Annual Issue

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Parmjeet Singh
Director
NISST

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"Adopting Industry 4.0 is No Cakewalk—Yet It's Inevitable" - Alok Sahay

Alok Sahay
Secretary General &
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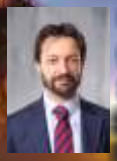
Indian Steel Association



"We Are Firmly Committed to a Sustainable Steel Future" Stefano Pari

Stefano Pari
COO, Region APAC & MEA,
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"From Bright Bars to Bold Reforms" Pankaj Chadha

Pankaj Chadha
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D. A. Chandekar
Editor

Dear Readers,

The steel industry has witnessed significant developments over the past year, shaped by global trends, technological advancements, and geopolitical shifts. As we reflect on the industry's performance, it's clear that India has emerged as a key player in the global steel landscape.

Global steel production trends indicate a mixed bag, with some regions experiencing growth while others face challenges. According to the World Steel Association, global crude steel production reached 1.95 billion tonnes in the previous year, with Asia accounting for a significant share. China's steel production continues to dominate the global market, although the country's efforts to shift towards higher value-added products and reduce carbon emissions have led to some adjustments in production volumes.

India, on the other hand, has been steadily increasing its steel production capacity, driven by government initiatives and investments in infrastructure development. The country's crude steel production has been on an upward trajectory, with a growth rate of over 5% in the previous year. This growth can be attributed to the government's focus on infrastructure development, housing, and transportation projects, which have driven demand for steel.

In terms of consumption, India's steel demand has been robust, driven by government initiatives and investments in infrastructure development. The country's steel consumption is expected to continue growing, driven by increasing demand from the construction, automotive, and engineering sectors.

International trade has been a significant factor influencing the steel industry, with geopolitical tensions and trade policies impacting exports and imports. The ongoing trade tensions between major economies have led to increased protectionism, with several countries imposing tariffs and quotas on steel imports. This has resulted in a shift in global steel trade patterns, with some countries exploring new markets and others adjusting their production strategies.

The Middle East has emerged as a significant market for steel exports, driven by large-scale infrastructure projects and construction activities. India's steel exports to the region have been growing, with the country capitalizing on its proximity and competitive pricing. However, the industry faces challenges from other exporting countries, including China Turkey and CIS.

On the technology front, the steel industry has been witnessing significant advancements, driven by the need for sustainability, efficiency, and quality. The adoption of electric arc furnaces (EAFs) is increasing, driven by their lower carbon footprint and energy efficiency. Some Indian steel producers have already started adopting EAF technology, which is expected to gain traction in the coming years.

The industry is also witnessing significant investments in research and development, with a focus on developing new steel grades and products. Advanced high-strength steels (AHSS) are gaining traction in the automotive sector, driven by their potential to reduce vehicle weight and improve fuel efficiency. Some Indian companies are already working on developing AHSS grades, which are expected to find applications in the domesticautomotive industry.

Geopolitics continues to play a significant role in shaping international trade, investments, and industrial activity in the steel sector. The ongoing trade tensions between major economies have led to increased uncertainty and volatility in the global steel market. However, this has also created opportunities for countries like India to capitalize on shifting trade patterns and emerging markets.

In conclusion, the steel industry has witnessed significant developments over the past year, driven by global trends, technological advancements, and geopolitical shifts. India's steel industry has emerged as a key player in the global landscape, driven by government initiatives and investments in infrastructure development. As the industry looks to the future, it is expected to be shaped by technological advancements, shifting trade patterns, and evolving market dynamics.

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"Industry 4.0 Is the Pathway to Energy Efficiency in Steel" - Parmjeet Singh

Parmjeet Singh
Director
NISST

Parmjeet Singh, Director at the National Institute of Secondary Steel Technology, holds a B.E. in Metallurgy from Punjab Engineering College, Chandigarh, and brings over 33 years of experience in the non-ferrous and steel industries. His expertise spans iron making, steel making, reheating furnaces, and rolling mills, with a strong track record in on-job training and industrial consultancy for productivity enhancement, energy efficiency, quality improvement, and energy audits. He has also served for seven years as Additional Industrial Adviser in the Ministry of Steel. A Certified Energy Manager and Energy Auditor (EA 15352) accredited by the Bureau of Energy Efficiency, Ministry of Power, he is a life member of the Institution of Engineers (India).

D.A.Chandekar, Editor & CEO of Steelworld magazine had an exclusive interaction with Parmjeet Singh to understand the role of technology in shaping the future of the steel sector, what key initiatives or strategic activities are being planned to advance the steel sector?, the current status of the Green Steel Mission in India, and how are we progressing toward decarbonization goals etc .

1. What is the role of technology in shaping the future of the steel sector?

Technology is playing a significant role in shaping the future of the steel. The future of the steel industry is poised for transformation, driven by digital technologies, sustainability initiatives, and the need to adapt to a volatile global landscape. Companies that embrace these emerging trends and invest in innovation will not only enhance their competitiveness but also contribute to a more sustainable steel sector. As the industry evolves, staying ahead of these trends will be essential for securing a prosperous future in steel. Smart manufacturing and AI integration are streamlining production processes, leading to increased efficiency and reduced waste. The development of new steel alloys with improved strength-to-weight ratios is revolutionizing the construction and automotive industries.

2. Under your leadership, what key initiatives or strategic activities are being planned to advance the steel sector?

The aims and objectives of the Institute are to provide trained technical manpower to the secondary steel sector, update their knowledge and skill level, awareness about the state-of-art technology, solving technological problems, improving energy efficiency, reducing pollution levels and testing of steel and R&D work on the problems of the secondary steel sector.

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PLOT NO. 26 & 27, CSIDC METAL PARK, PHASE 1, RAWABHATA, RAIPUR, CHHATTISGARH, 492003

institute, major focus would be on skill development to train the manpower working in the secondary steel sector to achieve decarbonization through improvement in energy & operational efficiency, training on safe working practices to ensure the safe ecosystem and zero fatality in this sector. Based on the needs of secondary steel sector, R&D Project can be taken to improve efficiency, quality, productivity and reduce impact on environment in association with industry and academia. Institute also committed to development of commercially viable technology to improve energy efficiency by encouraging implementation of industry 4.0 in the sector.

3. What is the current status of the Green Steel Mission in India, and how are we progressing toward decarbonization goals?

Green Steel Mission is a strategic initiative aimed at decarbonizing the steel sector and aligning it with the country's broader net-zero emissions targets. The Ministry of Steel has notified Green Steel Taxonomy vide Notification No. 1(6)-2024-ID-2 dated 23-12-2024. This is a significant step in the global steel decarbonization discussions, first of its kind green steel labelling system worldwide.NISST has been designated as the nodal agency for issuing greenness certificates. Pursuant to Notification, NISST has developed the registration format and guidelines, which are accessible at NISST website. Registration process has been started w.e.f . 01st April 2025. In this regard, NISST has also developed a emission calculation sheet (t-CO_2e/tfs), covering Scope-1, Scope-2 and limited Scope 3 as mentioned in the Gazette Notification abiding CCTS guidelines published by BEE. Institute has started receiving the applications for green steel certification and the process for issuance of Green Certificate will commence from August 2025.

4. Could you share insights into the key activities currently underway in the steel sector, especially in the context of modernization and sustainability?

In the context of modernization and sustainability, India's steel sector is currently engaged in a wide range of key activities that are transforming the industry from a traditional, carbon-intensive one into a more efficient, digital, and environmentally responsible powerhouse. Steel companies are continuously investing in modernization and expansion projects that adopt "Best Available Technologies" (BAT) to lower

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their carbon footprints. Companies are implementing technologies to recover waste heat and use it to generate power, further reducing their energy consumption and emissions. Steel plants are also actively embracing digital transformation to optimize operations. And also focusing on circular economy, resource efficiency.

The Ministry of Steel, in collaboration with the Ministry of New and Renewable Energy, has launched a significant initiative under the National Green Hydrogen Mission. Several pilot projects have been awarded to explore the use of green hydrogen in steelmaking to decarbonize the sector.

5. As the Director of the Biju Patnaik National Steel Institute, could you elaborate on the core activities and focus areas of the institute?

The main objectives of the Biju Patnaik National Steel Institute are:

- To develop human resources for meeting the needs of steel sector to face global competition.
- To enhance or develop skills of international standards among persons in sector.
- To upgrade the skills of the existing personnels in the steel sector.
- To act as a link between the industry and academic institutions.
- To be a centre for technological information for steel industries.
- To network with other institutions of similar nature.
- To provide consultancy services for steel and allied industries.

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"Adopting Industry 4.0 is No Cakewalk—Yet It's Inevitable" - Alok Sahay

Alok Sahay
Secretary General & Executive Head
Indian Steel Association

Alok Sahay, Secretary General & Executive Head of the Indian Steel Association, is a distinguished leader with over four decades of experience in the steel industry. Before joining ISA, he held key leadership positions at the Steel Authority of India Limited (SAIL). His deep expertise in Industrial Strategy, Global Trade Policies, and Sustainable Steelmaking has made him a pivotal figure in shaping the growth of the Indian steel sector. At ISA, he is dedicated to strengthening India's position as a global steel leader. Through his initiatives in fostering International Collaboration and advocating for Sustainable and Innovative Practices, he has played a crucial role in positioning the Indian steel sector at the forefront of global leadership. His visionary leadership continues to drive transformation within the industry, ensuring resilience, competitiveness, and long-term growth.

D.A.Chandekar, Editor & CEO of Steelworld magazine had an exclusive interaction with Mr. Alok Sahay to understand the perspective on How are steel companies trying to reduce the carbon emission and going in the direction of Green Steelmaking?, How are steel companies trying to reduce the carbon emission and going in the direction of Green Steelmaking etc.

1. How would you describe the present status of iron & steel industry in the country? How do you see the future of Indian steel sector especially in the light of the target of 300 MTPA capacity building by 2030-31 set by MoS?

India's iron and steel industry is striving towards making India Aatmanirbhar in Steel.

The Indian economy remains the fastest growing major economy in the world growing by 7.6%, 9.2% and 6.5% in the last three years or a CAGR of 7.76% in the last 3 years. It is the fourth largest economy after USA, China, and Germany. India's economic growth continues to be driven by domestic demand and not export led.

India Continues to be the Second largest steel producer and consumer in the world.

The Current Steel Capacity is around 200 million tons, the steel capacity as on 31st March 2024 was pegged at 180 million tons. It can be seen almost 20 million tones have been added in FY25.

The construction sector has been at the heart of India's rising steel demand growing by 9.4% last fiscal The construction and f infrastructure sector constitutes around 64% of the steel demand. The capital goods sector will continue to grow around 8% in the next couple of years. Automobile production growth has moderated but the sector will still grow above 6%. The Consumer durables sector with growth expect to be close to 9% in the next two years. The broad details on consumption have been shown as under-

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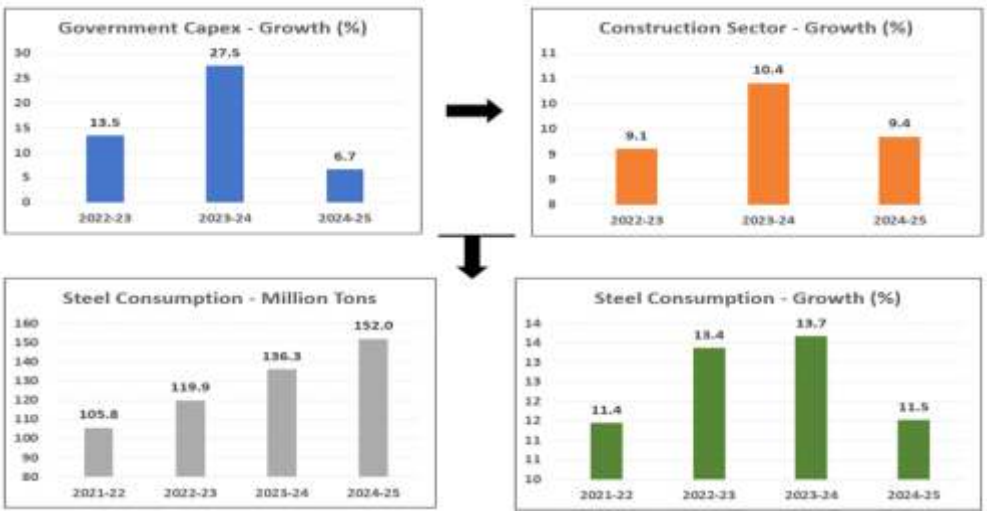

During FY25, India produced 152 million tons of crude steel and around 147 million tons of finished steel and Consumption grew by 11.5% as compared to FY24. This increase in the consumption is attributed on account of rising demand in construction, railways, infrastructure for which are all expanding rapidly. Strong growth in Union Government's capital expenditure is driving growth in Construction and Infrastructure, which is leading to the growth in 'steel use', thereby giving impetus to steel demand crossing to two digits figure (11.50%). During the last 4 years, India has added 46 million tons to annual demand in last 4 years, a trend that will continue. The India's steel industry is not focused on exports but is powered by strong demand within the country. This makes India different from many global steel producers who rely mainly on foreign markets.

India is working on producing high-quality special steels like those used in cars, power plants, and electronics, and defense. Production Linked Incentive Scheme (PLI) for specialty steel supports this have adopted endeavour. The country is also taking big steps to lead in green steel or to use correct term 'Low emission Carbon Steel' — steel made with clean energy like hydrogen, and major integrated steel makers have already adopted 'Best Available Technologies (BAT)' for energy conservation. With the right technology, better training, and smart trade strategies, India can supply not only to for its own needs but also become a reliable and become a consistent exporter of Low Emission Carbon Steel to regions like Africa, the Middle East, and Southeast Asia.

However, the main Challenge of the domestic Industry being the predatory dumped steel imports arriving into India. The steel arriving into India were around 9.6 million tons during FY25 — the highest in nine years — mostly cheap flat products from countries like China, Vietnam, Japan and South Korea, Vietnam and Japan. Whereas, the steel export from India were 4.86 million tons showing 35% decline.

Global steel demand is affected by escalating Geopolitical tensions, Trade & Tariff shocks and weak demand along with large steel surplus is resulting in Trade diversion, Export-Push and declining Global trade space. In past 3-years, world steel demand has contracted in a sustained manner by 100-MnT- including in US, Europe, Japan, Korea. World is saddled with large surplus steel capacity at around 600-MnT, with China, Japan and Korea accounting for approx. 500-MnT of surplus. China's exports more than doubled between 2020 to 2024 to 117-MnT to salvage surplus and increased by 7-MnT i.e. 15% during Jan-May'25 to 52-MnT while domestic steel demand contracted by -15-MnT i.e. -4% to 365-MnT. China steel industry has been operating at negative margins past 22-months on a sustained manner to support its employment and revenues for the local Govt. China, Japan, Korea and Vietnam – combined steel exports account in excess of 60% of Global steel exports (net of Intra-EU trade), while major imports are by the West comprising of the US, Europe, Canada and Mexico. Surplus in East Asia and Rising tariff barrier in the West threatens the survival of steel industry in accelerating economies like India.

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design doesn't extend any subsidy to its Steel Industry and outside the factory gate, as per the Niti Aayog, the Indian Government planning think tank, about 80-100 USD equivalent cost is incurred by Indian Steel producers outside the factory gate and is striving to remain globally competitive even with this structural disadvantage. In-spite of the above challenges which could impact the investment decision of Domestic Industry, India continues to add Steel capacity to meet its domestic demand to keep the pace of Indian Economy and the Nations Aatmanirbharta in all types of steel and is committed to hon'ble Prime Minister vision of Capacity built of 300 million tons by 2030 and 500 million tons by end of Amrit Kaal 2047.

2. How are steel companies trying to reduce the carbon emission and going in the direction of Green Steelmaking?

Steel companies in India and around the world are now working seriously to reduce carbon emissions and move towards green steelmaking rather to say low emission carbon steel, which means producing steel with reduced carbon foot prints.

Traditionally, steel is made using coal in blast furnaces, which releases a lot of carbon dioxide (CO_2). To reduce this, companies are shifting to cleaner methods. One major step is using electric arc furnaces (EAFs) instead of blast furnaces in new capacity additions in future post 2030. EAFs melt scrap steel using electricity, which produces far fewer emissions, especially when powered by renewable energy. However, this biggest bottleneck to adopt EAF process of steel making would be the non-availability of steel scrape.

Some companies are also investing in green hydrogen, which can replace coal in the process of reducing iron ore to iron. When hydrogen is used, the only by-product is water instead of CO_2. Though still expensive, this technology is seen as the future of low-carbon steelmaking and several Indian steelmakers like Tata Steel, JSP, SAIL, and JSW Steel are running pilot projects in this direction. At the same time new digital solutions and AI to monitor processes in real-time and reduce wastage is also being explored

Another approach is to improve energy efficiency — using less fuel and electricity per ton of steel produced — and to capture and reuse waste gases from furnaces. Technologies like Carbon Capture, Utilization and Storage (CCUS) are also being tested, which trap carbon before it escapes into the air.

Government of India's initiatives like the National Green Hydrogen Mission are supporting these green efforts. Over time, producing low emission -carbon or "green" steel will also help Indian companies remain competitive globally, especially with new rules like Europe's Carbon Border Adjustment Mechanism (CBAM.

In short, steel companies are moving step-by-step towards greener production — by changing fuels, improving technology, using more scrap, and capturing emissions — with the aim of making steel that is strong, clean, and future-ready.

3. What challenges industry is facing in implementing digitalization and Industry 4.0 technologies?

The steel industry is trying to adopt digital and smart technologies (like sensors, automation, AI, and data systems), but it's not so easy. There are many challenges. first, the cost is very high. Installing new machines, software, and systems requires a lot of money, which small and medium steel plants find difficult to spend. Second, many workers are not trained to use these new digital tools. They are used to working in the traditional way


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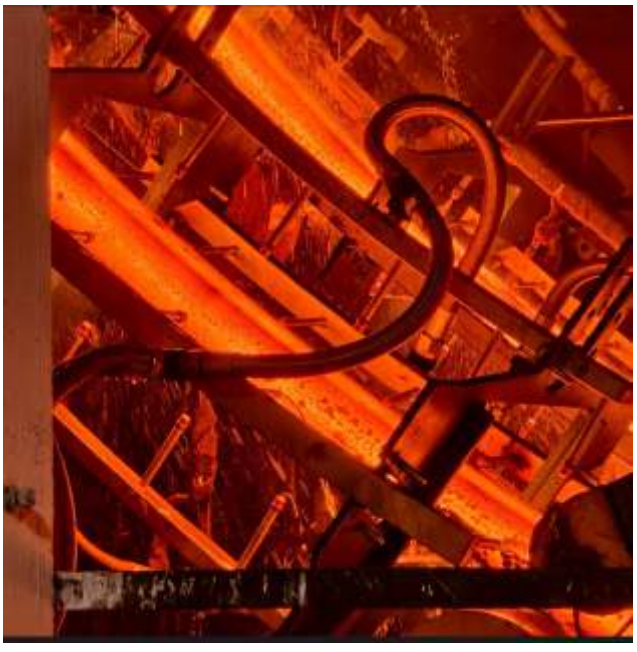

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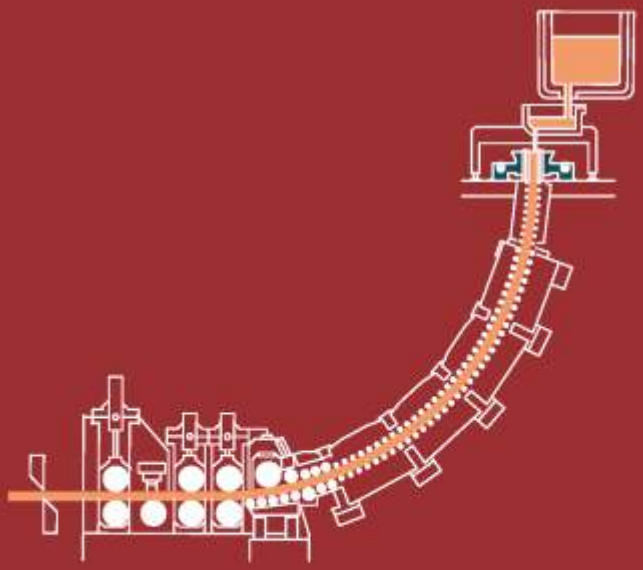

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and need proper training to understand how to use new technology. Third, old machines and systems in many plants are not ready for modern technologies. Upgrading them is expensive and takes time.

Also, with more digital systems, data safety becomes a big concern. If systems are not protected, there can be cyberattacks or data leaks, which can harm the company. Finally, the benefits of digitalization take time. Companies want quick results, but digital tools often show their full value only after a few years.

In short, the main problems are high cost, lack of training, old equipment, data safety issues, resistance to change, and slow returns. These need to be handled carefully for the steel industry to fully move towards smart and digital systems. Indian Steel Industry is committed on this front and some steel majors have adopted the digitization in personnel and process safety operations, which is being appreciated at Government level as well.

4. How is Indian Steel Association facilitating growth of the iron & steel sector in the country?

Indian Steel Association (ISA) represents around 65% of India's total crude steel capacity. All the integrated Steel makers and several other small and medium steel manufacturers are its members. ISA is playing a very important role in supporting the growth as its

acts as a bridge between the member steel makers and the government, helping solve problems, suggest policies, and promote new ideas. To make steel production more environment-friendly, ISA formed a SECC committee to focus on reducing pollution and carbon emissions. This includes promoting energy-efficient technologies, using renewable energy, and working toward the goal of carbon neutrality. ISA also acts as one platform where Government consults it on new policy initiative, being it Mining, Environment, Trade and Regulatory issues, FTA, Sustainability, Taxation, and discusses with it threadbare.

ISA also helped convince the government to remove steel slag from the hazardous waste list. This allowed better use of steel waste, encouraging recycling and circular economy in the industry. When rules were introduced that could have affected steel plant operations, like linking production with pollution monitoring systems, ISA raised safety concerns. Because of ISA's strong response, the government paused the rule and agreed to find better solutions with the industry. ISA is also deeply involved in policy-making. Its leaders have been part of important advisory committees of the Ministry of Steel and have submitted detailed suggestions on issues like decarbonization, logistics, mining, raw materials, and trade. Their inputs are helping shape the future of steel policy in India.

The inclusion of Melt and Pour Product Specific rules of origin (PSROO) in India-UAE CEPA, India Australia ECTA and now recently

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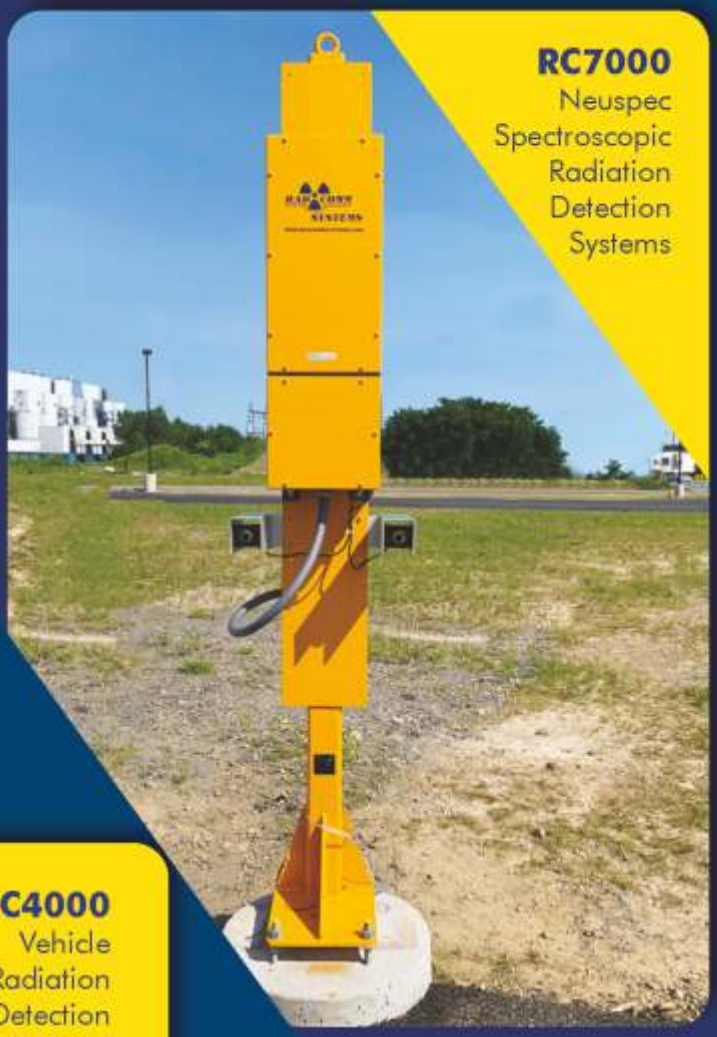

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India- UK FTA. This is also strongly recommended for India- EU, Canada FTA. Review also is being sought in other existing FTAs' ISA also has a Memorandum of Understanding with global iron and Steel Associations like JISF, KOSA, NCSI Kingdom of Saudi Arabia, AISI /SEAISI, CISA.

ISA regularly organizes it flag ship big event the ISA Steel Conclave since 2018, and new events like ISA coking coal Summit, and ISA InfraBuild since 2023, which brings together industry leaders, government officials, and global experts to talk about challenges and opportunities.

These events promote innovation, green steel, gender diversity, and technological progress in the sector and gives an opportunity to network with international exports.

At the international level, Indian Steel Association (ISA) has represented Indian Steel Industry at UNFCCC events on global climate meetings (CoPs) like COP. ISA is also an affiliate member World Steel Association. ISA also keeps the Indian Industry Point of View at Global Arena, be it EU Commission, OECD, UNID0, World Economic Forum, and another Global agency who matter.

Indian Steel Association and its members were a part of the 14 Task Forces constituted by the Ministry of Steel Government of India. That are preparing the roadmap for Green Steel, helping create standards, policies, and technology plans to reduce emissions and encourage cleaner steelmaking in India.

To strengthen trade and improve the steel supply chain, ISA signed agreements with international steel associations and also with the Government e-Marketplace (GeM), which helps Indian steel producers reach buyers across the country, including MSMEs.

In short, ISA is helping the steel sector grow by guiding on policy, promoting cleaner and smarter steelmaking, solving industry problems, organising knowledge events, and building strong national and international partnerships. Its work is helping the Indian steel industry become more competitive, sustainable, and ready for the future.

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"The Indian Steel Industry Must Aim Beyond Limits", says S.S. Mohanty

S.S. Mohanty
CEO & MD
Essar Minmet Limited, India

S.S. Mohanty, currently the CEO & MD of Essar Minmet Limited, is a stalwart in the steel industry with an illustrious career spanning over 45 years. His expertise covers the entire steel value chain—from mining to steel mills—having managed projects worth over $14 billion across mining, mineral processing (including pelletizing and sintering), iron and steel making, and rolling, along with significant contributions to R&D. A former Director (Technical), Commercial, and Projects on the SAIL Board, and ex-MD of Bokaro Steel Plant and Neelachal Ispat Nigam Ltd., Mr. Mohanty has been instrumental in achieving over $1 billion in cost savings through process optimization, technology upgrades, and operational efficiencies. He has held leadership roles with key industry bodies like AIST (India Chapter), BIS Metal Division, and CII Odisha, and has served as Director at ICVL, IDCOL, and various SAIL joint ventures. A distinguished alumnus of NIT Rourkela and VSSUT, he holds two patents and has published over 50 technical papers. In recognition of his exceptional contributions, he was honored with the Lifetime Achievement Award by the Ministry of Steel, Government of India, on 21st November 2024 in Bangalore.

D.A.Chandekar, Editor & CEO of Steelworld magazine had an exclusive interaction with Mr. S.S. Mohanty to understand the perspective on the current status of India's iron and steel industry, is mineral processing to the overall performance and sustainability of the iron and steel industry?, what are core objectives and long-term vision for the company etc.

1. What is your perspective on the current status of India's iron and steel industry?

The Indian iron and steel industry is currently positioned at a pivotal juncture, exhibiting strong momentum driven primarily by the country's rapid economic growth and infrastructure development programs. India is the 2nd largest steel producer after China, with robust domestic demand fueled by sectors such as construction, automotive, and manufacturing.

India produced 152 million tonnes of steel in 2024–2025, with a per capita steel consumption of 100 kg. The Government of India has set a target to produce 300 million tonnes of crude steel

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TRIAL OF PADDY FARMING ON LOW GRADE IRON ORE TAILING

by 2030–2031, with per capita steel consumption reaching 160 kg, growing at a CAGR of 8%. By 2047, the target is to produce 500 million tonnes of crude steel with per capita consumption around 300 kg, growing further at a CAGR of 4–6%. The consumption of steel in both flat and long products segments is almost equal, each contributing about 50%. This indicates that the Indian engineering industry primarily consumes flat products, while the construction industry's consumption of long products is growing at an accelerated pace.

Traditionally, the steel industry is cyclical in nature, with cycle durations normally lasting 5–10 years.

However, the current global geopolitical scenario, where supply chains and other components of the world economy are severely impacted, introduces some uncertainty regarding the cyclical nature of the industry in the future. Nevertheless, projected expenditure in infrastructure and evolving sectors such as energy transition and mobility indicate an immensely positive outlook.

Environmental regulations are tightening, compelling companies to adopt cleaner and more sustainable practices. Thus, innovation, sustainability, and strategic resource management are more important than ever. Regulatory tariff measures such as CBAM make it even more imperative to focus on environmental compliance to remain competitive in the international market. Any growing economy like India should aim for more than 10–15% growth in steel exports. Achieving this will require a strong commitment to adopting and upgrading technology, as well as integrating the latest digital practices in steelmaking.

2. How critical is mineral processing to the overall performance and sustainability of the iron and steel industry?

Efficient mineral processing maximizes the extraction of valuable minerals while minimizing waste generation. This leads to a significant reduction in operational costs and helps conserve scarce natural resources. Additionally, advanced mineral processing techniques enable the utilization of lower-grade ores, which are abundant but would otherwise remain unexploited, thereby extending resource longevity.

The agglomeration industry—specifically pellet and sinter plants—plays a crucial role in enhancing the operational efficiency of ironmaking. The importance of pellet burden in ironmaking, whether for Hot Metal or DRI (Direct Reduced Iron), cannot be overstated. Pellet burdens significantly reduce the carbon footprint. Worldwide, major steel producers in both the Blast Furnace and DRI routes have started using iron ore pellets on a large scale. The current global pellet production is about 540 million tonnes in 2024, including 155 million tonnes of DRI pellets. Pellet production is expected to increase to 940 million tonnes in total, including 350 million tonnes of DRI pellets.

From a sustainability perspective, mineral processing contributes to controlling the environmental footprint of mining operations. Enhanced beneficiation techniques reduce tailings volume and associated risks, mitigate air and water pollution, and improve reclamation efforts. This is crucial for complying with stringent environmental regulations and maintaining the social license to operate.

Essar has extensive experience in installing and operating pellet plants with a combined capacity of 20 million tonnes per annum within India. Currently, it plans to produce approximately 35 million tonnes per annum of iron ore pellets, primarily DRI-grade pellets, in phases both domestically and internationally. Essar Minmet Limited is adopting state-of-the-art technology with world-class benchmarks for

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3. With increasing global competition, how do you see technology shaping the Indian steel industry's path to competitiveness?

Sustainability-driven technological innovations are gaining increasing prominence in the steel industry. Technologies such as hydrogen-based steelmaking, carbon capture, utilization, and storage (CCUS), and energy-efficient furnaces are being explored and piloted. These innovations not only reduce carbon emissions but also align with global initiatives targeting net-zero goals.

The steel industry's technology landscape—from mining through steel production to finished products—has undergone significant changes over the past four decades. However, unlike sectors such as IT, mobility, energy transition, and others, technological advancements in metals and mining generally have longer gestation periods. Currently, approximately 2 billion tonnes of steel produced globally fall into three main categories: the BF-BOF (Blast Furnace – Basic Oxygen Furnace) route, the DRI-EAF (Direct Reduced Iron – Electric Arc Furnace) route, and the scrap-based EAF route.

In ironmaking, alternative technologies like COREX and FINEX, which provide substitutes to the traditional BF route, have not yet been widely adopted commercially. Their production volumes remain relatively small compared to conventional blast furnace methods. Emerging ironmaking technologies such as AUSMELT, HISMELT, Hisarna, Molten Oxide Electrolysis (MOE), and electric/plasma smelting show promise but require further time and development before commercialization.

The sustainability journey of the iron and steel sector strongly depends on technological support. Among the various options, the Green Hydrogen DRI – EAF route is currently the most proven for producing green steel. However, challenges persist, such as the availability of low-cost green hydrogen. For a country like India, with limited scrap availability and scarce natural gas resources, these factors pose significant obstacles to adopting this route extensively. Therefore, developing indigenous technologies tailored to Indian conditions, supported

by a robust R&D ecosystem in the steel sector, has become essential to achieve world-class advancements.

Automation is transforming operations by enhancing precision, reducing human error, and ensuring consistent product quality, while also increasing throughput. Digital tools and data analytics enable predictive maintenance, optimize resource allocation, and boost supply chain transparency, thereby minimizing downtime and cost.

Moreover, adopting Industry 4.0 principles, including IoT connectivity and digital supply chain integration, empowers Indian steel producers to respond agilely to market demands and evolving trade dynamics.

At Essar Minmet, we are deeply committed to embracing cutting-edge technologies to expand capacity, improve product consistency, and reduce environmental impact. Essar has pioneered several innovations, such as slurry pipelines, gas-based DRI, CONARC technology, and compact strip processing. We firmly believe that the successful convergence of technology and sustainable practices will propel the Indian steel industry to emerge as a global leader in quality and efficiency.

4. As the CEO & MD of Essar Minmet Limited, what are your core objectives and long-term vision for the company?

As the CEO & Managing Director of Essar Minmet Limited, my foremost objective is to lead the company towards world-

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class project execution and benchmarked process excellence, all while charting a sustainable future. Our guiding principle remains steadfast: to produce world-class products economically, with the lowest possible carbon footprint.

Essar Minmet is progressing towards establishing a large-scale iron ore pelletising complex in Odisha, featuring a Beneficiation Plant, Pellet Plant, and slurry pipeline, with an aggregate capacity of 2 x 7 million tonnes per annum. Concurrently, we are exploring the development of a large-scale, integrated, state-of-the-art steel plant with a 10 MTPA capacity, to be executed in phases.

Innovation stands as a cornerstone of our vision.

We are dedicated to significant investments in advanced technologies and research aimed at enhancing our capabilities, improving cost competitiveness, and minimizing our environmental impact. This commitment encompasses sustainable mining practices, adoption of eco-friendly beneficiation processes, and integration of digital solutions to enable smarter, data-driven decision-making.

Ultimately, our long-term vision is to position Essar Minmet as a benchmark leader in sustainable mining and mineral processing—a company that harmonizes profitability with social responsibility and environmental stewardship. We aim to contribute meaningfully to India's steel value chain and the broader economy, setting new standards in sustainable growth and industry excellence.

5. Green steel is emerging as a defining trend for the future. Can you share some of Essar Minmet's initiatives and strategies in the green steel space?

At Essar Minmet, we recognize that green steel is not only the future but an imperative to ensure the longevity and social license of our industry. Our approach to green steel is multi-faceted, encompassing technological innovation, process optimization, and active collaboration with industry partners and policymakers.

We are actively investing in low-carbon technologies, including the adoption of energy-efficient mineral processing equipment that significantly reduces power and water consumption. Our plants implement advanced automation systems for precise resource utilization and enhanced emission control.

Integration of renewable energy is another critical focus area. We are exploring solar and wind energy projects to power our operations, aiming to reduce dependence on fossil fuels and substantially lower our carbon footprint. Essar Energy Transition, a world-class initiative within the Essar Group, is driving transformation across all business verticals, including metals and mining, towards achieving net-zero goals.

The Ministry of Steel, Government of India has introduced the Green Steel Taxonomy and Production Linked Incentive (PLI) scheme for technology-driven steel production. Essar Minmet is fully committed to engaging with and advancing these unique initiatives of the Government of India.

Furthermore, we actively participate in industry forums and sustainability consortia to help shape best practices and advocate for supportive policies. Through these efforts, Essar Minmet is dedicated to setting new industry benchmarks and driving the transition towards a low-carbon, circular economy within the steel sector.

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"We Are Firmly Committed to a Sustainable Steel Future" Stefano Pari

Stefano Pari
COO, Region APAC & MEA,
SMS group

Stefano Pari, COO, Region APAC & MEA, SMS group in an interview with the editor of Steelworld D A. Chandekar shares his insights on SMS group's role in India's steel industry expansion. As India aims to increase its steel production to 300 million tons annually, SMS group supports this goal with advanced solutions combining technologies and service that improve efficiency and sustainability.

Key projects with JSW Steel, SAIL and Tata Steel illustrate SMS group's efforts to enhance production while reducing environmental impact. Innovations like Paul Wurth technologies in ironmaking and electric steelmaking are crucial for lowering CO2 emissions and promoting sustainable practices.

The discussion also addresses initiatives aligned with government objectives, emphasizing capacity growth, service and modernization. SMS group's workshop facilities in India are vital to its global strategy, serving both local and international markets and driving technological progress in the steel industry.

D.A.Chandekar, Editor & CEO of Steelworld magazine had an exclusive interaction with Stefano Pari to understand the SMS group's role in the development of the Indian steel industry, particularly in terms of doubling the production capacity to 300 million tons per year, Which specific projects are currently strategically important to achieve the goals of the Indian government and steel manufacturers etc.

1. How do you see SMS group's role in the development of the Indian steel industry, particularly in terms of doubling the production capacity to 300 million tons per year?

SMS group plays a pivotal role in the evolution of the Indian steel industry, especially in the context of India's ambitious plan to double its steel production capacity to 300 million tons per year. Achieving this target necessitates not only scaling up production capabilities but also integrating advanced technologies to optimize efficiency and sustainability.

SMS group significantly contributes to this expansion by offering state-of-the-art metallurgical solutions that enhance the operational efficiency and optimize environmental sustainability of blast furnaces, coke ovens, and direct reduction plants. SMS's innovative Paul Wurth-technologies, such as top gas recycling and heat recovery systems, further facilitate energy optimization

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and cost reduction—key elements for ensuring economic viability while meeting production goals.

For instance, SMS group is delivering the Paul Wurth 6.25-meter stamp charging oven to IISCO Steel Plant in Burnpur, West Bengal. Similarly, Tata Steel Meramandali in Odisha has taken a significant step towards decarbonization by placing an order with SMS group for the implementation of Paul Wurth Coke Oven Gas (COG) Injection Technology at Blast Furnace #1. This breakthrough innovation reduces the coke rate and, consequently, the carbon footprint of blast furnace operations. By utilizing the chemical potential of COG, the process saves approximately 0.65 kilograms of coke for every kilogram of COG injected, leading to reduced operational costs (OPEX) and a significantly improved CO2 footprint.

Another noteworthy collaboration is with JSW Steel Dolvi, which contracted SMS group to supply a 350-ton BOF converter along with a twin ladle furnace, gas cleaning plant, and advanced Level 1 and Level 2 automation systems. This project is part of JSW Steel's strategic expansion plans to increase its Dolvi plant capacity by 3.7 million tons per annum (mtpa). Additionally, SMS group secured orders in 2024 for a new 4.5-mtpa blast furnace and the first-of-its-kind CSP® Nexus integrated casting and rolling mill, capable of producing hot strips and plates up to 2,600 millimeters wide on a single plant.

While these developments are promising, the expansion of steel production capacity in India comes with challenges, particularly the environmental impact of traditional steelmaking processes, which are highly carbon intensive. Addressing this concern, SMS group offers Paul Wurth EasyMelt technology, which improves energy efficiency and integrates alternative energy sources to reduce the carbon footprint of steel plants.

Converter steelmaking facility at the Vijayanagar Works of Jindal South West Steel Ltd.

As India enforces stricter regulations on emissions, adopting such advanced technologies becomes imperative for regulatory compliance. However, this transition requires substantial investment and infrastructure development, posing additional challenges. Overcoming these obstacles is essential for the Indian steel industry to achieve its production targets while adhering to environmental standards and contributing to global sustainability efforts.

Furthermore, SMS group is continuing evolving towards the development of lifecycle partnerships , providing solutions which position SMS group as side-by-side partner for its customers, completing its plant making capabilities with a broad spectrum of solutions that support the optimization of the production, maintenance and in general performances of the assets.

2. What technological innovations does SMS group offer to reduce CO_2 emissions in steel production and support the transition to more sustainable practices?

SMS group offers a range of technological innovations aimed at reducing CO2 emissions in steel production and supporting the transition to more sustainable practices. Our approach includes specialized solutions for retrofitting existing steel plants to enhance their environmental performance. This involves upgrading equipment and processes to improve energy efficiency and reduce emissions. For example, at PT Krakatau Steel's hot strip mill, we have installed X-Roll® Oil Bearings on all six stands of the finishing line.

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These bearings are designed to ensure precision, productivity, and reliability, contributing significantly to the overall efficiency of the production process. Additionally, PTKS utilizes our X-Pact® Process Automation system to enhance control and diagnostics within the plant. This integration of level 1 and level 2 automation, along with X-Pact® Embedded controllers, ensures robust connectivity and efficient production. We also employ process models such as X-Pact® Pass Schedule Calculation and Cooling Section Control to optimize rolling and cooling processes, ensuring high-quality products with precise tolerances.

Furthermore, SMS group has partnered with Tata Steel to undertake a project focused on reducing CO2 emissions through the application of Paul Wurth-EasyMelt technology. This initiative aims to reduce coke input by 45–65% while maintaining the required energy output, achieved partly through the use of electricity for heating and the reinjection of reformed blast furnace off-gases. EasyMelt technology has the potential to significantly reduce CO2 emissions by 30–50%, providing a viable solution for mitigating the environmental impact of coal usage in blast furnaces, and has the specific advantage that can be used in most of the existing facilities. This collaboration underscores our commitment to leveraging technological advancements to address pressing environmental challenges.

Additionally, Electric Arc Furnaces (EAFs) are pivotal in supporting the circular economy within the steel industry. By utilizing scrap steel as their primary input, EAFs significantly reduce the need for raw materials and the associated environmental impact. By relying on green electricity rather than traditional fossil fuels, EAFs offer a cleaner alternative to conventional steelmaking processes, thus contributing to reduced CO_2 emissions. Through these initiatives, SMS group ensures that steel plants achieve superior operational standards and environmental sustainability.

PT Krakatau Steel's (PTKS) hot strip mill in Indonesia

3. Which specific projects are currently strategically important to achieve the goals of the Indian government and steel manufacturers?

The strategic initiatives currently being pursued by the Indian government and steel manufacturers focus on several key areas to achieve their goals. Sustainability and decarbonization are at the forefront, with projects exploring the use of green hydrogen as a reducing agent and expanding the application of electric arc furnaces for scrap recycling. The Ministry of Steel has initiated pilot projects to produce Direct Reduced Iron using hydrogen and reduce coal consumption in blast furnaces. Capacity expansion and modernization efforts are also significant, as demonstrated by SMS group's involvement in expanding JSW Steel's Dolvi Works, increasing its capacity by 3.7 million tons annually with advanced BOF converters and automation solutions. Similarly, a high-capacity hot strip mill supplied to Jindal Steel Odisha enhances production efficiency and sustainability. SMS group collaborates with the Steel Authority of India (SAIL) to advance sustainable steel production through technological expertise.

In terms of electrics and automation, the SMI 400 project by SMS group India aims to double its capacity, aligning with the "Make in India" initiative. The X-Pact® brand offers comprehensive solutions covering mechanical, electrical, automation, and digitalization processes across the metallurgical chain. Quality improvement initiatives are also underway, with SMS group supplying JSW Steel with CSP® Nexus technology to enhance

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productivity and reduce emissions. Additionally, a continuous caster for Saarloha focuses on producing high-quality large round blooms, and SMS group supports the setup of rolling mills for specialized electrical steel production.

Layout of the CSP® Nexus plant at JSW Steel (Dolvi Works).

Lifecycle support and service are crucial, with SMS group providing extensive support through its service workshop in Bhubaneswar, offering spare parts, repairs, and technical assistance to enhance plant performance and sustainability. Digital solutions play a key role in improving lifecycle services and performance indicators. Collaborations and awards further highlight strategic partnerships, such as SMS group's collaboration with Tata Steel on decarbonization and efficiency projects, including the EASyMelt technology and coke oven gas injection initiatives. Furthermore, SMS group acts as enabler to support key infrastructure projects, by supplying as example a state-of-the art rail and section mill to Hoa Phat in Vietnam too.

These projects collectively reflect a commitment to advancing India's steel industry through sustainable practices, technological innovation, and strategic partnerships.

4. What strategic value does SMS group derive from its manufacturing facilities in India, and how do these contribute to the company's global growth strategy?

SMS group's manufacturing facilities in India play a crucial role in its global production network, which includes OEM and Service workshops mainly in Germany, China, and India along with Service workshops across globe including the US. This network is designed to maximize efficiency and quality through collaboration across key areas, allowing SMS group to leverage its global presence to effectively serve regional markets. The opening of a second workshop in India by the end of this year will further enhance SMS group's capabilities and capacities, reflecting the strategic importance of India in SMS group's global growth strategy. Importantly, our workshops in India are aligned with 'Make in India' initiative to serve domestic as well as global markets, underscoring their primary role in international supply chains.

The Bhubaneswar Production facility, opened in November 2014, marks a significant milestone in the Indian manufacturing sector. It represents a substantial investment in India's industrial capabilities, supporting the 'Make in India' and 'Make in Odisha' initiatives. Located in the industrially vibrant regions of Khordha and Mancheswar, the workshop benefits from proximity to key transportation routes, enabling swift service delivery to major clients like Tata Steel, Jindal Steel, SAIL, and Hindalco. The facility offers advanced welding, precision machining, assembly, and refurbishment services, with a diverse product portfolio including metallurgical plants and critical equipment for non-steel industries. Recently, the production capabilities at Bhubaneswar have been expanded with the addition of a new unit, further enhancing its capacity to serve both domestic and international markets.

SMS India's collaboration with Tata Steel has led to innovative supply chain solutions and recognition through awards. The Bhubaneswar workshop also contributes to international projects, such as delivering caster equipment to Nucor, USA, during the COVID-19 pandemic. The implementation of the 'Quality Circle' concept has enhanced production capacity and garnered recognition at national and international quality forums.

Scheduled to commence operations in January 2026, the new SMS group workshop in Sanand, Gujarat will focus on manufacturing

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SMS group workshop in Bhubaneshwar facility in Odisha

key equipment for local and international markets, including Flat and Long rolling mills, processing lines and forging plants. Future collaborations are expected to transform the industry in Western India, were Influential clients like AM/NS India and JSW are located. Starting with an investment of 33 million euros, the facility plans to expand up to 50 million euros, with direct employment for 600 individuals, potentially increasing to over 1,000, plus additional indirect roles. Backed by the Gujarat state and national authorities, the initiative aligns with programs like 'Make in India' and 'Vibrant Gujarat'. Collaboration with vocational training initiatives and academic institutions is crucial to meet skill requirements.

SMS group's manufacturing facilities in India provide strategic value by enhancing production capabilities, supporting regional initiatives, and contributing to global projects. These facilities are pivotal in SMS group's global growth strategy, promoting sustainable expansion and strengthening India's position in the global market.

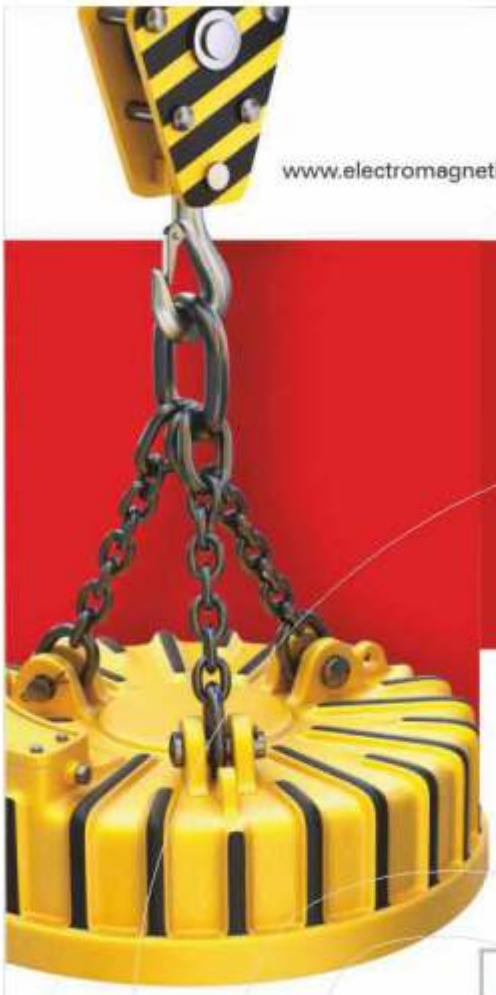
5. What role does digitalization and Industry 4.0 play in the operations and plant development of SMS group?

Digitalization and Industry 4.0 are key enablers in transforming SMS group's operations and plant development, enhancing efficiency, innovation, and competitiveness. By leveraging advanced digital technologies, SMS group optimizes processes, boosts productivity, and ensures precision in operations.

These technologies enable real-time monitoring, predictive maintenance, and seamless system integration, leading to improved decision-making, minimized downtime, and significant cost savings.

A key element of SMS group's strategy is the concept of the 'learning steel mill,' first realized at Big River Steel. This approach involves generating, enriching, and organizing data from processes and plants to be converted into actionable information. Artificial intelligence and predictive algorithms are used to forecast future events and suggest appropriate countermeasures, particularly enhancing plant and process monitoring, product quality, production planning, and energy management.

Digital twins—virtual replicas of physical assets and processes—are central to SMS group's projects. They facilitate simulation,



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testing, and optimization before implementation, ensuring accuracy and reducing risks. During digital commissioning of automation in X-Pact® Plug & Work integration tests, SMS group simulates processes and optimize them before plant assembly and operation. This

T. V. Narendran, CEO & MD Tata Steel (second from right) hands over the award to Stefano Pari (second from left), Sanjay Dasgupta and Narinder Singh Malhan from SMS India Pvt. Ltd. Award citation: "Technology Partner of the Year 2024"

integration testing allows for digital commissioning under realistic conditions, significantly shortening commissioning times for new plants and modernizations. Benefits include testing original equipment, virtual customer training, pre-optimization of processes, and remote service during and after commissioning

Comprehensive digitalization across projects enhances SMS group's competency, speed, and cost efficiency in design, service, and training. Virtual models and simulations streamline design processes, while digital tools improve service delivery and enable effective training programs for personnel. Through digitalization and Industry 4.0, SMS group is empowered to innovate, reduce costs, and deliver high-quality solutions, ensuring sustainable growth and operational excellence.

Quote:

"SMS group considers itself a proud and reliable partner of the Indian steel industry. We remain firmly committed to supporting the industry on its journey toward a sustainable future. We are confident that our technological expertise and innovative capabilities will play a key role in achieving the industry's ambitious goals while adhering to global environmental standards.". ■

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D5/Cr12MoV/DIN 2601

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Pankaj Chadha

Pankaj Chadha
Chairman
EEPC India and Board Member of FIEO

Pankaj Chadha, Chairman of EEPC India and Board Member of FIEO (MSME Panel), is a dynamic leader with a distinguished track record. A Chartered Accountant who cleared one of India's toughest exams at the young age of 21, he is an alumnus of Mumbai's prestigious Sydenham College. Over the years, he has held key leadership positions, including Chairman of EEPC Western Region, Senior Vice Chairman of EEPC India, and member of the RBI-constituted Padmanabhan Committee. As Managing Partner of Jyoti Steel Industries—a government-recognized 3-Star Export House—he oversees exports of steel and stainless steel bars and wires to over 45 countries, generating revenue of ₹350 crore. The company is among the top SME exporters under EEPC India's umbrella.

Chadha's contributions have been consistently recognized with accolades such as the EEPC Export Excellence Award for 24 consecutive years and similar honors from the Maharashtra Government for the past decade. Renowned for his in-depth expertise in Exim policy and taxation, he is often a key voice in policy discussions and government consultations. Outside the boardroom, Chadha is a passionate marathon runner, ranking among the top 25 in his age category at the Mumbai Marathon, and holds a Master's degree in Yoga, making him a certified yoga instructor as well.

D.A.Chandekar, Editor & CEO of Steelworld magazine had an exclusive interaction with Pankaj Chadha to understand the perspective on the main objectives and core activities of EEPC India, are the various incentive or benefit schemes offered by EEPC India for companies operating in the steel and metal sector etc.

1. What are the main objectives and core activities of EEPC India?

Set up under the aegis of Department of Commerce for promoting exports in the Engineering sector, EEPC India has grown to be the largest trade and investment promotion body. As an

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advisory body, it actively contributes to the policies of Government of India and acts as an interface between the engineering industry and the Government. It also serves as the largest facilitator of two-way trade between India and foreign companies. Keeping 'Engineering the Future' as the motto, EEPC India serves as the reference point for the Indian engineering industry and the international business community in its efforts towards establishing India as a major engineering export hub. The organisation has played instrumental role in promoting India's engineering exports from a mere US$ 10 million in 1955-56 to a record US$ 116.6 billion in 2024-25.

2. What are some of the flagship schemes and key events EEPC India organizes or participates in, particularly for the steel and metal sector?

EEPC India organises promotional activities like buyer-seller meets (BSM). It also manages India Pavilion at various overseas exhibitions such as Automachnika, BAUMA, etc. highlighting the capability of Indian engineering industry.

The organisation also has two flagship events:

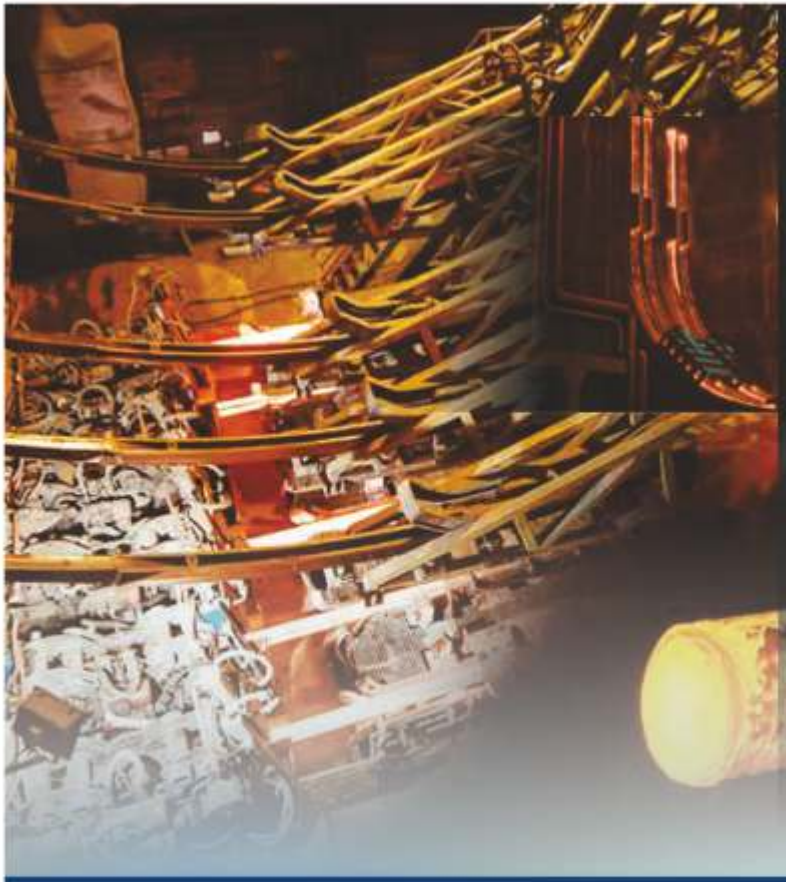
- IESS: It is the largest engineering sourcing show in India. So far there have been 12 editions with 6 partner countries. The latest version, IESS XII, held in November last year (2024) in Chennai brought provided scope to hundreds of Indian exhibitors to showcase cutting-edge technology across five diverse categories in front of many global buyers. There were many B2B sessions which acted as a catalyst for creating partnerships and boosting India's engineering exports.
- INDEE: INDEE showcases India's rapid progress in the engineering sector. EEPC India has organised 44 INDEES in 29 countries including Singapore, Indonesia, Thailand, Kenya, Nigeria, Sri Lanka, Egypt, Mexico, Columbia, Peru, etc.

3. What are the various incentive or benefit schemes offered by EEPC India for companies operating in the steel and metal sector?

EEPC India has been a major facilitator for the MSMEs in India's engineering export sector. To facilitate the availability of the most important raw material that is steel at export parity price for the MSMEs, EEPC India under the guidance of Ministry of Commerce and Industry collaborated with Indian steel producers namely, JSW, SAIL, Tata Steel, ArcelorMittal Nippon Steel India (AM/NS India), Jindal Steel & Power Ltd. and Rashtriya Ispat Nigam Ltd. (Vizag Steel).

4. As the Chairman of EEPC, what are the strategic goals and targets you've set during your tenure?

This is indeed a challenging period for global trade, particularly for exports. A series of protectionist measures being implemented by key trading partners, most notably the United States—India's largest destination for engineering exports, accounting for over 17% of the total—have raised significant concerns. The recent imposition of high tariffs on critical engineering products by the US poses a serious threat to India's



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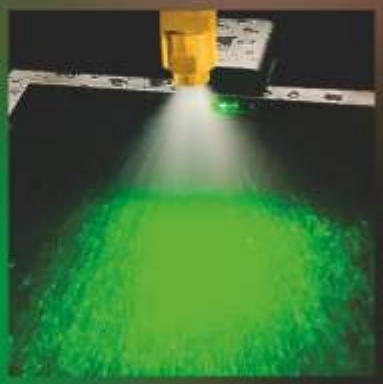

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export competitiveness.

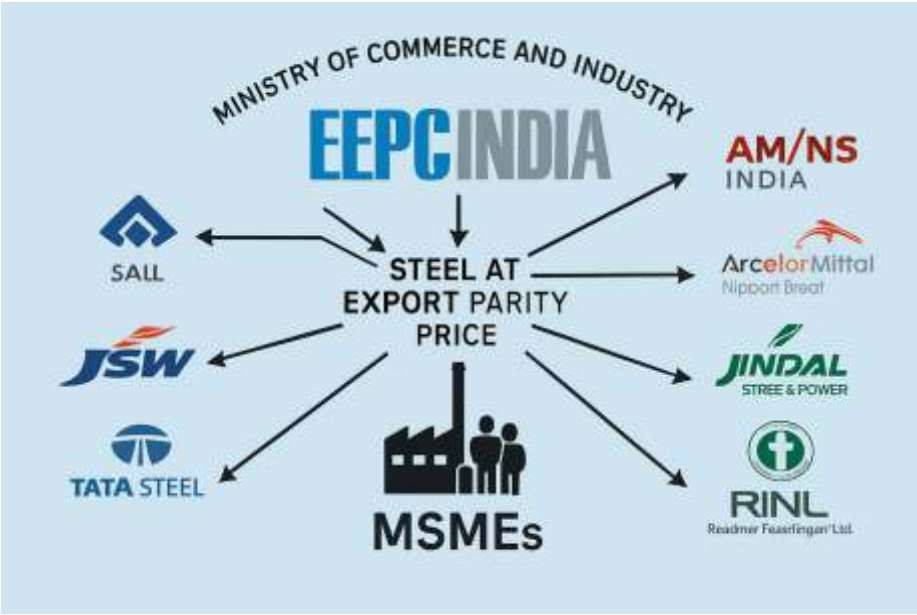
Adding to this, the European Union's Carbon Border Adjustment Mechanism (CBAM), set to come into force from January 2026, presents another major challenge—especially for exporters of carbon-intensive goods such as steel, aluminium, and certain machinery components. The compliance requirements under CBAM are highly complex and may create additional operational and cost burdens for Indian exporters.

India's engineering exports achieved a record high of US$ 116.67 billion in the last fiscal. However, given the prevailing uncertainties in the international trade environment, we anticipate only a marginal growth in the current fiscal. Our estimates suggest that engineering exports will be in the range of US$ 118–120 billion by the end of this year.

5.vBeing from the stainless-steel bright bar industry yourself, how do you assess the current state of this niche segment?

The stainless-steel bright bar industry, though a small part of the larger steel sector, plays an important role by supplying high-quality raw materials used in industries like automobiles, aerospace, railways, defence, capital goods, and general engineering.

However, the industry is facing several challenges—especially in exports. High import duties under Section 232 by the United States and safeguard measures by the European Union are making it harder for Indian exporters to compete in these key markets. On top of that, low-priced exports from China are adding pressure by undercutting Indian products.



Rising transportation and energy costs, along with logistics issues, are also reducing profit margins—especially for small and medium businesses that dominate this sector.

6. In light of former US President Donald Trump's recent announcement proposing a 50% tariff on steel and metal products, how do you see this impacting Indian exporter?

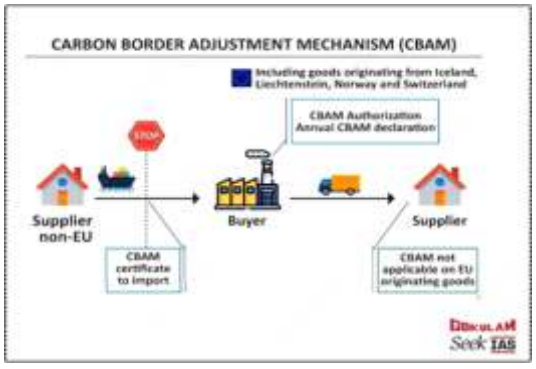
The proposed 50% tariff on all foreign steel and aluminium by US President Donald Trump could hurt India's engineering exports, as these metals and their derivatives account for nearly a quarter of the country's total engineering goods shipments to the US. In case the US goes ahead with its plan and impose a 50% tariff on steel, aluminium and their derivatives, exports of these key items will become costlier leading to a likely dip in shipments. As per EEPC India, the proposed tariff increase by the Trump administration will definitely impact the engineering exports which are about $5 billion under this head. The tariffs have also resulted in a shift in trade flows. It is to be noted that UK through its trade deal with the US recently got exemptions from 25% tariff on steel and aluminium and suggested that India should also ask for the same kind of waiver during the ongoing bilateral trade agreement (BTA) negotiations with the US.

CBAM's Role in a Greener World

Dhiraj K. Chauhan
Director: METCON-Metallurgical Consultants

Introduction: Carbon border adjustment mechanism, CBAM (pronounced Si BAM) is the EU's environmental policy tool for fair carbon emissions pricing. It is a carbon tariff on carbon intensive products, such as Iron/steel, cement, Aluminium, fertilizers, Hydrogen and some electricity imported to the European Union (EU).

(a) It provides information on the self-assessment and other relevant information for the various stakeholders involved. It is a system to confirm that a price has been paid for the embedded carbon emissions generated in the production of certain goods imported into the EU. It ensures that carbon price of imports is



equivalent to the carbon price

(b) domestic production; the EU's climate objectives are not undermined.

(b) It is an environmental policy instrument designed to apply the same carbon costs to imported products as would be incurred by installations operating in the European Union (EU). In doing so, CBAM reduces the risk of the EU's climate objectives being undermined by production relocating to countries with less ambitious decarbonisation policies (so-called 'carbon leakage'). Under the CBAM, in its definitive (post-transitional) period EU authorised declarants representing the importers of certain goods will purchase and surrender CBAM certificates for the embedded emissions of their imported goods. As the price for those certificates will derive from the EU Emission Trading System (EU ETS) allowance price and since Monitoring, Reporting and Verification (MRV) rules have been designed based on the MRV system of the EU ETS, this will equalise the price of carbon incurred between imported goods and goods produced in installations participating in the EU ETS.

Carbon removal refers to the process of capturing carbon dioxide (CO_2) from the atmosphere and storing it so it cannot easily re-enter the atmosphere. This can be achieved through natural processes such as reforestation and soil

Figure 1

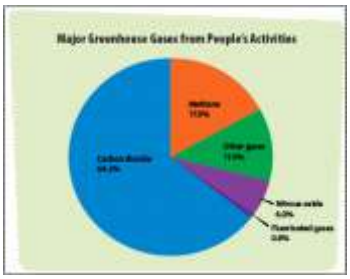


Figure 2

management or technological methods such as direct air capture and mineralization.

CBAM goods are the goods currently imported into the EU are, cement, iron and steel, aluminium and some fertilizers, hydrogen and electricity.

The EU ETS requires operators to pay a price for their own ("direct") emissions. However, if they consume electricity, they also experience the CO_2 costs included in the price of electricity they purchase4 ("indirect emissions").

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Strategically located, the site is well-connected by a deep-sea port and robust infrastructure to facilitate efficient handling of incoming materials and outgoing products.

Key Highlights

The project aims to produce environmentally friendly Green HBI/Iron and Green Slab, with a carbon emission of <<200 Kg per Ton for HBI and <<500 Kg per Ton for Iron/Slab. The product will also meet the EU CBAM standards.

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- Enhanced Marketability

Product Categories

Green Slab:

- 50% NG + 50% H2 DRI based Green Slab
- **Thickness:** 200-300 mm
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- Customisation Available

Green HBI/Green Pig Iron

Standard Market Grades:

- C: 0.3%-0.6%, Ultra Low Sulphur and Phosphorus for high H2 DRI smelted product.
- C: 1.6%-2.2%, Si: 0.3%-1.0%, Ultra Low Sulphur & Phosphorus.
- Customization is available to meet specific steel-making needs.

Special Product Extras:

- Zero C or lower carbon Iron content for hydrogen applications.
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- Special grades for the US market,heat-treated Nodular grades.
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Product Applications

Green Slab

Low/mid/high carbon

Ballistic and Military Plates

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Plates for offshore, Pipes and Tubular for Oil & Gas

Atmospheric corrosion resistance plates

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requirements of the CBAM, it is expected that many importers may make use of customs representatives, i.e. importers may delegate their obligations. Where the importer is not established in an EU Member State, the CBAM reporting obligations apply to the indirect customs representative. If an importer established in the EU appoints an indirect customs representative, the reporting obligations can be fulfilled by the indirect customs representative. The operator of an installation producing CBAM goods outside the EU is the second key role for the functioning of the CBAM. Installation operators are the persons who have direct access to information on the emissions of their installations. They are therefore responsible for monitoring and reporting the embedded emissions of goods they have produced and are exporting to the EU. Third-party verifiers will play an important role in the definitive period. However, during the transitional period, verification is a fully voluntary measure which operators of installations may choose as a means to improve their data quality, and to prepare for the requirements of the definitive period.

Carbon capture and storage (CCS) is a process by which carbon dioxide (CO_2) from industrial installations is separated before it is released into the atmosphere, then transported to a long-term storage location. The CO_2 is captured from a large point source, such as a natural gas processing plant and is typically stored in a deep geological formation. Around 80% of the CO_2 captured annually is used for enhanced oil recovery (EOR), a process by which CO_2 is injected into partially depleted oil reservoirs in order to extract more oil and then is largely left underground. Since EOR *utilizes* the CO_2 in addition to *storing* it, CCS is also known as carbon capture, utilization, and storage (CCUS).

Oil and gas companies first used the processes involved in CCS in the mid 20th century. Early CCS technologies were mainly used to purify natural gas and increase oil production. Beginning in the 1980s and accelerating in the 2000s, CCS was discussed as a strategy to reduce greenhouse gas emissions. Around 70% of announced CCS projects have not materialized, with a failure rate above 98% in the electricity sector. As of 2024 CCS was in operation at 44 plants worldwide, collectively capturing about one-thousandth of global carbon dioxide emissions. 90% of

CCS operations involve the oil and gas industry. Plants with CCS require more energy to operate, thus they typically burn additional fossil fuels and increase the pollution caused by extracting and transporting fuel.

CCS could have a critical but limited role in reducing greenhouse gas emissions. However, other emission-reduction options such as solar and wind energy, electrification, and public transit are less expensive than CCS and are much more effective at reducing air pollution. Given its cost and limitations, CCS is envisioned to be most useful in specific niches. These niches include heavy industry and plant retrofits. In the context of deep and sustained cuts in natural gas consumption, CCS can reduce emissions from natural gas processing. In electricity generation and hydrogen production, CCS is envisioned to complement a broader shift to renewable energy. CCS is a component of bio energy with carbon capture and storage, which can under some conditions remove carbon from the atmosphere.

The effectiveness of CCS in reducing carbon emissions depends on the plant's capture efficiency, the additional energy used for CCS itself, leakage, and business and technical issues that can keep facilities from operating as designed. Some large CCS implementations have sequestered far less CO_2

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than originally expected.

The following information must be reported by importers in the CBAM report: The total quantity of each type of goods, expressed in megawatt hours (MWh) for electricity and in tonnes for other goods, specified per installation producing the goods in the country of origin; The actual total embedded emissions, expressed in tonnes of CO2e emissions per MWh of electricity or for other goods in tonnes of CO2e emissions per tonne of each type of goods; The total indirect emissions, including amount of electricity consumed and the applicable emissions factor; The carbon price due in a country of origin for the embedded emissions in the imported goods, taking into account relevant rebates or other forms of compensation.

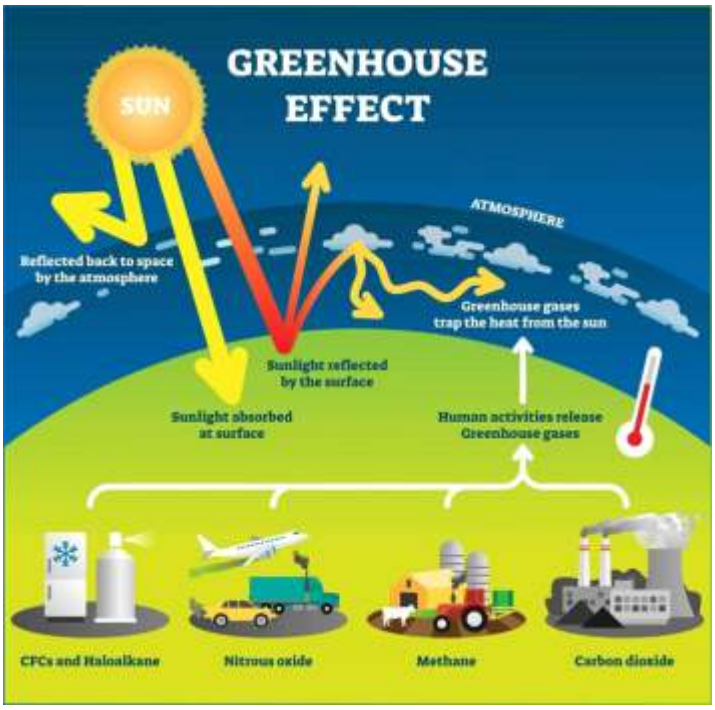

Figure 3

	CBAM Good					
Metrics	(Per) Tonne of Goods					MWh
Gases covered	/ h	nitrous oxide for some fertilisers	/ h	perfluorocarbons (PFCs) for some Aluminium goods	h	h
coverage during transitional period	Direct and indirect					
coverage during definitive period	Direct and indirect		Only direct, subject to review			
of direct embedded emissions	can be used for up to 100% of the specific direct embedded emissions for imports until 30 June 2024 and for up to 20% of the total specific embedded emissions for imports until 31 Decemb er 2025					default values.
of indirect embedded emissions	for electricity, unless conditions are met (i.e. direct technical connection or power purchase agreement). Estimations (including default values) can be used for up to 100% of the specifi c indirect embedded emissions for imports until 30 June 2024					applicable

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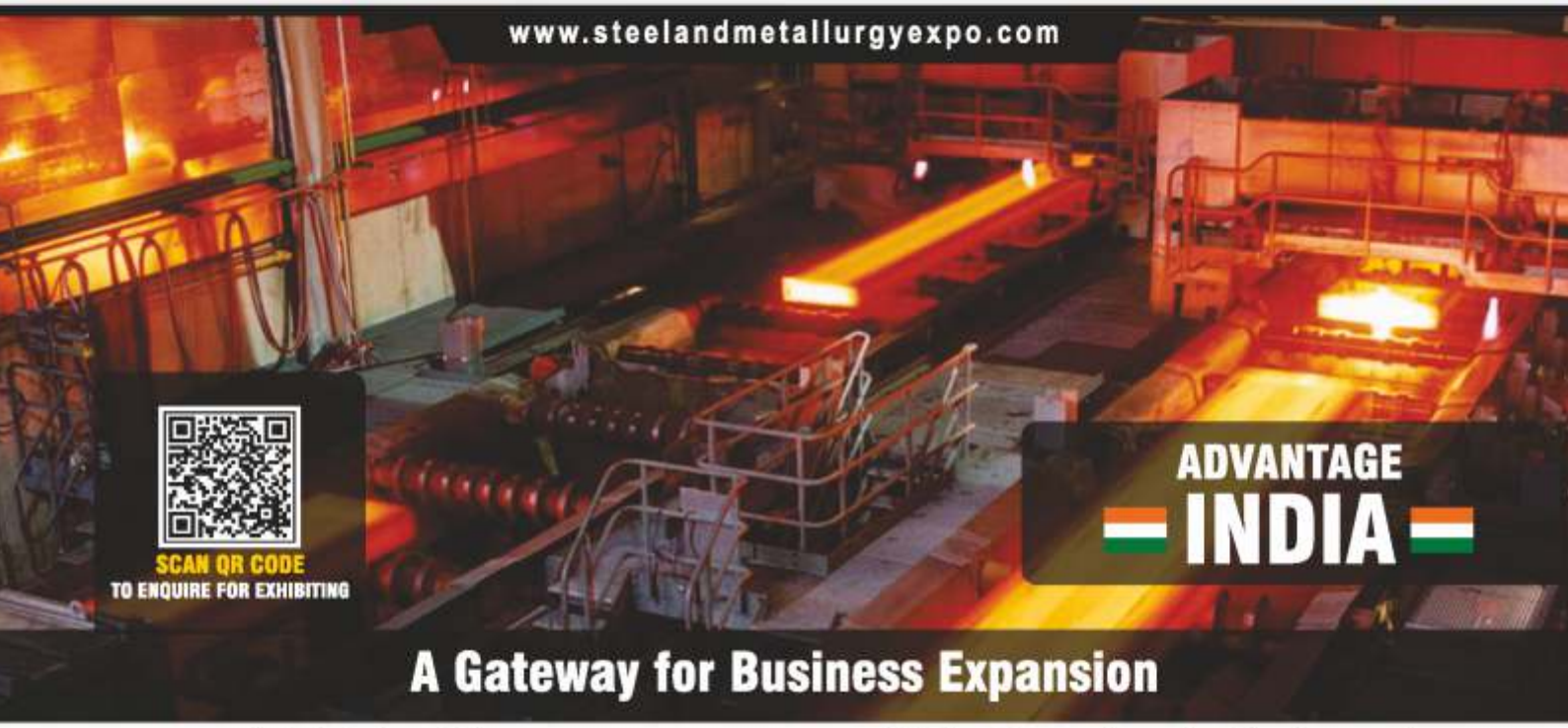

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Feature

Green Steel: Charting India's Path to Sustainable Industrial Leadership

When I began my journey in steel manufacturing three decades ago, the priorities were clear: maximize production, enhance quality, and manage costs. Environmental considerations, though respected, rarely shaped industrial decisions. Today, the narrative has dramatically shifted. Sustainability is no longer optional; it's a business imperative. As India stands on the brink of a global climate-conscious industrial era, Green Steel emerges not just as a desirable goal, but as a necessity.

Steel is fundamental to development. Yet, traditional steelmaking is a heavy emitter, contributing nearly 8% of global CO_2 emissions. With India's ambitious plans to increase production from nearly 200 million tonnes per annum (MTPA) to over 330 MTPA by 2030, sustainability is no longer optional. International markets, especially in Europe, are rapidly shifting towards strict environmental standards, posing significant challenges and opportunities for Indian producers.

Thus, embracing Green Steel isn't merely compliance, it's about securing our industry's future competitiveness and ensuring responsible growth.

India, as the second-largest steel producer globally, currently produces steel primarily via two methods: the coal-intensive Blast Furnace (BF-BOF) route and the Electric Induction Furnace (EIF) route. While BF-BOF dominates in integrated plants, the EIF route: characterized by induction melting of scrap and direct reduced iron (DRI) constitutes over 60% of India's steel production, especially serving rural and semi-urban regions.

India's steel sector emits approximately 2.6 tonnes of CO_2 per tonne of steel, substantially higher than the global average of around 1.8 tonnes. However, this high emission intensity predominantly reflects the coal-heavy BF-BOF route. In contrast, the EIF-based production route inherently offers lower emissions due to its significant use of scrap and DRI, making it ideally positioned to spearhead India's green transition.

Nitin Rambilas Kabra
Director
Bhagyalaxmi Rolling Mill Pvt. Ltd.

India's extensive network of induction furnaces represents a crucial advantage in our Green Steel ambitions. Induction furnaces, typically employing a combination of recycled steel scrap and DRI, naturally align with sustainability objectives.

A transformative pathway to achieving green steel involves harnessing hydrogen as a clean reducing agent in the rotary kiln process for Direct Reduced Iron (DRI) production. By replacing traditional coal-based

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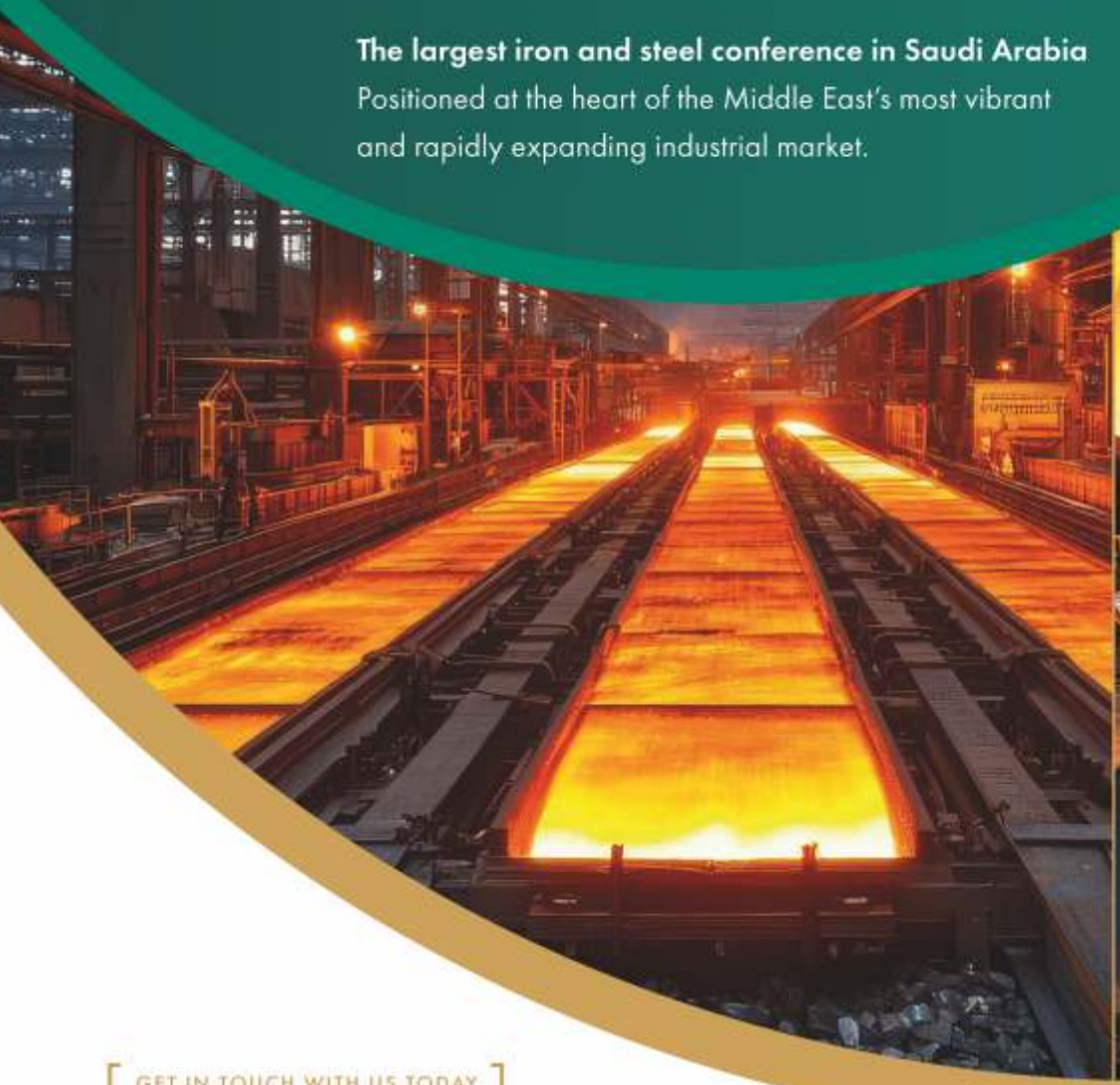

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reductants with renewable hydrogen, CO_2 emissions can be drastically reduced, positioning India as a pioneer in sustainable steelmaking. To accelerate this ambitious transition, collaboration with India's premier academic institutions such as IIT Bombay, IIT Madras, IISc Bangalore, and other leading technical universities becomes essential. Leveraging the expertise and innovation capabilities of these institutions can fast-track the development, optimization, and deployment of hydrogen-DRI technology tailored specifically for India's induction furnace ecosystem. Joint research initiatives, industry-academia partnerships, and government-supported pilot projects will ensure that Indian steel manufacturers not only adopt cutting-edge hydrogen technologies effectively but also establish global benchmarks in green steel production.Efficient scrap segregation is fundamental to India's vision for green steel, especially within the induction furnace industry. India's predominantly informal scrap collection system often yields scrap contaminated with tramp elements such as aluminium, copper, and nickel.

Establishing organized, technology-driven scrap segregation facilities equipped with advanced sorting methods such as magnetic separators, eddy-current separators, and sensor-driven automation can significantly improve scrap purity, enhancing furnace efficiency and reducing energy consumption. Importantly, recovering these tramp elements enables their reuse in manufacturing supply chains, thereby lowering dependency on primary mining and refining operations, conserving natural resources, and significantly reducing carbon emissions. A structured and technology-driven scrap recycling ecosystem will position India's induction-based steel sector as a global model for sustainability and resource efficiency.

Recognizing these potentials, both industry and policymakers have embarked on ambitious green steel initiatives. The Ministry of Steel's introduction of the Green Steel Taxonomy in December 2024 defined clear benchmarks, categorizing steel as "Green" if emissions fall below 2.2 tonnes of CO_2 per tonne. The coveted five-star rating mandates emissions below 1.6 tonnes.

Simultaneously, the government has proposed a ₹150 billion allocation in the 2025–26 budget to incentivize green technologies. Policies encouraging renewable energy integration, mandatory procurement of green steel in government projects, and incentives linked to emission reductions via the NISST (National Indian Steel Sustainability Taxonomy) framework reflect a significant commitment to sustainability.

The NISST framework is integral in this transformation. Providing transparent, credible emission benchmarks and third-party certifications, NISST evaluates producers

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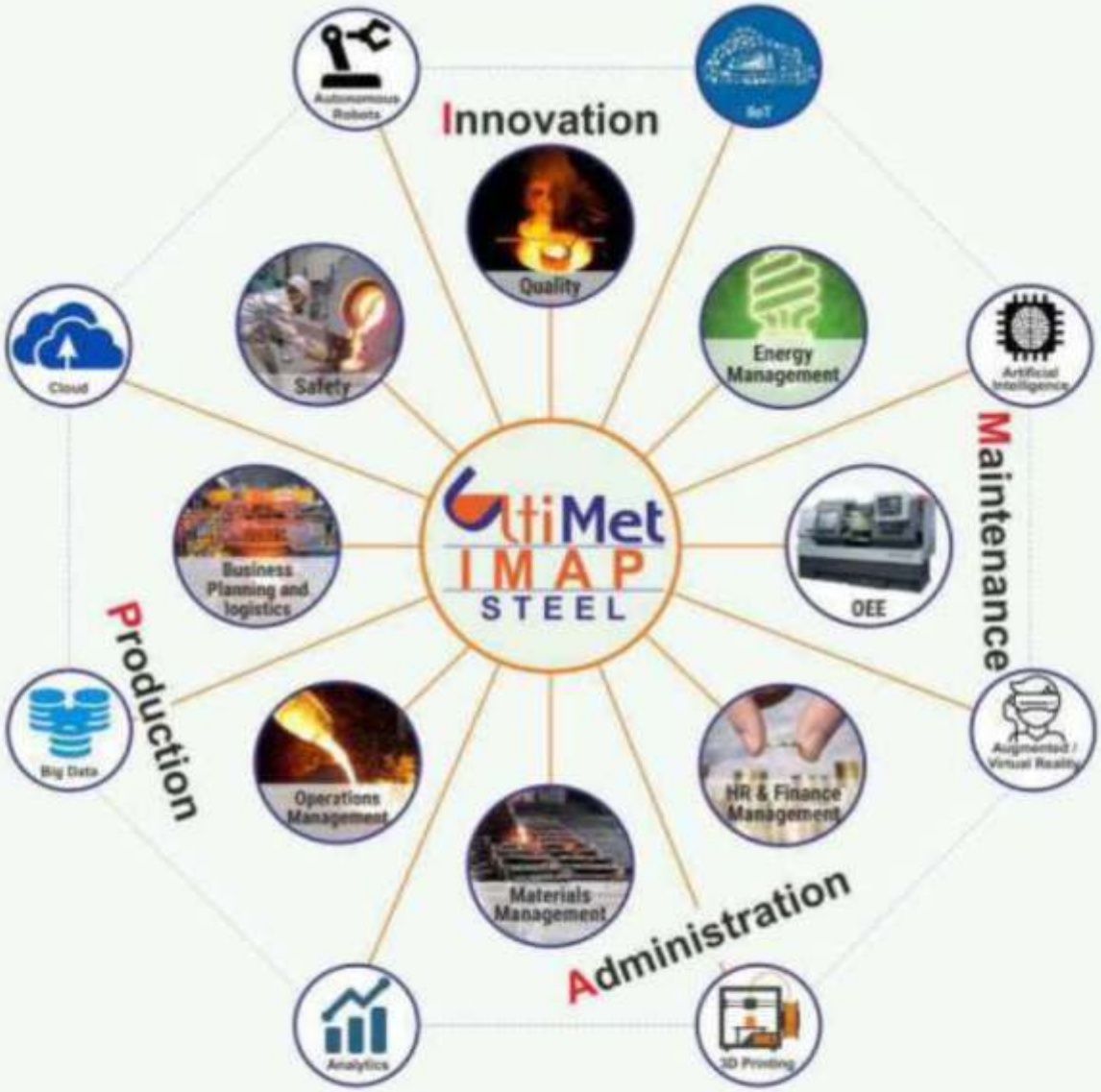

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based on lifecycle emissions, including Scope 1, 2, and 3 emissions. Producers are incentivized to enhance transparency through Environmental Product Declarations (EPDs), fostering trust and market confidence, essential for India's global competitiveness.

As we transition, it's essential to appreciate all sustainability efforts beyond emissions alone. Initiatives such as slag recycling for road construction and cement-making, advanced smoke and dust extraction systems, water conservation, and effective sequestration practices significantly contribute to holistic sustainability.

Companies investing in capturing and recycling waste heat, implementing dust extraction to improve air quality, and managing slag responsibly must be recognized. These practices reflect genuine commitment, and incentives through NISST should duly reward and encourage broader environmental stewardship.

India's steel leaders, including prominent induction-based producers, have begun aligning operations with sustainability targets. Many have adopted extensive recycling programs, increased reliance on renewable energy, and piloted hydrogen-based DRI production methods. Some induction plants are already nearing the five-star green rating as per NISST taxonomy, demonstrating practical feasibility.

However, scaling these

successes requires supportive policy measures, substantial investment in renewable hydrogen infrastructure, and expanded recycling capabilities to ensure a continuous scrap supply.The roadmap for India's induction-led green steel future should encompass the following priorities:

- Accelerate Hydrogen Integration: Rapidly scale hydrogen infrastructure for widespread use in rotary kiln-based DRI production, significantly reducing emissions from existing induction-based processes.
- Strengthen the Scrap Ecosystem: Enhance formalized scrap collection and processing, leveraging India's induction-based ecosystem to maximize recycling.
- Enhance Renewable Energy Usage: Promote captive renewable energy plants to power induction furnaces and hydrogen generation.
- Technology and R&D Investment: Encourage industry-academia collaborations to optimize hydrogen-DRI-induction integration, slag recycling, and comprehensive waste management.
- Policy Incentives and Enforcement: Ensure robust, continuous policy backing, linking financial incentives explicitly to verified sustainability metrics under the NISST framework.
- Carbon Market Creation: Establish domestic carbon trading platforms to financially reward low-carbon producers.

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India's US$ 3.83-bn retaliation to US steel tax

India is considering levying import duty on merchandise goods imported from the United States in retaliation with Washington imposing 50% tariff on steel. While the United Stated levied import duty on all countries unanimously, Indian exporters believe to lose US export market to the tune of US$ 3.83 billion per annum due to this tariff. India mostly exports value added products and engineering steel goods for specialised application across various sectors in the United States.

In a notification to the World Trade Organisation (WTO) India has said that it will adjust duties on the US imports in such a way that it will bring additional import duties to the tune of US$ 3.83 billion. The notification comes at a time when both the United States and India are aggressively negotiating Bilateral Trade Agreement (BTA). With both sides agreeing to major points, there exist some differences that need to be shorted out for smooth transition to the BTA.

Announcing the progress, US President Donald Trump announced recently that the agreement with India will be 'historic' and tariff levy at less than 20%. According to the communication conveyed to the WTO, higher duties will impact US$ 7.6 billion of India exports to the United States and through these additional taxes the US will collect US$ 3.83 billion as taxes. The latest notice of retaliation comes in response to an increase in duties on steel and their derivatives by the US to 50% on June 3 from 25 % earlier.

Under President Donald Trump administration, the United States levied the first trench of 25% additional duties on steel from March 12, through a proclamation. Against the 25% duty, India had intimated the WTO on May 9 that it will respond to them by imposing additional duties that will lead to collection of an additional US$ 1.91 billion on US imports. On July 4, India had notified the WTO of its proposal to retaliate against 25 % additional duties on auto and auto parts by the US.

Dilip Kumar Jha
Journalist

India's communication to the Council for Trade in Goods at WTO India reads that the additional 25% US tariff from May 3 on imports of passenger vehicles and light trucks and on certain automobile parts origination from India would impact US$ 2.89 billion of the country's exports to Washington. Through extra duties the US will collect duty of around US$ 723.75 million so India's retaliatory action would be designed in such as way that it would collect the same amount of duties of imports collect the same amount of duties on imports from the US, India notified the WTO.

The Trump administration had imposed 25 % additional duties on steel in 2018. India retaliated with these duties in 2019 by imposing additional tariffs on imports from US of almonds, apples, chickpeas, lentils, walnuts, boric acid

India's steel trade scenario (million tonnes)			
Financial year (April – March)	**Export**	**Import**	**Trade balance**
2019-20	8.36	6.77	1.59
2020-21	10.78	4.75	6.03
2021-22	13.49	4.67	8.83
2022-23	6.72	6.02	0.70
2023-24	7.49	8.32	(-)0.83
2024-25*	3.60	7.27	(-)3.67
2023-24*	4.77	6.05	(-)1.28

A
US tariff implementation

India's steel exports to the United States		
Financial year (April -March)	**Volume ('000 tonnes)**	**Value (INR billion)**
2023-24	95	19.24
2022-23	165	31.77
2021-22	214	26.21
2020-21	27	435
2019-20	51	571

A

and diagnostic reagents among 21 other products. Both these impositions were challenged at the WTO by the opposite party. During Joe Biden administration, Indian Prime Minister Narendra Modi's visit to the United States in 2023, both parties agreed to end tariff and reciprocal tariffs including the one on steel.

Stringent measures

India is taking stringent measures to deal with the ongoing tariff menace with the United States which emerged after the President Donald Trump assumed the White House early this year. India clarified in its strict message to the WTO that it reserves the right to suspend concessions or other obligations after the expiration of thirty days from the date of notification to the WTO which understandably was filed late last month.

The communication to the WTO also maintained that US has not notified these measures to the WTO, as required, even though these are, in essence, safeguard measures. The notification said that the actions taken by the US are inconsistent with its obligations under the GATT 1994 and Agreement on

Safeguard (AoS). Understandably, the US has not consulted India before imposing these duties, which was mandatory under the AoS rule. ■

Shaping a Sustainable Future: Solar Energy and the Indian Metal Industry's Path to Net-Zero

1. Introduction: Metal and the Sun—Forging a New Alliance

The Indian metal industry, a vital pillar of the nation's economy, stands at a pivotal juncture. With the Government of India committing to achieving net-zero carbon emissions by 2070, and under the framework of global accords such as the Kyoto Protocol and the Paris Agreement, heavy industries are under increasing pressure to decarbonize operations. Solar energy offers a compelling solution—not just as a clean power source but as a strategic enabler of long-term sustainability, financial viability, and global competitiveness.

With India's installed solar capacity now exceeding 116 GW (AC) as of mid-2025, solar power is no longer aspirational—it is mainstream. For metal producers, solar adoption presents an opportunity to align with international climate frameworks, reduce dependence on volatile fossil fuels, and transform their carbon-heavy legacy.

2. Solar Energy in India: Current Landscape and Capacity

2.1 Solar Abundance

India receives around 5,000 trillion kWh of solar radiation annually. Even if only 1% of this is captured efficiently, the country could meet its entire electricity demand many times over. With an average of 300 sunny days a year, the conditions are ripe for solar energy proliferation.

2.2 Growth in Solar Installations

India's National Solar Mission, launched in 2010, has catalyzed exponential growth. From just 2.6 GW in 2014, the country reached over 116 GW AC capacity by mid-2025, with ambitious targets of 280 GW by 2030 under its Nationally Determined Contributions (NDCs).

Dr. Kaustubh D. Gondhalekar
Solar Energy & Environmental Consultant

Notable developments include:

- Bhadla Solar Park (Rajasthan): The world's largest at 2.25 GW.
- Pavagada Solar Park (Karnataka): Spread across 13,000 acres.
- Gujarat Hybrid Renewable Energy Park: Expected to generate 30 GW.

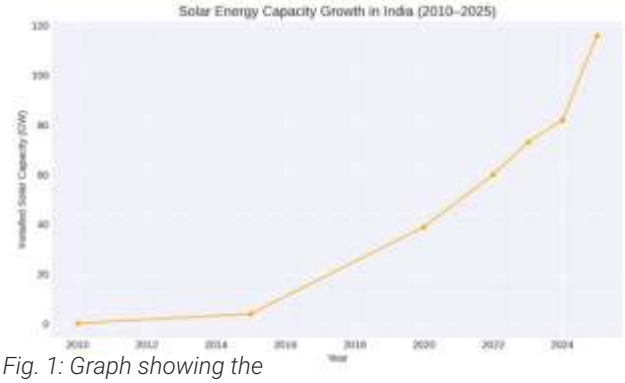


Fig. 1: Graph showing the rapid growth of solar energy capacity in India from 2010 to 2025, showing India's commitment towards solar energy

3. The Energy Footprint of the Metal Industry

3.1 Heavy Energy Consumption

Steel, aluminium, copper, and zinc production involve energy-intensive operations such as smelting, refining, annealing, rolling, and casting. Power typically accounts for:

- 30–40% of production costs in aluminium smelting.
- 20–25% in steel production.
- Even higher in secondary metal recycling.

Electricity interruptions or

rate hikes can significantly impact profitability and throughput.

3.2 Greenhouse Gas Emissions

The Indian metal industry contributes a significant share of industrial CO_2 emissions:

- Steel: ~220 Mt CO_2 annually
- Aluminium: ~55 Mt CO_2
- Others combined: ~40 Mt CO_2

Switching to renewable energy, particularly solar, can drastically reduce Scope 2 emissions.

4. Aligning with Global Climate Frameworks

4.1 Kyoto Protocol & CDM

India ratified the Kyoto Protocol in 2002, which established legally binding obligations for developed countries to reduce greenhouse gases. Though India had no binding targets, it actively engaged in Clean Development Mechanism (CDM) projects. Metal industries installed renewable projects and earned Certified Emissions Reductions (CERs) tradable globally.

4.2 India's Net-Zero by 2070 Commitment

At COP26, India declared a roadmap to achieve net-zero emissions by 2070, including:

- 500 GW of non-fossil capacity by 2030.
- 50% of total energy from renewables by 2030.
- Reduction of carbon intensity of GDP by 45% by 2030.

The metal industry—a hard-to-abate sector—plays a central role in this transition. Decarbonizing energy sources using solar energy is the first and most direct path toward compliance.

5. Solar Energy Integration in Metal Production

5.1 Use Cases in Industry

- Rooftop Solar: Ideal for rolling mills, casting units, and metal fabrication plants.
- Ground-Mounted Solar Farms: Suitable for integrated steel / aluminium plants with large land banks.
- Captive Solar Power Plants: Integrated with HT lines to supply 100% of plant energy.

5.2 Hybrid Systems & Storage

Pairing solar with wind and battery storage ensures 24x7 availability. This is essential for continuous process plants like aluminium smelters.

5.3 Solar Thermal in Process Heat

In addition to PV, solar thermal is increasingly used in:

- Pre-heating furnaces
- Electrolyte bath temperature control
- Water heating and steam generation

6. Sustainability and Environmental Benefits

6.1 Emissions Reduction

A 1 MW solar PV system avoids approximately 1,100–1,500 tonnes of CO_2 annually. When scaled to the metal industry:

- A 50 MW solar plant powering a rolling mill can eliminate over 75,000 tonnes of CO_2 each year.
- Across a fleet of metal plants, this totals millions of tonnes in avoided emissions.

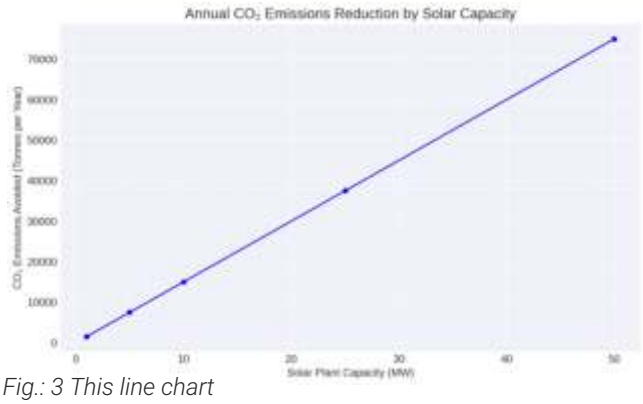


Fig.: 3 This line chart illustrates how increasing solar capacity directly leads to significant CO_2 emissions reductions.

6.2 Water Conservation

Unlike coal-fired plants, solar PV systems require minimal water—vital in regions like Rajasthan, Odisha, and Gujarat where both metals and water stress co-exist.

6.3 Air Quality Improvement

Eliminating coal or diesel backup power reduces local pollutants (NOx, SOx, PM2.5), especially critical in industrial belts near residential zones.

7. Financial Returns and Cost Viability

7.1 Cost Trends

Solar costs in India have fallen by over 90% in the last decade. As of 2025:

- Utility-scale solar tariffs: ₹2.1 – ₹2.9 per kWh.
- Rooftop solar LCOE: ₹3 – ₹4.5 per kWh.
- Compared to industrial grid tariffs: ₹6 – ₹11 per kWh.

7.2 ROI Metrics

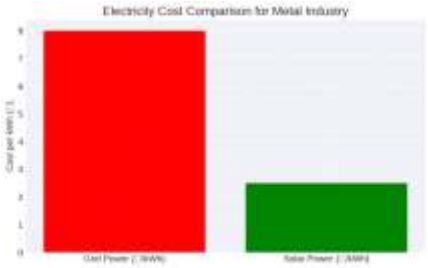


Fig. 2: bar chart comparing electricity costs for the Indian metal industry:

A typical 1 MW industrial solar PV plant (CAPEX: ₹4–5 crore) yields:

- Payback period: 3–5 years.
- IRR: 14–20% (post-tax).

Annual savings: ₹25–35 lakh.

For larger captive plants (10–50 MW), economies of scale and RECs further boost ROI.

8. Government Incentives and Tax Benefits

8.1 Central Incentives

- Accelerated Depreciation (AD): 40% in Year 1 under Income Tax Act Section 32.
- 10-Year Tax Holiday: Under Section 80-IA for power-generating firms.
- Capital Subsidies: Up to 30% under MNRE for small and medium-scale users.

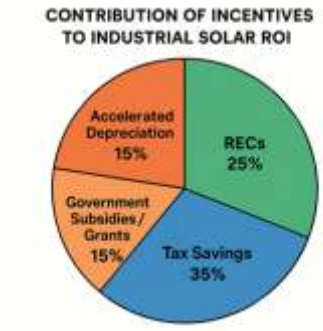


Fig. 4: Representation of how different incentives fuel the ROI of industrial solar projects (only for illustration)

8.2 State-Level Incentives

Different states offer:

- Net metering
- Land use concessions
- Wheeling and banking at nominal charges
- Preferential open access terms

Top solar-friendly states: Gujarat, Karnataka, Rajasthan, Maharashtra, Tamil Nadu.

9. Renewable Energy Certificates (RECs)

9.1 How RECs Work

RECs are tradable instruments representing 1 MWh of renewable energy. They allow industries to:

- Meet Renewable Purchase Obligations (RPOs).
- Offset carbon footprints.
- Earn revenue by selling surplus certificates.

9.2 Metal Industry Use Case

If a steel plant generates 100,000 MWh/year from solar, it can :

- Earn up to ₹3–4 crore/year from RECs.
- Fulfil RPO mandates.
- Enhance ESG scores and investor appeal.

10. Case Study: Solar at an Aluminium Smelter

An Aluminium Smelter in India commissioned a 25 MW captive solar plant in Odisha:

- Offset ~40,000 tonnes of CO_2 annually.
- Achieved ₹2.5/kWh power cost.
- Improved ESG ratings and received RECs.
- Used in powering its cold rolling and downstream processes.

Another example is of a steel manufacturer, which has invested in hybrid solar-wind farms to meet over 30% of its energy needs at its Vijayanagar plant.

11. Challenges and Mitigation Strategies

11.1 Land Constraints

Solar requires ~2

hectares/MW. Rooftop and vertical bifacial panels can help in land-scarce locations.

11.2 Dust and Pollution

Urban-industrial areas face a 9–12% output reduction due to air pollution. Regular cleaning and high-performance modules are key.

11.3 Intermittency

Battery storage systems are increasingly economical (₹4–6/kWh) and provide grid independence.

11.4 Regulatory Delays

Single-window clearance, robust net metering, and open access harmonization are essential for faster adoption.

12. Strategic Role in Net-Zero India

12.1 Supply Chain Decarbonization

Global buyers, especially from the EU and the US, are imposing carbon border taxes. Green energy use helps:

- Reduce product embedded emissions.
- Avoid export penalties.
- Enter green supply chains.

12.2 ESG and Investor Pressure

Global investors favour companies with low-carbon trajectories. Several companies are adopting renewables to align with SBTi (Science-Based Targets initiative).

12.3 Just Energy Transition

Solar adoption offers job creation in:

- Installation and O&M of solar plants.
- Skilled technicians and electricians.
- Supply chains in module manufacturing.

This aligns with India's twin goals: decarbonization and employment generation.

13. Conclusion: A Sunrise Industry for a Greener Metal Future

India's metal industry stands at the crossroads of climate ambition and industrial growth. As it faces mounting pressure to reduce its emissions, solar energy provides not just a way out—but a way forward.

By integrating solar energy at scale—through rooftop, captive, and hybrid models—metal manufacturers can:

- Reduce carbon footprint.
- Lower energy costs.
- Comply with national and international climate commitments.
- Tap into green finance and ESG-focused investments.

With strong government support, proven ROI, and long-term sustainability gains, solar energy is no longer a choice but a strategic imperative for the metal industry. The sun may rise every day—but it is now rising on a cleaner, smarter, and more competitive Indian metal sector.

*** The figures can change over a period of time, also based on the regions / states / state and central government policies / size and location. The article gives an outline of the benefits of implementation of solar energy in the metal industry and its benefits to them in general.*

View Point

The Importance of Steel Recycling in Today's World

In an era defined by climate urgency and resource scarcity, steel recycling has emerged as a cornerstone of sustainable industrial development. The steel industry, a major contributor to global emissions, has immense potential to reduce its environmental footprint through efficient recycling processes. This shift not only aligns with climate goals but also promotes a circular economy and enhances resource conservation. India's secondary steel production registered a steady compound annual growth rate (CAGR) of 6.7% from FY2020 to FY2025, rising from 44 million tonnes (MT) to 60 MT as reported by JMK Research.

Figure 1: Trends in production and scrap consumption in the secondary steel sector

Recycling promotes the principles of the circular economy, where materials are reused and recycled after their life cycle to minimize waste, conserve resources, and avoid intermediate transportation and storage processes. The steel recycling process contributes to a closed-loop system where steel is continuously used and recycled, further reducing environmental impacts.

It also significantly reduces the amount of waste that would otherwise end up in landfills. Steel scrap that is reused not only returns to the production cycle but also reduces the need to generate new waste. This helps extend the lifespan of landfills and reduces the burden of waste disposal.

Environmental Impact: Cutting Emissions through Recycling

One of the most compelling environmental advantages of steel recycling is the significant reduction in CO_2 emissions. Producing steel from recycled scrap in Electric Arc Furnaces (EAFs) emits far less CO_2 than producing new steel via Blast Furnaces (BF) using iron ore and coking coal. This directly contributes to reducing the greenhouse effect and advancing global climate commitments.

Pramod Shinde
Head - Communication
MRAI

Recycling also supports a closed-loop production cycle, where steel is continually reused, minimizing the need for raw material extraction, reducing energy consumption, and avoiding intermediate transportation and storage. This model is integral to the circular economy.

The positive impact of recycling on the environment goes beyond reducing emissions and energy consumption; it also plays a vital role in sustainability and resource conservation.

Waste Reduction and Landfill Diversion

Steel recycling prevents vast amounts of waste from ending up in landfills. Reusing scrap reintroduces it into the production cycle, extending landfill lifespans and reducing the burden of waste disposal. It also lessens the environmental costs associated with mining and raw material transportation.

India's Steel Industry: Primary vs. Secondary

India, the second-largest steel producer and consumer

globally, plays a pivotal role in the international steel market. The industry consists of two main segments:

- Primary Producers: Manufacture steel from raw materials using BF-BOF routes.
- Secondary Producers: Use scrap-based technologies such as EAF and Electric Induction Furnaces (EIF).

In India, EIF-based production accounts for ~35% of total steel output, while EAF contributes around 22%. The preference for EIF is driven by lower capital investment needs.

The secondary steel sector contributes around 38–40% of India's total crude steel production, dominated by SMEs with capacities between 1,000 tonnes to 1 lakh tonnes per annum. Major clusters include Raipur, Mandi Gobindgarh, Kolhapur, Wada, and Jalna, Durgapur, etc.

Emissions from Steelmaking Routes

Steelmaking emissions vary depending on the route:

- Coal-based DRI-EAF plants: 2.70–3.10 tCO_2/tcs
- Natural gas-based DRI-EAF: 1.40–1.60 tCO_2/tcs
- EAF/EIF-only plants: 1.60–2.60 tCO_2/tcs

Secondary steel plants using scrap significantly outperform traditional methods in terms of emissions and resource efficiency.

To reduce emissions, Indian secondary producers are adopting:

- Hydrogen-based direct reduction
- Carbon capture and storage (CCS)
- Renewable-powered electric furnaces

Trends in Secondary Steel

India's secondary steel production registered a steady compound annual growth rate (CAGR) of 6.7% from FY2020 to FY2025, rising from 44 million tonnes (MT) to 60 MT as reported by JMK Research. As per the Secondary Steel Production Trend,. A defining characteristic of the secondary steel sector is its reliance on ferrous scrap (steel scrap), a vital but limited resource in India.

Facing high electricity tariffs in Maharashtra, Yash Metallics invested ₹3–3.2 crore/MWp (approx. USD $0.35–0.37 million) in renewable energy.

While analysing the emissions intensity in the steel making varies significantly across different steel production routes. Coal-based DRI-EAF plants emit approximately 2.70-3.10 tCO2/tcs.

To reduce steelmaking emissions, the Indian secondary steel players are now adopting low-carbon methods such as hydrogen direct reduction, carbon capture and storage, and electric arc furnaces powered by renewables.

In contrast, natural gas-based DRI EAF systems have a significantly lower emissions intensity, emitting around 1.40-1.60 tCO2/tcs. Within the coal-based DRI-EAF/EIF route, EAF and EIF operations are estimated to contribute about 38-40% of the total emissions intensity, reflecting their significant role in the overall carbon footprint of this configuration.

For steelmakers operating solely through EIF or EAF, without in-house ironmaking, the emissions intensity typically falls within an emissions range of 1.60-2.60 tCO2/tcs. Whereas secondary steel, especially the recycling process using each tonne of scrap steel saves 1.1 tonnes of iron ore, 630 kilograms of coking coal, and 55 kilograms of limestone, while also reducing emissions by up to 58% compared to conventional iron ore-based steel production.

Parameters	Description
Total capacity of solar park	28.46 MWp
Yash Metallic Capacity	7.5 MWp solar
Project developer	KALPA POWER PVT LTD
Project location	Osmanabad, Maharashtra
Project off-taker	
Power generation source	Solar Park
Date of commissioning	April-May 2024
CUF_{DC}	17.95%
Annual RE generation	About 12 GWh
Estimated share of RE in electricity	About 51%

Secondary Steel manufacturers stand to gain significantly by shifting to renewable energy sources. Such a transition reduces energy costs and helps companies meet increasingly

stringent environmental standards.

Facing high electricity tariffs in Maharashtra, Yash

Metallics invested approximately ₹3–3.2 crore per MWp (around US$0.35–0.37 million) in renewable energy infrastructure. This strategic move has enabled the company to achieve cost savings of nearly 49%, resulting in a payback period of just 2.3 years—underscoring the project's strong economic viability. Additionally, the shift to cleaner energy sources is helping the company reduce its carbon footprint by approximately 8,442 tonnes of CO_2 annually.

These gains improve operational efficiency and enhance the company's sustainability profile in an increasingly climate-conscious manufacturing landscape. Since energy costs typically account for 20-40% of total operational expenses, reducing reliance on costly grid electricity significantly improves the company's operational efficiency and secures a long-term cost advantage.

As India accelerates its transition toward a low-carbon economy, steelmaking clusters nationwide will play a critical role in driving industrial decarbonization. These hubs, characterized by concentrated demand and shared infrastructure, present an opportunity to offer an ideal platform for deploying scalable clean technologies and resource-efficient practices.

Looking at the above, the most promising opportunities for decarbonizing steel clusters lies in adopting renewable energy. Electricity-intensive processes such as EIFs or EAFs stand to benefit significantly from a cleaner power mix.

To enable this shift, developers are viewing industrial clusters as viable markets, attracted by their consolidated and predictable demand. This growing interest supports the rollout of group captive and open access renewable projects, which offer cluster units a practical pathway to reduce dependence on high-cost grid power and hedge against future tariff volatility.

Conclusion: Building a Sustainable Steel Future

Steel recycling is a vital strategy to mitigate climate change, conserve natural resources, and transition to a circular economy. So overall, through continuous improvements and innovations in the recycling process, the steel industry can further improve its environmental footprint and make a significant contribution to environmental protection. Especially, in a world increasingly shaped by the challenges of climate change and resource scarcity, steel recycling and the development of environmentally friendly products like Green Steel are gaining importance. The steel recycling process is one of the most effective methods to minimize the

ecological footprint of steel production while conserving valuable resources.

For a rapidly

industrializing nation like India, embracing recycling and sustainable steelmaking can:

- Strengthen energy security
- Reduce environmental burden
- Enhance global competitiveness

As the demand for energy-transition metals accelerates, robust investment in recycling will become not merely an option, but an imperative.

Overcoming systemic barriers will open doors to significant opportunities for green growth, economic resilience, and environmental sustainability. We therefore expect stronger collaboration among industry associations, businesses, technology providers, financial institutions, and policymakers—to catalyze investment, exchange best practices, and drive the widespread adoption of low-carbon, circular solutions.

In alignment with the Government of India's Vision 2047, which aims to increase the share of scrap-based steel production to 50% over the next 25 years, and in view of the national commitment to achieve net zero carbon emissions by 2070, it is imperative to accelerate the transition toward sustainable steelmaking practices.

As part of this ongoing commitment to environmental responsibility and circular economy principles, we respectfully recommend that all government steel procurement—including for major infrastructure projects and other central and state agencies—mandate that at least 30% to 35% of their total steel requirements be sourced from recycled steel.

We urge the government to support integrating public policy procurement guidelines to help India move closer to its decarbonization and sustainability goals. ■

View Point

Management of 'Green Steel Manufacturing' with Golden Hearts

Balanced Sustainability, Systems Excellence & Human-Centric Leadership for the Steel Industries of Tomorrow.

A Turning Point in History: Paris 2015 and the Birth of a Green Awakening

In December 2015, the world witnessed a defining moment in history, when 196 nations came together at the United Nations Climate Change Conference (COP21) in Paris, to sign a landmark agreement aimed at limiting global warming and safeguarding the planet for future generations.

This collective commitment didn't just stay confined to words and documents. It became a spark for innovation, introspection and industrial reinvention.

One such powerful transformation was the birth of the Green Steel Movement - Steel, the backbone of industrialization, had long been associated with significant CO_2 emissions. But post-Paris, the narrative began to change and I'm proud to share that my beloved country 'Bharat', has emerged not just as a participant but a front-runner in this green revolution.

Across our nation, visionary minds, progressive organizations and purpose-driven leadership have come together to reimagine steel production - ushering in what I call "Green Steel with Golden Hearts" … a fusion of sustainability, ethics and excellence.

Definition of Green Steel

Environment responsible production using low-carbon/renewable energy sources

Green steel refers to steel that is produced in a way that significantly reduces carbon emissions compared to traditional methods. It includes using energy-efficient technologies & sustainable practices across the entire steelmaking process - from raw material extraction to final product delivery.

Reduction of CO_2 emissions via hydrogen-based production, EAFs and recycling

Traditionally, iron is made using coal in blast furnaces, which emits large amounts of CO_2.

In contrast, green steel focuses on:

- Hydrogen-based production (like Hydrogen DRI), where green hydrogen replaces coal as the reducing agent.
- Electric Arc Furnaces (EAFs),where steel scraps are melted using electricity - especially clean electricity from renewables.
- Recycling of steel scrap, which requires significantly less energy and emits fewer greenhouse gases.

Why Green Steel Matters

Steel accounts for nearly 7 - 9% of global CO_2 emissions.

Transitioning to green steel, supports global climate goals.

Sapan Kumar Bardhan
TQM Professional,
People & Organisation Development Coach
Strategist & Trainer

Innovations Driving the Change

Use of green hydrogen instead of coal in Direct Reduced Iron (DRI) processes.

Electrification of furnaces using renewable energy (solar, wind, hydro).

Circular economy principles - scrap recycling and zero waste initiatives.

Economic & Competitive Advantage

Green steel helps future-proof businesses against carbon taxes and regulatory penalties.

Premium pricing potential from environmentally conscious markets (Europe, Japan, etc.).

Role of Indian Steel Industries

India as a leading steel producer has a global responsibility

India, as one of the top three steel-producing nations in the world, plays a pivotal role in shaping the future of the global steel industry. With a growing economy and expanding infrastructure needs, India's production scale demands that it leads by example in sustainable practices, influencing both regional & global transitions to green steel.

Government incentives and

policies

The Indian government is actively promoting a green transition in the steel sector through initiatives like National Green Hydrogen Mission, Production-Linked Incentives (PLI), Carbon Credit Markets and Mandates on Cleaner Production Technologies.

Private sector commitments to decarbonisation pathways

Indian steel giants such as Tata Steel, JSW Steel, JSPL and Arcelor Mittal Nippon Steel India … are taking bold steps to align with global sustainability goals. Their leadership is vital for setting industry benchmarks and collaborating with international partners for a greener future.

It's worth to mention that India is the first country in the world to define Green Steel.

Definition: Green steel is defined as finished steel with carbon-equivalent emission

Launch : Unveiled on 12th Dec' 2024; officially gazetted on 23rd Dec'24 by the Ministry of Steel.

`Star Rating System:

- 5-star: <1.6 t CO_2 e/tfs
- 4-star: 1.6–2.0 t CO_2 e/tfs
- 3-star: 2.0–2.2 t CO_2 e/tfs
- Not eligible: < 2.2 t CO_2 e/tfs
- Emission Scope: includes Scope 1, Scope 2 and limited Scope 3 emissions up to the finished steel stage (e.g. pellet making, sintering), excludes mining, downstream emissions & transportation beyond plant boundaries.
- Review Cycle : Thresholds and rating criteria will be reviewed every three years to stay aligned with technology and global standards.
- Nodal Agency : The National Institute of Secondary Steel Technology (NISST) will handle measurement, reporting, verification (MRV) and issuance of certificates & star ratings.
- Certification is annual by default, with more frequent audits available upon request.

Objectives & Purpose:

- Benchmarking : Standardises low-carbon steel criteria to prevent greenwashing.
- Decarbonisation Incentive: Pushes industry toward cleaner production to meet India's net-zero emissions intensity by 2070.
- Market Creation: Enabling demand for certified green steel through government procurement and private sector adoption.
- Policy Integration: Provides a foundation for the National Mission on Green Steel (NMGS) and the Green Steel Public Procurement Policy (GSPPP)
- Policy Developments &
- Procurement Mandates: A draft Green Steel Public Procurement Policy is under consultation to create a Regulated market for certified steel usage.

According to recent reporting, central government projects and centrally-sponsored schemes will be mandated to use green-rated steel starting FY2027–28 and continuing for eight years.

The Path Forward

The future of steel manufacturing belongs to those who can integrate *systems, sustainability and spirit*. By managing Green Steel with Golden Hearts, we do not just reduce costs or improve safety metrics - we elevate the entire culture of the organization.

This model is not an idealistic dream - it is an achievable reality, as proven by organizations that have chosen to lead with values, manage with vision and grow with gratitude. The question is not *if*, but *when* we begin this journey.

The Cost Challenge

While the transition to Green Steel is imperative for environmental sustainability, it comes with a significant economic challenge. The adoption of cleaner technologies such as Hydrogen-based Direct Reduced Iron (H_2-DRI), electric arc furnaces (EAFs) powered by renewable energy and the establishment of low-emission supply chains are capital-intensive and likely to

increase the cost of production in the short term.

This raises an important question:

How do we balance the planet's needs with profitability?

The answer I believe, lies in embracing the concept of 'Golden Hearts' - a philosophy where leadership and workforce unite around shared values of Total Quality Management (TQM), Purpose-Driven Work and Collective Excellence.

When we nurture human commitment, instil a sense of ownership and foster a culture of discipline, compassion and continuous improvement, we naturally begin to:

- Eliminate waste and rework
- Reduce the cost of poor quality
- Streamline processes with empathy-driven efficiency
- Build an organisation that's not just productive but positive and resilient.

These aren't just management tools … they are life principles.

When lived sincerely, they don't just optimize production costs to match or even beat current levels but they also generate a powerful aura of peace, helping reduce stress-related health issues such as blood pressure, diabetes and mental fatigue. It leads to a workplace where people thrive, not just survive.

What looks simple on paper demands sincere understanding, unshakable belief and consistent action … the true spirit of Green Steel with Golden Hearts.

Call for Action

CEOs, entrepreneurs and steel plant heads must adopt a dual vision …

Green Technology + Golden Values

Industry leaders to combine technological transformation with value-based leadership. It's not enough to simply shift to green production methods - there must also be a cultural shift toward compassion, integrity and inclusivity. The best outcomes emerge when advanced green technologies are led by Golden Hearts … leaders with a conscience and courage.

Building organizations that are not only profitable but also purposeful and planet-friendly

The future belongs to companies that redefine success beyond profits. This means creating organizations that:

- Deliver strong economic performance
- Uplift society through purpose-led missions
- Respect the planet by minimizing their ecological footprint.

Such organizations become beacons of trust and transformation, attracting talent, investments and admiration.

The Golden Hearts: The Human Side

Emphasis on ethical leadership, social responsibility and community welfare

- Employee well-being, safety and skill development as central values

Leadership with empathy, integrity and a vision for both people and the planet

Green Steel symbolizes sustainable innovation ~ *representing the technical evolution of the industry i.e. cleaner energy, lower emissions and smarter processes* – whereas Golden Hearts reflect compassionate leadership ~ symbolizing moral & human side of industry. It is about the kind of people who lead the change - compassionate, ethical, inclusive and committed to make a difference.

When Green Steel & Golden Hearts come together, they form a legacy of 3 'R's i.e.

- Resilient to environmental and economic challenges
- Responsible in its treatment of people and nature
- Respected across society for doing what's right.

This is the kind of legacy we must build - for next generation, for the planet and for humanity.

TQM – A Pathway to Cost-Effective Green Steel with a Human Face

Total Quality Management (TQM) is more than a system. It is a way of life in the workplace - a culture where every process, every person and every problem is viewed as an opportunity for excellence.

In the context of Green Steel manufacturing, where costs are a natural concern due to advanced technologies and

new infrastructure, TQM becomes a strategic necessity, not just a best practice.

Here's how adopting TQM with a Golden Heart approach can help bring costs under control while maintaining world-class standards:

1. Daily Work Management (DWM)

Empowering frontline workers and supervisors to manage their own processes efficiently reduces dependency, downtime and delays.

- *Outcome: Faster cycles, fewer errors, lower rework costs.*

2. Problem-Solving Culture

Encouraging a "find-and-fix" mindset through structured problem-solving tools like 5 Whys, Ishikawa Diagrams, PDCA and Root Cause Analysis leads to long-term solutions, provided we devote sufficient time, in working with these tools with a honest desire for the right solutions.

- *Outcome: Prevents recurrence of issues, reducing hidden costs.*

3. Quality Circles & Employee Involvement / Engagement

When workers are trusted and involved in identifying improvement opportunities, their commitment rises.

- *Outcome: Increases morale and reduces attrition, improving efficiency.*

4. Visual Management & Standardization

Clear but updated SOPs, W/Is and visual controls ensure consistency in operations.

- *Outcome: Minimizes quality defects and energy waste.*

5. Internal Customer-Supplier Relationship

Every department is trained to view the next process as their customer.

- *Outcome: Enhances flow, accountability, and teamwork across functions.*

6. Cost of Quality (CoPQ/CoQ) Monitoring

Tracking costs associated with prevention, appraisal, internal & external failures ~ helps pinpoint wastages.

- *Outcome: Data-driven decisions to reduce costs proactively.*

7. 5S – ADVANCED Workplace Organization:

1S: Organizing, 2S: Neatness, 3S: Cleaning, 4S: Standardisation, 5S: Discipline.

- *Outcome: Safe environment to work at, Increased efficiency & lesser mistakes.*

It's recommended to adopt 'MABEC's – 'Design for 5S' Concept to have meaningful benefits, lay outs of new factories are designed during construction itself, before start of the operations and make a habit by one & all.

8. The skills development on regular basis

- *Outcome: To be updated & trained on the latest developments and improved way of doing things.*

9. Review meetings at plant premise and preferably shift in-charge to present

- *Outcome: Discussions on fact based data/progress, can be verified on site itself in case of any doubt, listening real issues, process/machine requirements from ground leaders and thus empowering those who are directly involved in day to day operations.*

Note: The technical parameters and insights presented in this article have been enriched by valuable inputs received from my former colleagues, S/shri :

- **Y. K. Degan,** Former Executive Director (Works), Bhilai Steel Plant, SAIL.
- **Saibal Kanti Das,** Former Chief General Manager, RDCIS, SAIL @ Ranchi.
- **Dr. Arvind Bodhankar,** Chief Sustainability Officer, Arcelor Mittal Nippon Steel. He is also serving as a member of Task Force constituted by the Secretary – Ministry of Steel, Government of India *…. a matter of pride for me.*
- **Rajendra Potdar,** CEO & Founder, Mfg. & Business Excellence Consulting (MABEC).

The Golden Heart Connection

While systems and tools are critical, it is human intention that breathes life into TQM, when employees:

- Believe in what they do
- Feel respected and empowered
- Sense a higher purpose in their work...

...they begin to operate not just with skill, but with soul.

This inner motivation … the essence of Golden Hearts leads to:

- Voluntary excellence, not forced compliance
- Harmony at the workplace, reducing stress and conflicts
- Shared ownership of sustainability, aligning everyone to the green mission.

The Bigger Picture

By embedding TQM principles into the DNA of Green Steel manufacturing, with a Golden Heart philosophy, we don't just create a cost-effective product but create an organization that heals the planet, supports its people and leads the industry with purpose, pride and peace. ■

Concast (India) Private Limited
A Primetals Technologies Group Company

Concast India Opens New Facility at Taloja

Concast (India) inaugurated their new facility, Taloja Works in Taloja, Maharashtra. This strategic move shall elevate customer service and facilitate business

expansion both domestically and internationally.
The establishment of the Taloja Works underscores Concast (India)'s commitment to meeting customer requirements with greater efficiency and streamlining the entire business process. This new location is ideally suited to enhance the overall customer experience, and the services provided by Concast (India) Private Limited, ensuring seamless processing and shorter delivery timelines for all projects.

This advanced facility features modern office spaces promoting collaboration and efficiency. Concast (India)'s first ever integrated assembly area incorporating 12 assembly stations, 3D inspection tables, dedicated cutting and machine piping sections that guarantee high precision and optimized workflows. A specialized paint booth with advanced climate control and air filtration systems ensures impeccable surface finishes. Moreover, this facility also consists of a warehouse with digital tracking system, enabling optimal management and

stringent quality control of all equipment. Demonstrating a commitment to sustainability, the facility is equipped with solar panels that contribute to the energy supply for the office, warehouse, and assembly areas.
Furthermore, Concast (India) has integrated a state-of-the-art 3D scanner technology for comprehensive quality inspection and reverse engineering. This allows for precise quality control, faster product development cycles, and improved decision-making through data-driven insights.
This strategic expansion reinforces Concast (India) Private Limited's focus on enhancing product quality and operational efficiency, further solidifying its position as a leading player in the manufacturing sector.

Global steel output down 2.2% in the first half of 2025

Global raw steel production fell to 151.4 million metric tons during June, a nearly -5.0% drop from the previous month and -5.8% from June 2024. The tonnages reported by several of the largest producer nations – but not including the U.S. steel industry – may indicate some effects of the 25% U.S. tariffs implemented March 12 on imports of steel and aluminum. With the latest totals, global raw steel production for the first half of 2025 totals 934.3 million metric tons, or -2.2% less than the January-June 2024 total.

All the figures are supplied by the World Steel Association and cover raw steel production in 70 nations. World Steel's monthly tracks raw-steel production in 70 countries. The trade association also tracks steel consumption, though it suspended is Q2 2025 short-term outlook for consumption citing the uncertain effects of the U.S. tariffs on global steel consumption.

China, the world's largest steelmaking nation and one of the largest exporters of semifinished steel, produce 83.2 million metric tons of raw steel during June, -4.1% less than in May and -9.2% less than in June 2024. For the current year to-date, Chinese steelmakers have produced 514.8 million metric tons of raw steel, a decline of -3.0% compared to January-June 2024.

Crude steel production by region

Africa produced 1.7 Mt in June 2025, up 3.0% on June 2024. Asia and Oceania produced 112.9 Mt, down 6.2%. The EU (27) produced 10.4 Mt, down 8.2%. Europe, Other produced 3.3 Mt, down 8.4%. The Middle East produced 4.3 Mt, down 4.9%. North America produced 8.7 Mt, up 1.2%. Russia & other CIS + Ukraine produced 6.7 Mt, down 8.8%. South America produced 3.5 Mt, up 1.3%.

svef!tuf rlqspevdujpo!cz!sf hjpo!; Jan to Jun 2025

!	Kvo!3136! (Mt)	&!di bohf ! Jun 25/24	Kbo -Jun 3136!)Nu	&!di bohf ! Jan -Jun 25/24
Bgsjdb	2/8	4	22/5	5/2
Bt jb!boe!Pdf bojb	223/:	.6.2	7: 4/:	.1.9
FV!)38*	21/5	.8.2	76/5	.3.3
Fvspqf -!Pui f s	4/4	.8.4	31/9	.7.1
Njeerfn!Fbt u	5/4	.4.9	38/6	.5.4
Opsui !Bn f sjdb	9/8	2/3	64/3	.0.6
Svt t jb!' !pui f s!DJT!, !Vl sbjof	7/8	.8.8	52/7	.5.4
Tpvui !Bn f sjdb	4/6	2/4	31/6	.0.4
Upubm81!dpvousjf t	**262/5**	**.5.8**	**: 45/4**	**.2.2**
U f !81!dpvousjf t !jodmvef e!jo!ui jt !ubcmf!bddpvouf e!gps! approximately 98% of total world crude steel production in 2024.	A	A	A	A

Top 10 steel-producing countries

China produced 83.2 Mt in June 2025, down 9.2% on June 2024. India produced 13.6 Mt, up 13.3%. Japan produced 6.7 Mt, down 4.4%. The United States produced 6.9 Mt, up 4.6%. Russia is estimated to have produced 5.6 Mt, down 7.4%. South Korea produced 5.0 Mt, down 1.8%. Türkiye produced 2.9 Mt, down 3.5%. Germany produced 2.7 Mt, down 15.9%. Brazil produced 2.8 Mt, down -0.5%. Iran is estimated to have produced 2.2 Mt, down 15.5%.

Top 10 steel-producing countries: Jan to Jun 2025

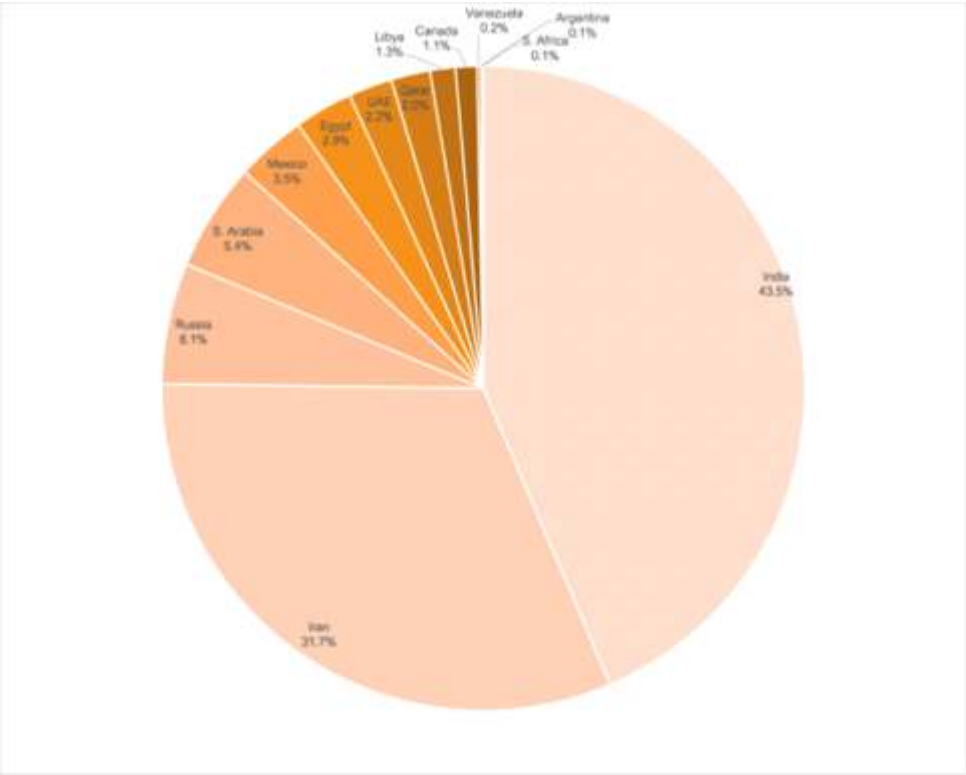
!	!Jun 2025 (Mt)	&!di bohf ! Jun 25/24	Kbo -Jun 2025 (Mt)	&!di bohf ! Jan -Jun 25/24
Di job	94/3	.9.2	625/9	.3
Jbejb	24/7	24/4	91/:	: /3
Kbqbo	7/8	.4.4	51/7	.5
Vojuf e!Tubuf t	7/:	5/7	51/3	1/9
Svt t jb	6/7!f	.7.4	45/9	.5.6
Tpvui !Lpsf b	6	.1.8	41/7	.2.8
Uhsl jzf	3/:	.3.5	29/4	.1.7
Hf sn boz	3/8	.15.9	28/2	.11.6
Csb{jm	3/9	.0.5	27/6	1/6
Jsbo	3/3	.15.5	26/7	.10.3

f !– estimated. The ranking of the top 10 producing countries is based on year -to-date aggregate

According to the data released by the World Steel Association (worldsteel), global direct reduced iron (DRI) production in the 13 countries accounting for approximately 87 percent of total world DRI production in 2024 amounted to 11.05 million metric tons in June this year, decreasing by 8.9 percent month on month and increasing by 1.7 percent year on year.

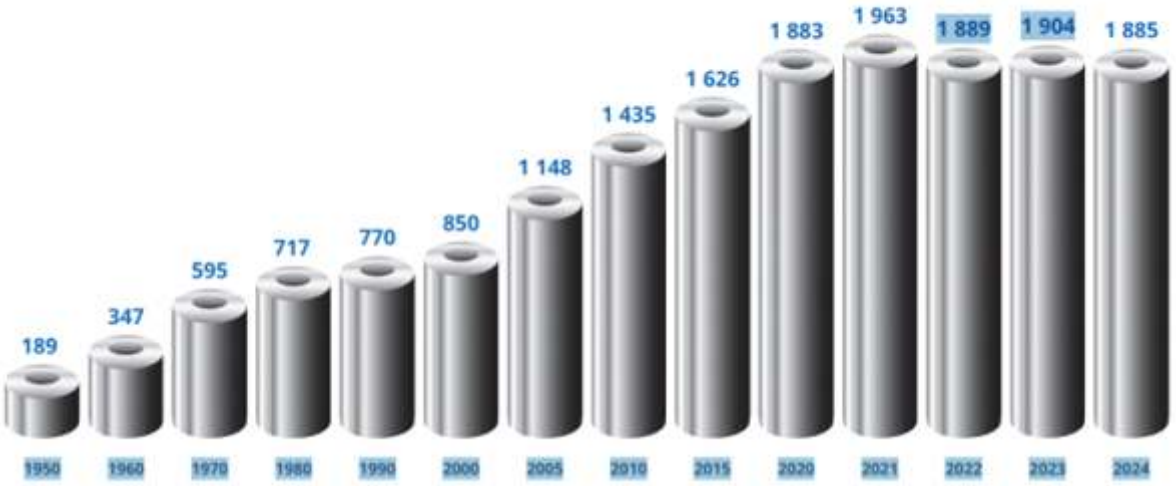
Meanwhile, world DRI output came to 64.24 million metric tons in the first half of this year, up by 4.3 percent compared to the corresponding period of 2024.

The worldsteel data show that India was the largest DRI producer among the countries surveyed in June this year, with its DRI output amounting to 4.81 million metric tons in the given month. India was followed by Iran, Russia and Saudi Arabia in June, with outputs of 3.5 million mt, 670,000 mt and 598,000 mt respectively.



World Steel in Figures 2025

World crude steel production 1950 to 2024 (million tonnes)



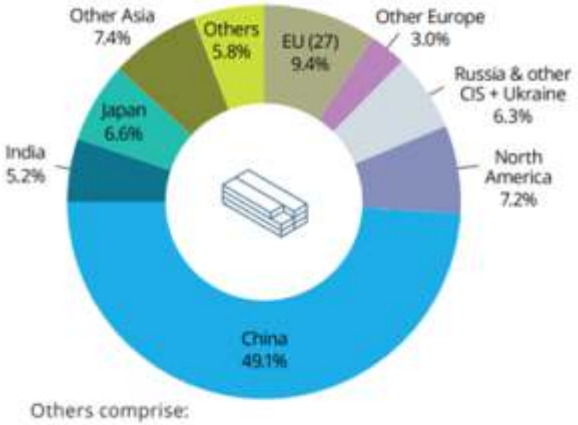
Top 20 steel-producing countries 2024 (million tonnes)

Steel production and use: geographical distribution in 2014 & 2024

CRUDE STEEL PRODUCTION

2014

World total: 1 676 million tonnes

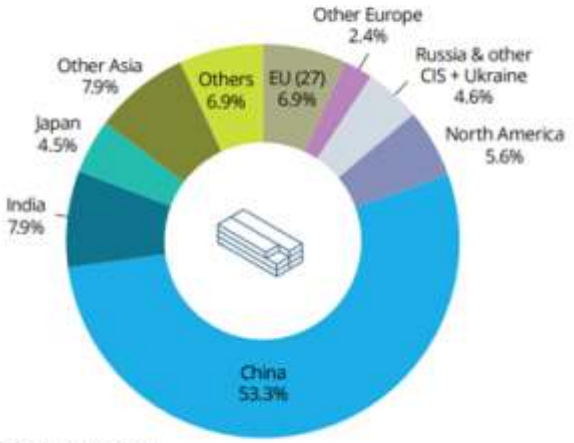


Others comprise:

Africa	1.0%	South America	2.7%
Middle East	1.8%	Australia and New Zealand	0.3%

2024

World total: 1 885 million tonnes



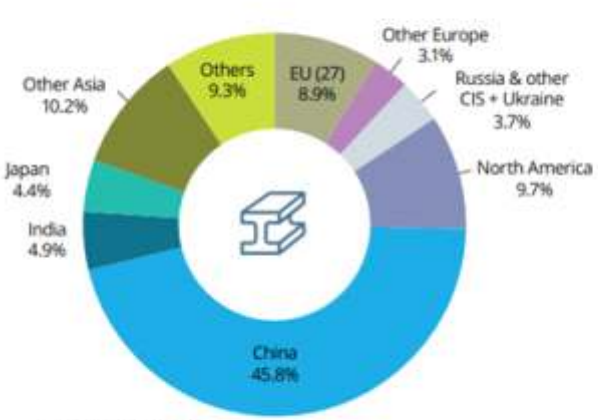
Others comprise:

Africa	1.5%	South America	2.2%
Middle East	2.9%	Australia and New Zealand	0.3%

APPARENT STEEL USE (FINISHED STEEL PRODUCTS)

2014

World total: 1 552 million tonnes

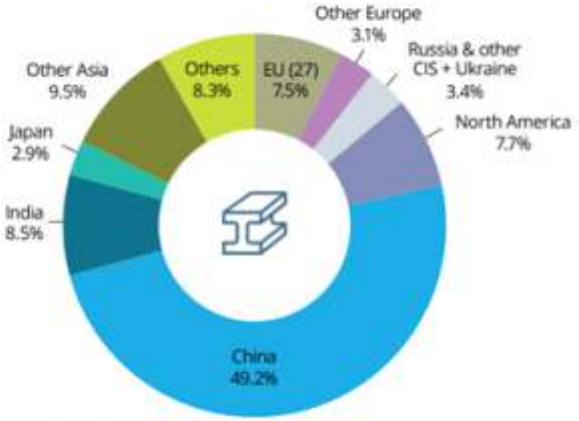


Others comprise:

Africa	2.4%	South America	2.9%
Middle East	3.5%	Australia and New Zealand	0.5%

2024

World total: 1 742 million tonnes



Others comprise:

Africa	2.2%	South America	2.4%
Middle East	3.2%	Australia and New Zealand	0.4%


Apparent steel use (consumption) per capita 2024 (kilograms)
Netherlands 255.2
Germany 312.7
Sweden 289.6
United Kingdom 119.4
Canada 329.4
Belgium-Luxembourg 266.7
Poland 320.5
Ukraine 95.0
Russia 303.6
South Korea 923.5
USA 260.6
France 177.1
Romania 212.3
Türkiye 443.6
China 601.1
Japan 419.0
Iran 224.8
Mexico 213.5
Spain 283.9
Italy 388.5
Egypt 80.9
India 102.6
Taiwan, China 745.7
Venezuela 8.8
Austria 335.9
Czechia 532.3
Brazil 119.3
Oceania 153.2
South Africa 70.6
Argentina 73.3
worldsteel
ASSOCIATION
worldsteel.org

Crude steel production by process 2023

	Million tonnes	Oxygen %	Electric %
Austria	7.1	90.7	9.3
Belgium e	5.9	69.3	30.7
Bulgaria	0.5	–	100.0
Croatia	0.2	–	100.0
Czechia	3.4	95.6	4.4
Finland	3.8	62.0	38.0
France	10.0	59.2	40.8
Germany	35.4	72.3	27.7
Greece	1.2	–	100.0
Hungary	0.5	52.3	47.7
Italy e	21.1	14.2	85.8
Luxembourg	1.9	–	100.0
Netherlands	4.7	100.0	–
Poland	6.4	48.8	51.2
Portugal	2.0	–	100.0
Romania e	1.6	53.2	46.8
Slovakia e	4.4	90.0	10.0
Slovenia	0.5	–	100.0
Spain	11.4	28.1	71.9
Sweden	4.3	68.6	31.4
European Union (27)	126.3	55.2	44.8
Türkiye	33.7	28.4	71.6
United Kingdom	5.6	79.6	20.4
Others e	4.3	41.0	59.0
Other Europe	43.6	36.2	63.8
Russia e	76.0	65.1	32.0
Ukraine	6.2	48.1	12.3
Other CIS e	8.2	46.9	51.6
Russia & Other CIS + Ukraine	90.5	62.2	32.4
Canada	12.2	58.2	41.8
Mexico	16.2	6.6	93.4
United States e	81.4	31.7	68.3
Other North America e	0.5	–	100.0
North America	110.2	30.8	69.2
Argentina	4.9	42.9	57.1
Brazil	31.8	76.2	22.5
Chile	1.2	61.5	38.5
Venezuela	0.0	–	100.0
Other South America e	3.6	6.8	93.2
South America	41.6	65.7	33.3
Egypt	10.4	–	100.0
South Africa e	4.9	56.8	43.2
Other Africa e	9.0	4.4	95.5
Africa	24.2	13.1	86.9
Iran e	31.0	7.9	92.1
Saudi Arabia	9.9	–	100.0
Other Middle East e	13.5	–	100.0
Middle East	54.5	4.5	95.5
China e	1 019.1	90.1	9.9
India	140.8	43.6	56.4
Japan	87.0	73.8	26.2
South Korea	66.7	70.5	29.5
Taiwan, China	19.1	59.2	40.8
Other Asia e	62.6	48.8	51.2
Asia	1 395.2	81.2	18.8
Australia	5.5	73.2	26.8
New Zealand	0.6	100.0	–
Total of above countries	1 892.2	71.1	28.6

Statistics

Continuously-cast steel output
2021 to 2023

	Million tonnes		
	2021	2022	2023
Austria e	7.6	7.2	6.9
Belgium	6.9	7.0	5.9
Bulgaria	0.5	0.5	0.5
Croatia	0.2	0.2	0.2
Czechia	4.7	4.2	3.3
Finland	4.3	3.5	3.8
France e	13.6	11.8	9.7
Germany e	39.2	35.9	34.5
Greece	1.5	1.5	1.2
Hungary	1.1	0.9	0.5
Italy e	23.2	20.5	20.0
Luxembourg	2.1	1.9	1.9
Netherlands	6.6	6.1	4.7
Poland	8.3	7.3	6.3
Portugal	2.0	1.9	2.0
Romania e	3.3	2.6	1.6
Slovakia	4.9	3.9	4.4
Slovenia	0.5	0.5	0.4
Spain	14.0	11.4	11.3
Sweden 1 e	4.1	3.9	3.9
European Union (27)	148.6	132.6	122.9
Türkiye	40.4	35.1	33.7
United Kingdom	7.2	5.9	5.6
Others e	4.7	4.7	4.3
Other Europe	52.2	45.8	43.5
Russia e	49.6	47.5	49.0
Ukraine	14.1	4.7	3.7
Other CIS e	9.0	8.2	8.1
Russia & Other CIS + Ukraine	72.7	60.4	60.8
Canada	10.1	10.9	11.0
Mexico	18.5	18.4	16.2
United States	85.6	80.3	81.1
Other North America e	0.6	0.6	0.5
North America	114.8	110.2	108.8
Argentina	4.9	5.1	4.9
Brazil	35.3	33.3	31.3
Chile	1.3	1.2	1.2
Venezuela	0.0	0.0	0.0
Other South America e	3.3	3.7	3.6
South America	44.8	43.2	41.0
Egypt	10.3	9.8	10.4
South Africa	5.0	4.4	4.9
Other Africa e	7.5	8.8	9.0
Africa	22.8	23.0	24.2
Iran	28.3	30.6	31.0
Saudi Arabia	8.7	9.9	9.9
Other Middle East e	12.7	13.8	13.5
Middle East	49.7	54.2	54.5
China e	1 019.0	1 002.9	1 002.9
India	110.2	117.8	132.1
Japan e	95.4	88.4	86.2
South Korea	69.4	64.7	65.4
Taiwan, China	23.1	20.8	19.1
Other Asia e	63.6	61.9	61.9
Asia	1 380.7	1 356.4	1 367.7
Australia	5.8	5.6	5.5
New Zealand	0.6	0.6	0.6
Total of above countries	1 892.9	1 831.9	1 829.6

The countries in this table accounted for approximately 100% of world crude steel production in 2023.

e – estimate

1 – Continuously-cast steel includes steel powders

Apparent steel use 2019 to 2023

million tonnes, finished steel products

	2019	2020	2021
Austria	4.0	3.6	4.5
Belgium-Luxembourg	3.4	3.0	4.8
Czechia	6.7	6.3	7.9
France	14.6	12.2	13.8
Germany	35.1	31.3	35.5
Italy	25.1	20.4	26.5
Netherlands	4.6	4.1	4.7
Poland	13.6	12.9	15.3
Romania	4.5	4.1	4.4
Spain	13.2	11.7	13.0
Sweden	3.8	3.1	3.8
Other EU (27)	19.1	18.0	19.9
European Union (27)	147.8	130.9	154.1
Türkiye	26.1	29.5	33.4
United Kingdom	10.2	8.4	11.0
Others	6.8	6.5	6.8
Other Europe	43.1	44.3	51.2
Russia	43.5	42.3	43.9
Ukraine	4.7	4.6	4.8
Other CIS	10.1	10.7	10.0
Russia & other CIS + Ukraine	58.3	57.6	58.7
Canada	13.0	13.7	14.5
Mexico	24.4	21.9	25.5
United States	97.7	80.0	97.1
Other North America	4.5	3.6	4.8
North America	139.5	119.2	141.8
Argentina	3.9	3.6	5.0
Brazil	21.0	21.4	26.3
Venezuela	0.1	0.1	0.1
Other South America	12.6	10.3	14.6
South America	37.6	35.4	46.1
Egypt	10.4	9.7	10.2
South Africa	4.8	3.8	5.0
Other Africa	26.0	23.2	24.0
Africa	41.1	36.7	39.2
Iran	18.5	17.2	18.2
Other Middle East	32.5	30.9	33.4
Middle East	51.0	48.1	51.6
China	911.9	1 008.7	954.4
India	102.6	89.3	106.2
Japan	63.2	52.6	57.4
South Korea	53.2	49.2	56.0
Taiwan, China	17.6	18.8	21.1
Other Asia	105.7	93.5	98.5
Asia	1 254.3	1 312.2	1 293.7
Oceania	6.6	6.1	7.3
World	1 779.3	1 790.4	1 843.7

(e) = estimate

Apparent steel use per capita
2019 to 2023

kilograms, finished steel products

	2019	2020	2021
Austria	448.2	409.7	504.0
Belgium-Luxembourg	281.3	243.7	392.8
Czechia	637.1	599.2	754.2
France	226.1	189.4	213.7
Germany	422.6	376.1	425.7
Italy	419.8	343.1	447.3
Netherlands	265.8	237.6	269.9
Poland	354.2	336.0	398.3
Romania	232.5	212.2	226.0
Spain	280.9	246.8	274.0
Sweden	370.1	302.3	361.2
Other EU (27)	259.4	245.0	271.9
European Union (27)	332.0	293.9	346.1
Türkiye	312.4	350.4	393.7
United Kingdom	152.1	125.1	163.8
Others	209.0	198.2	209.6
Other Europe	235.4	241.2	277.5
Russia	298.6	290.6	302.7
Ukraine	105.3	104.8	109.4
Other CIS	98.0	102.1	95.2
Russia & other CIS + Ukraine	198.8	195.9	199.7
Canada	345.8	361.4	379.2
Mexico	195.3	173.6	201.2
United States	292.1	238.3	288.1
Other North America	47.7	37.9	49.9
North America	236.2	200.5	237.4
Argentina	87.6	79.8	111.2
Brazil	99.0	100.6	122.9
Venezuela	4.5	3.2	3.4
Other South America	88.3	70.8	100.0
South America	87.9	82.0	106.2
Egypt	98.0	90.2	93.4
South Africa	81.8	63.8	84.2
Other Africa	22.4	19.5	19.6
Africa	31.0	27.0	28.2
Iran	213.6	197.1	207.4
Other Middle East	179.2	167.3	178.6
Middle East	190.3	176.9	187.8
China	641.3	707.9	669.3
India	74.2	64.0	75.5
Japan	502.5	420.2	460.7
South Korea	1 027.5	948.9	1 081.2
Taiwan, China	740.8	788.9	886.1
Other Asia	89.7	78.3	81.6
Asia	299.7	311.3	305.0
Oceania	152.5	139.8	164.1
World	229.2	228.4	233.2

Pig iron
2022 and 2023

million tonnes

	Production 2022	Production 2023	
Austria	5.8	5.5	
Belgium-Luxembourg	4.4	3.6	
Czechia	3.4	2.7	
Finland	1.9	2.2	
France	8.2	6.2	
Germany	23.9	23.6	
Hungary	0.5	0.2	
Italy	3.5	3.1	
Netherlands	5.5	4.1	
Poland	3.1	2.7	
Romania	1.5	0.6	
Spain	3.4	3.0	
Sweden	2.8	2.9	
Other EU (27) e	3.2	3.6	
European Union (27)	70.9	64.1	
Türkiye	9.1	8.7	
United Kingdom	4.8	4.5	
Others	1.9	1.8	e
Other Europe	15.8	15.0	
Kazakhstan	2.9	2.7	e
Russia	51.6	54.6	e
Ukraine	6.4	6.0	
Other CIS	0.0	0.0	e
Russia & other CIS + Ukraine	60.9	63.3	
Canada	5.8	5.8	
Mexico	2.5	1.0	
United States	20.0	20.6	
Other North America	0.0	0.0	e
North America	28.3	27.4	
Argentina	2.1	2.0	
Brazil	26.8	25.7	
Chile	0.6	0.6	
Other South America	0.3	0.3	e
South America	29.7	28.5	
South Africa	2.4	2.9	
Other Africa	0.0	0.0	e
Africa	2.7	3.2	
Iran	3.5	3.5	e
Other Middle East	0.0	0.0	e
Middle East	3.5	3.5	
China	863.8	871.0	
India	79.9	86.3	
Japan	64.1	63.0	
South Korea	42.7	45.2	
Taiwan, China	13.4	12.2	
Other Asia	20.6	21.9	e
Asia	1 084.6	1 099.7	
Australia	3.7	3.5	
New Zealand	0.6	0.6	
Other Oceania	–	–	
Oceania	4.3	4.1	
World	1 300.7	1 309.0	

(e) = estimate

Direct reduced iron production 2019 to 2023

million tonnes

	2019	2020	2021
Germany	0.5	0.5	0.5
Sweden	0.1	0.1	0.1
European Union (27)	0.6	0.6	0.6
Russia	8.0	7.8	7.8
Canada	1.4	1.2	1.6
Mexico	6.0	5.2	5.8
Trinidad and Tobago	1.7	1.3	1.6
United States	3.2	3.4	5.0
North America	12.4	11.0	14.1
Argentina	1.1	0.5	1.4
Venezuela	1.0	0.9	0.8
South America	2.1	1.4	2.2
Algeria	1.5	2.2	3.1
Egypt	4.4	4.8	5.4
Kenya e		0.1	0.1
Libya	0.9	0.8	0.9
South Africa e	0.7	0.2	0.2
Zambia e	0.1	0.1	0.1
Africa	7.6	8.2	9.7
Bahrain	1.5	1.4	1.5
Iran	28.5	30.8	31.6
Oman	1.8	1.7	1.7
Qatar	2.4	0.8	0.8
Saudi Arabia	5.8	5.2	6.1
United Arab Emirates	3.7	3.0	3.7
Middle East	43.6	42.8	45.4
India	36.8	33.6	39.0
Malaysia	0.6	0.7	0.4
Asia	37.5	34.4	39.4
World	111.8	106.3	119.2

(e) = estimate

Trade in ferrous scrap
2022 and 2023

million tonnes

	Exports		Imp
	2022	2023	2022
Austria	1.2	1.2	1.1
Belgium	3.9	3.8	4.5
Bulgaria	0.5	0.5	0.2
Czechia	2.2	2.5	0.5
Finland	0.6	0.7	0.2
France	6.3	6.3	1.4
Germany	7.2	7.5	4.2
Greece	0.2	0.1	0.9
Italy	0.8	0.9	5.2
Netherlands	6.7	7.1	3.8
Poland	2.2	2.6	0.8
Slovakia	0.9	0.7	0.2
Spain	0.9	0.7	3.0
Sweden	1.4	1.8	0.2
Other EU	8.3	8.4	5.6
European Union (27)	43.5	44.7	31.8
Türkiye	0.2	0.2	21.1
United Kingdom	8.2	7.2	0.2
Others	1.8	2.0	1.0
Other Europe	10.2	9.4	22.3
Kazakhstan	0.1	0.0	0.0
Russia	1.0	0.9	0.0
Ukraine	0.1	0.2	0.0
Other CIS	0.2	0	0.1
Russia & other CIS + Ukraine	1.4	1.2	0.1
Canada	4.7	4.8	1.1
Mexico	0.8	1.0	2.9
United States	17.5	16.3	4.7
Other North America	1.0	1.0	0.0
North America	24.0	23.0	8.8
Brazil	0.4	1.1	0.0
Other South America	1.9	1.6	1.2
South America	2.2	2.6	1.2
South Africa	0.5	0.2	0.1
Other Africa	1.3	1.4	0.9
Africa	1.8	1.5	0.9
Middle East	3.6	3.2	0.6
China	0.0	0.0	0.6
Japan	6.3	6.9	0.1
South Korea	0.3	0.4	4.7
Taiwan, China	0.1	0.1	2.9
Other Asia	3.1	3.9	22.9
Asia	9.8	11.3	31.1
Oceania	2.4	2.2	0.2
World	98.9	99.1	97.0

World trade in ferrous scrap by area 2023

million tonnes

Exporting region / Destination	European Union (27)	Other Europe	Russia & other CIS + Ukraine	North America	South America	Africa and Middle East	China	Japan	Other Asia
European Union (27)	25.5	2.7	0.3	0.5	0.2	0.2	-	0.0	1.2
Other Europe	12.0	1.5	0.5	4.4	0.7	1.1	-	0.0	0.3
Russia & other CIS + Ukraine	0.2	0.0	0.0	0.0	0.0	0.0	-	-	-
North America	0.8	0.1	0.0	8.5	0.0	0.0	-	0.0	- 0.7
South America	0.0	0.0	-	0.8	0.2	0.0	-	-	0.0
Africa	1.2	1.7	0.0	0.2	0.0	0.2	0.0	-	0.2
Middle East	0.1	0.0	-	0.0	0.1	0.1	0.0	0.0	0.0
China	0.0	0.0	0.0	0.0	0.0	0.0	-	0.3	0.2
Japan	0.0	0.0	-	0.0	-	0.0	0.0	-	0.0
Other Asia	5.0	3.3	0.4	8.6	1.5	3.1	0.0	6.6	3.2
Oceania	0.0	0.0	-	0.0	0.0	-	-	-	0.0
Total exports	44.7	9.4	1.2	23.0	2.6	4.7	0.0	6.9	4.4
of which: extra-regional exports*	19.2	7.9	1.2	14.5	2.5	4.4	0.0	6.9	1.2
Net exports (exports-imports)	14.2	- 11.0	1.0	14.3	1.7	0.8	- 0.5	6.9	- 29.5

* Excluding intra-regional trade marked

World steel exports by product 2019 to 2023

million tonnes

	2019	2020	2021
Ingots and semi-finished material	56.1	55.7	61.1
Railway track material	4.9	2.6	2.8
Angles, shapes and sections	21.5	19.6	20.3
Concrete re-inforcing bars	19.1	19.2	22.0
Bars and rods, hot-rolled	15.2	12.8	15.3
Wire rod	26.8	25.2	29.0
Drawn wire	8.8	8.7	9.6
Other bars and rods	5.6	4.5	6.1
Hot-rolled strip	3.2	2.8	3.4
Cold-rolled strip	4.0	3.7	4.8
Hot-rolled sheets and coils	78.4	74.6	79.3
Plates	32.8	29.4	30.9
Cold-rolled sheets and coils	32.5	19.0	36.7
Electrical sheet and strip	4.1	3.9	5.1
Tinmill products	6.9	7.0	6.8
Galvanised sheet	43.0	37.0	45.3
Other coated sheet	18.2	18.1	20.2
Steel tubes and fittings	40.9	32.3	34.3
Wheels (forged and rolled) and axles	0.8	0.7	0.9
Castings	1.3	1.1	1.4
Forgings	1.0	0.9	1.0
Total	425.2	378.8	436.3

Exports data is reported by countries and therefore includes for example intra-EU trade, trade between USMCA countries, etc.

The figures are based on a broad definition of the steel industry and its products, including ingots, semi-finished products, hot-rolled and cold-finished products, tubes, wire, and unworked castings and forgings.

The above table comprises the exports of 62 countries, which represents approximately 95.5 per cent of total world trade in 2023.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THE STEEL OF INDIA