAF). Presently, over 70% of global crude steel is produced through BF-BOF which is associated with more carbon emissions.

Within the manufacturing sector, iron and steel segment is a major player, roughly contributing to around 9%-10% of the total global carbon emissions. As per the Global Efficiency Intelligence, the carbon emissions from the steel sector were over 3600 MT CO_2 in 2019 with China alone contributing over 54% of these emissions, followed by India at 6.6%.

Over the years, the average carbon emissions per tonne of crude steel have increased. The intensity was recorded at 1.8 tonne CO_2/tonne crude steel in 2007. This has increased to 1.89 tonne CO_2/tonne crude steel in 2020.

The carbon emissions are usually the highest (approximately 2.4 tonne/tonne of crude steel) in the BF-BOF route because of the high usage of coal. On the other hand, the DRI-EAF route has comparatively lesser emissions (approximately 1.4 tonne/tonne of crude steel). The scrap based EAF releases the least emissions (approximately 0.4 tonne/tonne of crude steel).

It may be noted that almost 45% of India's crude steel production is through BF-BOF facility. Out of the India's total 2508 MT CO_2 of carbon emissions in 2019, almost 12% was contributed by iron and steel industry. Globally, India's contribution to total iron and steel industry emissions is around 7%-8%.

Steel Decarbonisation and Policy Support

To meet the goals of the Paris Agreement towards limiting global CO_2 emissions and keeping global temperature rise well below 2° Celsius by 2100, it is imperative that an industry like iron and steel adopts low carbon-emitting production process.

Various relevant technologies are being used in the modern times to shift to a low carbon steel. These include technologies such as carbon capture and storage (CCS); carbon capture and utilisation (CCU); top pressure recovery turbine (TRT); natural gas-EAF method; etc. It may also be noted that steel can be reused to a large extent promoting the circular economy. Every tonne of scrap used for steel production avoids the emission of 1.5 tonnes of carbon dioxide, and the consumption of 1.4 tonnes of iron ore, 740 kg of coal and 120 kg of limestone.

Green Hydrogen in Steel Making: Progress and Potential

In order to achieve zero carbon emissions, it is vital for the steel industry to adopt hydrogen technology in electric arc furnaces. There are three major types of hydrogen - grey, blue, and green and the one obtained from cleaner sources is called green hydrogen.

The International Energy Agency (IEA) estimates that the share of hydrogen driven steel production in total steel production could reach 8% by 2050 under a Sustainable Development Scenario (SDS) which sets out the major changes that would be required to reach the main energy-related goals of the UN Sustainable Development Agenda.

However, it may be noted that one of the important challenges with respect to moving towards green hydrogen is cost. But with greater policy support, the cost of producing green hydrogen could decline from US$ 3.23/kg in 2020 to US$ 1.43/kg in 2030, as per NITI Aayog. Government of India has set a production target of 5 million tonnes per annum (MTPA) of hydrogen by 2030 under the recently announced Green Hydrogen Policy.

Decarbonization Efforts by India

Under COP 26, India has committed to reach net zero carbon emissions by 2070 in which iron and steel industry is expected to play an important role. During 2005 to 2020, the average CO_2 emission intensity from India's steel sector has reduced from around 3.1 tonne/tonne of crude steel to 2.6 T/tcs. India is further required to reduce this to 2.4 T/tcs by 2030 as per its Nationally Determined Contributions (NDCs).

At COP 27 in November 2022, India released its Long-Term Low Emissions Development Strategy (LT-LEDS) for transition to net zero emissions by or around mid-century. The plan focuses on strategic transition of high-emission sectors, including electricity, transport, industries, and urbanisation.

India has in place the National Mission for Enhanced Energy Efficiency (NMEEE). One of the important initiatives under NMEEE is Perform Achieve and Trade (PAT) Scheme. In accordance with this plan, Designated Consumers (DCs) are given particular energy reduction goals over a three-year cycle. By March 2023, it is anticipated that a total of roughly 26 MTOE (Million Tonnes of Oil Equivalent) in energy savings will be made, eliminating nearly 70 million tonnes of CO_2 under PAT.

Further, under the Green Hydrogen Policy, green hydrogen producers are exempted from paying interstate transmission charges for 25 years on the renewable energy bought by projects which are commissioned by 30 June 2025.

Efforts are also being made by various Indian companies towards decarbonisation of steel. For instance, in 2021, Tata steel commissioned a 5 tonne per day carbon capture plant. It also commissioned its first steel recycling plant in Rohtak in 2021. Similarly, JSW steel has allocated ₹ 10,000 crore to lower carbon emissions by 42% by 2030 from the base year of 2005. JSW also has the TRT mechanism installed at its Vijayanagar plant. It was also the first company to use Corex technology to produce hot metal.

Policy Support in Other Countries

China

China's steel industry contributes significantly to China's total carbon emissions. It is also the largest global producer of steel and contributes heavily to the steel-based carbon emissions in the world. As a result, China has set a carbon neutrality goal for itself which is to be achieved by 2060, towards which it has started working on it with significant focus.

Under its 14th five year plan, China announced strict control on coal consumption and increase the share of non-fossil fuel energy consumption in total energy consumption to 20% by 2025, up from 15.8% in 2020. In the 15th five-year plan (2026-2030), China expects to increase the share of non-fossil fuel in energy consumption to 25% by 2030. In 2021, China also lifted the import ban on steel scrap and aims to gather 300 MT of steel scrap every year by 2025. China has implemented the New Capacity Swap programme, which came into effect from June 2021 and also cancelled tax rebates on various steel products.

The European Union

The EU's 2030 Climate Target Plan has the proposal to cut the region's emissions by at least 55% by 2030, as compared to 1990 levels. As part of its decarbonisation efforts, the EU has laid out a 'Fit for 55 package'. Under this, there are various provisions such as revision of the EU Emissions Trading System (ETS), revisions of renewable energy directive, and carbon border adjustment mechanism.

The EU also has a hydrogen strategy under which it is aiming to bring together electrolyser manufacturers and suppliers of components and materials to achieve a combined annual electrolyser manufacturing capacity of 17.5 GW by 2025 in Europe. Further, the EU has also launched a clean steel partnership in 2021. It focuses on developing, upscaling, and rolling out new technologies which could reduce carbon emissions from steel production in the EU by 50% by 2030, in comparison to 1990 levels.

The USA

In 2021, the USA announced targets to achieve 50-52% reduction of GHGs by 2030 from 2005 levels. It is planning to achieve near-zero emission by 2050 through a mix of energy-efficiency methods, such as Pulverized Coal Injection (PCI) in blast furnaces and decarbonizing the power industry so that electricity obtained from renewable resources can be used for hydrogen production, along with new age technologies such as CCUS.

In September 2022, the Government of USA released the 'Industrial Decarbonization Roadmap' which identifies pathway to reduce industrial emissions from American manufacturing. This involves sectors such as chemicals, petroleum, iron and steel, food and beverages, and cement. The roadmap recommends the iron and steel industry to pilot demonstrations for transformative technologies such as hydrogen steel, CCUS, etc.

The USA also has 'Buy Clean California Act' in place since 2017 under which maximum acceptable Global Warming Potential (GWP) limit for four eligible materials, namely structural steel (hot-rolled sections, hollow structural sections, and plate), concrete reinforcing steel, flat glass, and mineral wool board insulation, is established and published.

Challenges and Strategies

Securing Coking Coal Supply

India's proven reserves of anthracite and bituminous are 106 BT and of sub-bituminous and lignite are 5.1 BT. In comparison, the USA has 219 BT of anthracite and bituminous reserves. However, under the category of 'anthracite and bituminous', most of the reserves are of bituminous in India. Coking coal contributes around 40-45% of the steel production cost. India's import dependence for coking coal is around 85% and India targets to get this down to 65% by 2030-31.

The first step to secure the raw materials such as coking coal would be to diversify the import sources. Currently, India is heavily dependent on Australia, with almost 68% of India's coking coal imports coming from Australia.

India should also focus more on the mining and the washing technology if it wants to reduce the import dependence. Further, mining exploration can also be helpful in finding more coking coal reserves, which could be low in ash content. Overall, investing in technology could be a game changer and could ultimately reduce the import dependence.

Enhancing Exports

A well laid out export strategy for the steel products can be a guiding force for the industry. Currently, steel exports are majorly dependent on either a fall in domestic demand or better international prices. Additionally, non-alloys dominate the finished steel exports from India. Out of the 15.5 MT of finished steel exports in FY 22, 13.9 MT were of non-alloys. As a result, the export realization in terms of value is lesser vis-à-vis products at the higher end of the steel value chain.

Further, the cost competitiveness of the steel sector also needs to be addressed. While domestically, the steel produced might be cost effective, the outbound steel for exports especially high-grade steel or special steel is not much export competitive. Finally, a stable policy environment could be one of the most important factors in determining the direction of the exports. Policy decisions such as export duty on steel could negatively impact the steel exports.

Logistical Challenges

Most of the steel plants in India are far from the ports, while being closer to places which supply raw materials. Given large distances, railways are usually the preferred mode of freight and over 80% of steel industry's logistics requirement is met through railways. However, freight cost of railways in India is on the higher side due to cross subsidization of passenger travel.

One of the important solutions is to revise the freight class under railways for iron ore. Currently, the iron and steel, including iron ore, both are under class 165. However, coal is under the class 145. Revising the freight class to 145 for iron ore and steel would attract lower freight rates and would make Indian steel even more competitive. It may be noted that in railways, higher the freight class, higher is the fare. Further, consistent investing in the new logistics infrastructure will be an important step. This could involve strengthening and development of new ports, dedicated railway connectivity between ports and plants and upgrading it to increase the average speed, building new expressways, etc.

Integrating Industry 4.0 and Steel Industry

Integrating the industry 4.0 practices in the steel manufacturing is important because this has the capability to create efficient steel plants and reduce the cost of production. Basically, IoT sensors can be used in the plants to collect the data and feed the data to the AI. This would allow the AI to adjust the temperature or air pressure on its own, after sufficient data has been generated.

By monitoring the machines in real time, the AI technology can help reduce the human errors which will prevent the injuries from happening, and consequently, will increase productivity. Also, with industry 4.0, smart meters and IoT work together and can reduce the wasted energy. AI can assess the amount of energy required as per the steel products being manufactured, thereby rationalizing the energy consumption.

Moving Towards a Greener Steel

The iron and steel industry contributes to around 9-10% of the global carbon emissions. Globally, India is the second largest contributor to carbon emissions from steel with a share of 6.6%.

One of the biggest steps in the direction of a green steel is the use of green hydrogen in the iron and steel industry. However, moving towards green steel will require policy efforts. For instance, even with the forecasted lower cost of production for green steel, the cost could be well above the BF-BOF technique. Therefore, solutions should be explored where in green hydrogen can be blended with grey hydrogen. Further, the Government may also explore rolling out a PLI scheme specifically to produce green steel.

Scrap Utilization

The scrap based EAF releases the least emissions (approximately 0.4 tonne/ tonne of crude steel), amongst the process. The use of every ton of scrap saves 1.1 ton of iron ore, 630 kg of coking coal and 55 kg of limestone.

To ensure the availability and the right quality of steel scrap, it will be important for the producers to design products in a way which makes the recycling easier. This must be supplemented by developing an appropriate recycling infrastructure.

Conclusion

The Indian steel industry has seen a massive increase in its size since its independence. It is currently the second largest producer of crude steel in the world. At the same time, there is a rising consciousness globally about rising carbon emissions and given the production processes, steel has been a major contributor to the same. India also has set ambitious targets for achieving carbon neutrality. As India intends to reach production capacity of 300 MT crude steel per annum by 2030-31, firms in this sector are expected to play an important role in achieving the same through carbon-reduction strategies. Large steel plants in India would be expected to lead from the front in a big way to set up means and mechanisms to reduce carbon emissions from their factories, while setting the tone for the manufacturing industry at large. It will be vital to observe how India balances its ambitious production dream and carbon emission reduction targets together, in the coming years. With the implementation of strategies as outlined in this Study, India could increase its export of iron and steel in greater numbers, while also taking care of the atmosphere.

1. GLOBAL IRON AND STEEL SCENARIO

Today, steel is the most significant material used in engineering and building worldwide. Every aspect of human life uses it, including cars, building supplies, washing machines, cargo ships, surgical scalpels, amongst others.

Steel is made from iron ore, a compound of iron, oxygen and other minerals that occur in nature. With steel heavily connected to the global value chains, its basic raw material, iron ore assumes a major importance. Almost 98% of global iron ore is used in steelmaking, and it is mined in about 50 countries[3].

The raw materials for steelmaking are mined and then transformed into steel using two different processes: the blast furnace/basic oxygen furnace (BF-BOF) route, and the electric arc furnace route (EAF). The kind of raw materials used on each route are what distinguish them most from one another. While the EAF method makes steel mostly utilizing recycled steel and power, the BF-BOF route primarily uses iron ore, coal, and recycled steel. It may however be noted that almost 70% of the global steel is produced using the BF-BOF route.

Global Scenario of Iron Ore and Steel

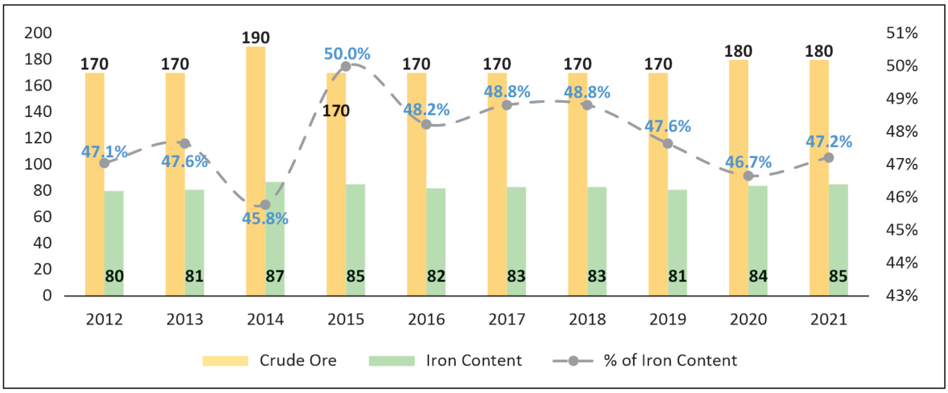
Iron Ore Reserves and Production

The world's crude iron ore reserves have fluctuated between 170 and 190 billion metric tons (BT) over the past decade. Changes in reserves are majorly due to mine closures, policy changes, and exploration of new mines, among other factors. The average iron content of the total iron ore reserves in the

[3] USGS

world has been in the range of 47%-49%, indicating an iron content of 80-87 BT by weight.

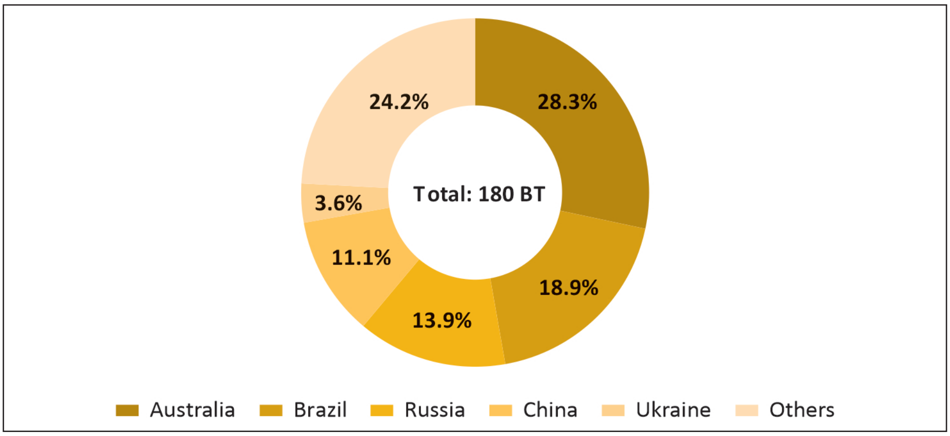
Figure 1: Global Crude Iron Ore Reserves and Iron Content (in Billion Metric Tons)



Source: United States Geological Survey (USGS); India Exim Bank Research

With respect to the countries, Australia accounts for over 28% of the global crude iron ore reserves, followed by Brazil (18.9%), and Russia (13.9%). India's reserves of crude ore are around 5.5 BT with a global share of 3.1%, which is the seventh highest in the world.

Figure 2: Crude Iron Ore Reserves by Country

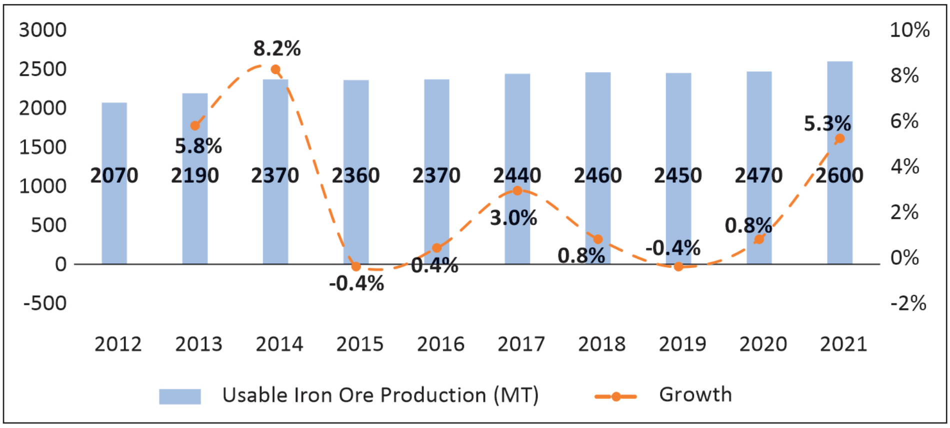


Source: USGS; India Exim Bank Research

Even though there are many iron ore deposits in the world, only a few of them are physically and economically suitable for undertaking mining operations. The resources that have not yet been identified are essentially theoretical or speculative estimates[4].

As per the USGS, while the global iron ore reserves as stated above are around 180 BT, the global resources are estimated to be greater than 800 BT of crude ore containing more than 230 BT of iron. The rising global demand of steel has driven the global iron ore production which registered an AAGR of 2.6%, during 2012 to 2021. The usable[5] iron ore production was recorded at 2600 million tonnes (MT) in 2021, up from 2070 MT in 2012.

Figure 3: Usable Iron Ore Production



Source: USGS; India Exim Bank Research

Australia is the largest producer of iron ore in the world with a share of almost 35% in 2021. It is followed by Brazil (14.6%), China (13.8%), and India (9.2%).

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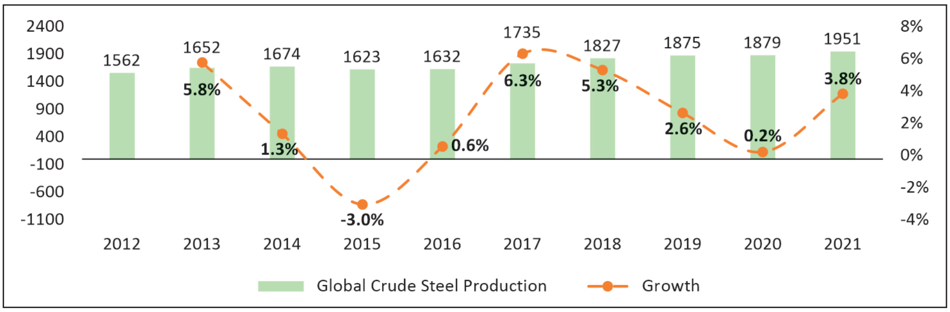
[4] Undiscovered and recognized reserves are two categories for the reserves. As per the viability of executing the extraction, the detected resources are calculated based on geological surveys and can be classified as economically viable, marginally economically viable, and sub economically viable. The estimated untapped resources are based on similarities in geographic characteristics.

[5] Industry term for high-grade iron ore, concentrates, or agglomerates which can be used in blast furnaces or other processing plants.

Crude Steel Production

As stated earlier, almost all of iron ore mined is used for the production of steel. As a result, the production of crude steel directly impacts the demand for iron ore. The global crude steel production increased from 1562 MT in 2012 to 1951 MT in 2021, recording an AAGR of 2.5%.

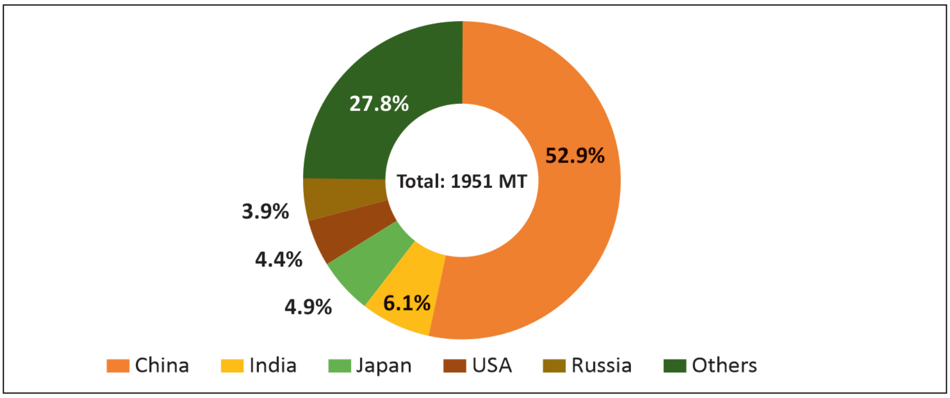
Figure 4: Global Crude Steel Production (in MT)



Source: World Steel Association; India Exim Bank Research

It may be noted that a major chunk of the global crude steel production comes from China which has a share of almost 53%. India is second in rank with a share of over 6% in the global crude steel production. As compared to a decade ago, China's share has increased by almost 7%. India has also gained in terms of the global share in the crude steel production, during the last decade.

Figure 5: Major Crude Steel Producers: 2021



Source: USGS; India Exim Bank Research

About the Study

This study attempts to understand the dynamics of global and Indian iron and steel market, as well as its trade performance in recent years. Further, the Study attempts to list down the ongoing policy changes in the iron and steel industry in the country. Finally, taking cognizance of the increasing concerns around global emissions and the possible remedial measures being taken by various steel companies, the Study makes efforts to dwell on this important aspect as well.

2. IRON AND STEEL INDUSTRY SCENARIO IN INDIA

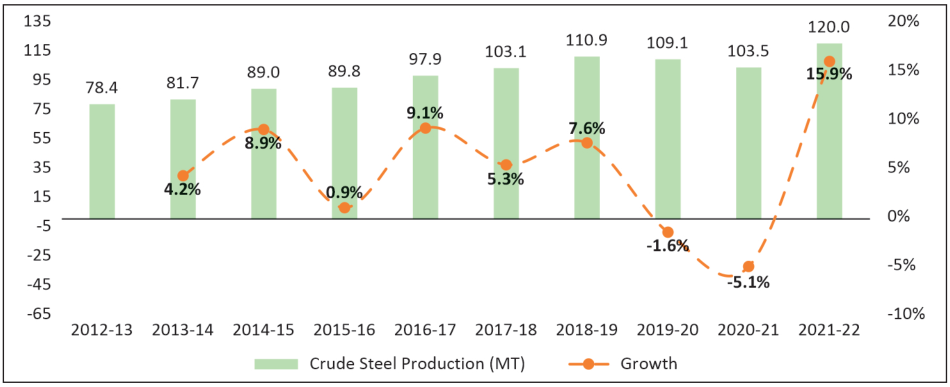
India has a highly developed steel manufacturing sector, capable of manufacturing crude steel to value added steel products. It is the second largest producer of crude steel in the world currently as it surpassed Japan in 2018. Being one of the core industries, steel contributes to slightly more than 2 % of India's GDP.

Domestic iron ore availability is a major reason for the establishment of the steel industry in India. Huge scope for growth is offered by India's comparatively low per capita steel consumption and the expected rise in consumption due to increased infrastructure construction and the thriving automobile and railways sectors.

Crude Steel Production in India

India's crude steel production was registered at 120 MT in FY 22, up from 78.4 MT, a decade ago. The Indian steel industry has registered an impressive performance by growing at an average of 5% every year, during FY 13 to FY 22.

Figure 6: Crude Steel Production Trend in India



Source: CMIE Industry Outlook; India Exim Bank Research

Box 1: Major Indian Steel Players and their Expansion Plans

Steel industry plays an important role for the economic growth of India. Indian crude steel production stood at 120 million tonnes in FY 22 with an installed capacity of 154 million tonnes becoming the second largest producer in the world. Steel industry is dominated by public players like SAIL and few private sector majors like JSW, Tata Steel, AMNS, and JSPL who have a total share of 60% of Indian crude steel capacity. The steel industry is driven by demand from end user segments like construction, infrastructure, automobile and other segments like pipes and tubes, agriculture etc.

Player name	Crude steel capacity (MTPA)	Key locations
JSW Steel	28	Dolvi, Jamshedpur, Salem
Tata Steel	20.7	Jamshedpur, Meramandali, Kalinganagar
SAIL	19.6	Bhilai, Durgapur, Rourkela, Bokaro
RINL	6.3	Vishakhapatnam
JSPL	9.6	Angul, Raigarh
AMNS	10	Hazira

Major capacity additions are being carried out by players like Tata Steel, JSPL, RINL, JSW, and AMNS. JSW steel plans to spend ₹ 47,457 crore towards capital expenditure during 2021-24, primarily for adding 5 MTPA steelmaking capacity at Vijaynagar, Karnataka, and building mining infrastructure in Odisha. Further, in October 2022, AMNS started its ₹ 60,000-crore project expansion at Hazira, Gujarat. Tata steel also plans to invest ₹ 8,500 crore in its India's operations for FY 23. Tata Steel is in process of expanding capacity of its plant in Kalinganagar, Odisha to 8 MT from 3 MT.

Source: India Exim Bank Research

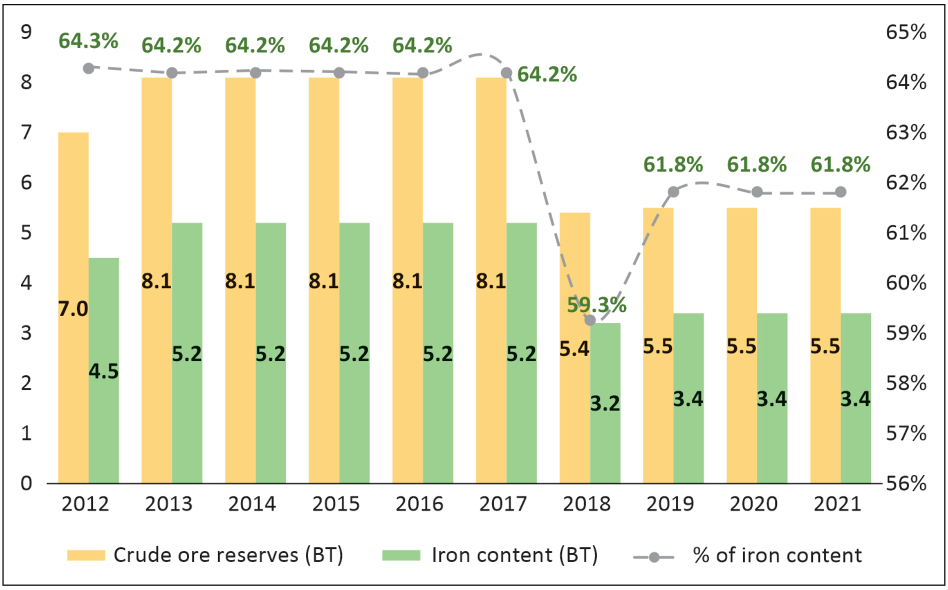
Iron Ore Supply

The growth of Indian iron and steel industry will largely be commenusrate with the supply and availability of suitable iron ore, given that it is an important raw material for the industry, and hence it becomes important to touch upon the supply dynamics of iron ore as well.

Reserves and Iron Ore Classification

India's reserves of crude iron ore decreased from 7 BT in 2012 to 5.5 BT in 2021. Due to the Supreme Court of India's decision to lift the moratorium on several mines in the states of Karnataka, Goa, and Odisha, the crude iron ore reserves increased to 8.1 BT in 2013. However, later when India's Supreme Court banned operations at all mines in Goa to combat unlawful mining, the reserves of crude iron ore plummeted even more dramatically in 2018.

Figure 7: Crude Iron Ore Reserves and Iron Content in India



Source: USGS; India Exim Bank Research

According to Minerals Yearbook 2020 of Indian Bureau of Mines, the total crude iron ore resources in India were 33.3 BT as of 2015. Out of these, 22.5 BT are of iron ore haematite while the rest are of iron ore magnetite. It may be noted that about 79% of the haematite resources are found in the eastern India including states such as Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh while 93% of magnetite are found in the southern states like Andhra Pradesh, Goa, Karanataka, Tamil Nadu, and Kerala.[6]

Table 1: Classification of India's Resources and Reserves of Iron Ore (in BT)

	Haematite	Magnetite
Total Resources	22.5	10.8
Reserves	5.5	0.05

Source: Indian Bureau of Mines (IBM)

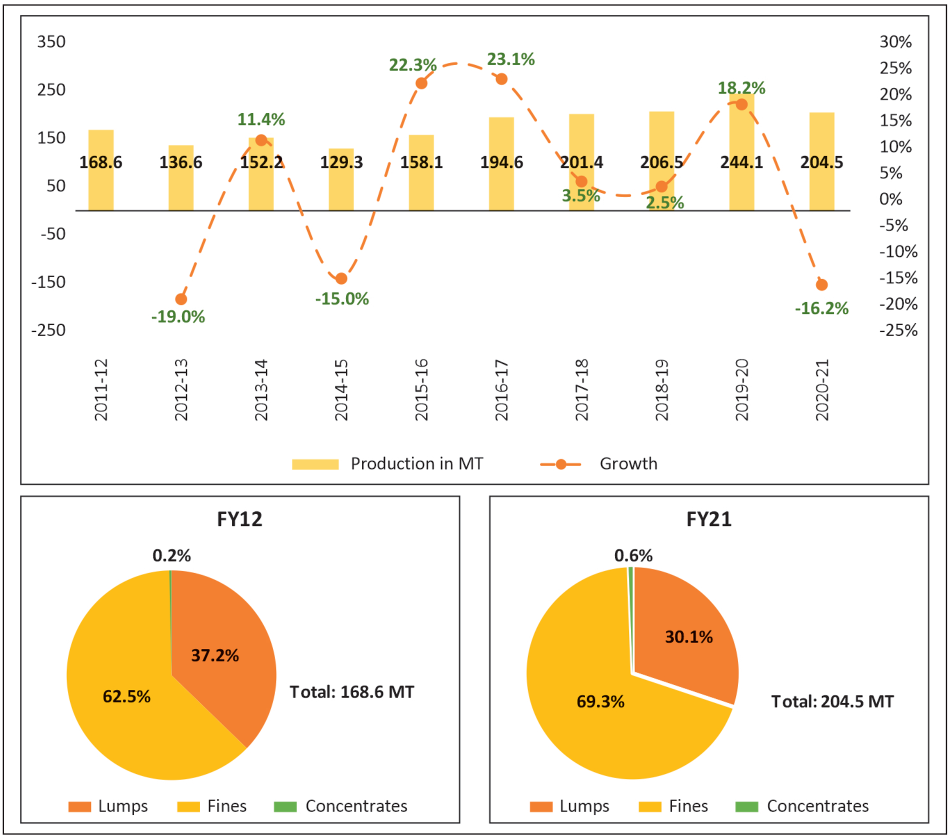
Between the two categories of iron ore, haematite is considered to be a superior quality because of the higher grade. Even with respect to the reserves, India has higher reserves of haemitite at 5.5 BT while the same for magnetite is almost negligible.

Production and Variety

The iron ore production in India reached 204.5 MT in FY 21, up from 168.6 MT in FY 12, thereby recording an AAGR of 3.4%. The production reached as high as 244.1 MT in FY 20.

[6] A resource is that amount of a geologic commodity that exists in both discovered and undiscovered deposits. On the other hand, reserves are that subgroup of a resource that have been discovered, have a known size, and can be extracted at a profit.

Figure 8: India's Iron Ore Production and Share by Variety



Source: IBM; CMIE Industry Outlook; India Exim Bank Research

The production trends in iron ore have been erratic during the last decade, due to various reasons. The production fell by over 16% in FY 21 due to the pandemic. In FY 13, the production fell by 19% due to the cancellation of mine leases in Goa. However, the production started to increase in FY 16, post the re-auction of mines in Goa and newer mines auctions in Odisha and Karnataka. The mines operations have also become more efficient with large steelmakers taking over, leading to a pick-up in production.

Lumps, fines, and concentrates are the three main types of iron ore that are produced. After the iron ore has been processed, concentrates are created. Further, steelmakers prefer lumps over fines because the former may be used immediately in the blast furnace while the latter has to be sintered and/or pelletized before use. While the percentage of lumps form fell throughout this time, the share of fines form climbed from 62.5% in FY 12 to 69.3% in FY 21.

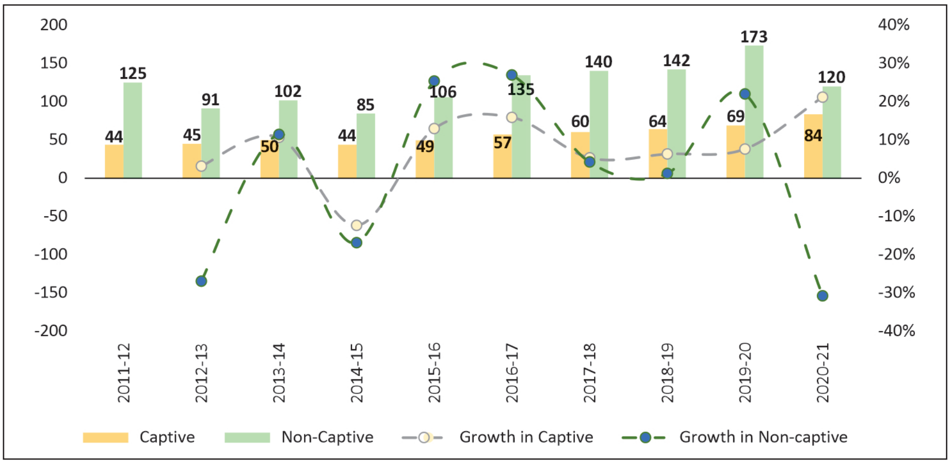
Further, it may be noted that there are different grades of iron such as below 55% Fe, 55% to below 58% Fe, >58% Fe to <62%, >62% Fe to 65%, 65% and above Fe. The higher-grade iron ore is simple to process since it does not require the beneficiation process to produce steel. Lower grade iron ore, especially <58% Fe and below, must be beneficiated or blended with the high variety to be used in the furnace. It is also important to mention that because fines come in the form of dust, steelmakers prefer lumps over fines of the same grade.

Within the 'lump' production, in FY 19, 48% was in the category of 62%-65% Fe, while 28% was in the category of 65% Fe and above. On the other hand, in the 'fines' segment, during the same year, 51% production was in the category of 62%-65% Fe, and 18% was in 65% Fe and above category.

Captive and Non-captive Production

Iron ore mines in India are either captive (owned by steel mills such as SAIL, Tata Steel, JSW Steel, etc.) or non-captive (owned by miners who sell merchant iron ore to steel makers such as National Mineral Development Corporation (NMDC) and Odisha Mining Corporation (OMC)).

Figure 9: Captive and Non-Captive Iron Ore Production (in MT)



Source: IBM; CMIE Industry Outlook; India Exim Bank Research

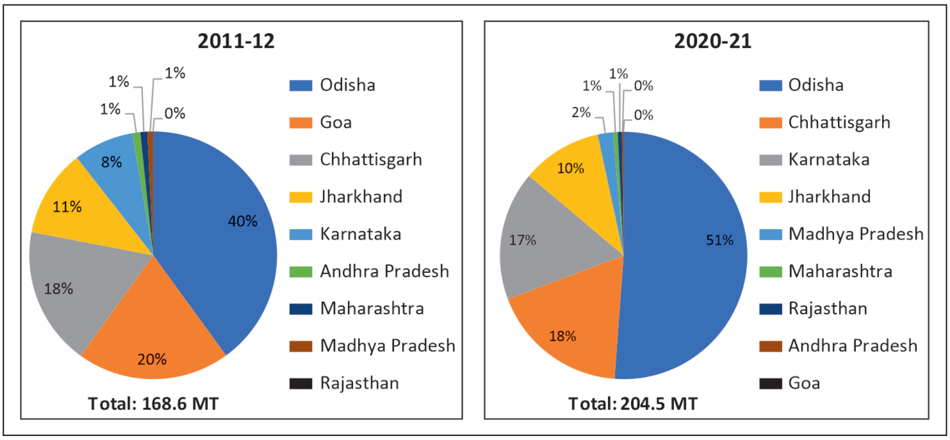
The share of captive iron ore production has increased from 26% in FY 12 to 41% in FY 21. The AAGR registered by the captive iron production during the last decade has been 8%, as compared to the non-captive production where the AAGR has been 2%, during the same period.

The increase in captive iron ore output is attributable to steel companies' aggressive bids on iron ore mines following the passage of the MMDR Act, 2015[7] in India. Large players desire to acquire iron ore mines to decrease their reliance on merchants for raw materials and input costs now that the GOI has permitted steel producers to compete for iron ore mines.

State-wise Production

The state of Odisha remains the largest producer of iron ore in India with a share of over 51% in FY 21, followed by Chhattisgarh (18.1%), and Karnataka (16.9%). The share of Odisha has increased from 40% in FY 12. The production in the state registered an AAGR of 8.3% during FY 12 to FY 21. Chhattisgarh, on the other hand, registered a lower AAGR (2.6%) in production than that of India (3.4%), during this period.

Figure 10: State-Wise Iron Ore Production



Source: IBM; CMIE Industry Outlook; India Exim Bank Research

[7] The Act provides that captive mines (other than atomic minerals) may sell up to 50% of their annual mineral production in the open market after meeting their own needs.

Further, Goa was amongst the top states in FY 12 with a share of almost 20% in India's iron ore production. However, the mines in Goa were closed in 2012 leading to the fall in the state's share in the subsequent years.

Road ahead

The National Steel Policy, 2017 envisages 300 million tonnes of production capacity by 2030-31. The government has an objective of increasing rural consumption of steel from the current 19.6 kg/per capita to 38 kg/per capita by 2030-31. A number of policy changes are also taking place with the evolving scenario, which are further detailed in chapters ahead.

3. INTERNATIONAL TRADE OF IRON AND STEEL

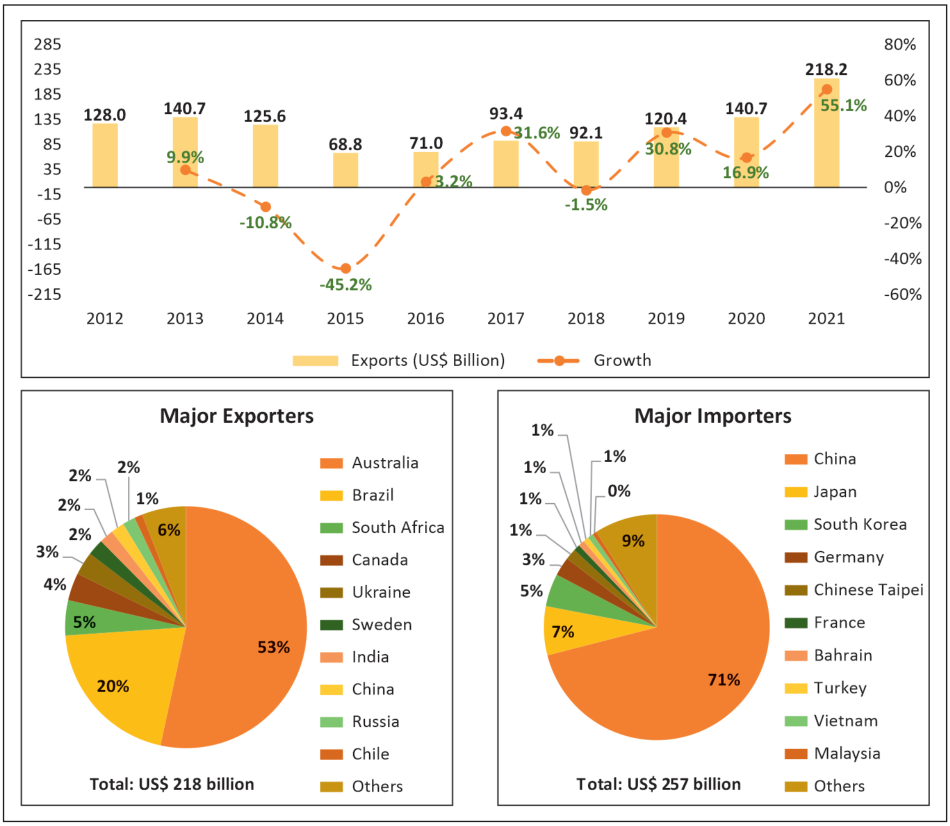
The previous chapters have focused on the size of the iron and steel industry, both for the world and India. However, trade is an important component when it comes to economies like India given its iron ore reserves and size of the steel industry as well as recent policy changes. This chapter attempts to understand the trade dynamics for three segments, namely, iron ore (HS 2601), iron and steel (HS 72), and articles of iron or steel (HS 73).

Iron ores and concentrates (HS 2601)

Global Trade

The global exports of iron ore and concentrates were registered at over US$ 218 billion in 2021, up from US$ 128 billion in 2012. The exports registered an average annual growth rate (AAGR) of 10%, owing to a growth of over 55% in 2021. It may be noted that the high growth in 2021 is the result of record high prices of iron ore. The iron ore prices with 63.5% iron content reached as high as US$ 215/tonne in June 2021, highest in the last decade. The average price during 2012 to 2021 has remained just below US$ 100/tonne.

Figure 11: Global Exports of Iron Ore and Major Traders (2021)



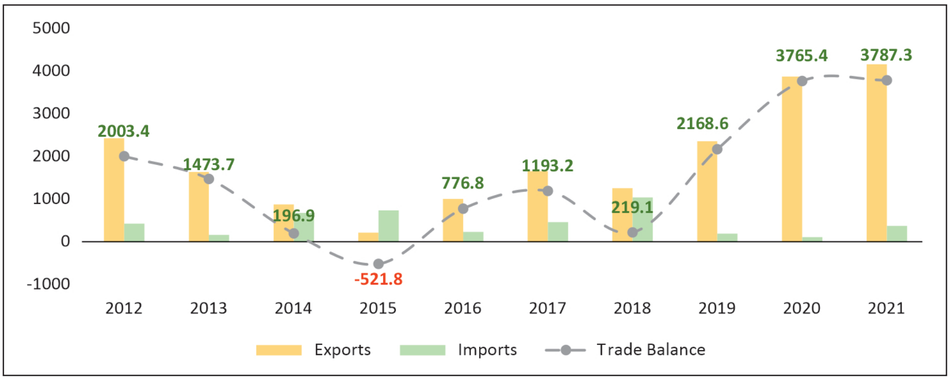
Source: ITC Trade Map; India Exim Bank Research

Further, with respect to major players in trade, it may be noted that exports are heavily concentrated with over 50% of the exports coming from Australia. However, the import demand is even more concentrated with China importing 70% the global iron ore and concentrates by value. India was the seventh largest exporter of iron ore in 2021.

India's Trade

India commands a surplus in the trade of iron ore. The country's exports were recorded at over US$ 4 billion in 2021 with imports being close to US$ 0.4 billion, thereby leading to a trade surplus of US$ 3.8 billion. During the last decade, India registered a trade deficit in only 2015 as there were various bans and production caps in states such as Karnataka and Goa.

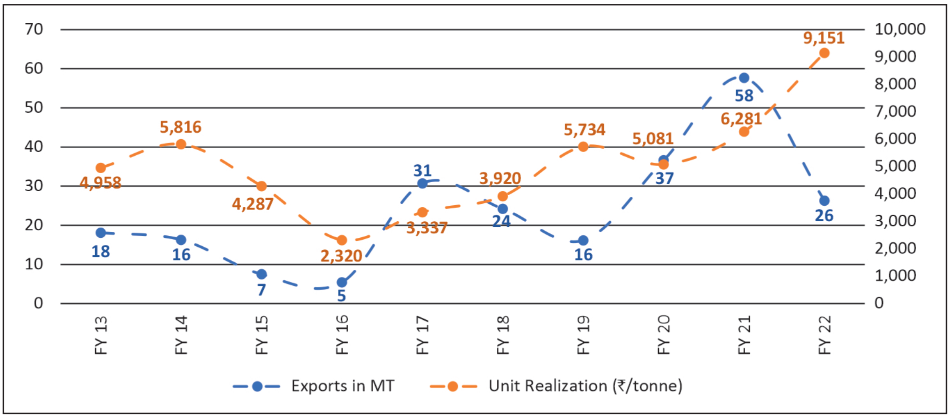
Figure 12: India's Trade in Iron Ore and Concentrates (US$ Million)



Source: ITC Trade Map; India Exim Bank Research

Given the high prices of iron ore in FY 22, the unit realization for Indian exporters reached an all-time high of ₹ 9151/tonne in FY 22, a growth of 45.7% over FY 21. In fact, the analysis shows that in FY 22, while the unit realization grew by over 45%, the exports in quantity terms fell by over 54%.

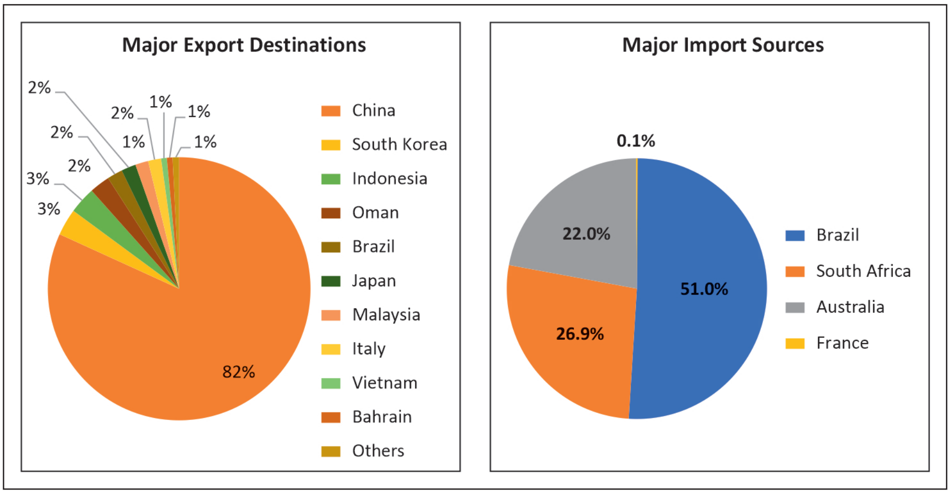
Figure 13: India's Exports of Iron Ore and Concentrates in Quantity vis-à-vis Unit Realization



Source: CMIE Industry Outlook; India Exim Bank Research

With respect to India's major export destinations, it may be noted that given the size of the China's steel industry and its demand for raw materials, India's 80% exports went to China in 2021. When it comes to imports, while Brazil was the top import source for India in 2021, the pattern has been erratic, given the nature of India's domestic industry and policy changes. South Africa, and Australia have however been the major sources of India's imports of iron ore and concentrates, during the last decade.

Figure 14: India's Trading Partners in Iron Ore and Concentrates: 2021



Source: ITC Trade Map; India Exim Bank Research

India's Export Competitiveness in Iron Ore and Concentrates

It is also vital to evaluate the export competitiveness of India's iron ore and concentrates given that India has significant iron ore reserves as well as a large steel industry. The export competitiveness in this Study is being evaluated through the revealed comparative advantage (RCA) methodology. The equation for the same is,

$$RCA_{ij} = (x_{ij}/X_{it}) / (x_{wj}/X_{wt})$$

Where,

x_{ij}: exports of commodity j from country 'i'

X_{it}: total exports from country 'i'

x_{wj}: exports of commodity 'j' from world

X_{wt}: total exports from world

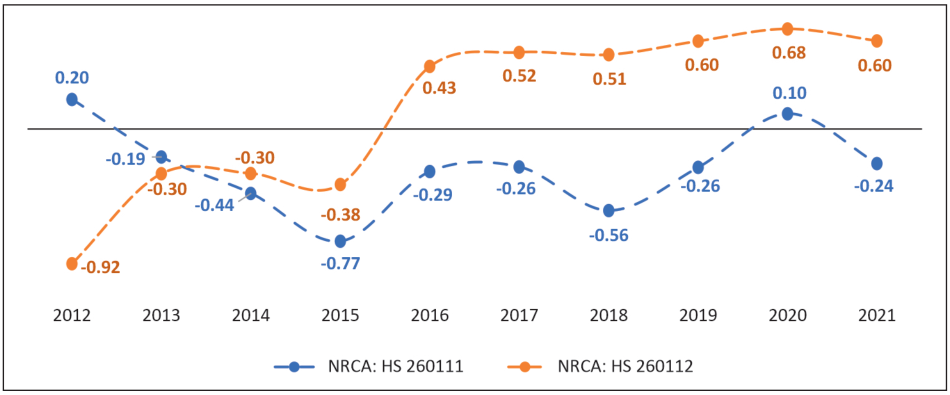
The RCA index can range from 0 to infinity with 1 as the break-even point. That is, an RCA value of less than 1 means that the product has no export comparative advantage, while a value above 1 indicates that the product has a comparative advantage. The index can further be normalized to know the extent of competitiveness and can be called Normalized Revealed Comparative Advantage (NRCA).

$$NRCA_{ij} = (RCA_{ij} - 1)/ (RCA_{ij} + 1)$$

NRCA ranges from -1 to 1 with 0 as the breakeven point. That is, an NRCA value of less than 0 means that the product has no export comparative advantage, while a value above 0 indicates that the product has a comparative advantage.

Iron ores and concentrates (HS 2601) is divided into three HS 6 digit codes, namely, HS 260111 (Non-agglomerated iron ores and concentrates), HS 260112 (Agglomerated iron ores and concentrates), and HS 260120 (Roasted iron pyrites). However, India only exports HS 260111, and HS 260112. For these two, the analysis reveals that in 2015 both the items were not competitive; however, since then, while HS 260111 has mostly been in the non-competitive zone, HS 260112 has shown impressive improvement in export competitiveness.

Figure 15: NRCA comparison of HS 260111 and HS 260112



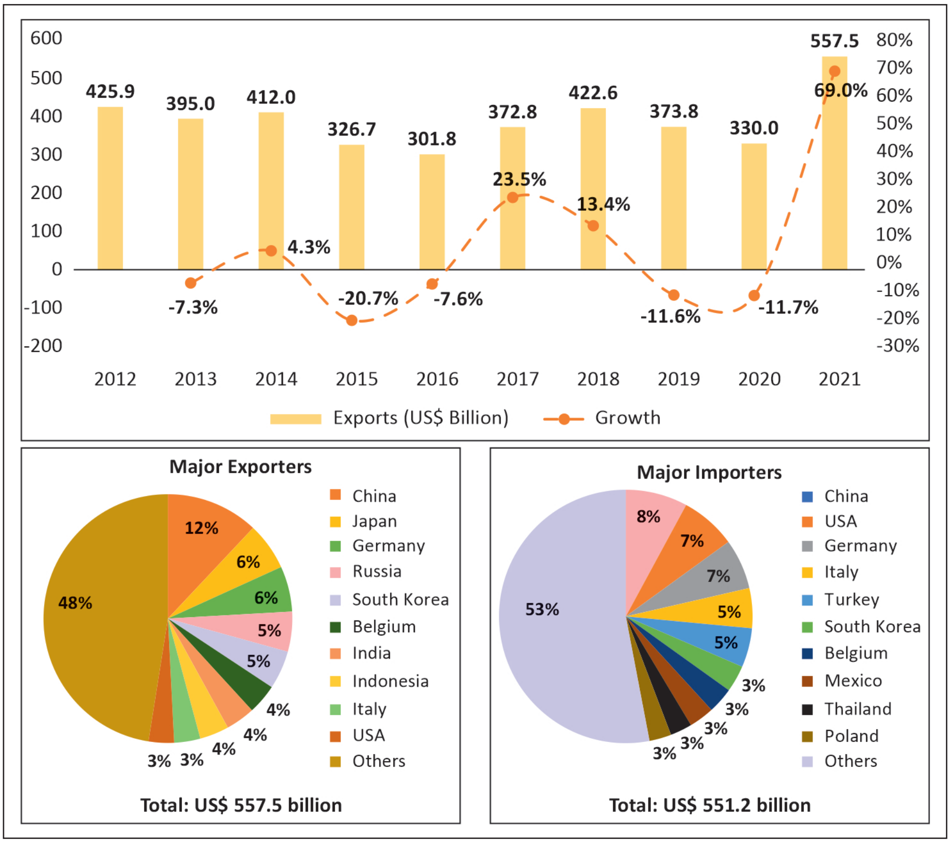
Source: ITC Trade Map; India Exim Bank Research

Iron and Steel (HS 72)

Global Trade

The global exports of iron and steel (HS 72) have grown from US$ 425.9 billion in 2012 to US$ 557.5 billion in 2021, registering an AAGR of 5.7%. The exports registered a growth of almost 70% in 2021 over 2020.

Figure 16: Global Exports of Iron and Steel and Major Traders (2021)



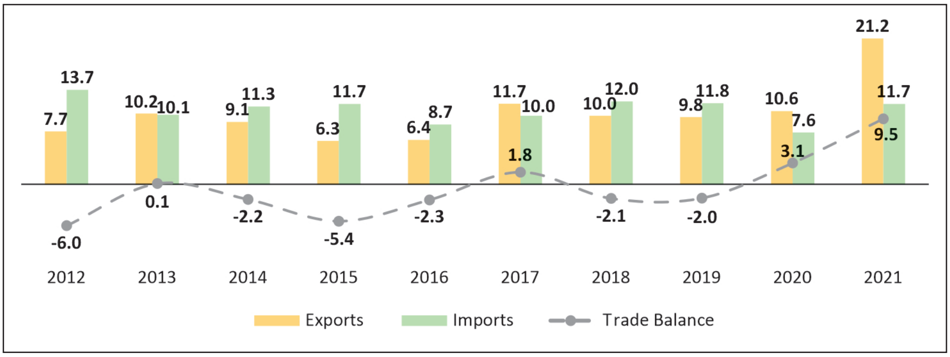
Source: ITC Trade Map; India Exim Bank Research

Unlike the global production, the trade in iron and steel is significantly scattered. China, Japan, Germany, Russia, and South Korea have remained the major exporters during the last decade. China also remains the top importer of HS 72.

India's Trade

India's exports of iron and steel (HS 72) have registered an impressive growth during the last decade, increasing from US$ 7.7 billion in 2012 to US$ 21.2 billion, thereby recording an AAGR of over 18%. On the other hand, imports grew much slower at an average of 1.7%, during 2012 to 2021. While India recorded a trade deficit in six out of the last ten years in the trade of iron and steel, it recorded a surplus in the last two years. Given the growth of exports, India's share in the global exports of iron and steel increased from 1.8% in 2012 to 3.8% in 2021. The import share, on the other hand, declined from 3.1% to 2.1%, during the same period.

Figure 17: India's Trade in Iron and Steel (HS 72) (in US$ Billion)

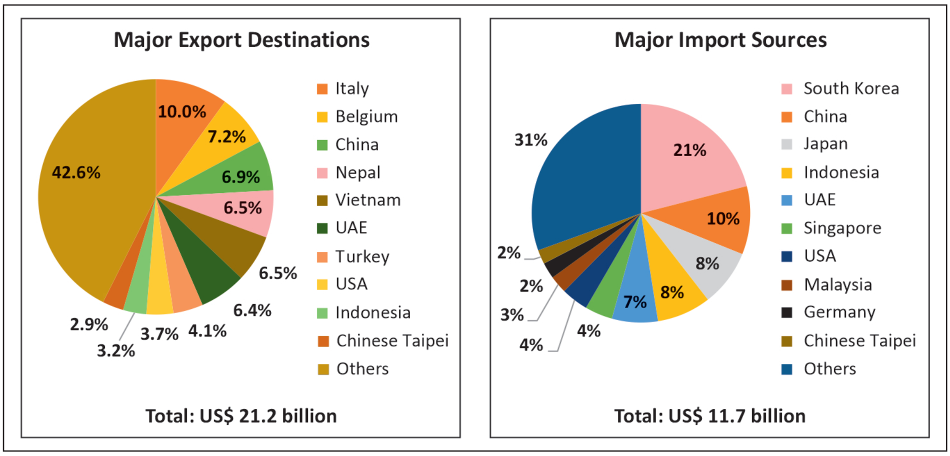


Source: ITC Trade Map; India Exim Bank Research

With respect to India's trading partners, India's exports in 2021 majorly went to Italy, Belgium, China, Nepal, and Vietnam. However, the export destinations are not as concentrated as the import sources. Over one-fifth of India's HS 72 imports in 2021 were from South Korea. The share of South Korea was 12%, a decade ago. China's share, on the other hand has declined, from its peak of 21% in 2015 to 10% in 2021.

It is also interesting to note that the share of Indonesia was just 0.2%, a decade ago and currently stands at 8%. Most of India's imports from Indonesia under HS 72 are of stainless steel. The reason for the increase of this magnitude could be the ramped up capacity of Chinese producers in Indonesia making use of the India-ASEAN FTA.

Figure 18: India's Major Trading Partners for Iron and Steel: 2021



Source: ITC Trade Map; India Exim Bank Research

HS 72, which has exports of over US$ 21 billion for India, consists of 171 HS 6 digit codes. The top ten exports at HS 6 digit level contribute to 56.2% of the HS 72 exports. It may be noted that except HS 720241, all other items in top ten have registered a double digit AAGR, during the last decade.

Table 2: Major Products Exported by India at HS 6 digit for HS 72

(US$ Million)

Code	Product label	2012	2021	Share in 2021	AAGR (2012-2021)
720839	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of < 3 mm	212.9	2761.3	13.0%	61.3%
720719	Semi-finished products of iron or non-alloy steel containing, by weight, < 0.25% of carbon of circular cross-section	273.4	1995.4	9.4%	49.2%
721049	“Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, hot-rolled or cold-rolled “”cold-reduced””	807.9	1290.8	6.1%	41.6%
720230	Ferro-silico-manganese	936.0	1276.6	6.0%	10.9%
720241	Ferro-chromium, containing by weight > 4% of carbon	738.6	981.2	4.6%	9.5%
720838	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of >= 3 mm but < 4,75 mm	102.3	970.1	4.6%	62.5%
720711	Semi-finished products of iron or non-alloy steel containing, by weight, < 0.25% of carbon, of square or rectangular cross-section	26.3	902.0	4.3%	73.8%
720211	Ferro-manganese, containing by weight > 2% of carbon	127.3	627.3	3.0%	40.2%

Code	Product label	2012	2021	Share in 2021	AAGR (2012-2021)
721391	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel, of circular cross-section measuring < 14 mm in diameter	29.4	568.8	2.7%	67.3%
720837	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of >= 4,75 mm but < 10 mm	95.7	541.8	2.6%	39.7%
Top 10		**3349.9**	**11915.2**	**56.2%**	**22.8%**
Total		**7699.8**	**21199.5**	**100.0%**	**18.5%**

Source: ITC Trade Map; India Exim Bank Research

On the other hand, with respect to the imports at HS 6-digit level, the top ten items contributed to over 57% of imports in 2021, with the top two items contributing to almost 33% of total HS 72 imports. Both these items are in the category of 'waste or scrap'.

Table 3 : Major Products Imported by India at HS 6 digit for HS 72

(US$ Million)

Code	Product label	2012	2021	Share in 2021	AAGR (2012-2021)
720421	Waste and scrap of stainless steel (excluding radioactive, and waste and scrap of batteries etc.)	1016.3	2233.5	19.1%	12.6%
720449	Waste and scrap of iron or steel (excluding slag, scale and other waste etc.)	3189.9	1568.8	13.4%	-3.9%
720260	Ferro-nickel	199.0	615.3	5.3%	40.9%

Code	Product label	2012	2021	Share in 2021	AAGR (2012-2021)
722519	Flat-rolled products of silicon-electrical steel, of a width of >= 600 mm, non-grain-oriented	240.0	454.8	3.9%	18.2%
722511	Flat-rolled products of silicon-electrical steel, of a width of >= 600 mm, grain-oriented	362.5	360.4	3.1%	3.0%
720838	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of >= 3 mm but < 4,75 mm	124.3	348.8	3.0%	21.2%
721070	"Flat products of iron or non-alloy steel, of a width of >= 600 mm, hot-rolled or cold-rolled ""cold-reduced"", painted, varnished or coated with plastics"	149.9	293.3	2.5%	16.1%
720221	Ferro-silicon, containing by weight > 55% of silicon	144.9	283.0	2.4%	9.8%
721049	"Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, hot-rolled or cold-rolled ""cold-reduced"", not corrugated, plated or coated with zinc	339.1	279.6	2.4%	1.5%
722530	Flat-rolled products of alloy steel other than stainless, of a width of >= 600 mm, not further worked than hot-rolled, in coils	343.9	233.0	2.0%	7.2%
Top 10		**6109.7**	**6670.4**	**57.1%**	**4.5%**
Total		**13739.6**	**11680.0**	**100.0%**	**1.7%**

Source: ITC Trade Map; India Exim Bank Research

India’s Export Competitiveness in Iron and Steel (HS 72)

An analysis of the top ten exported products of HS 72 by India shows that India largely remains competitive in the exports of HS 72. For a few items, while the exports were not competitive in select years, in the year 2021, all top ten items seem to be export competitive.

Table 4: NRCA for HS 72 at HS 6-digit level

Code	Product label	2012	2015	2018	2021	Major Export Destinations for India: 2021 (Share in %)
720839	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of < 3 mm	-0.01	-0.13	0.56	0.75	Vietnam (38.4), UAE (11), Turkey (8.8), South Africa (7.9), Italy (7.3)
720719	Semi-finished products of iron or non-alloy steel containing, by weight, < 0.25% of carbon of circular cross-section	0.89	0.86	0.91	0.94	Nepal (28.8), China (23.7), Indonesia (10.3), Philippines (7), Kenya (6.4)
721049	“Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, hot-rolled or cold-rolled “”cold-reduced””	0.39	0.33	0.06	0.34	Belgium (41.6), Italy (14.2), UK (8.6), Spain (6.4), Poland (5.6)
720230	Ferro-silico-manganese	0.90	0.88	0.86	0.87	Japan (13), Italy (12.9), UAE (8.1), Chinese Taipei (6.6), Egypt (6.1)
720241	Ferro-chromium, containing by weight > 4% of carbon	0.73	0.70	0.77	0.72	China (42.7), South Korea (19.3), Indonesia (15), Chinese Taipei (9.2), Japan (7.7)

Code	Product label	2012	2015	2018	2021	Major Export Destinations for India: 2021 (Share in %)
720838	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of >= 3 mm but < 4,75 mm	0.13	-0.12	0.46	0.67	Italy (21.6), Vietnam (16.3), Turkey (14), UAE (13.7), Belgium (4.6)
720711	Semi-finished products of iron or non-alloy steel containing, by weight, < 0.25% of carbon, of square or rectangular cross-section	-0.65	0.27	0.31	0.57	China (37.5), Indonesia (21), Sri Lanka (19.6), Thailand (5.4), Turkey (5.2)
720211	Ferro-manganese, containing by weight > 2% of carbon	0.78	0.82	0.83	0.91	USA (13.6), Italy (10.6), UAE (8.2), Chinese Taipei (7.2), Brazil (7.2)
721391	Bars and rods, hot-rolled, in irregularly wound coils, of iron or non-alloy steel, of circular cross-section measuring < 14 mm in diameter	-0.64	-0.30	0.10	0.44	Nepal (25.2), Chinese Taipei (22.7), Thailand (8.9), USA (8), South Korea (7.6)
720837	Flat-rolled products of iron or non-alloy steel, of a width of >= 600 mm, in coils, simply hot-rolled, not clad, plated or coated, of a thickness of >= 4,75 mm but < 10 mm	0.19	0.23	0.42	0.63	UAE (22.5), Belgium (17.2), Italy (11.7), Spain (9.1), Vietnam (6.5)

Source: ITC Trade Map; India Exim Bank Research

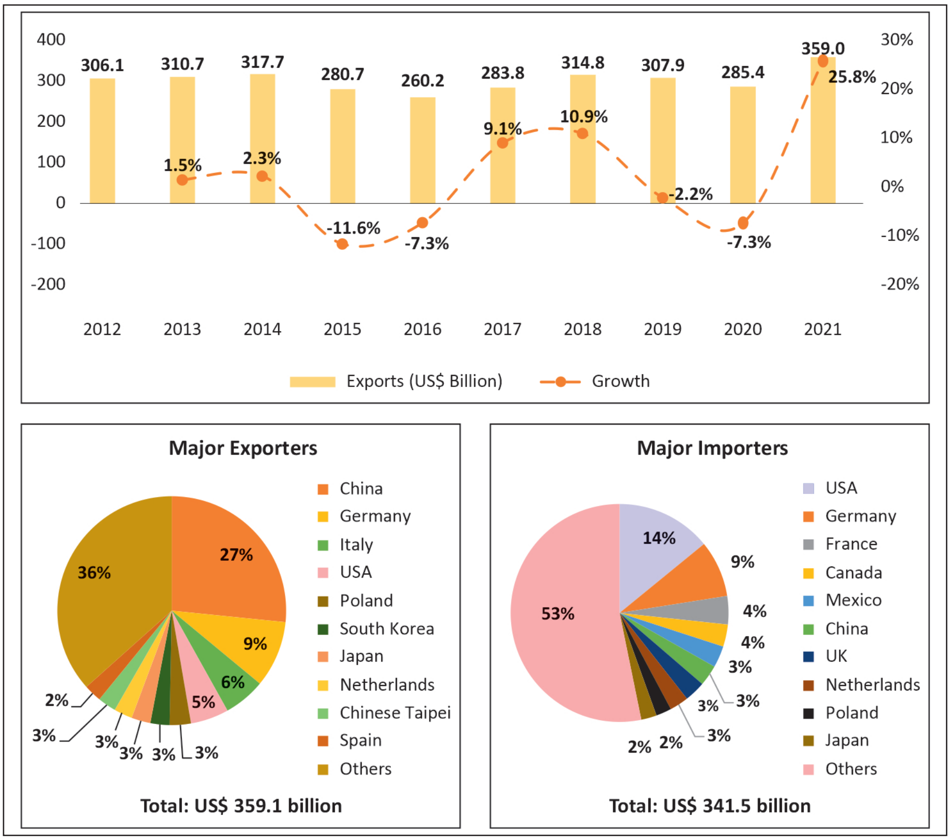
Note: Green indicates export competitiveness while the orange indicates no export competitiveness

Articles of Iron or Steel (HS 73)

Global Trade

The global exports of articles of iron or steel (HS 73, hereafter) have grown from US$ 306.1 billion in 2012 to US$ 359 billion in 2021, registering an AAGR of 2.3%. During the last decade, the highest growth for exports of HS 73 was recorded in 2021, when the exports grew by 25.8%.

Figure 19: Global Exports of Articles of Iron or Steel and Major Traders (2021)



Source: ITC Trade Map; India Exim Bank Research

The global exports of articles of iron or steel (HS 73) are much more concentrated than exports of iron and steel (HS 72). The top five exporters contribute to half of the global exports with China alone contributing to more than 25% of the global exports. Further, with respect to the global importers, it may be noted that the major importers except China and Japan are concentrated in Europe and North America.

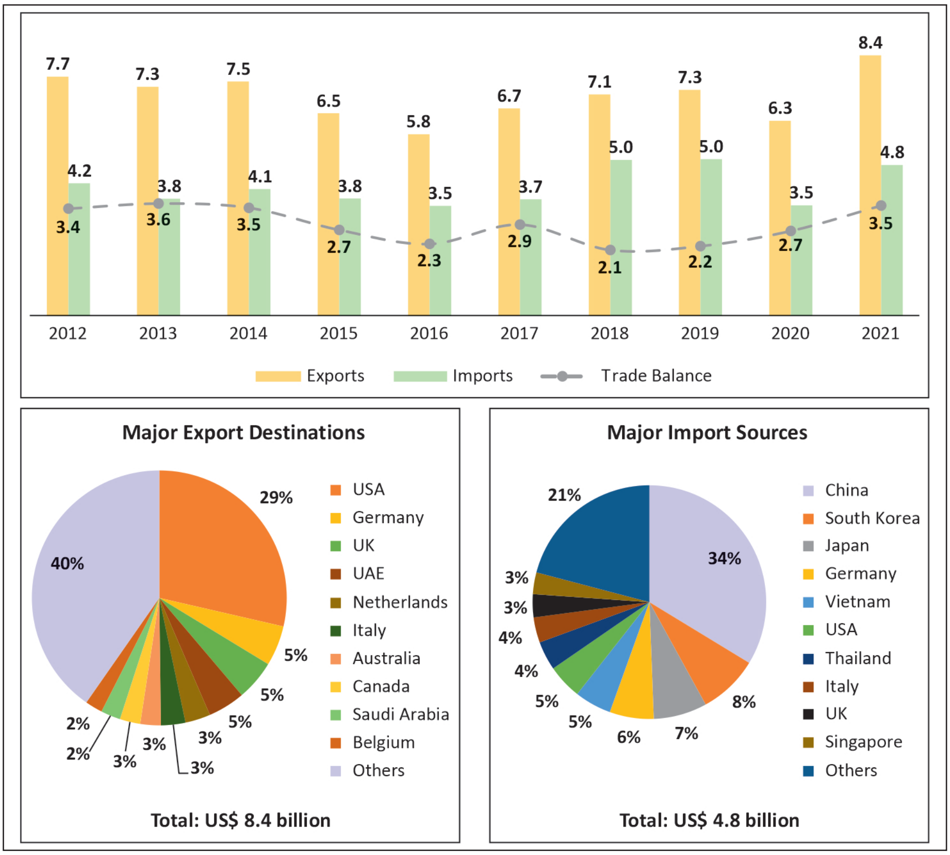
India's Trade

India has consistently maintained a surplus in the trade of articles of iron or steel, during the last decade. While its exports grew by an average of 1.9% during 2012 to 2021, annually, the imports grew much faster by an average of 3.4%.

Further, India majorly relies on China (34%) for the imports of HS 73, while almost 30% of India's exports of HS 73 go to the USA. The biggest gainer in India's import sources, during the last decade, has been Vietnam, whose share increased from 0.4% in 2012 to 5.1% in 2021, in India's total imports of HS 73. The HS 73 imports from Vietnam are significantly concentrated towards steel pipes and tubes.

Figure 20: India's Trade in Articles of Iron or Steel and Major Trading Partners (2021)

(US$ Billion)



Source: ITC Trade Map; India Exim Bank Research

Out of the 136 HS 6-digit codes under HS 73 that India exports, the top ten contribute to over 58% of the exports, reflecting the concentration on a few items. In fact, HS 732690 and HS 732599 make for over one-fifth of India's

HS 73 exports. The item HS 730630 (Tubes, pipes, etc.) has recorded an AAGR of over 25%, during the last decade.

Table 5: Major Products Exported by India at HS 6 digit for HS 73

(US$ Million)

Code	Product label	2012	2021	Share in 2021	AAGR (2012-2021)
732690	Articles of iron or steel, n.e.s. (excluding cast articles or articles of iron or steel wire)	490.0	956.5	11.4%	9.2%
732599	Cast articles of iron or steel, n.e.s. (excluding articles of non-malleable cast iron, and grinding balls and similar articles for mills)	889.2	839.3	10.0%	0.1%
730890	Structures and parts of structures, of iron or steel, n.e.s.	394.2	723.5	8.7%	8.2%
732393	Table, kitchen or other household articles, and parts thereof, of stainless steel (excluding cans, boxes and similar containers of heading 7310; waste baskets; etc.)	224.3	461.5	5.5%	9.9%
730630	Tubes, pipes and hollow profiles, welded, of circular cross-section, of iron or non-alloy steel	91.0	400.3	4.8%	25.6%
731815	Threaded screws and bolts, of iron or steel, whether or not with their nuts and washers	254.4	379.5	4.5%	6.7%
730511	Line pipe of a kind used for oil or gas pipelines, having circular cross-sections and an external diameter of > 406.4 mm	1291.4	298.7	3.6%	-9.9%
730820	Towers and lattice masts, of iron or steel	285.4	294.2	3.5%	2.6%
732619	Articles of iron or steel, forged or stamped, but not further worked, n.e.s. (excluding grinding balls and similar articles for mills)	443.5	293.2	3.5%	-1.7%
730840	Equipment for scaffolding, shuttering, propping or pit-propping	112.1	225.5	2.7%	10.8%
Top 10		**4475.5**	**4872.3**	**58.3%**	**1.6%**
Total		**7677.7**	**8361.2**	**100.0%**	**1.9%**

Source: ITC Trade Map; India Exim Bank Research

On the other hand, with respect to the imports at HS 6-digit level, the top items contributed to over 51% of imports in 2021, with the top two items contributing to over 22% of total HS 73 imports.

Table 6: Major Products Imported by India at HS 6 digit for HS 73

(US$ Million)

Code	Product label	2012	2021	Share in 2021	AAGR (2012-2021)
732690	Articles of iron or steel, n.e.s. (excluding cast articles or articles of iron or steel wire)	405.1	699.5	14.5%	7.6%
730890	Structures and parts of structures, of iron or steel, n.e.s.	440.8	370.6	7.7%	0.8%
731815	Threaded screws and bolts, of iron or steel, whether or not with their nuts and washers	276.7	369.2	7.6%	5.1%
731210	Stranded wire, ropes and cables, of iron or steel (excluding electrically insulated products and twisted fencing wire and barbed wire)	73.5	202.6	4.2%	15.5%
731290	Plaited bands, slings and the like, of iron or steel (excluding electrically insulated products)	76.7	183.4	3.8%	21.8%
730459	"Tubes, pipes and hollow profiles, seamless, of circular cross-section, of alloy steel other than stainless, not cold-drawn or cold-rolled ""cold-reduced""	183.9	143.9	3.0%	13.8%
730490	Tubes, pipes and hollow profiles, seamless, of non-circular cross-section, of iron or steel (excluding products of cast iron)	230.4	141.8	2.9%	1.6%
731816	Nuts of iron or steel	111.2	134.0	2.8%	4.1%
730799	Tube or pipe fittings, of iron or steel (excluding cast iron or stainless steel products; flanges; threaded elbows, bends and sleeves; butt welding fittings)	113.5	118.8	2.5%	2.9%
731819	Threaded articles, of iron or steel, n.e.s.	73.3	111.7	2.3%	7.2%
Top 10		**1985.1**	**2475.5**	**51.2%**	**4.5%**
Total		**4246.3**	**4832.1**	**100.0%**	**3.4%**

Source: ITC Trade Map; India Exim Bank Research

India's Export Competitiveness in Iron and Steel (HS 73)

An analysis of the top ten exported products of HS 73 by India shows that India largely remains competitive in the exports of HS 73. HS 730890 (Structures and parts of structures, of iron or steel, n.e.s.), however, has consistently been in the negative zone. Further, HS 731815 (Threaded screws and bolts, of iron or steel, whether or not with their nuts and washers) was only borderline positive (comparative advantage in exports) in 2021 and has previously been in the negative segment.

Table 7: NRCA for HS 73 at HS 6-digit level

Code	Product label	2012	2015	2018	2021	Major Export Destinations for India: 2021 (Share in %)
732690	Articles of iron or steel, n.e.s. (excluding cast articles or articles of iron or steel wire)	-0.08	-0.05	0.07	0.11	USA (40.3), UK (6.3), Thailand (4.9), Germany (4.2), Netherlands (3.7)
732599	Cast articles of iron or steel, n.e.s. (excluding articles of non-malleable cast iron, and grinding balls and similar articles for mills)	0.86	0.86	0.83	0.84	USA (31.5), Germany (13.1), Italy (8.3), UK(6.1), Spain (3.6)
730890	Structures and parts of structures, of iron or steel, n.e.s.	-0.15	-0.17	-0.12	-0.06	USA (40.1), UK (3.7), Bangladesh (3.5), Mauritius (3), Saudi Arabia (2.7)
732393	Table, kitchen or other household articles, and parts thereof, of stainless steel (excluding cans, boxes and similar containers of heading 7310; waste baskets; etc.)	0.54	0.55	0.50	0.41	USA (27.8), UAE (8.6), Saudi Arabia (6.5), UK (4.4), Nigeria (3.8)
730630	Tubes, pipes and hollow profiles, welded, of circular cross-section, of iron or non-alloy steel	-0.12	0.20	0.33	0.38	UK (15.1), USA (12.3), Australia (10.2), UAE (10.1), Belgium (9.9)

Code	Product label	2012	2015	2018	2021	Major Export Destinations for India: 2021 (Share in %)
731815	Threaded screws and bolts, of iron or steel, whether or not with their nuts and washers	-0.01	0.07	-0.07	0.003	Netherlands (17.1), USA (14.3), Germany (13), UK (8.5), I taly (7.2)
730511	Line pipe of a kind used for oil or gas pipelines, having circular cross-sections and an external diameter of > 406.4 mm	0.82	0.76	0.61	0.77	Oman (35.1), Iraq (13), Malaysia (11.3), UAE (8.2), USA (6)
730820	Towers and lattice masts, of iron or steel	0.63	0.75	0.64	0.61	Nepal (12), Bangladesh (10.4), Oman (6.5), Philippines (6.1), Saudi Arabia (5.5)
732619	Articles of iron or steel, forged or stamped, but not further worked, n.e.s. (excluding grinding balls and similar articles for mills)	0.74	0.68	0.67	0.60	USA (31.6), Germany (13.4), Mexico (7.5), Brazil (4.9), Italy (4.9)
730840	Equipment for scaffolding, shuttering, propping or pit-propping	0.24	0.47	0.40	0.37	UK (22), USA (14.5), UAE (8.1, Germany (6.9), Egypt (6.4)

Source: ITC Trade Map; India Exim Bank Research

Note: Green indicates export competitiveness while the orange indicates no export competitiveness

4. POLICY CHANGES IN THE IRON AND STEEL INDUSTRY IN INDIA

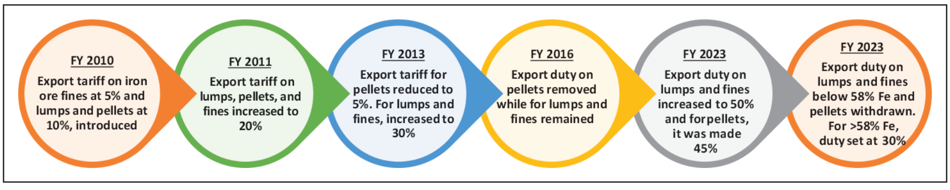
The previous chapters assessed the global and Indian market scenario of the iron and steel industry. However, it may be noted that the Indian market has evolved significantly in the last decade or so, due to various policy changes impacting the production as well as trade scenario of iron and steel in the country. This chapter highlights some of the key policy changes.

Iron Ore

Customs duty hike post FY 2010

Iron ore, which is key mineral required to produce iron and steel, its exports were seeing an increase during FY 2002 and FY 2010. The exports of iron ore from India increased from 23.1 MT in FY 2002 to 101.5 MT in FY 2010. To protect the domestic steel industry, an export levy on iron ore lumps, fines, and pellets was imposed in FY 2010. Regardless of grades, the export tariff on iron ore fines was 5% and on iron ore lumps and pellets it was 10%. However, in the next fiscal year, the export tariff on iron ore lumps, pellets, and fines was increased to 20% across all grades.

Figure 21: Various Measures Taken in the Iron-Ore Industry



Source: India Exim Bank Research

While the export tariff on iron ore pellets was reduced to 5% in FY 13, it was increased to 30% on iron ore lumps and fines. In the FY 14 and 15, the export duty on high quality iron ore lumps and fines remained at 30%, and the export duty on iron ore pellets remained at 5%. In FY 16, export duty on iron pellets was removed to support the exports while the duty on iron ore lumps and fines remained at 30% until May 2022.

In May 2022, Government of India hiked the export duty on iron ore lumps and fines to 50% from 30% across all iron grades. The duty on iron ore pellets was also increased to 45% from 0% to bring the domestic steel prices under control.

However, in November 2022, GOI withdrew the export duty on iron ores lumps & fines below 58% Fe content, and iron ore pellets. For the exports of iron ore lumps and fines > 58% Fe, duty was set at 30%.

Mining Ban in States

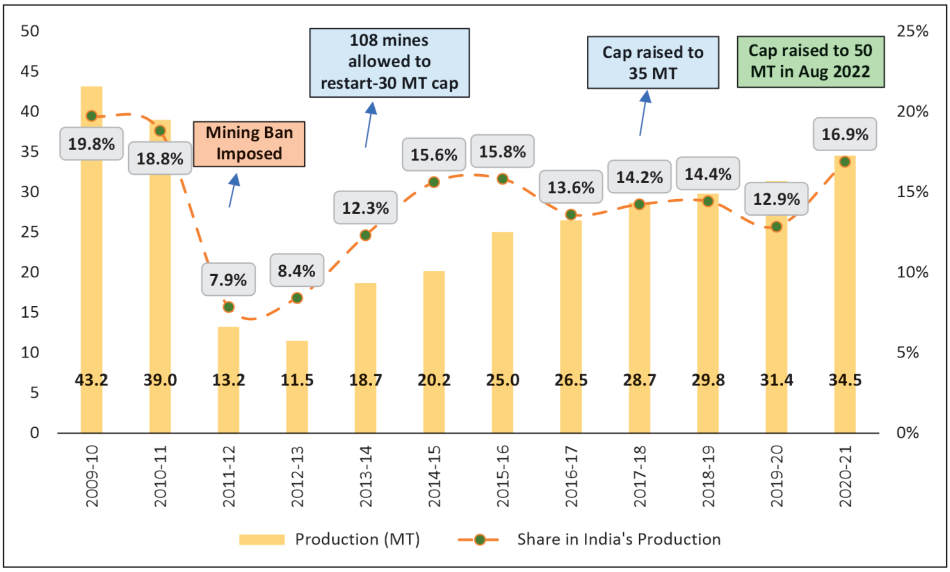
<u>Export Ban and Production Cap in Karnataka</u>

In 2009-10, iron ore production in Karnataka was recorded at 43.2 MT with a share of almost 20% in India. The state was the second largest producer of iron ore in India, after Odisha. However, in 2011, the Supreme Court banned mining in Ballari, Chitradurga, and Tumakuru due to contentions of illegal mining and environmental degradation, based on the report of the Centrally Empowered Committee (CEC). The court also banned the exports of iron ore pellets from Karnataka.

However, in April 2013, 108 mines were allowed to restart production with a total cap of 30 MT per year. Supreme Court also ordered the miners to exclusively sell their iron ore to steel producers through e-auctions, in addition to imposing an output restriction. But only a few mines were in operation for 3-4 years because of several outstanding environmental approvals.

The Supreme Court approved a rise in the ceiling cap in December 2017 that raised it from 25 MT to 28 MT in the Ballari district and from 5 MT to 7 MT for the combined Chitradurga and Tumakuru districts. In total, the cap was raised to 35 MT in December 2017.

Figure 22: Iron Ore Production in Karnataka and Share in India's Production



Source: IBM; CMIE Industry Outlook; India Exim Bank Research

In May 2022, the court granted permission to sell the previously mined iron ore through direct contracts rather than through an e-auction in an effort to improve system availability and close the supply-demand imbalance.

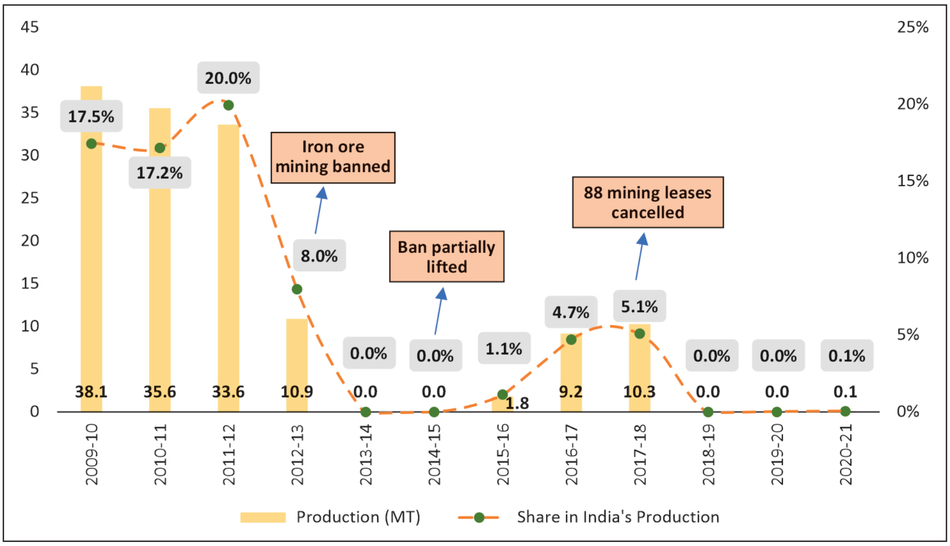
Ultimately, in August 2022, the court increased the maximum limit for mining iron ore in the Ballari district from 28 MMT to 35 MMT and in the Chitradurga and Tumakuru districts from 7 MMT to 15 MMT, bringing the overall cap to 50 MT.

With the revision in production cap, the increase in production will be gradual given that most mines were shut for a long period.

Goa Mining Ban

Goa was the third largest producer of iron ore in India in 2009-10 with a share of 17.5% and production of 38.1 MT. In fact, the state had a share of almost 30% in India's exports of iron ore in the same year.

Figure 23: Iron Ore Production in Goa and Share in India's Production



Source: IBM; CMIE Industry Outlook; India Exim Bank Research

However, in October 2012, the Supreme Court banned iron ore mining in the state to curb the illegal mining operations. The mining leases were also cancelled along with the ban on exports of iron ore. As a result, the production was almost nil in the next couple of years.

The Supreme Court, however, partially lifted the ban in April 2014, with a production cap of 20 MT per year. However, due to several pending environmental clearances, the production number was not impressive in the coming years.

In addition, 88 mining licenses that the government had renewed in 2014 and 2015 before the Mines and Minerals (Regulation and Development) (MMDR) Act came into force were revoked by the Supreme Court in 2018. As a result, output has been almost non-existent since FY 19.

MMDR Act

Pre-2015

Before introduction of MMDR (Mines and Minerals Development and Regulation) Act 2015, the regime allowed for Reconnaissance Permit (RP) on a first come first serve basis. Reconnaissance permit means the permit to primary survey for the mineral through regional, aerial, or geochemical surveys. This method was not much successful to attract private players and global players.

The first come, first serve system meant that the distribution of mines was not transparent. There were issues of unlawful mining as well. As a result, the private players were hesitant to take part at that time.

The production limit in major iron ore producing states and the export prohibition to lessen environmental effects and stop unlawful mining, in addition to regulatory issues, had a significant negative influence on the iron ore sector in India. As a result, the MMDR Act 2015 was introduced in the Parliament.

MMDR Act, 2015

Under the MMDR Act, 2015, the earlier process of RPs on first come first serve basis was replaced with non-exclusive RPs. A non-exclusive RPs holder shall not be entitled to make any claim for the grant of any prospecting license-cum-mining lease or a mining lease. Also, mines auction was made the only mode for mines allocation.

The Act also allowed for the mine lease to be non-renewable 50-year lease and at the end of it, the same could be re-auctioned. The Act stated that “Any holder of a lease granted, where mineral is used for captive purpose, shall have the right of first refusal at the time of auction held for such lease after the expiry of the lease period”.

Another important provision was that the captive players were allowed to bid for the mines previously held by non-captive players. However, the captive players could not sell the non-required iron ore production to external buyers.

Further, as per the act, when mineralization has not been established, Prospecting Lease (PL) cum Mining Lease (ML) composite licence can be auctioned with prior approval of the central government.

Mines and Minerals (Development and Regulation) Amendment Act, 2021

The Government of India introduced further amendments to MMDR Act in 2021 to improve the availability of high-grade iron ore for the Indian market. In accordance with the Act, the central government may set aside any mining (apart from coal, lignite, and atomic minerals) for leasing for a specific end-use. In short, no mine will be reserved for a specific end-use.

The amendments allowed that the captive mines could sell up to 50% of the production to external buyers. Additionally, an auction was used to transfer a mine lease to a new owner when it expired. The new lessee had to get new clearances within the next two years because the statutory clearances were only valid for two years following the transfer. The amendments, however, altered this clause and permitted the transferred approvals to be valid for the whole duration of the new lessee's lease. This will promote the ease of doing business.

Further, the act stated that after the expiration of the mining lease, if the auction process for new lease is not completed or the new lease has been terminated within a year of the auction, the state government can grant the lease to a government company for up to 10 years or until the selection of the new lessee.

Steel

Customs Duty and Anti-Dumping Duty (ADD)

In the last decade, the Government of India has taken various measures to curb the rising steel imports from nations such as China and South Korea. In the budget of 2012-13, the Government of India decided to enhance the customs duty on flat rolled products of non-alloy steel from 5% to 7.5%.

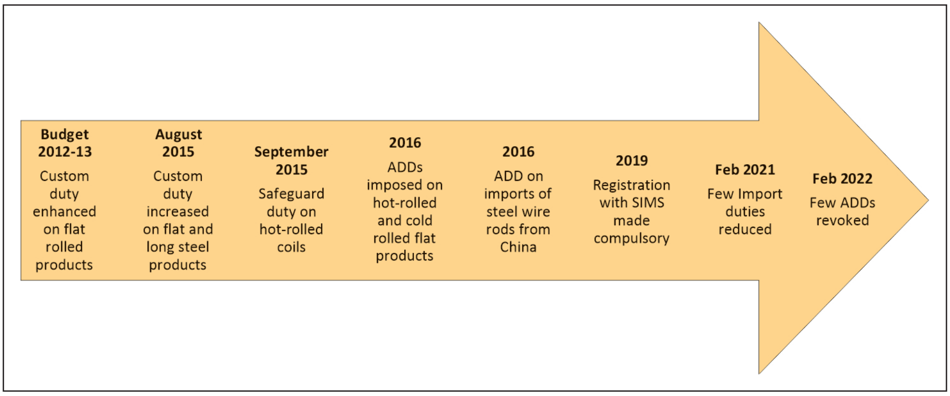
In August 2015, when China devaluated its yuan against US dollar by nearly 3%, Government of India increased the customs duty by 2.5% on flat and long steel products.

In September 2015, GOI imposed a safeguard duty of 20% on hot-rolled coils for a period of 200 days. In March 2016, the tapering duty was extended till 2018 with the highest duty of 20%. Further, in November 2016, the Government imposed a safeguard duty on a few hot rolled flat sheets and plates, which was valid until May 2019. This duty was also tapering in nature reducing from 10% to 8% to up to 6%.

India additionally imposed ADDs (anti-dumping duties) in 2016 for a period of five years on hot-rolled flat products originating from China, Japan, South Korea, Russia, Brazil, and Indonesia, as well as on cold-rolled flat products from China, Japan, South Korea, and Ukraine. These measures were aimed to provide a level playing field to the domestic steel industry, which was then going through a severe downturn because of cheaper imports. The ADD for hot-rolled steel products was US$ 478/t, US$ 489/t, and US$ 561/t, with cold-rolled steel set at US$ 576/t.

Further, in late 2016, India imposed ADD on imports of steel wire rods from China to protect domestic manufacturers from cheap in-bound shipments. The duty was effective for 6 months.

Figure 24: Duties Imposed by India in Recent Times



Source: India Exim Bank Research

In 2019, the GOI made it mandatory for importers to register themselves with Steel Import Monitoring System (SIMS) to be able to import around two hundred iron and steel products including certain flat-rolled products; some stranded wire, ropes, cables; certain items of springs and leaves for springs of iron and steel; tubes, pipes and hollow profiles; diesel-electric locomotives; and some parts of railways.

In February 2021, due to the rising steel prices, the Government reduced import duties on a host of steel items. Further, safeguard measures like anti-dumping and countervailing duties were revoked on some products including those from China.

In February 2022 also, the GOI announced revoking of anti-dumping duties on certain steel products imported from countries including China. This move was made in an effort to lower metal prices and support domestic production. On certain imports of hot-rolled and cold-rolled stainless steel flat goods from China, countervailing duty (CVD) was permanently eliminated.

Export Duty on Finished Steel

Export duty on finished steel was introduced in May 2008, when global steel prices had reached a multi-year high, to reduce domestic steel deficit. However, it was rolled back in November 2008, when the Global Financial

Crisis occurred. Post calendar year 2008, the government did not introduce any export duty on finished steel until May 2022.

However, in May 2022, GOI levied a 15% duty on the export of steel. During 2020 to 2022, international steel prices witnessed a relentless rally with prices more than doubling to an all-time high in April 2022 from March 2020 levels, which prompted steel manufacturers to increase exports. The increase in export duty was with the objective of levelling the export prices with the international prices, and thereby curb exports, and ensure ample availability in the domestic market, leading to easing of prices. Even as domestic demand remained weak, domestic steel prices kept rising due to a surge in export realizations amid higher input costs. In November 2022, GOI withdrew the export duty on steel products.

Minimum Import Price (MIP)

In February 2016, Government of India imposed a minimum import price (MIP) on 173 steel products, in order to protect the domestic players against the cheaper imports. For ingots and billets, the MIP was kept at US$ 362 per tonne. For blooms and slabs, it was kept at US$ 352/tonne and US$ 341/tonne, respectively. The MIP was imposed for six months and was exempted for the imports under the advance authorization scheme and high-grade pipes used in the petroleum and natural gas industry. It may be noted that stainless steel products were also left out of this mechanism. However, in August 2016, the GOI further extended MIP mechanism for 66 steel items, thereby trimming down the list under MIP.

The impact of the MIP was also seen in the prices. Prior to the MIP implementation, for instance, the price of HR coils was ₹ 30756/tonne. In Nov 2016, the price stood at ₹ 37938/tonne.

Table 8: Impact of MIP Implementation on Steel Prices (in ₹/tonne)

Prices as on	TMT Bars	HR Coils	CR Coils
Prior to MIP implementation			
1st Feb. 2016	31674	30756	34213
Post MIP implementation			
15th Feb. 2016	33673	33513	36750
1st Aug. 2016	29723	35030	38063
15th Aug. 2016	29478	35122	38987
1st Oct. 2016	32506	39572	41475
15th Oct. 2016	32447	37538	43313
1st Nov. 2016	32624	37938	41475

Source: JPC; PIB; India Exim Bank Research

National Steel Policy, 2017

The National Steel Policy was introduced to enhance domestic consumption, ensure high quality steel production and create technologically advanced and globally competitive steel industry.

Some of the key elements under this policy are:

- The government targets crude steel capacity of 300 million tonnes per annum (MTPA) by 2030-31. The capacity was around 154 MTPA in FY 22.
- The government envisages finished steel exports of 24 MT by 2030-31. The exports were recorded at 13.5 MT in FY 22.
- The GOI also projects the per capita consumption of the finished steel to reach 158 kg by 2030-31, from the current 61 kg.
- The government aims to develop production capabilities of electrical steel, speciality steel and alloys to reduce imports of specific products. It has introduced Production Linked Incentive Scheme worth ₹ 6,322 crore to develop domestic production capacities.

5. CLIMATE CHANGE AND IRON & STEEL

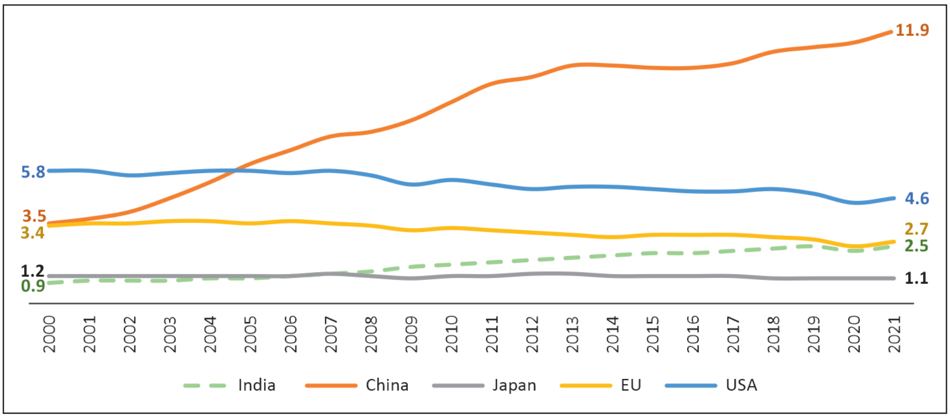
In the modern times, the impacts of climate change that are being seen are unprecedented. The global stakeholders are increasingly acting against the negative effects of climate change such as frequent droughts, rising sea levels, and increased greenhouse gas (GHG) emissions. Additionally, it has been noted that over the past few years, economic expansion and an increase in carbon emissions have occurred in lockstep.

As per the Intergovernmental Panel on Climate Change (IPCC), human-induced warming has already reached about 1°C above pre-industrial levels. In addition, human activity warmed the planet by 0.87°C between 2006 and 2015 compared to pre-industrial periods (1850–1900). Around 2040, if the present warming trend holds, the globe could experience 1.5°C of human-caused global warming.

In order to prevent further warming, 196 countries signed the Paris Agreement on December 15, 2015. Since then, every nation is aggressively acting on reducing carbon dioxide (CO_2) emissions. GHG emissions are considered major causal agents for global temperature rise, and CO_2 accounts for 65% of the GHG emissions.

Globally, the total CO_2 emissions have increased from 24.3 GT in 2000 to 36.3 GT in 2021. China's emissions currently are the highest in the world and increased by more than 3 times, in the last two decades. China's energy-intensive industrial operations is the leading factor for its huge carbon dioxide emissions.

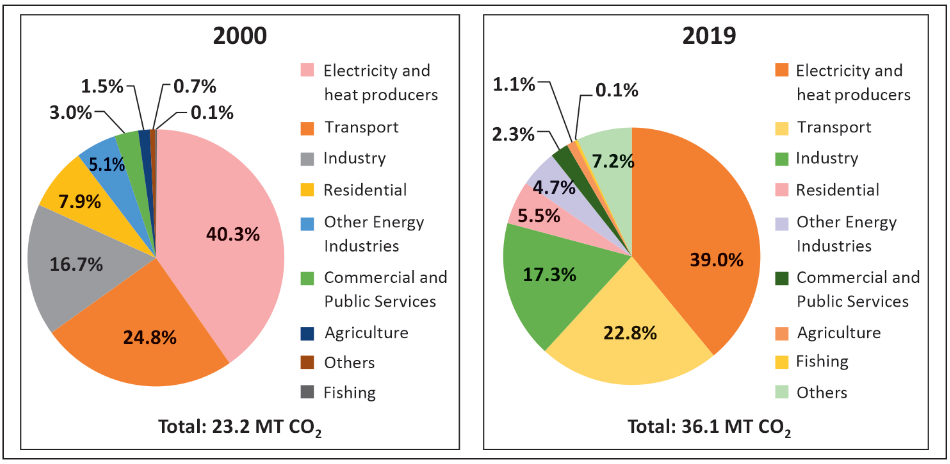
Figure 25: Global CO_2 Emissions for Major Economies (Gigatonnes (GT) of Carbon dioxide)



Source: International Energy Agency (IEA); India Exim Bank Research

Further, it may be noted that the industry has a significant role in the global emissions. While a couple of decades ago, the contribution of industry was 16.7% in the total CO_2 emissions of the globe, today, its share has crossed the 17% mark. The 'electricity and heat producers' segment remains the biggest contributor to global carbon emissions, with 39% contribution coming from this segment.

Figure 26: Sector-wise CO_2 Emissions



Source: IEA; India Exim Bank Research

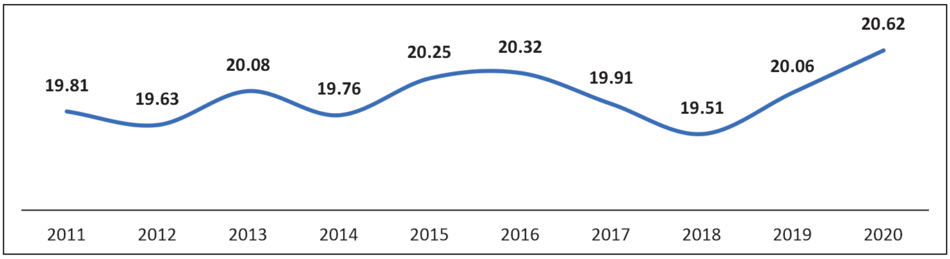
Resource Consumption in the Iron and Steel Industry

Steel making is a multistage process. It includes iron making, primary and secondary steel making, casting (steel is casted into semi-finished shapes), and finally, hot rolling (HR) and cold rolling (CR) to deliver the desired end-products for various industries.

The key raw materials used for producing steel are iron ore, limestone, coal, natural gas, biomass, and charcoal. The inputs change based on the production technique employed. Three types of production techniques are typically used: BF-BOF, direct reduced iron (DRI)-electric arc furnace, and induction furnace, and all these are carbon-based. With respect to the iron making, the process involves removing oxygen from magnetite and haematite ore after they are pelletised and sintered in a blast furnace or DRI and undergo a smelting reduction process.

As far as steel making process is concerned, it involves oxidation of carbon present in excess quantities to produce steel, which can be done through primary or secondary processes. In the primary process, blast oxygen furnace is used, where oxidation takes place. The secondary process involves the direct reduced iron-electric arc furnace (DRI-EAF) route, where DRI is used along with steel scrap in the electric furnace for melting using electricity.

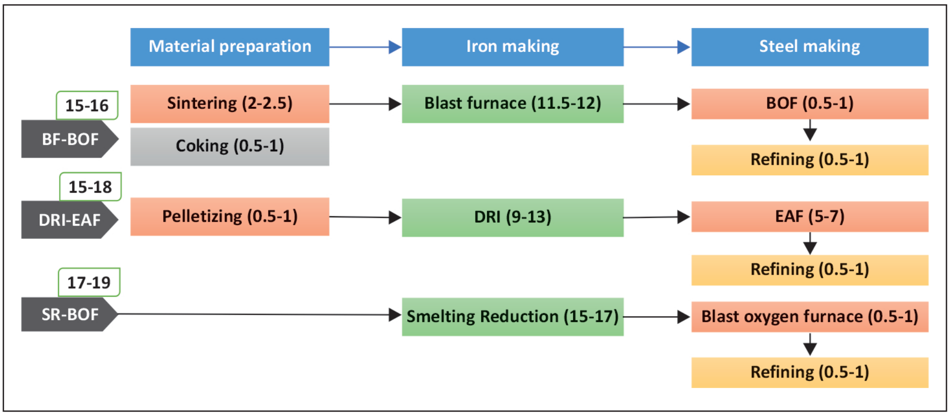
Figure 27: Energy Intensity (Gj/tonne crude steel cast)



Source: World Steel Association

It may be noted that the steel making is a highly energy intensive process. The Figure 27 shows the data for 94 steel companies representing 54% of global steel production. It is observed that steel industry's energy consumption has risen since 2018. This is probably because of the increased production of crude steel from China which majorly uses the BF-BOF method, a highly energy intensive method of steel production.

Figure 28: Energy Consumption at Various Stages of Steelmaking (giga joules or GJ)



Source: CRISIL

Table 9: Crude Steel Production by Process, 2021 (in %)

Country	Oxygen %	Electric %	Other %
World	**70.8**	**28.9**	**0.3**
China	89.4	10.6	-
India	44.8	55.2	-
Japan	74.7	25.3	-
USA	30.8	69.2	
Russia	59	39	2
South Korea	68.2	31.8	-
Turkey	28.4	71.6	-
Germany	69.8	30.2	-
Brazil	75.2	23.6	1.2
Iran	9.7	90.3	-

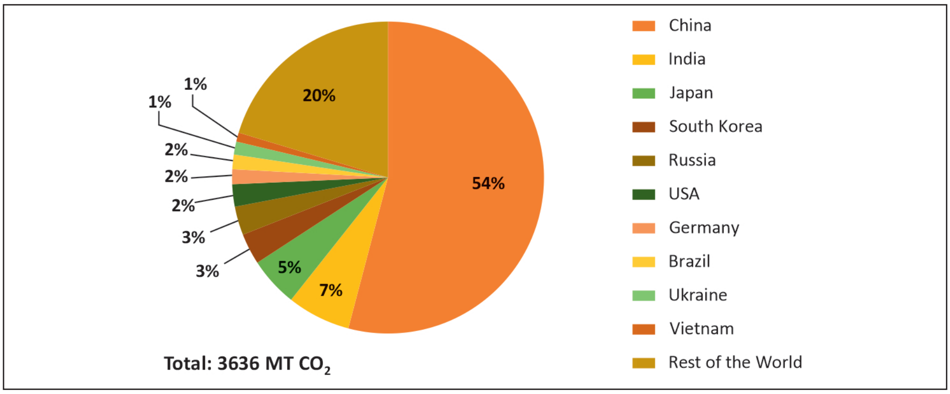
Source: World Steel Association

As mentioned earlier, steel can be produced using different techniques, and energy requirements for each differs. Steel produced through the BF-BOF route consumes ~16 GJ of energy per ton of steel produced and steel produced through the EAF-DRI consumes ~15 GJ of energy if natural gas is used. The blast furnace and DRI processes consume higher energy due to the combustion of fossil fuels. The EAF route consumes more energy as electricity is also used in the process.

Impact of Steel Production on Emissions

As mentioned earlier, industry segment contributes to over 17% of the global carbon emissions. It may be noted that within the industry iron and steel segment is a major player, roughly contributing to around 9%-10% of the total global carbon emissions. As per the Global Efficiency Intelligence, the carbon emissions from the steel sector were over 3600 MT CO_2 in 2019 with China alone contributing over 54% of these emissions. It was followed by India with a contribution of 6.6%. China, being the highest producer of steel, with almost 90% of its crude steel production through the blast furnace-basic oxygen furnace (BF-BOF) method, was the highest emitter of carbon.

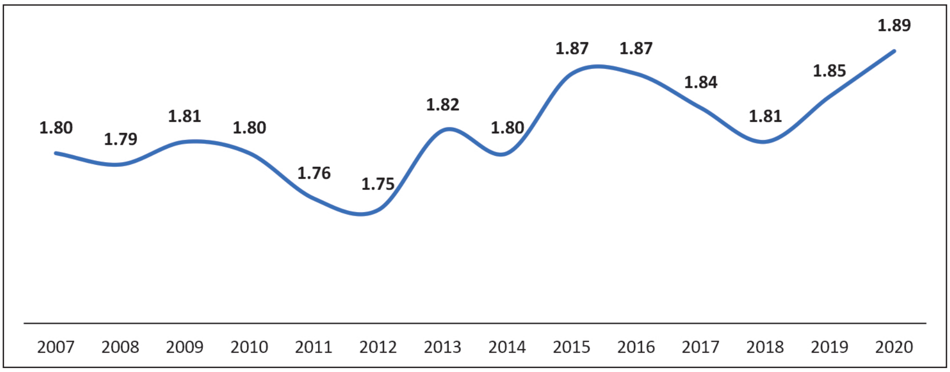
Figure 29: Contributors to Emissions from Steel Industry: 2019



Source: Global Efficiency Intelligence; India Exim Bank Research

Over the years, the average carbon emissions per tonne of crude steel have increased. The intensity was recorded at 1.8 tonne CO_2/tonne crude steel in 2007. This has increased to 1.89 tonne CO_2/tonne crude steel in 2020.

Figure 30: CO_2 intensity (tonnes CO_2/tonne crude steel cast)



Source: World Steel Association; India Exim Bank Research

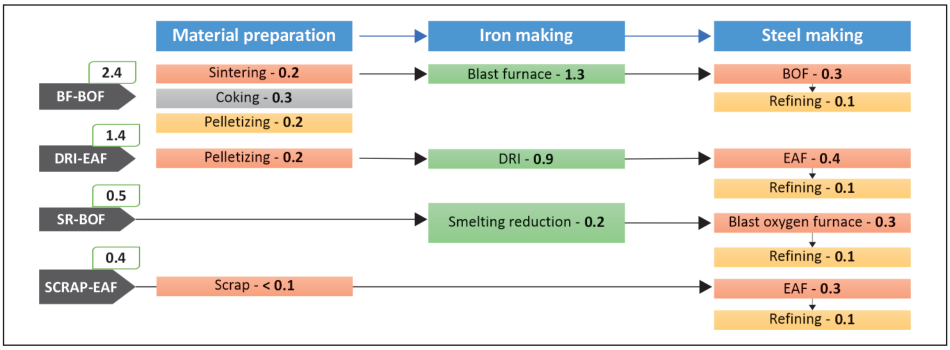
It may be noted that the CO_2 intensity for producing one tonne of crude steel could differ across companies and countries. This depends on the process being used by these entities. As discussed before, all countries have different shares with respect to the processes such as BF-BOF, DRI-EAF etc. being used to produce steel.

The carbon emissions are usually the highest (approximately 2.4 tonne/ tonne of crude steel) in the BF-BOF route because of the high usage of coal. On the other hand, the DRI-EAF route has comparatively lesser emissions (approximately 1.4 tonne/tonne of crude steel). The scrap based EAF releases the least emissions (approximately 0.4 tonne/tonne of crude steel).

Overall, CO_2 emissions from the iron and steel industry comes from two sources; one, emissions because of energy consumption, and two, emissions from processing of raw materials, such as limestone and use of electricity.

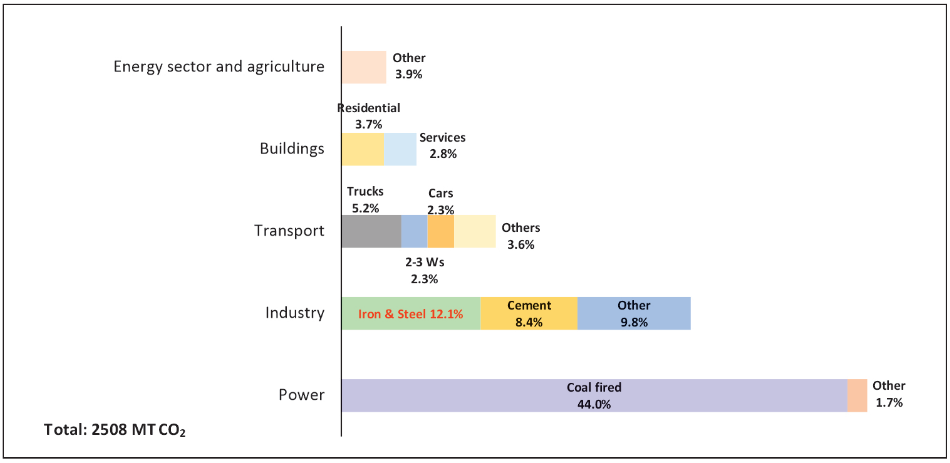
Out of the India's total 2508 MT CO_2 of carbon emissions in 2019, almost 12% were contributed by iron and steel industry. Globally, India's contribution to total iron and steel industry emissions is around 7%-8%. It is noteworthy that almost 45% of India's crude steel production is through BF-BOF facility.

Figure 31: Carbon Emissions at Different Stages of Steel Making Process (Tonne/Tonne of Crude Steel Production)



Source: CRISIL

Figure 32: CO_2 Emissions from Indian Energy Sector



Source: World Steel Association; India Exim Bank Research

In conclusion

As regulatory and investor pressures increase including intensification of consumers' concerns, the iron and steel industry faces growing demands for concrete plans to reduce emissions. To meet significant CO_2 reduction targets, the iron and steel industry at large will be required to make fundamental changes to its production processes.

Europe is one of the leaders when it comes to regulatory reforms. It has a target of 55% reduction in carbon by 2030 and further achieving carbon neutrality by 2050. In addition, there are mechanism like Carbon Border Adjustment Mechanism (CBAM) which could facilitate the region in moving closer to its targets.

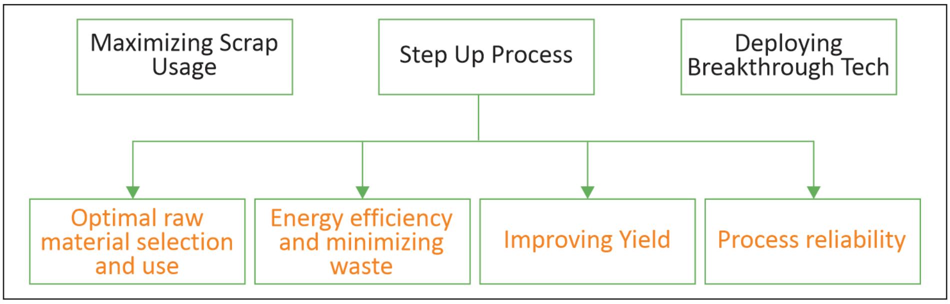
In fact, the following chapter will highlight some of the efforts being made towards decarbonisation by Europe as well as other relevant regions.

6. STEEL DECARBONISATION AND POLICY SUPPORT

Steel is crucial to a country's growth. It is a major input for sectors such as transportation, construction, automobile, infrastructure, capital goods, and consumer durables. To meet the goals of the Paris Agreement towards limiting global CO_2 emissions and keeping global temperature rise well below 2^o Celsius by 2100, it is imperative that an industry like iron and steel adopts low carbon-emitting production process. For that, relevant technologies need to be put in place.

According to World Steel Association, the steel industry needs to focus on a three-way process to reduce the carbon emissions, namely, step up process, maximising scrap usage, and deploying breakthrough technologies at various stages.

Figure 33: Reducing Carbon Emissions in the Iron and Steel Industry



Source: World Steel Association; India Exim Bank Research

The step up program is a four-stage efficiency methodology which involves optimal raw materials selection and use, energy efficiency and minimizing waste, improving yield, and process reliability. The program was initially tested across nine mills which showed a potential of reducing CO_2 emissions 0.2-0.5 tonne/tonne crude steel across the sites.

Figure 34: Benefits of Scrap Usage (Per tonne of Scrap in Steel Production)

1.5 tonnes of CO_2 emissions avoided	1.4 tonnes of iron ore consumption reduced	740 kg of coal consumption reduced	120 kg of limstestone consumption cut

Source: World Steel Association

With respect to maximising the scrap usage, it may be noted that steel can be reused to a large extent promoting the circular economy. Circular steel manufacturing models involve reducing, reusing, remanufacturing, and recycling. Currently, the recycling rate is at around 85%, signifying the limited room for improvement on this front[8].

Finally, there are various technologies being used for the production of low carbon steel. A few of these technologies are listed below:

- <u>Carbon Capture and Storage (CCS):</u> This involves capturing of CO_2 emissions from steel-making processes such as burning of fossil fuels in the blast furnace. The carbon is then transported to storage sites. This requires proper infrastructure for storage such as caverns, deep pipelines, and oil and gas reservoirs. With CO_2 not released in the air, the intensity of carbon emissions will reduce.
- <u>Carbon Capture and Utilisation (CCU):</u> This process is like CCS, except that CO_2 is not stored underground. It is, in fact, used for other purposes such as production of synthesis gas, methanol, polymers, ammonia, and higher alcohols.
- <u>Top pressure Recovery Turbine (TRT):</u> A top-pressure recovery turbine plant is installed in the downstream of gas-cleaning equipment for a blast furnace. TRT uses the high pressure to generate electric power by driving the turbine.

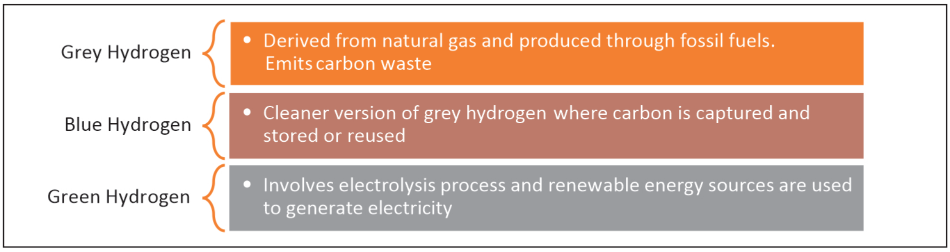
[8] World Steel Association

- Natural Gas–EAF method: Coal as a reducing agent releases a large amount of CO_2 emissions compared with natural gas. If natural gas is used as a reducing agent, the process is natural gas-EAF method or if H_2 is used, the process is H_2 – DRI method. The type of H_2 used determines CO_2 emissions. If green hydrogen is used, zero emissions are produced.

Green Hydrogen in Steel Making: Progress and Potential

In order to achieve zero carbon emissions, it is imperative for the steel industry to adopt hydrogen technology in electric arc furnaces. There are three major types of hydrogen - grey, blue, and green and the one obtained from cleaner sources is called green hydrogen. Green hydrogen is produced by using electricity generated from renewable sources such as solar or wind. Therefore, it can be used for steel production to achieve Net Zero emissions.

Figure 35: Forms of Hydrogen



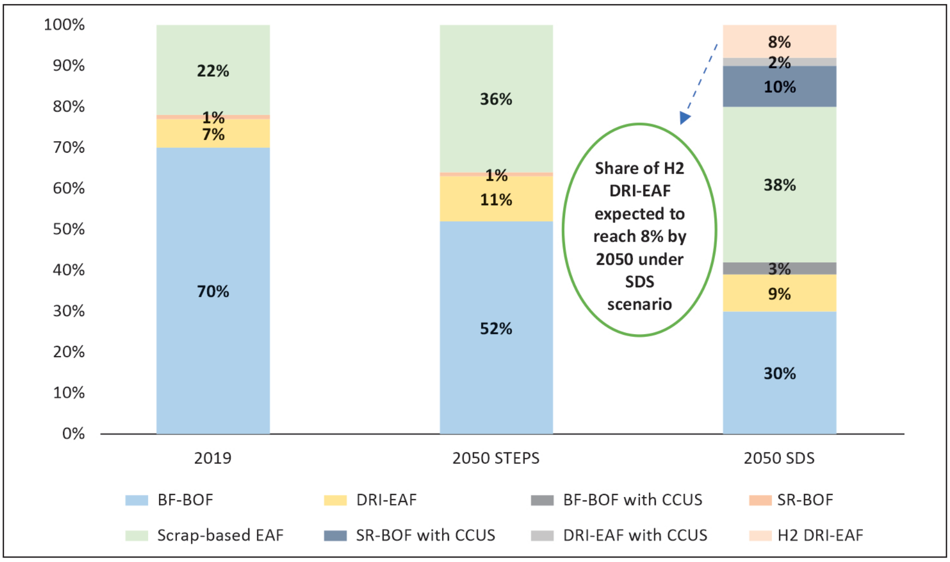
Source: India Exim Bank Research

In a typical setting, the hydrogen based steel units could consist of hydrogen production system, storage system for hydrogen, iron and steel producing units, and renewable energy storage systems for hydrogen electrolysis. Additionally, the unit might also have an alkaline electrolyser for electrolysis to produce hydrogen from fresh water.

It is vital to mention here the International Energy Agency's (IEA) analysis of two scenarios of global steel production by 2050. The first scenario is called Stated Policies Scenario (STEPS). This scenario considers countries' energy- and climate related policy commitments. The second scenario is Sustainable Development Scenario (SDS) which sets out the major changes that would be required to reach the main energy-related goals of the UN Sustainable Development Agenda.

As per the analysis, the share of hydrogen driven steel production in total steel production could reach 8% by 2050, under the SDS scenario. Further, the share of scrap based EAF could reach 36% by 2050 under the STEPS scenario and 38% by 2050 under the SDS scenario.

Figure 36: Global Crude Steel Production by Process Route and Scenario, 2019-2050

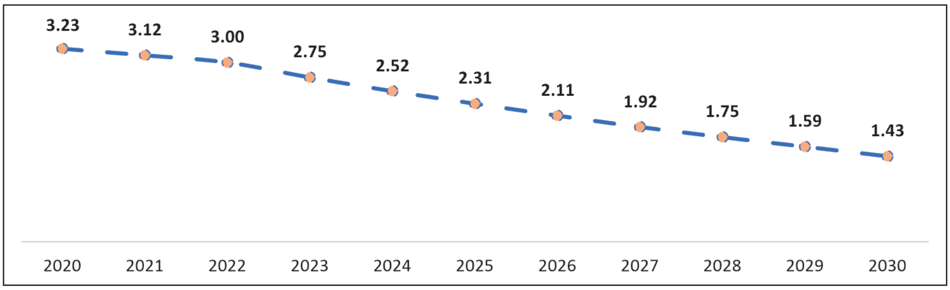


BF-BOF: Blast Furnace-Basic Oxygen Furnace; DRI-EAF: Direct Reduced Iron Electric Arc Furnace; CCUS: Carbon capture, utilisation, and storage; SR-BOF: Smelting Reduction-Blast Oxygen Furnace

Source: IEA; India Exim Bank Research

However, it may be noted that one of the important challenges with respect to moving towards green hydrogen is cost. There are high capital expenses involved for setting up electrolysers. At the same time, it is highly possible that in the coming years with policy support and economies of scale, the cost of this can reduce. As per NITI Aayog, the cost of producing green hydrogen could decline from US$ 3.23/kg in 2020 to US$ 1.43/kg in 2030.

Figure 37: Expected Price Trajectory of Green Hydrogen (US$/kg)



Source: Niti Aayog

With respect to the progress in the green hydrogen space, the use of green hydrogen in steel production is still in the nascent stage. The technology calls for huge investments in green hydrogen plants and electrolysers. Nevertheless, several companies have announced their intent to invest in green hydrogen. Government of India has also set a production target of 5 million tonnes per annum of hydrogen by 2030 under the recently announced Green Hydrogen Policy.

Table 10: Green Hydrogen Projects in India

Company	Type	Tie up with	Location	Status
Oil India Ltd	Indian	-	Jorhat Pump Station, Assam	Active
NTPC Ltd.	Indian	-	Simhadri, Andhra Pradesh	Announced
Gas Authority of India Ltd	Indian	-	Guna, Madhya Pradesh	Announced
Indian Oil Corporation	Indian	L&T, ReNew Power	-	Announced
L&T	Indian	-	Hazira, Gujarat	Active
Greenko & John Cockerill	Foreign	-	Likely on the east coast	Announced
Adani	Indian	TotalEnergies	-	Announced
Reliance	Indian	-	-	Announced
JSW	Indian	Fortescue	-	Announced

Source: India Exim Bnk Research (As on September 2022)

Decarbonization Efforts by India

India has set the ambitious goal of installing 300 MT steel production capacities by 2030 (National Steel Policy). Given that a significant amount of steel production in India is through the BF-BOF route, carbon footprint of the steel can increase further. As a result, emerging countries such as India will have to focus on reducing their carbon footprint, besides emphasizing on sectoral and economy growth. As a result, under COP 26, India committed to reach net zero carbon emissions by 2070.

In this goal of net zero emissions, the Indian iron and steel industry is expected to play a vital role. During 2005 to 2020, the average CO_2 emission intensity from India's steel sector reduced from around 3.1 tonne/tonne of crude steel to 2.6 T/tcs[9]. India is further required to reduce this to 2.4 T/tcs by 2030 as per its Nationally Determined Contributions (NDCs)[10].

India is planning to decarbonise its steel sector by implementing best available technologies such as pulverized coal injection (PCI) in blast furnaces, coke dry quenching (CDQ), TRT, etc., in future steel expansion projects. Also supporting this is the country's efforts towards replacing coal, the main causal agent for carbon emission, with green hydrogen, to produce steel.

At the broader level, in the COP 26, India presented five elements for decarbonization, known as *Panchamrit*, namely,

- Increasing non-fossil energy capacity to 500 GW by 2030
- Meeting 50% of its energy requirements from renewable energy by 2030
- Reducing total projected carbon emissions by one billion tonnes till 2030
- Reducing India's carbon intensity by 45% by 2030
- Achieving the target of net zero by 2070.

At a narrower level, India has few policies and missions as well that can help towards changing the way, the iron and steel industry operates.

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[9] Ministry of Steel

[10] Indian Steel Association

First is the National Mission for Enhanced Energy Efficiency (NMEEE).

- This is one of the 8 missions under the National Action Plan on Climate Change. The NMEEE consists of four initiatives, out of which, one relates to the implementation of cost effective improvements in energy efficiency in large energy-intensive industries such as iron and steel. This initiative is called Perform Achieve and Trade (PAT) Scheme. In accordance with this plan, Designated Consumers (DCs) are given particular energy reduction goals over a three-year cycle. Each DC's target reduction is dependent on its existing levels of energy efficiency, so DCs with higher levels of energy efficiency will have lower reduction targets. Up till March 2020, six cycles of PAT with a total of 1073 DCs across 13 sectors had been implemented. By March 2023, it is anticipated that a total of roughly 26 MTOE (Million Tonnes of Oil Equivalent) in energy savings will be made, eliminating nearly 70 million tonnes of CO_2[11].

Second is the Green Hydrogen Policy which the Government of India launched in 2022.

- Under this, the Government has announced various measures to enable transition towards a hydrogen-based economy. The policy exempts the green hydrogen producers from paying interstate transmission charges for 25 years on the renewable energy bought by projects which are commissioned by 30 June 2025. This would mean that companies can set up renewable power capacity anywhere in the country and transmission will be free when the power is used for producing green hydrogen.
- It may be noted that industries such as steel use hydrogen which they produce from natural gas or naphtha. While hydrogen is carbon-free, use of fossil fuel to manufacture it involves carbon emissions.

It may also be noted that at COP 27 in November 2022, India released its Long-Term Low Emissions Development Strategy (LT-LEDS) for transition to net zero emissions by or around mid-century. The plan focuses on strategic transition of high-emission sectors, including electricity, transport, industries, and urbanisation.

[11] Bureau of Energy Efficiency (BEE)

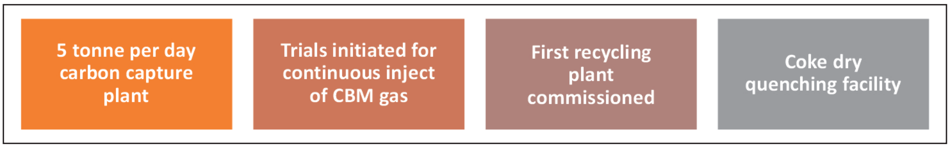
Efforts of Select Indian Steel Companies

Tata Steel

Tata steel is one of the largest players in the Indian steel industry contributing to 16% of India's crude steel production. The carbon intensity at its Jamshedpur plant is 2.29 tCO_2/tcs while at the Kalinganagar plant is 2.44 tCO_2/tcs. The carbon intensity at both these plants is higher than the world average, which is 1.89 tCO_2/tcs[12].

Tata steel has committed to adopting best practices to produce low carbon steel and is currently following the Task Force on Climate-related Financial Disclosures framework. The company intends to bring down the carbon emission intensity to less than 1.8 tCO_2/tcs by 2030.

Figure 38: Tata Steel's Efforts to Reduce Carbon Emissions



Source: Tata Steel; India Exim Bank Research

To achieve this objective, Tata steel has been taking various measures. In 2021, Tata steel commissioned a 5 tonne per day carbon capture plant. This will help the company in reusing the captured CO_2 on site, and ultimately reduce the emissions. Further, in 2022, Tata steel initiated the trial for continuous injection of coal bed methane (CBM) gas in one of the Blast Furnaces (E Blast Furnace) at its Jamshedpur plant. This process is expected to reduce 33 kg of CO_2 per tonne of crude steel.

In 2021, Tata steel also commissioned its first steel recycling plant in Rohtak which has a capacity of 0.5 MTPA. It may also be noted that in 2017, Tata steel established India's largest CDQ facility at its Kalinganagar Industrial Complex plant. This is expected to reduce the CO_2 emissions by 0.11-0.14 tonnes per tonne of coke.

[12] FY 21 annual report, Tata Steel

JSW Steel Ltd.

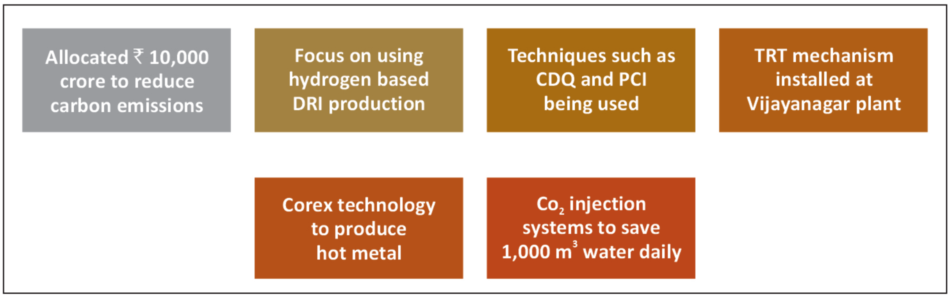
JSW Steel Ltd is an integrated manufacturer of steel products and has approximately 21 MT of crude steel capacity in India. It targets to have 30.5 MT capacity by FY 25. Its manufacturing facilities are in Dolvi (Maharashtra) and Vijayanagar (Andhra Pradesh). Its iron ore mines are in Karnataka and Odisha. It procures 35% of its iron ore requirement from its captive mines.

The GHG intensity of JSW Steel Ltd. is 2.49 tCO_2/tcs. This is higher than the world average. As a result, JSW Steel has been taking various steps in the direction of reducing carbon emissions. JSW Steel has committed to lowering carbon emissions by 42% by 2030 from the base year of 2005 and has allocated ₹ 10,000 crore for the same. It plans to become carbon neutral by 2050. Further, the company also has committed to reduce the CO_2 emissions to 2 tCO_2/tcs by 2030.

With respect to the other measures taken by JSW Steel, it may be noted that JSW is focusing on using hydrogen based DRI production, but on a small scale before 2030. Other techniques such as CDQ and PCI are being used to improve efficiencies in the blast furnace.

JSW Steel has the TRT mechanism installed at its Vijayanagar plant. It also has the PCI system in all four units of Vijayanagar plant. JSW Steel was also the first Indian company to use Corex technology to produce hot metal. Corex is a smelting-reduction process for cost-efficient and environmentally friendly production of hot metal from iron ore and low grade coal.

Figure 39: JSW Steel's Efforts to Reduce Carbon Emissions



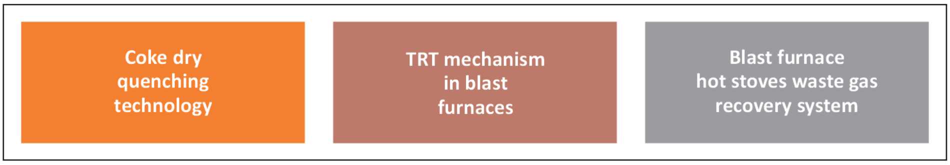
Source: JSW Steel; India Exim Bank Research

In addition, the JSW is also setting up 175 MW Waste Heat Recovery Boilers (WHRB) and a 60 MW captive power plant to harness flue gases and steam from CDQ. The power plants operate through the waste gases and heat generated from operations is environmentally friendly and cost-efficient. Finally, JSW is also using CO_2 injection systems to save 1,000 m^3 water daily. CO_2 injections are used in the water tanks to reduce PH levels and reuse water.

Steel Authority of India Ltd

Steel Authority of India Ltd (SAIL) is one of the largest steel manufacturers in India with an installed capacity of 34 MTPA. It is one of the Maharatnas under central public sector enterprises. It has five integrated steel plants at Bhilai, Bokaro, Burnpur, Durgapur, and Rourkela. It has three special steel plants at Durgapur (alloy), Salem (stainless), and Bhadravathi, along with a ferro alloy manufacturing unit at Chandrapur.

Figure 40: SAIL's Efforts to Reduce Carbon Emissions



Source: India Exim Bank Research

The CO_2 emissions from SAIL's units are 2.55 tCO_2/tcs, signifying that the emissions are way higher than the global average. In the past few years, SAIL has adopted various technologies in order to curb the carbon emissions. These include coke dry quenching technology to recover sensible heat from coke, TRT mechanism in blast furnaces, blast furnace hot stoves waste gas recovery system to utilize the waste, among others[13]. However, given its high carbon intensity, SAIL will have to take even more drastic steps in the coming years.

[13] https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1796110

Box 2: Stressed Assets in Iron and Steel Industry

Being a capital-intensive sector, the iron and steel industry offer has on outstanding debt. The total outstanding credit of scheduled commercial banks for the industry stood at over ₹ 2 trillion as of October 2022. Total outstanding debt has come down over the last 5 years led by resolution of NCLT cases, where financial institutions took major haircuts, as well debt repayment by major steel players on the back of strong profitability over FY 21 and FY 22.

While the industry witnessed record profitability over the last 2 years, it had witnessed a lot of stress prior to that, especially over 2015-2016 period when profitability of steel producers plummeted in line with global prices.

While there have been a lot of cases that were admitted to NCLT since its inception, 12 large cases stood out, which included 5 large steel companies. Given robust demand prospects of domestic steel industry, all the 5 steel cases out of the 12 large accounts have been resolved.

Status of key steel accounts admitted under IBBI

Account	Claims of FCs Dealt Under Resolution (₹ crore)			Successful Resolution Applicant
	Amount Admitted	Amount Realised	Realisation as % of Claims	
Electrosteel Steels Limited	13175	5320	40.38	Vedanta Ltd.
Bhushan Steel Limited	56022	35571	63.50	Bamnipal Steel Ltd.
Monnet Ispat & Energy Limited	11015	2892	26.26	Consortium of JSW and AION Investments Pvt. Ltd.
Essar Steel India Limited	49473	41018	82.91	Arcelor Mittal India Pvt. Ltd.
Bhushan Power & Steel Limited	47158	19350	41.03	JSW Limited

Source: The Insolvency and Bankruptcy Board of India (IBBI)
Note: Bamnipal Steel Ltd. Is an undertaking of Tata Steel Limited and is now merged with Tata Steel Limited

Bhushan Steel

Bhushan Steel was admitted for insolvency proceedings in July 2017. The company started making losses at a net level since Q3 FY 14. With losses mounting, the company was unable to pay its debt obligations and was thus admitted to NCLT. The company received a record 22 bids in early proceedings.

In March 2018, Tata Steel's resolution plan was approved by the committee of creditors. Tata Steel Limited renamed the company as TATA Steel BSL. Even in the pandemic-hit year of FY 21, TATA BSL made a net profit of ₹ 2518 crore at a consolidated level. The company was later amalgamated into TATA Steel in FY 22.

Essar Steel Limited

Essar Steel Limited was the largest steel company that went to the NCLT. In August 2017 the insolvency resolution process against Essar Steel was admitted by NCLT. The company generated interest among global players like ArcelorMittal and NuMetal (a consortium led by VTB bank of Russia).

After various hiccups and rejections in the process, Supreme court of India ruled in favour of ArcelorMittal and the company took over Essar Steel in 2020, which was renamed to ArcelorMittal Nippon Steel Limited (AM/NS).

With the backing of two global steel giants, the company witnessed a quick turnaround. Buoyed by rising steel prices and growing demand, the company recorded robust sales of ₹ 55,634 crore in FY 22, along with a net profit of ₹ 7,944 crore. The company reported its highest ever operating margin in the last decade in FY 21, which was bettered in FY 22.

Monnet Ispat

Monnet Ispat was admitted under NCALT in June 2017 after the recommendation of RBI to initiate proceedings against the company. The company after successfully running for over 3 decades, started making heavy losses on the back of cooling steel prices along with de-allocation of coal blocks awarded to industries.

The only resolution plan that was received for the asset was that of JSW Steel-Aion Investment combined, which was accepted in April 2018. However, the Gare Palma mines were not included as a part of the resolution and were returned to the government.

The company benefitted from the takeover by a steel giant and both its operational and financial metrics improved. The company was rechristened JSW Ispat Special Products Limited. To ensure sustainable growth, a lot of past planned capex of the company was scrapped and the company is now focused on increasing its pellet capacity along with increasing production capacity of special steel products.

Source: India Exim Bank Research

Policy Support Across Geographies

Decarbonisation of the steel industry is a challenge as it is a carbon and energy-intensive sector and requires a push from all countries to produce low-carbon steel. Also, steel manufacturers across countries need to implement measures for improving operational processes that decrease their carbon footprint and plan strategies that will help mitigate global climate risk. This calls for policy and financial support from governments as steel is a capital-intensive industry.

China

Almost one-third of global carbon emissions are from China with total emissions from China amounting to 11.9 GT in 2021. Further, in the global carbon emissions from the steel industry, China's contribution is 54%, given that 90% of its steel production is through BF-BOF process. In its own total carbon emissions, China's steel industry's contribution is around 15%. Given the significant contributions of China's steel industry in China's own total emissions as well as global steel carbon emissions, it becomes important for China to work toward its carbon neutrality goal which is to be achieved by 2060. For the same, China aims to peak carbon emissions by 2030.

Under its 14th five year plan, China announced strict control on coal consumption and increase the share of non-fossil fuel energy consumption in total energy consumption to 20% by 2025, up from 15.8% in 2020. Further, during this five-year plan, China set an 18% reduction target for CO_2 intensity and announced its focus on improving policy framework for carbon neutral and circular development methods.

In the 15th five-year plan (2026-2030), China expects to increase the share of non-fossil fuel in energy consumption to 25% by 2030. Additionally, the carbon dioxide emissions per unit of GDP are expected to drop more than 65% as compared to the 2005 levels.

In 2021, China also lifted the import ban on steel scrap, given that steel production from steel scrap can play an important role in reducing the carbon emissions from China. In fact, China aims to gather 300 MT of steel scrap every year by 2025. As a result, it also plans to increase the share of EAF in total steel production to 15% by 2025 from the current 10%.

Figure 41: Major Steps Taken by China to Reduce Steel Carbon Emissions

Source: India Exim Bank Research

In addition, the government in China has implemented the New Capacity Swap programme, which came into effect from June 2021. Under this programme, steel manufacturers in certain regions in China – Beijing-Tianjin-Hebei, Yangtze River delta, Pearl River delta, Fen-Wei plain – are not permitted to expand production capacity. Also, in several other regions, the replacement ratio has been changed from 1.25:1.00 (old capacity swap programme) to 1.5:1.0, which means, to expand crude steel production by 1.0 MT, the manufacturers need to eliminate 1.5 MT of crude steel capacity.

On trade front also, in 2021, China raised export tariffs on various steel products such as pig iron, ferrochrome, steel scrap etc. in order to ensure domestic supply and controlling output to curb the emissions. China also cancelled tax rebates on various steel products such as cold-rolled sheets, colour-coated coils, hot-rolled coils, amongst others.

Overall, China is looking to stop further capacity additions in the steel industry besides replacing existing production capacity with EAF facilities, which will aid the industry to shift towards DRI /green hydrogen production technology. Promoting clean energy, creating awareness on non-blast furnace technology, and incentivising a circular economy through recycling and reuse of steel scrap are key objectives laid in the fourteenth and fifteenth five-year plans.

However, there will also be certain challenges to achieve these long term goals. The cost of DRI-EAF is higher than the BF-BOF route as it uses electricity, which is costlier. Also, China is rich in coal reserves as compared to natural gas, with coal accounting for almost 70% of total energy consumption in crude steel production. Hence, China will have to focus on stabilising its energy resources before it focuses on reducing coal consumption.

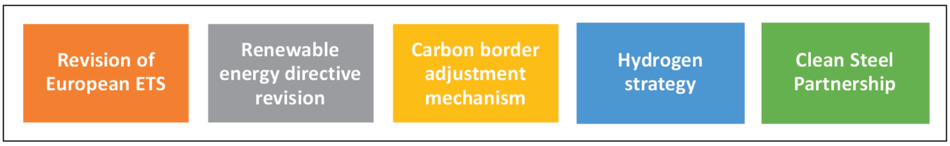
European Union

The EU's 2030 Climate Target Plan has the proposal to cut the region's emissions by at least 55% by 2030, as compared to 1990 levels. By 2050, the EU targets to become carbon neutral. To achieve its goal, the EU must focus on decarbonising its steel industry. Iron and steel industry has played an important role in the growth of the European region and as a result, it becomes important to involve all the stakeholders in reducing the emissions from this sector. The steel sector contributes to roughly 5% of the EU's carbon emissions[14].

[14] https://joint-research-centre.ec.europa.eu/jrc-news/eu-climate-targets-how-decarbonise-steel-industry-2022-06-15_en#:~:text=The%20steel%20industry%20is%20responsible,7%25%5B1%5D%20globally.

As a result, it will be vital for the EU to embrace technologies such as CCUS, top pressure recovery systems, coke dry quenching, maximising usage of scrap and hydrogen-based steel production, etc. Currently, many European economies are producing more through the BF-BOF route. For instance, Germany (69.8% through BF-BOF), and France (66.8%) both have high BF-BOF share in total crude steel production.

Figure 42: Major Steps Taken by the EU to Reduce Steel Carbon Emissions



Source: India Exim Bank Research

As part of its decarbonisation efforts, the EU has laid out a 'Fit for 55 package' which is the EU's target of reducing net greenhouse gas emissions by at least 55% by 2030. There are various provisions under the same.

- Revision of the EU Emissions Trading System (ETS): The EU's ETS is based on the cap-and-trade principle. The cap is set on the maximum emissions all installations under this system can emit. If a plant emits lower CO_2 levels, it can use the remaining allowance in the future, or trade it with another installation that is falling short. ETS includes power and manufacturing sectors, including the iron and steel industry. ETS covers around 45% of the EU greenhouse gas emissions. In the revised plan, the GHG emissions have to be reduced by 61% by 2030 compared to 2005 levels (previous target was 43%).
- Revision of Renewable Energy Directive: Under the package, the EU has proposed to increase the share of renewable energy resources in total energy mix to 40% by 2030 (current target is 32%). As more renewable energy sources replace fossil fuels in the steelmaking process, CO_2 emissions will reduce. Besides this, the EU aims to lower energy consumption levels by imposing new targets of 36% and 39% as energy efficiency for final and primary consumption, respectively, as part of efforts to attain the final target of reducing carbon emissions.

- Carbon Border Adjustment Mechanism: To protect and incentivise low-carbon steelmakers, the EU has introduced the Carbon Border Adjustment Mechanism. The mechanism encourages producers in non-EU countries to adhere to EU standards of low-carbon steel. If a high-carbon product is exported to the European Union, it could carry higher import duty compared to low-carbon steel products to prevent carbon leakage through trade. Sectors such as iron and steel, cement, aluminium, fertilisers, and electric energy production are covered under this mechanism.

Other than these stated measures as part for Fit for 55 package, the EU also has a hydrogen strategy. This is because hydrogen-based green steel production will help limit CO_2 emissions vis-à-vis the BF-BOF mode. Since green hydrogen could be a potential replacement for fossil fuels such as coal or natural gas through the DRI-EAF route in the steel production process, the EU is aiming to bring together electrolyser manufacturers and suppliers of components and materials to achieve a combined annual electrolyser manufacturing capacity of 17.5 GW by 2025 in Europe[15]. This is under the European Clean Hydrogen Alliance.

Further, the EU has also launched a clean steel partnership in 2021. It focuses on developing, upscaling, and rolling out new technologies which could reduce carbon emissions from steel production in the EU by 50% by 2030, in comparison to 1990 levels. The partnership has also proposed a three stage process for research, innovation, and development, wherein the first stage would target projects that generate immediate carbon reduction opportunities[16]. The second stage allows for a quick evolution towards improved processes and third stage looks at revolutionizing the steel industry through breakthrough technologies.

[15] https://energy.ec.europa.eu/topics/energy-systems-integration/hydrogen_en#:~:text=EU%20hydrogen%20strategy,-The%20EU%20strategy&text=The%20strategy%20explored%20how%20producing,the%20first%20quarter%20of%202022.

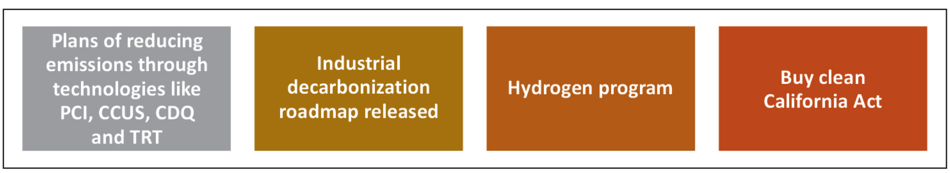
[16] https://www.estep.eu/assets/Uploads/CSP-SRIA-Oct2021-clean.pdf

United States of America

In 2021, the US announced targets to achieve 50-52% reduction of GHGs by 2030 from 2005 levels. The US contributes to almost 14% of the global carbon emissions. Further, the US iron and steel industry has a significant share in the GHG emissions from the global industrial sector. It may be noted that in US, the share of BF-BOF in the crude steel production is 30.8% only.

The US is planning to achieve near-zero emissions by 2050 through a mix of energy-efficiency methods, such as PCI[17] in blast furnaces and decarbonizing the power industry so that electricity obtained from renewable resources can be used for hydrogen production, along with new age technologies such as CCUS. In the near future, the US is also planning to adopt low capital carbon transition techniques, such as CDQ and TRT, and subsequently shift towards hydrogen-based production over the longer term.

Figure 43: Major Steps Taken by the US to Reduce Steel Carbon Emissions



Source: India Exim Bank Research

In September 2022, the Government of US released the 'Industrial Decarbonization Roadmap' which identifies pathway to reduce industrial emissions from American manufacturing. This involves sectors such as chemicals, petroleum, iron and steel, food and beverages, and cement.

Particularly to achieve net zero goals for iron and steel, the roadmap recommends transition to low-and no-carbon fuels and expand industrial electrification. It also recommends the industry to pilot demonstrations for transformative technologies such as hydrogen steel, CCUS, etc. Further, it

[17] Involves blowing large volumes of fine coal granules into the blast furnace. This reduces the demand for coke production by adding an additional source of carbon to accelerate the production of metallic iron. Energy consumption and emissions can be decreased as a result.

calls for improving materials efficiency and materials circularity. Overall, the roadmap identifies four key pillars for the American industry, namely, energy efficiency, industrial electrification, low-carbon fuels, feedstocks and energy sources, and CCUS[18].

Other than this roadmap, given that the hydrogen is going to play a key role in the steel industry in the coming years, the US has its own hydrogen program which conducts research in areas of hydrogen production, delivery, infrastructure, storage, and fuel cells. It also has an associated Energy Earthshots Initiative which aims to accelerate breakthroughs of more abundant, affordable, and reliable clean energy solutions within the decade. The first Energy Earthshot was launched in June 2021 and targets to reduce the cost of clean hydrogen by 80% to US$ 1 per 1 kilogram in 1 decade ("111")[19].

Finally, the US has 'Buy Clean California Act' in place since 2017. Under this law, the Department of General Services (DGS), in consultation with the California Air Resources Board (CARB), is required to establish and publish the maximum acceptable Global Warming Potential (GWP) limit for four eligible materials, namely structural steel (hot-rolled sections, hollow structural sections, and plate), concrete reinforcing steel, flat glass, and mineral wool board insulation[20]. The law acts as an incentive to manufacture low carbon products since it differentiates against steel made in India/China to steel made in the US as the latter has low carbon emissions.

Conclusion

Being the second-largest producer of crude steel, India will have to focus on decarbonising the steel industry quickly to achieve carbon neutrality by 2070. Domestic steel players rely on fossil fuels, such as coal and natural gas, which increase the industry's carbon footprint.

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[18] https://www.energy.gov/eere/doe-industrial-decarbonization-roadmap

[19] Department of Energy, US Government

[20] Department of General Services, US Government

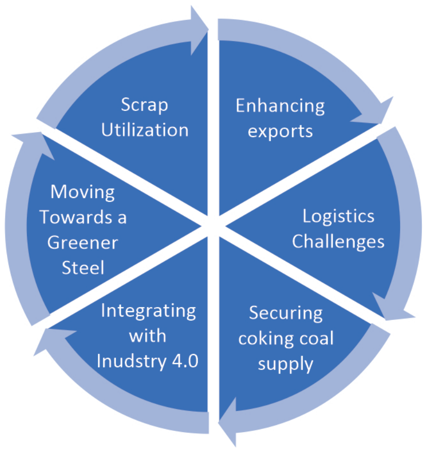
Indian steel industry is on the verge of developing low carbon steel products by using renewable energy sources, such as hydrogen and carbon-free electricity in the production process. However, replacing fossil fuels is replete with challenges, such as availability of technology, high capital costs, and raw material availability.

To overcome these, all stakeholders, including the government and steel players, will have to join hands. Global, and Indian, steelmakers have realised this urgency to lower carbon footprint and are committed to becoming Net Zero carbon emitters.

7. Challenges and Strategies

The Indian steel industry is at an important junction as the country experiences further growth. While on the one hand, the National Steel Policy has a vision to achieve crude steel production capacity target of 300 MT per annum by 2030, on the other hand, India has committed emission reductions under COP 26 which makes green steel an important development for the future. This chapter makes an attempt to understand the challenges under both these broad areas and provides relevant strategies.

Figure 44: Select Challenges and Strategies for Indian Iron & Steel Industry



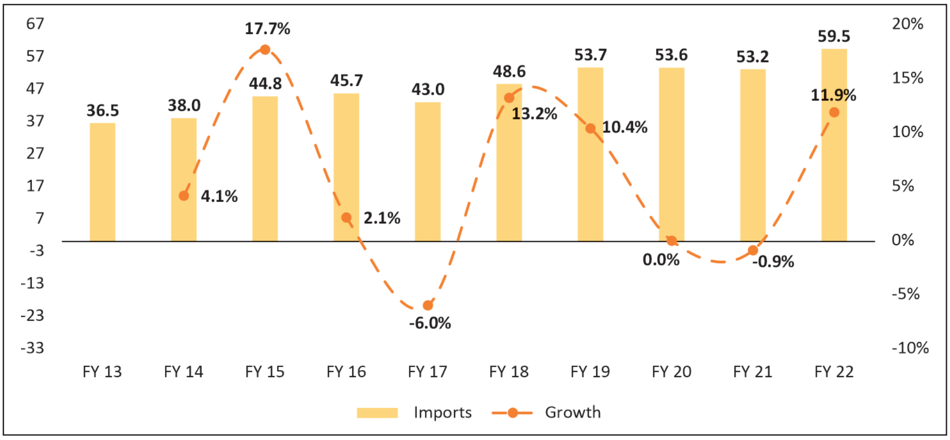
Securing Coking Coal Supply

Coking coal or metallurgical coal is a sedimentary rock which occurs naturally and is found in the earth's crust. It has various types such as hard coking coal, semi-hard coking coal, semi-soft coking coal and PCI. These are different grades of coking coal and are used in steel production. The coking coal is better than the thermal coal for steel production because coking coal has more carbon, lesser ash, and low moisture.

It may be noted that there are four types of coal-anthracite (highest carbon content), bituminous, sub-bituminous, and lignite. As per the British Petroleum statistics, India's proved reserves of anthracite and bituminous are 106 BT and of sub-bituminous and lignite are 5.1 BT. In comparison, the USA has 219 BT of anthracite and bituminous reserves. However, under the category of 'anthracite and bituminous', most of the reserves are of bituminous in India. Anthracite is found in only small quantities in Jammu and Kashmir.

Coking coal is a vital component in the production of steel and contributes around 40-45% of the steel production cost. With respect to the foreign dependence, India's coking coal imports have increased from 36.5 BT in FY 13 to 59.5 BT in FY 22, recording an AAGR of 5.8%. Around 68% of India's coking coal imports in FY 22 were from Australia. Other important sources include the USA, Russia, Canada, Mozambique, and Indonesia.

Figure 45: Coking Coal Imports by India (in Billion Tonnes)



Source: Ministry of Coal; CMIE Industry Outlook; India Exim Bank Research

It is important to mention that India's import dependence for coking coal is around 85% and India targets to get this down to 65% by 2030-31. Given that India intends to achieve crude steel production capacity target of 300 MTPA by 2030, securing coking coal supply becomes even more important.

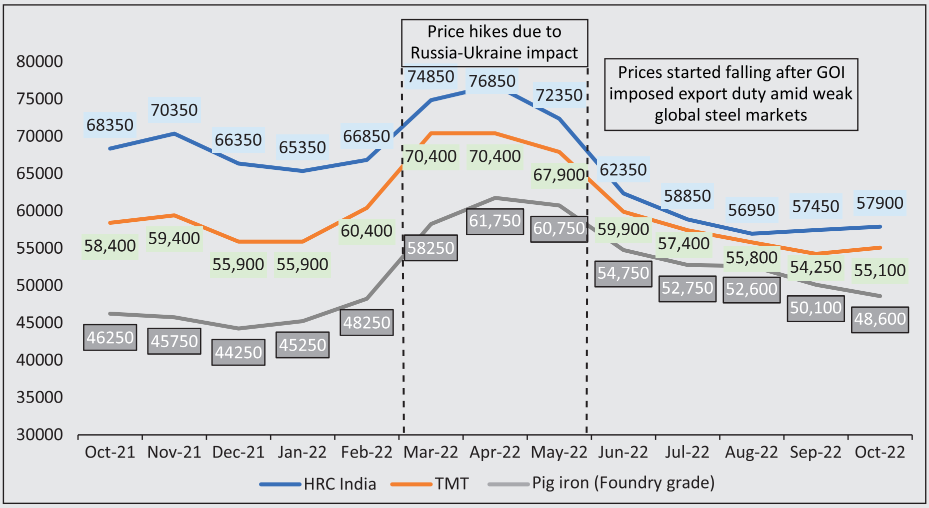
The first step to secure the raw materials such as coking coal would be to diversify the import sources. Currently, India is heavily dependent on Australia, with almost 68% of India's coking coal imports coming from Australia. India is already targeting Russia for increased coking coal imports in the coming years. Other than this, Canada, and the US can also be important sources to explore. But, given the distance factor between India and American continent, Russia could be an important sourcing country for India.

Box 3: Impact of Russia-Ukraine War on Steel Industry

Due to Russia-Ukraine conflict since the month of February 2022, supply chain got disrupted resulting in price hikes across commodity products. Global steel industry witnessed rise in pig iron and coking coal prices along with iron ore costs.

Russia has a share of 8% of total production in coking coal and has a share of 4% in products across iron and steel industry. Further, Russia's share in global pig iron exports is around 32%. The same for Ukraine is 20%. As these countries have a significant share in products across steel industry, the conflict has resulted in immediate price rises.

Domestic Trend of Prices (₹/tonne)



Source: CRISIL Research

This event had opened doors for export opportunities for India in the case of pig iron as well as steel. Further, prices shot up in domestic market due to elevated input costs as well as higher exports realisations.

This led to imposition of export duty by the GOI on finished steel products as well as iron ore, which drove quick price correction. In fact, flat steel, which accounts for over 80% of India's finished steel exports witnessed a sharp correction of over 25% since the duty imposition correcting from a peak of ~₹ 79000 to ₹ 57,000 in mid-September 2022.

Source: India Exim Bank Research

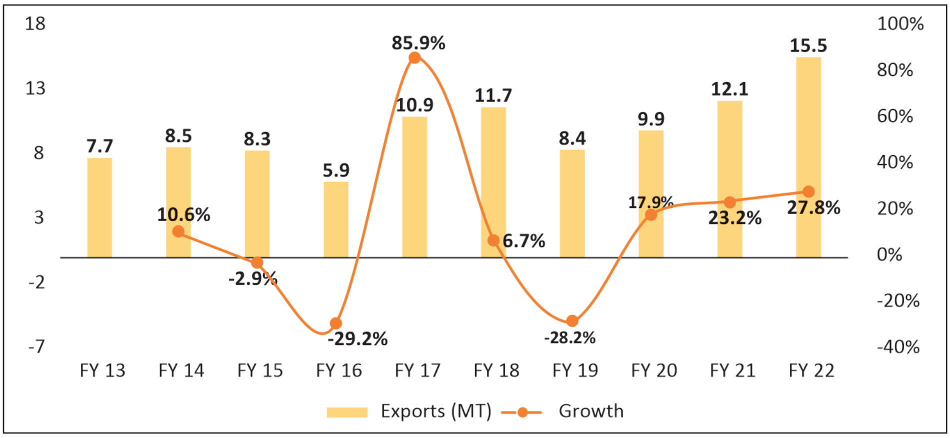
However, the diversification would not actually reduce the import dependence of Indian steel players. Therefore, India should focus more on the mining and the washing technology if it wants to reduce the import dependence. Currently, most of the domestic coking coal is being used by the power industry due to its high ash content (18%-49%). In order to make it useful for the iron and steel industry, it has to be washed to reduce the ash content, which can then be blended with the low ash content imported coking coal. Further, mining exploration can also be helpful in finding more coking coal reserves, which could be low in ash content. Overall, investing in technology could be a game changer and could ultimately reduce the import dependence.

Enhancing Exports

India's exports of finished steel were recorded at 15.5 MT in FY 22. This is up from 7.7 MT in FY 13, thereby recording an AAGR of 12.4%, during this period. Almost 11% of these exports in FY 22 went to Vietnam, followed by UAE (8.9%), Italy (8.8%). Belgium, Turkey, and the USA, are which all important destinations.

While the exports have been impressive in the last decade, there is potential for much more. Firstly, a well laid out export strategy for the steel products can be a guiding force for the industry. In fact, currently, steel exports are majorly dependent on either a fall in domestic demand or better international prices. This is what happened in FY 22 as well when the international prices of steel were booming.

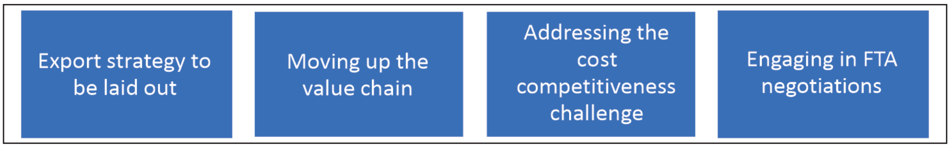
Figure 46: India's Finished Steel Exports



Source: CMIE Industry Outlook; India Exim Bank Research

Second, an interesting aspect to know is that non-alloys dominate the finished steel exports from India. Out of the 15.5 MT of finished steel exports in FY 22, 13.9 MT were of non-alloys. India majorly exports commodities such as hot rolled coils (7.1 MT in FY 22) which lie at the lower end of the value chains. As a result, the export realization in terms of value is lesser vis-à-vis products at the higher end of the steel value chain such as galvanized steel.

Figure 47: Strategies to Enhance Steel Exports



Further, the cost competitiveness of the steel sector also needs to be addressed. While domestically, the steel produced might be cost effective, the outbound steel for exports especially high-grade steel or special steel is not much export competitive. This is because this kind of steel requires economies of scale, to become competitive. In the present scenario, various taxes which are not a part of GST can be counter-beneficial for these products. For instance, VAT on diesel for transportation, electricity duty etc. are levied on the steel industry and are not refunded. While the GOI has introduced the Remission of Duties and Taxes on Exported Products (RoDTEP) scheme for various sectors, steel is not a part of this scheme.

Finally, a stable policy environment could be one of the most important factors in determining the direction of the exports. Policy decisions such as export duty on steel could negatively impact the steel exports. For instance, in May 2022, duty on exports of iron ore was hiked by up to 50% and for a few steel intermediaries to 15% as the steel manufacturers increased their exports owing to increased steel prices during March 2020 to April 2022. The duties were later withdrawn/revised in November 2022.

Overall, laying down a well-defined export strategy could be helpful for the industry. Competitive products and markets can be identified for the various steel products. At the same time, engaging in FTA negotiations with countries and regions where Indian steel is competitive could be one of the solutions. Additionally, the negotiations should be regular to cover steel under the RoDTEP scheme. This would help the steel industry in becoming more competitive.

Logistical Challenges

Logistics plays an extremely crucial role in the iron and steel industry. The imported iron ore and coking coal which is to be transported from ports to the plants and the finished steel which is to be transported from the unit to the port for exports, both are bulk materials. As a result, logistics, especially the transportation component, plays an important role in the steel industry.

Further, in case of India, most of the steel plants in India are far from the ports, while being closer to places which supply raw materials. To reduce the anomaly, it is important that India creates state of the art last mile connectivity to the ports.

Given the significant distance between the plants and the ports, railways are usually the preferred mode of freight and over 80% of steel industry's logistics requirement is met through railways. However, freight cost of railways in India is on the higher side. This is because railways in India is hugely dependent on freight for the revenue and in turn, cross subsidizes the passenger traffic. As per Niti Aayog, freight cost from Jamshedpur to Mumbai can be as high as US$ 50/ton, in comparison with US$ 34/ton from Rotterdam to Mumbai.

It may be noted that for every 1 tonne of steel produced, roughly 3 tonnes of raw material need to be transported. With high targets set by India to reach 300 MT of crude steel production capacity by 2030-31, which is almost double from current level, the logistics demand is going to increase exponentially. Therefore, long-terms solutions are important to address this challenge.

First solution could be to revise the freight class under railways for iron ore. In railways, higher the freight class, higher is the fare. Currently, the iron and steel, and iron ore, both are under class 165. However, coal is under the class 145. Bringing down the iron and steel and ore both under the class 145 could give a major push to the competitiveness of the Indian Steel industry.

Further, consistent investments in the new logistics infrastructure will be an important step. This will also promote the exports from India as the logistics costs could decrease. This could involve strengthening and development of new ports, dedicated railway connectivity between ports and plants and upgrading it to increase the average speed, building new expressways, etc.

Additionally, container shortages were seen across the globe, in the post-pandemic period. Investing in new infrastructure could also involve manufacturing the containers domestically, although a specific grade of steel might be required for the same and in the initial time frame, import dependence may have to be created. However, in the long run, this would help in decreasing the logistics cost, as well as creating steel demand from the logistics sector.

Integrating Industry 4.0 and Steel Industry

Industry 4.0, also known as smart manufacturing is the realization of the digital transformation of the field, delivering real-time decision making, enhanced productivity, flexibility, and agility[21]. Technologies such as IoT, cloud computing, AI and ML, among others, are being integrated in the manufacturing processes. In short, manufacturing process is moving towards 4.0.

[21] IBM

Integrating the industry 4.0 practices in the steel manufacturing is important because this has the capability to create efficient steel plants and reduce the cost of production. Basically, IoT sensors can be used in the plants to collect the data and feed the data to the AI. For instance, sensors can be installed on the steel slab which goes to the furnace. Accordingly, data can be collected by the sensors regarding the temperature, air pressure etc. This would allow the AI to adjust the temperature or air pressure on its own, after sufficient data has been generated. This would not only improve the quality of production, but the AI will also be helpful in predicting the factors such as maintenance requirements which could save significant costs for the plants.

Further, steel plants are tough environments to work in. There could be accidents and injuries which could lead to loss of human lives and at the same time, could lead to fall in productivity. This is because huge blast furnaces can generate lot of heat and gases. By monitoring the machines in real time, the AI technology can help reduce the human errors which will prevent the injuries from happening, and consequently, will increase productivity.

Finally, steel plants use humungous amounts of energy. With industry 4.0, smart meters and IoT working together can reduce the energy waste. AI can assess the amount of energy required as per the steel products being manufactured, thereby rationalizing the energy consumption. Additionally, efficient utilization of materials is another benefit of industry 4.0 through the usage of AI. For instance, which product requires how much thickness and coating, once AI is able to evaluate this through regular feeding of data, the processes could be streamlined, and the end result will be a better-quality product.

Moving Towards a Greener Steel

Steelmaking is a highly energy intensive process. It can be produced through different technologies and the energy consumption by each can differ. As mentioned previously, the steel produced through the BF-BOF route consumes ~16 GJ of energy per ton of steel produced and steel produced through the EAF-DRI consumes ~15 GJ of energy if natural gas is used. The iron and steel industry contributes to around 9-10% of the global carbon emissions. Globally, India is the second largest contributor to carbon emissions from steel with a share of 6.6%.

One of the biggest steps in the direction of a green steel is the use of green hydrogen in the iron and steel industry. A decline in the renewable energy prices over the last few years as well as the prospects of fall in the prices of electrolyzers could create an appropriate environment to move towards green hydrogen. As per Niti Aayog, the cost of producing green hydrogen could decline from US$ 3.23/kg in 2020 to US$ 1.43/kg in 2030.

However, moving towards green steel will require policy efforts. For instance, even with the lower cost of production for green steel, the cost could be well above the BF-BOF technique. Therefore, solutions should be explored where in green hydrogen can be blended with grey hydrogen. The Government of India may explore the possibility to come up with specific rules of the blending in this context.

Further, the Government may also explore rolling out a PLI scheme specifically for the production of green steel. The states should also be encouraged to come out with their own green hydrogen policies and targets. This will create a competitive environment whilst addressing the larger goal of reducing the carbon emissions from steel.

Scrap Utilization

Steel is one of the most recycled metals in the world. This is increasingly encouraging many countries to use the steel scrap in the production of steel as it will help in cutting down the emissions significantly. It may be noted that the scrap based EAF releases the least emissions (approximately 0.4 tonne/ tonne of crude steel). The use of every ton of scrap saves 1.1 ton of iron ore, 630 kg of coking coal and 55 kg of limestone[22].

The National Steel Policy, 2017 highlighted that the Indian steel sector faces challenges due to the shortage of various raw materials like coking coal,

[22] Ministry of Steel

ferrous scrap etc. The quality of scrap is as important as the availability of scrap. Therefore, the availability of the appropriate quality of scrap is important for the future of the production scale of Indian steel industry. As per the Steel Scrap Recycling Policy, 2017, there could be considerable saving in specific energy consumption due to scrap usage as the same will reduce from around 14 MJ/Kg in BF/BOF route to less than 11 MJ/ Kg in EAF/IF route, i.e., savings in energy by 16- 17%.

The current supply of steel scrap is around 25 MT from domestic unorganized scrap units, and another 7 MT is imported. The imported steel scrap can be sourced from the domestic market through setting up of more collection centres[23].

Further, to ensure the availability and the right quality of steel scrap, it will be important for the producers to design products in a way which makes the recycling easier. This must be supplemented by developing an appropriate recycling infrastructure. Some companies are already taking a step in this direction. For instance, recently, in 2021, Tata Steel commissioned its first steel recycling plant in Rohtak which has a capacity of 0.5 MTPA.

[23] Steel Scrap Recycling Policy

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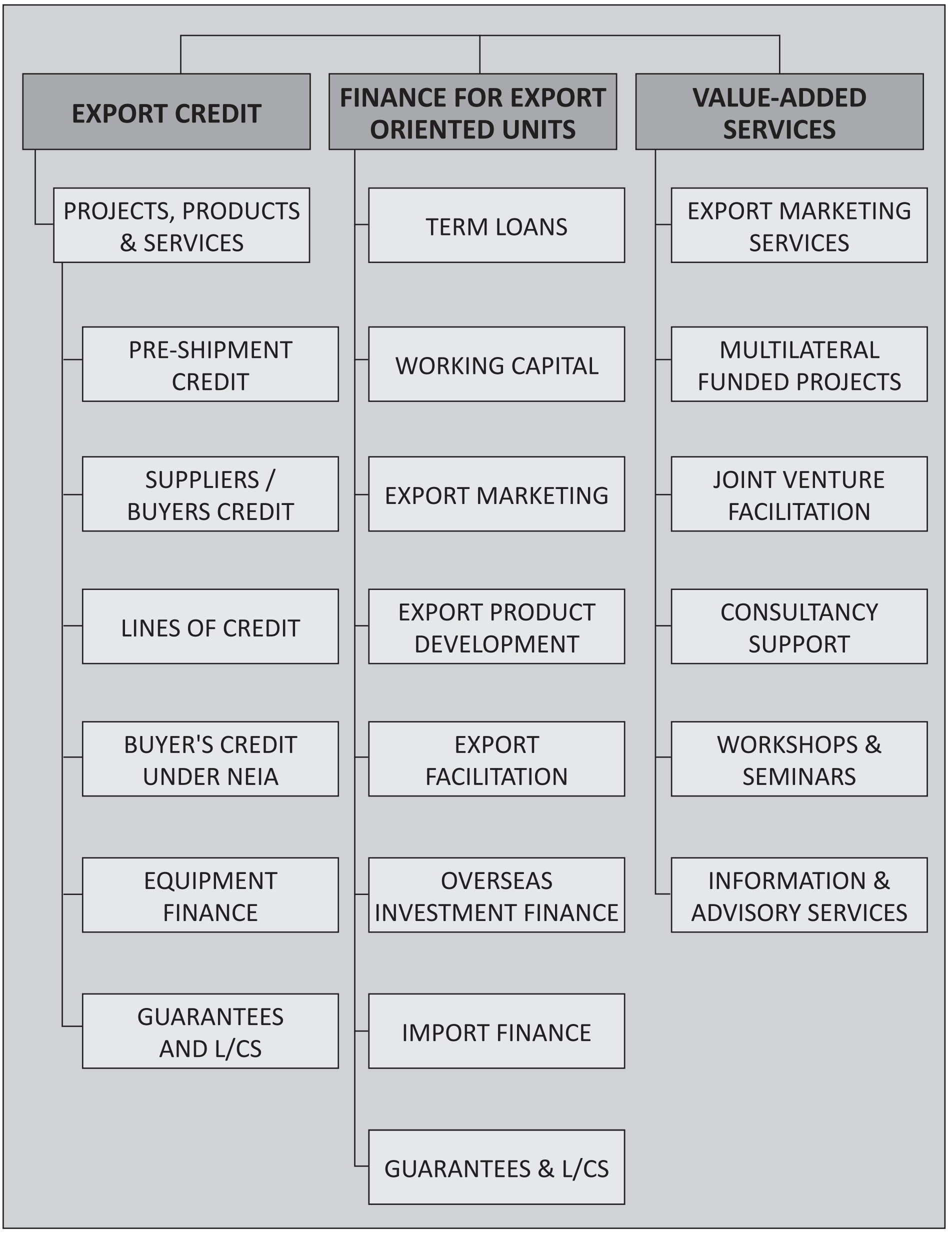

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