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The Indian Institute of Metals
Delhi Chapter

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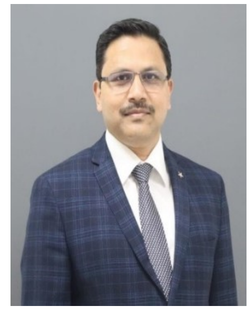
Chairman's Message



Dear Esteemed Member,

It is my proud privilege to be the Chairman of The Indian Institute of Metals, Delhi Chapter, and I feel honoured to serve this Chapter having renowned members from Industries, R&D Institutions, Academia, and Government. I would like to sincerely thank the members for reposing their trust in me and look forward to our collective leadership in organizing various technical activities.

I would also like to thank all the past Chairmen of IIM Delhi Chapter and Executive Committee Members for their outstanding contribution in keeping this Chapter vibrant and active. I would like to mention that the flagship event of our Chapter, i.e. MMMM 2024 was held successfully in September 2024. Our Chapter also organized the IMMS 2025 Summit in February 2025. The entire credit of organizing these two big events goes to the outgoing Executive Committee Members under the able leadership of Shri R K Vijayavergia.

As the members are aware, metal sector is witnessing a steady growth in our country while grappling with environmental concerns, technological limitations and global competition. Our focus will be on organising technical activities to find out cost-effective solutions for the challenges faced by Indian Metal Industry.

I look forward to receiving suggestions and ideas from illustrious members to increase the activities of IIM Delhi Chapter. I have no doubt that with your support and active participation, our Chapter will continue to move forward in climbing ladders of excellence and make the Chapter more industry focused.

Thank you,

With Best Regards,

Manoranjan Ram
Chairman (IIM Delhi Chapter)

Steel as the Backbone of a Rising India

A revitalised steel sector is shaping India's infrastructure revolution and will play a key role in the green transition.

A new Bharat is rising and at the very foundation of this rise stands steel.

Whether it is highways or homes, renewable energy parks or high-speed rail corridors, smart cities or defence manufacturing hubs India's decade-long infrastructure revolution has depended deeply on a sector that once stood stagnant but is now forging ahead with confidence and capacity.

In 2014, our steel production was just over 81 million tonnes. Today, it has crossed 152 million tonnes. Capacity has nearly doubled. India is now the world's second-largest producer of steel, and the only major economy where steel demand is consistently rising.

This transformation is no coincidence. It is the direct result of Prime Minister Narendra Modi's vision of Atmanirbhar Bharat, and his belief that India must build with its own hands, and with its own strength.

Under his leadership, the Ministry of Steel has reoriented the sector around three pillars: strategic investment, self-reliance, and sustainability.

Infra's Hidden Backbone

From metro rails to modular airports, from electric vehicle frames to defence-grade alloys, steel is everywhere, yet rarely seen.

India now builds 30 km of highways every day, up from just 12 km in 2014. These corridors-like the Delhi-Mumbai Industrial Corridor, Samruddhi Mahamarg, or the Purvanchal Expressway - are now constructed with high- strength Indian steel.

Metro rail networks now span 900+ km in 20+ cities. From rolling stock to station infrastructure, steel has enabled this expansion.

Our airports have more than doubled from 74 in 2014 to over 150 today with smart steel-enabled terminal construction. Under the PM Awas Yojana, over 3 crore homes have been sanctioned, many using Indian steel frames for durability and disaster resilience.

One of our most important interventions was the revision of the Domestically Manufactured Iron & Steel Products (DMI&SP) Policy, which mandates 30-95 percent domestic value addition in centrally funded projects. This not only ensured Indian steel for Indian infrastructure, but also catalysed investments into capacity and innovation.

The Production Linked Incentive (PLI) Scheme for Specialty Steel has already attracted over Rs. 44,000 crore in investments across 86 projects. These cater to defence, renewables, automotive, and high-end industrial segments. More than 31,000 direct jobs have been created and many more indirectly.

India no longer imports steel for critical needs. We now export capability and manufacture self-reliance.

The revival of Rashtriya Ispat Nigam Limited (RINL) is one of the strongest indicators of what targeted government support can achieve. With Rs. 10,300 crore in assistance, operational reforms, and leadership clarity, RINL has doubled hot metal output and returned to profitability.

This is not just a financial recovery. It is a revival of India's industrial soul, and proof that with the right intent, even legacy PSUs can rise again.

Green Steel, Green Bharat

The Green Steel Taxonomy sets benchmarks for low-emission production. Under the National Green Hydrogen Mission, five pilot projects are underway to replace fossil fuels in steelmaking with hydrogen. This will usher in a new era of clean, competitive steel.

Digital tools like SIMS 2.0 (Steel Import Monitoring System) have brought transparency to imports. The revamped Ministry of Steel portal ensures real-time tracking of data and policies.

Economy Beyond Steel

The steel sector's expansion has had ripple effects:

- MSMEs in fabrication, construction, and engineering now enjoy stable supply chains and affordable raw materials.
- EVs and automotive sectors benefit from cost-effective, high-grade Indian steel.
- Wind turbines and solar frames are being made domestically, aligning perfectly with our clean energy goals.
- Defence now uses indigenously produced high-tensile and ballistic-grade steels.

The Road Ahead

By 2030-31, our target is clear: Steel production capacity of 300 MTPA; Per capita steel consumption of 160 kg.

The next phase will focus on green steel, export readiness, and deep R&D in partnership with the private sector.

Under the leadership of the Prime Minister, the steel sector has moved from stress to strength -and has become the spine of a rising India.

As we march toward Viksit Bharat@2047, steel will not just build structures. It will build dreams. It will build dignity. And it will build a nation stronger than steel itself.

Source: Speech by Hon. Minister of Minister of Heavy Industries & Steel,
The Hindu Businessline, 30th June 2025

Attero to Invest in Rare Earth Elements Recycling

India based obsolete electronics recycling firm plans to grow its rare earth elements recycling capacity one hundredfold.

NCR based Attero's patented process extracts rare earth elements from obsolete items including hard disk drives, laptop computers, wearables and earphones. Attero, which also recycles electronic scrap and lithium-ion batteries, intends to increase its ability to make recycled-content rare earth elements (REE) from 300 metric tons to 30,000 metric tons of annual capacity.

The recycling company plans to invest 1 billion Indian rupees, or $11.5 million, over the next two years to harvest rare earth metals, including neodymium, praseodymium and dysprosium, from obsolete items such as hard disk drives, laptop computers, wearables and earphones. Attero claims that the move directly supports the National Critical Mineral Mission (NCMM), launched this year by the government of India to reduce import dependence and promote self-reliance in critical mineral supply chains.

The REEs being targeted are used in applications including electric vehicles (EVs), wind energy and consumer electronics and are part of a global market projected to reach more than $10.9 billion in value by 2029.

Attero has consistently advocated for India's self-reliance in critical minerals to reduce dependence on imports and counter China's dominance in rare earth supply chains. Attero claims to be the only Indian company with proven deep-tech and globally patented processes to refine black mass and recover REEs with over 98 percent efficiency and 99.9 percent purity.

The current global environment only reinforces the urgency of building domestic infrastructure. With the existing capability and technology, Attero is ready to scale up its REE recycling capacity from 1 to 100 metric tons per day to reach a total of 30,000 metric tons annually and explore further expansion as demand accelerates.

In addition to neodymium, praseodymium and dysprosium, Attero's patented technology also can extract cerium and gadolinium. It claims that its process is energy efficient and cost-effective and significantly reduces greenhouse gas emissions compared with traditional mining.

Beyond REEs, Attero also refines black mass to produce high-purity recycled-content lithium, cobalt, nickel and manganese. In its most recent fiscal year, Attero processed more than 150,000 metric tons of obsolete electronics and another 15,000 metric tons of lithium-ion batteries.

This year, Attero is targeting year-on-year growth of 100 percent, including plans to expand its geographic footprint in the United States and Europe.

The company was founded in 2008 and has a presence in India, Australia, Poland, Singapore, South Korea and the U.S.

Source: Recycling Today, June 24, 2025

Cathode Copper Production in India

India, copper is classified as a critical mineral given limited domestic production and high demand in conventional and emerging technologies – from air conditioners and transformers to electric vehicle (EV) batteries and wind turbines. It is also seen as a bellwether of economic activity owing to its extensive application across sectors.

Domestic Cathode Output Rises

Domestic copper cathode production rose12.6 percent to 5.73 lakh tonnes in FY25, driven primarily by Hindalco Industries Ltd, which holds a 70 percent market share and has a capacity of 5 lakh tonnes. Production last year surpassed the previous peak of 5.55 lakh tonnes recorded in FY23.

Vedanta's Sterlite Copper, with a smaller capacity of 2.16 lakh tonnes, contributed 26 percent of cathode in FY25. Notably, India remained self-sufficient in copper cathode until 2018, when Vedanta's Tuticorin Plant was shut down over environmental violations.

Adani's Kutch Copper Ltd produced 22,000 tonnes (4 percent share) in its first year, with a smelter capacity matching Hindalco's at 5 lakh tonnes. Production is expected to ramp up to full capacity by October, with sources stating. Once the Adani plant is fully operational, India's entire cathode demand will be met internally.

Additionally, the JSW Group plans to establish a 5 lakh tonnes copper smelter in Odisha by 2028-29. With India's per capita copper consumption still at 0.6 Kg – well below the global average of 3 Kg – demand is set to surge. To meet this, India's smelting capacity must expand as global supplies tighten.

India's Rare Earth Reserves

Rare earths are a collection of 17 elements – scandium, yttrium and 15 lanthanides, which are: lanthanum (La), cerium (Ce), praseodymium (Pr), neodymium (Nd), promethium (Pm), samarium (Sm), europium (Eu), gadolinium (Gd), terbium (Tb), dysprosium (Dy), holmium(Ho), erbium (Er), thulium (m), ytterbium (Yb) and lutetium (Lu).

India imports most of its rare earth requirements. Imports rose 16.7% to 2,270 tonnes in FY24.

As per the US Geological Survey, India has the third largest reserves of rate earth elements, at about 6.9 million tonnes, after China (44 million tonnes) and Brazil (21 million tonnes). However, there is no significant production of rare earths in India.

Hindalco to buy AluChem for $125mn, its 3rd US deal

Hindalco Industries is set to acquire AluChem Companies, an Ohio-based manufacturer of specialty alumina, for an enterprise value of $125 million, marking its third acquisition in the US. The company previously acquired Novelis and Aleris Corporation.

The AluChem acquisition will be carried out through Aditya Holdings, a step down wholly owned subsidiary of Hindalco.

The Indian company currently operates 500,000 tons of specialty alumina capacity and aims to double it to 1 million tons by FY30. The global specialty alumina market is projected to grow significantly, with increasing demand for solutions in sectors ranging from ceramics and electronics to aerospace and medical applications to electric mobility and semiconductors.

AluChem brings Hindalco a strong presence in North America with an annual capacity of 60,000 tons across its three manufacturing facilities in the states of Ohio and Arkansas.

Source: The Economic Times, 25th June 2025

Green Nickel Extraction Method

Scientists at the Max Planck Institute for Sustainable Materials have developed a carbon-free, energy-saving method to extract nickel for batteries and stainless steel.

By 2040, the demand for nickel is expected to double due to the increasing electrification of the infrastructures and transport systems. Yet, producing one ton of nickel currently emits around 20 tons of CO_2, raising concerns about shifting the environmental burden from transportation to metallurgy. Researchers at the Max Planck Institute for Sustainable Materials (MPI-SusMat) have developed a carbon-free, energy-saving method for nickel extraction. Their approach also enables the use of low-grade nickel ores, which have been overlooked due to the complexity of conventional extraction processes.

If we continue producing nickel in the conventional way and use it for electrification, we are just shifting the problem rather than solving it. Researchers at MPI-SusMat have developed a new method to extract nickel from ores in a single step, using hydrogen plasma instead of carbon-based processes. The new process reduces CO_2 emissions by 84% and is up to 18% more energy-efficient when renewable electricity and green hydrogen are used, as the repeated heating and cooling of the ore, which is common in conventional processes, is avoided.

A major breakthrough of this method is its ability to process low-grade nickel ores (which account for 60% of total nickel reserves) in a single reactor furnace, where smelting, reduction, and refining occur simultaneously, producing a refined ferronickel alloy directly.

By using hydrogen plasma and controlling the thermodynamic processes inside the electric arc furnace, it is possible to break down the complex structure of the minerals in low-grade nickel ores into simpler ionic species, even without using catalysts.

The next step for the Max Planck team is scaling up the process for industrial applications. The reduction of nickel ores into simpler ionic species occurs only at the reaction interface, not throughout the entire melt. In an upscaled system, it is crucial to ensure that unreduced melt continuously reaches the reaction interface. This can be achieved by implementing short arcs with high currents, integrating an external electromagnetic stirring device beneath the furnace, or employing gas injection.

The reduced nickel alloy can be used directly in stainless steel production and, with additional refinement, as a material for battery electrodes. Additionally, the slag produced during the reduction process can serve as a valuable resource for the construction industry, including brick and cement production.

The same process can also be applied for cobalt, which is used in electric vehicles and energy storage systems.

Source: Green Steel World News Update, 15 may 2025

Torrefied Biomass in Steelmaking

Japan's Kobe Steel (Kobelco) plans to use torrefied wood pellets in steelmaking and has entered into an agreement with Mitsubishi UBE Cement (MUCC) to source the biomass fuel. This move underscores the rise in usage of torrefied or carbonised biomass for the steel and metal industries as the non-power sector is increasingly looking at options to cut its carbon footprint. The demand for torrefied or carbonised biomass by steel and metal companies is expected to grow in Japan as well as globally, and could increase competition with the power sector for biomass supplies.

Kobe and MUCC agreed in May to conduct a feasibility study on torrefied wood pellets and aim to set up a joint venture for this project in 2026, the companies told Argus.

MUCC has developed torrefaction technology to produce torrefied wood pellets, which are also called black pellets. Torrefied wood pellets have a higher calorific value than normal biomass fuels including typical wood pellets. They have better water resistance and grindability compared with typical wood pellets. They also share key characteristics with coal and can be handled like coal.

MUCC has a production capacity of 60,000 t/yr in its Ube factory. MUCC's black pellets have been co-fired with coal in its thermal power plant since 2019. Normal wood pellets imported from Canada are used as feedstock to produce the torrefied wood pellets.

Kobelco plans to use MUCC's torrefied wood pellets in steelmaking at its blast furnace in the Kakogawa steelworks, but the company did not elaborate further. The black pellets could be used instead of ground coal at the plant to provide heat, but may not be utilised as a major carbon source to replace coking coal as a reducing agent. The torrefied wood pellets could also be burned for power generation at the steel mill.

The joint venture between Kobelco and MUCC may build factories to produce torrefied wood pellets in southeast Asian and other countries in the future. The pellets could be sourced back to Japan, and also sold commercially to other companies.

*Source**:** https://www.argusmedia.com/en/news-and-insights/latest-market-news/2697272-japan-s-kobelco-to-use-torrefied-biomass-in-steelmaking; 20 June 2025*

Update on Boston Metal Process for Green Steel Process

Massachusetts-based Boston Metal is on the verge of earning its first revenue for its novel steelmaking process.

The technique, which was developed at the Massachusetts Institute of Technology and is now being scaled up for commercialization, uses electricity to remove contaminants from iron ore, producing a small fraction of the emissions generated by traditional fossil fuel–fired blast furnaces. Indeed, the technology releases no carbon dioxide — just oxygen — and the only greenhouse gas emissions are those associated with the electricity used to power the system.

Boston Metal was founded in 2013 to take on the challenge of reducing the tremendous amounts of greenhouse gases released by the steel industry, a sector responsible for 7% to 9% of global emissions. Boston Metal has since received some $400 million in investments from a range of backers including global steel giant ArcelorMittal, the venture-capital arm of oil company Saudi Aramco, global investment manager M&G Investments, the World Bank's International Finance Corp., and major climatetech funds such as Breakthrough Energy Ventures and Microsoft's Climate Innovation Fund.

The possible payoff is significant: Demand for low-emissions steel is expected to increase by at least 6.7 million tons by 2030, though production of green steel is still very limited globally.

A novel way to refine iron ore

The task of greening steel production is daunting. Globally, nearly 1.9 billion metric tons of steel are produced each year, and on average, each ton of steel is responsible on the average for about 2 tons of carbon dioxide emissions.

Roughly 90% of the emissions associated with steelmaking are generated in smelting iron. The step has historically depended on coal — to create the high temperatures at which iron ore can be smelted and impurities removed. Seven such blast furnace plants remain in operation in the United States.

Another process, known as direct reduction of iron, or DRI, depends on natural gas to remove contaminants from iron ore. DRI systems can also be configured to use hydrogen, though the current supply of green hydrogen — hydrogen created using renewable energy — is too scant and too expensive to be a reliable source of low-emissions fuel right now. Still, hydrogen-based DRI is currently the most promising emerging alternative to traditional, emissions-intensive steel production. DRI plants can start using more hydrogen as it becomes available.

Boston Metal sidesteps that complication by producing iron through a process called molten oxide electrolysis. Iron ore is poured into a brick-lined chamber, where it dissolves in an electrolyte solution. An electric current runs through the liquid, melting the ore. Contaminants in the ore — like alumina, silica, and calcia — are left behind in the solution, while the molten metal settles to the bottom of the chamber.

When enough iron has accumulated, the chamber is tapped. A meter-long bit drills into the cell, allowing the molten iron to flow out. Then the hole is plugged with a ceramic clay until the next tapping.

Though the equipment runs constantly at a temperature of about 1,600 degrees Celsius, the air just a few feet away remains cool. The entire production floor is light and clean, and the only noise is a low buzz from the machines — a far cry from the traditional sweltering, clamorous steel mills.

The electricity powering the process runs from an anode at the top of the chamber to the molten metal, which acts as a cathode. The anode is one of Boston Metal's major technological innovations. For the equipment to produce significant quantities of molten iron, the anode must be made of a material that can resist corrosion in the oxygen-rich environment. MIT researchers developed an alloy that can do just that.

The anode "can run for a month and it comes out the same shape and size. The company relies on laser imaging to precisely find and measure even the most miniscule changes.

The first trial runs in the MIT lab used an anode about the size of a marble and produced a roughly 1-gram nugget of purified iron. At Boston Metal's 38,000-square-foot facility in a Boston suburb, five of these small-scale systems are still in operation, allowing technicians, over the course of several hours, to see how variations in the electrical current or the electrolyte composition affect the process.

Several midsize systems also run in the facility as does one full-scale cell that can produce roughly a ton of iron per month using 10 anodes, each roughly the size and shape of half a basketball. When expanded to production scale, each cell can be fitted with more anodes, and each operation can have multiple cells running. It is estimated that commercial producers will be able to put out multiple tons every day.

Commercializing molten oxide electrolysis

As Boston Metal continues to refine its system, it is also trying to work its way toward profitability. To get there, company decided on a strategy that, perhaps unexpectedly, puts steel on the back burner for the moment.

The key is niobium, a metal that is removed from iron ore as it is being refined and is valuable as an alloying element in steel production. Niobium sells for about $82 per kilogram (about $74,000 per ton) right now, according to the Shanghai Metals Market, while steel goes for roughly $900 per ton. Boston Metal plans to focus on extracting and selling the metal for now, to start bringing in money while continuing to hone its method for producing green steel.

In 2023, the company began building a facility in Brazil that will use molten oxide electrolysis to extract niobium from iron ore for sale. The first cell in the operation should come online this month, and revenue is expected to start flowing later this year.

This graduated approach gives the company some stability at a time when the future of green steel in the U.S. is anything but certain.

Boston Metal plans to build a demonstration plant for steel production by 2028 — it's still looking for the right site — then take the system to market. The company intends to license the technology to steel-making operations, rather than owning and operating facilities itself, and is already exploring opportunities in the United States, Europe, the Middle East, and Asia.

Producers using Boston Metal's technology are likely to seek out locations with a clean, low-priced electric supply to maximize the economic and environmental advantages.

Boston Metal's technology and that of other companies exploring the use of electricity hold a lot of promise, but plenty of questions and hurdles remain.

Source: Canary Media Daily, 5 June 2025

Electra's Clean Iron Electrowinning Process

Purifying iron ore is a key step in steelmaking — and a carbon-intensive one. Big steel and mining players are funding this startup's all-electric tech to see if it can scale.

Electrowinning is a time-tested method for removing impurities from metals. It is able to run on clean electricity and at low temperature. It can help clean up steel industry by replacing the blast furnaces.

Startup *Electra*, is developing electrolytic clean-iron technology. It has raised $186 million from investors, including some major players to further test its proposition. Investors include Capricorn Investment Group and Temasek Holdings, Breakthrough Energy Ventures, Lowercarbon Capital S2G Investments, Rio Tinto, Roy Hill, BHP's venture capital arm, steelmakers Nucor and Yamato Kogyo, and major iron and steel buyers organizations Interfer Edelstahl Group and Toyota Tsusho Corp., the trading arm of Toyota Group and supplier to Toyota Motor Corp.

The funding will finance Electra's first demonstration-scale project, which aims to produce about 500 tonnes of high-purity iron annually when it opens next year. The company hopes to have a commercial-scale production site, of undisclosed size and capacity, operational in 2029.

Steelmaking accounts for 7% to 9% of global greenhouse gas emissions, and most of those emissions are tied to the process of iron making in blast furnaces that needs metallurgical coal.

Cutting that carbon footprint requires shifting to electric arc furnaces that use electricity to melt a mix of steel scrap and crude iron into new steel. But to clean up the industry, the iron going into those furnaces must first be produced in ways that don't choke the atmosphere.

Electra's process is competing against a number of alternative methods for making lower-carbon iron. The most prevalent approach — and the one that's got billions of dollars of investment — is direct reduction of iron via hydrogen.

Direct reduced iron is being deployed by the biggest green-steel projects in the world, such as the *H2 Green Steel* and Hybrit plants in Sweden. But early-stage efforts to build up capacity for hydrogen direct reduced iron in the U.S. have faltered in the face of high costs, and lack of commitments from buyers. The process also requires cost-effective production of carbon-free hydrogen, a challenging prospect in and of itself.

Boston Metal, a spinout of the Massachusetts Institute of Technology, aims to decarbonize steelmaking with a very different method known as *molten oxide electrolysis*, which uses electricity to heat iron ore to blast-furnace temperatures. The startup plans to open its first demonstration plant in 2026. That process avoids carbon emissions but still requires super-high temperatures and hefty electricity inputs.

Electra's approach, electrowinning, is already used to purify metals such as copper, nickel, and zinc. It works by dissolving iron ores into an aqueous acidic solution to separate iron ions from impurities in the ores, and then electrifying the solution to deposit pure iron onto metal plates.

Electra's quest to purify iron via electrowinning has faced some key challenges. For example, the company had to figure out how to accelerate the dissolution of iron ore in the solution and how to maintain the purity of the ions collected through the electrowinning process. A handful of research consortiums and corporations are pursuing electrowinning iron but using an alkaline rather than an acidic solution.

Electra has produced plates of pure iron in pilot tests. That's just the first of many steps in proving it can cost-effectively scale up the technology to operate in high-throughput industrial settings using iron ores with a wide mix of chemical compositions.

Electra's technology can also purify a wide range of iron ores, which could open up new markets for iron-mining giants like those investing in the startup's latest round. That's particularly valuable for low-carbon steelmaking since hydrogen direct reduced iron can handle only a narrow range of impurities, which could limit its use to the available supplies of higher-quality ores.

Another distinguishing feature of Electra's approach — its modularity. A typical steel plant that uses a blast furnace or the direct reduced iron process costs billions of dollars, takes years to build, and involves coordinating the delivery of massive amounts of iron and fuel.

Electra's electrolytic modules, by contrast, can be deployed at a variety of scales to match supply and demand dynamics in different markets. "One electrical array can go up to 50,000 tons. It may be possible to have to a 2-million-ton plant to become economically viable. It also allows Electra to test its modules and improve performance and cost in succeeding generations.

Similar dynamics have helped propel solar panels and lithium-ion batteries to the cheapest and most easily deployable energy technology today. It helps to improve repeat unit and aiming for perfection for quality, for defects — and to learn fast as a result.

Canary Media, 24 April 2025

US Steelmaking is Slowly Getting Cleaner

None of the new steel and ironmaking capacity planned for the U.S. is coal-fired — but old units aren't going anywhere, either.

All new steelmaking and ironmaking capacity in the U.S. is slated to use technologies that sidestep the need to burn coal.

Steel and iron are among the most essential and widely used materials in the world. They're also among the dirtiest to produce, responsible together for as much as 9% of global carbon dioxide emissions and a staggering amount of harmful local air pollution. This is because the sector uses an enormous amount of coal. The fossil fuel is traditionally used in blast furnaces.

In the U.S., 12 blast furnaces are still producing iron ore this way, but the country's steelmakers have largely shifted away from making primary steel. Instead, they increasingly rely on electric arc furnaces, a much cleaner technology that uses electricity to melt iron and scrap steel and turn it into fresh steel.

About 70% of the country's steelmaking capacity today uses electric arc furnaces. All of the new capacity planned in the U.S. will come in the form of facilities that use electric arc furnaces.

In theory, steelmakers can run this electric equipment on clean power and pair it with a coal-free iron production process called direct reduction to create carbon-free primary steel. All of the new ironmaking capacity planned in the U.S. will use direct reduction to make "low-carbon" steel. The country will more than double its capacity for direct reduction of iron in the coming years.

For now, U.S. facilities that use direct reduction will mainly rely on natural gas to purify the ore. Doing so can halve carbon emissions compared with using a coal-based blast furnace. This eventually will use carbon-free hydrogen in place of gas in the reduction process.

However, despite plans for cleaner facilities, steelmakers don't intend to retire their dirtiest assets. Several of the dozen coal-fired blast furnaces still operating are slated to undergo costly relinings before 2030 — effectively committing to operating for many more years. A retirement plan has been announced for only one.

Source: Canary Media Daily, 30 May 2025

Green Graphite

Graphite is an essential yet often overlooked material in green transition, crucial for sustainable steelmaking, batteries, nuclear power, and electrification. Current graphite production methods also present major sustainability challenges, with significant climate impacts due to heavy reliance on fossil-based materials and energy-intensive processes.

The growing graphite shortage

Graphite is a unique form of carbon with excellent electrical and thermal conductivity, making it vital for high-temperature industrial processes like steelmaking. As the steel industry moves away from traditional blast furnaces, EAF steelmaking is gaining traction as a cleaner, more sustainable alternative. Central to this transition are graphite electrodes, which conduct high-current electricity to achieve temperatures exceeding 3,000°C — essential for melting and refining steel. Each tonne of EAF-produced steel consumes approximately 2 to 4 kg of graphite electrodes, emphasizing graphite's strategic importance. But as EAF steelmaking expands globally, graphite demand is rising, further straining an already tight supply.

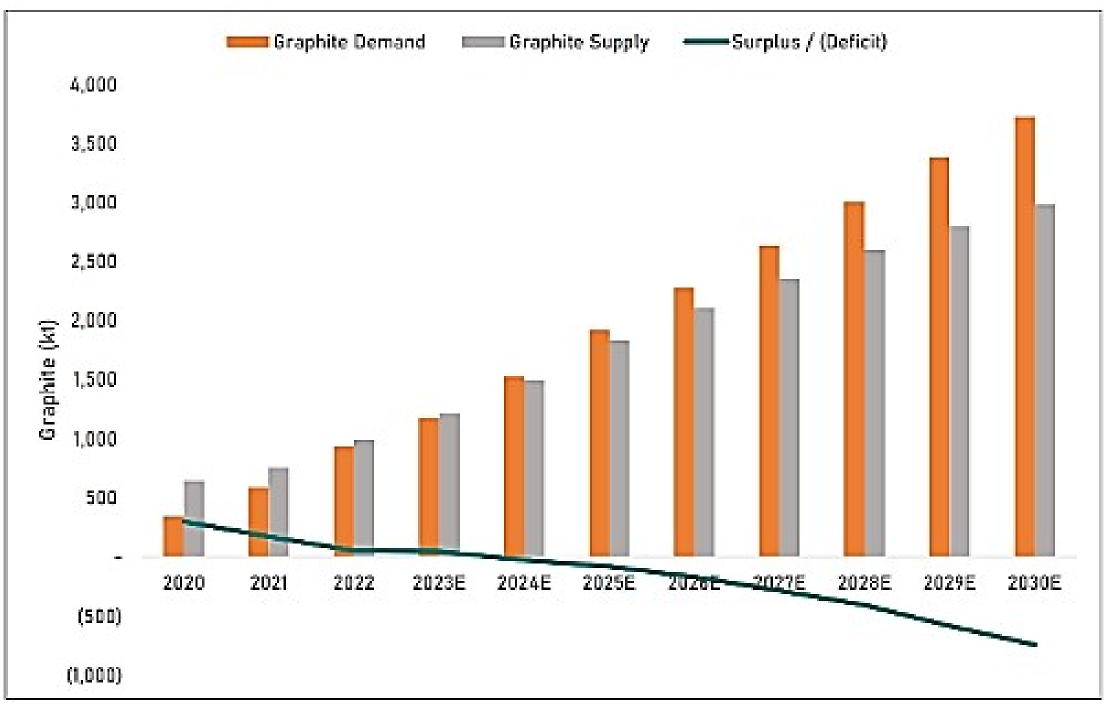


Figure 1: Graphite demand / supply showing market deficit beginning 2025E

Source: Macquarie Research (March 2023)

Steelmaking isn't the only industry driving this demand. Graphite is critical for lithium-ion batteries, with each electric vehicle battery containing around 70 kg of graphite on average. It's also vital in nuclear reactors, fuel cells, and the defence industry. As these sectors grow, competition for graphite intensifies, creating additional pressure on supply chains. By 2030, graphite demand is expected to surpass supply by more than 15%, posing a serious bottleneck for dependent industries like steelmaking.

The hidden fossil footprint of graphite

Graphite comes in two main forms: natural and synthetic. Natural graphite, mined from the earth, causes environmental harm such as deforestation and water pollution, and it also faces supply risks due to geographic concentration. However, natural graphite is unsuitable for EAF electrodes because it lacks sufficient strength, density, and conductivity.

As a result, synthetic graphite, produced from needle coke (a petroleum refining by-product) and coal tar pitch, dominates electrode manufacturing. Converting coke and pitch into graphite requires substantial electricity, which can contribute significantly to its overall emissions, depending on the energy source used. The production process also directly emits CO_2 due to the chemical composition of raw materials. Imported synthetic graphite from China averages around 17 kg of CO_2 emissions per kilogram produced. In coal-reliant regions like Inner Mongolia, this figure can rise to 40 kg per kilogram.

Moreover, graphite electrodes used in steelmaking are mostly carbon. Their combustion releases an additional 3.67 kg of CO_2 per kilogram.

For industries pursuing emissions reductions, this is a critical challenge. Steelmakers urgently need a greener graphite supply to meet climate targets.

Can recycling fill the gap?

Recycling graphite, particularly from electrode stubs, has potential but faces significant limitations. Currently, only about 3%–10% of graphite from electrodes can realistically be recycled. Recycling involves energy-intensive processes such as purification, cleaning, and re-graphitization at high temperatures (~3,000°C), leading to substantial energy consumption and additional costs.

Contamination from other materials further reduces recycled graphite's strength and conductivity. Due to these limitations, recycled graphite is primarily reused as a carbon additive (recarburizer) rather than for electrode production.

Despite these challenges, recycling still comes with significant environmental impacts. Studies estimate that the carbon footprint of recycled graphite ranges from 0.5 to 9.8 kg CO_2 per kilogram, which, while lower than imported synthetic graphite, remains substantial.

A new path forward with bio-graphite

Bio-graphite offers a sustainable alternative to fossil-based graphite by utilizing biomass as a renewable carbon source. While bio-based graphite still emits CO_2 when consumed, this carbon originates from renewable biomass rather than fossil fuels. Biomass absorbs CO_2 as it grows, making the entire process carbon-neutral overall. Consequently, bio-graphite is exempt from ETS, both in terms of production emissions and its use in applications such as steelmaking electrodes.

For years, universities, including Sweden's Royal Institute of Technology (KTH), have explored bio-graphite production. Although research made progress, scalable production methods remained elusive.

Nordic Bio-Graphite (NBG) developed a patent-pending process enabling efficient, industrial-scale bio-graphite production. The method starts with biochar, a carbon-rich material derived from biomass. Through a specialized refining process, biochar is converted into high-purity graphite suitable for electric arc furnace (EAF) steel electrodes and battery anodes. Unlike synthetic graphite derived from petroleum coke, the bio-graphite is entirely fossil-free, significantly reducing emissions, cutting chemical use by 95%, and lowering energy consumption by 70%.

Currently to scale up the technology, it is planned to build a pilot facility and initiate larger-scale testing.

Time for Action

Graphite shortages threaten to increase steelmaking costs and hinder progress toward climate goals. A shortage could also slow the transition to electric vehicles and renewable energy storage, impacting multiple industries.

Companies like NBG demonstrate that sustainable, fossil-free graphite production is not only feasible but scalable. Accelerating this transition requires investment, supportive policies, and industry collaboration. Graphite isn't just another commodity — it's the backbone of the clean industries of the future.

Source: Green Steel World News Update, 15 may 2025

Surging Excess Capacity Threatens Steel Market Stability, Employment and Decarbonisation Plans

Countries must urgently address policies that are driving the continued expansion of steel excess capacity to prevent further erosion of market stability and fair competition in the steel industry, according to a new OECD report.

The *OECD Steel Outlook 2025* shows that excess capacity is projected to rise to 721 million metric tonnes (mmt) by 2027, exceeding by around 290 mmt the combined steel production of OECD countries in 2024. This surge is being driven by continued capacity expansion, despite weak growth in global steel demand. High levels of subsidies and other policy distortions in several non-OECD economies are key drivers of this imbalance, posing risks to market stability, employment, supply chains and decarbonisation efforts.

Notably, China's steel subsidisation rate, as a percentage of firm revenues, is ten times higher than that of OECD countries. Chinese steel exports have more than doubled since 2020, reaching a record level of 118 million tonnes in 2024. This surge has disrupted steel markets in OECD economies, leading to a fivefold increase in anti-dumping measures since 2023.

These developments place considerable pressure on steel companies across OECD countries, with profitability falling to near historic lows. Employment has also been affected, with an estimated 113 000 jobs lost in the member countries of the Global Forum on Steel Excess Capacity (GFSEC) between 2013-21. Moreover, the ongoing imbalance threatens decarbonisation efforts, as 40% of projected new capacity additions between 2025 to 2027 are expected to rely on emission-intensive blast furnace/basic oxygen furnace (BF/BOF) processes, undermining investments in low-carbon technologies.

The OECD Steel Outlook calls for targeted international action in three key areas. First, structural reforms, with governments needing to eliminate market-distorting subsidies and support that fuel excess capacity. Second, enhanced transparency and greater disclosure of government support measures and capacity developments to help ensure effective international co-ordination and a level playing field. Third, international co-operation to accelerate the development and deployment of low-carbon technologies, including by tackling low-efficiency excess capacity and by sharing decarbonisation policy best practices.

{The OECD (Organization for Economic Co-operation and Development) has 38 member countries. ***Europe:*** *Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye, and the United Kingdom.* ***North America:*** *Canada, Mexico, and the United States.* ***Asia:*** *Japan, South Korea.* ***Australia and New Zealand:*** *Australia and New Zealand.* ***South America:*** *Chile.* ***Central America:*** *Costa Rica.****Other:*** *Colombia and Israel.}*

Source: OECD Steel Outlook 2025, Press release, 27 May 2025

Global Steelmaking Capacity: 2024		
	Million Tonnes	Annual Change, %
China	1,141.5	0.0
EU	205.7	0.0
India	179.5	11.4
US	119.3	0.0
Japan	117	-0.7
Russia	90.8	0.0
S Korea	81.6	0.0
Iran	59.2	1.7
Turkiye	59	208
Brazil	50.9	0.0
Rest of the World	367.6	
World Total	2472.1	0.6

This Start-up Turns Steel and Aluminium Waste into Usable Metals

Sun Metalon in Chicago-area removes gunk and grime from metal slivers normally thrown away, helping to reduce emissions from aluminium and steel production.

The Chicago-area start-up claims its technology could shave emissions from the global metal industry by allowing companies to recycle grimy metal slivers and sludge left over from steel and aluminium production.

Steel and aluminium production involves substantial carbon emissions. Decarbonizing these sectors is expected to be a huge and costly undertaking, involving the overhaul of industrial processes more than a century old and the retrofitting of sprawling mills.

Sun Metalon aims to take smaller bites of the steel-decarbonization apple with an oven-sized box that promises to extract recyclable metal from a waste stream that would otherwise be sent to a landfill.

A lot of waste material is thrown away, in some cases paying for it because it's contaminated with toxic materials. *Sun Metalon* is offering a way to create value from that.

The company announced it had raised a total of $9.1 million in second-round start-up funding from four investors, including Japanese steelmaking giant Nippon Steel.

Substantial amount of steel and aluminium is made from recycled metal, not raw ore, as recycled metal emits much less carbon emissions. Increasing the amount of metal that can be recycled is one means of decarbonizing the industry.

Some companies are looking at making steel in a new way, as opposed to conventional way based on coke, an energy-dense substance derived from coal. These methods may be the faster and most direct way to reduce emissions.

Hot boxes: How Sun Metalon's tech works

The technology involves cleaning up tiny scraps too contaminated with oil or other substances to be recycled.

Sun Metalon's units are modular "ovens" that can be placed on a factory or foundry floor; the metal waste fed into them is basically cleaned with intense heat and turned into "pucks" or "coins" that can be recycled in metal-making processes.

Heating evaporates fluids, condense impurities back to liquid, which are collected. The process involves reaching the boiling point of oil. The whole thing is powered by electricity, making it carbon-free if renewable energy is available.

Sometimes scrap has a negative value, especially for sludges — no one can recycle it, so they have to pay for disposal.

Sun Metalon's technology turns waste into pucks that can be recycled in metal-making processes.

The pucks can be sold to electric arc furnaces — essentially steel mills making recycled steel — or other metal recycling operations.

Source: Canary Media Daily, 9 June 2025

Cleveland-Cliffs Ohio Plant Turning Back to Fossil Fuels

It was supposed to be the United States' grand entry to the global race to make green steel — a symbol of a return to American innovation and of revival in the nation's rusting industrial heartland.

Instead, Cleveland-Cliffs' plan to replace coal-based blast furnaces with cleaner, hydrogen-ready technology at its Middletown Works facility in Ohio now risks being swept away.

Neither the Cleveland-based steelmaker nor the Department of Energy, which put up $500 million to back the project, has formally pulled the plug on the plan to build a direct reduced iron plant capable of using hydrogen and two electric melting furnaces. But updates from the company in recent weeks suggest the ambitious carbon-free version of the project is all but dead.

The company was negotiating with the Department of Energy to “explore changes to the scope to better align with the current energy priorities. Rather than use hydrogen, the green version of which remains expensive and in limited supply, the project would “instead rely on readily available and more economical fossil fuels. The lack of a hydrogen-generating hub nearby made it impossible to source the fuel on the project’s timeline.

Without hydrogen, the entire thing falls apart. Before all this uncertainty, this project was going to be, potentially, the first green-steel plant in the U.S.

The up-front costs of installing entirely new equipment always outweighed those of simply renovating the existing coal-fired unit. Relining a blast furnace costs up to $400 million. The total cost of building the DRI plant and electric melting furnaces came out to $1.6 billion.

The traditional coal-based method of making steel — which involves melting iron ore in a blast furnace then refining the iron into steel in a basic oxygen furnace — produces the cheapest metal, at roughly $390 per metric ton. Scrap melted down in an electric arc furnace came out to $415 per metric ton. Steel made with iron from DRI fueled with natural gas and then refined in an electric arc furnace averaged out to $455 per metric ton.

Producing the iron through DRI with entirely green hydrogen, instead of gas, spiked the price to around $800 per metric ton.

The cost of making hydrogen with electrolyzers powered by certifiably clean electricity is among the biggest challenges to green steel in the U.S.

That isn’t an issue for Europe’s leading green steel project. Formerly known as H2 Green Steel, the newly renamed Stegra plant benefits from the vast amount of carbon-free energy in Sweden, where the overwhelming majority of power is generated from hydroelectricity, wind turbines, and nuclear reactors.

In the U.S., by contrast, green hydrogen plants hinged on massive projects to construct wind turbines and solar panels that needed to be 70% larger in capacity to make up for the intermittency of the renewables. A dedicated nuclear reactor to generate the power for electrolysis could do so more efficiently, noting that the availability of underground salt caverns to store hydrogen for later use could also further bring down the cost of projects.

Amount of new renewables that would have to build out, along with transmission infrastructure, was clearly going to be expensive.

In 2021, a target was set of $1 per kilogram of green hydrogen within the next decade. A Florida-based geothermal startup called Magma Power filed patents that claimed it could generate green hydrogen for less than $1 per kilogram.

If the U.S. managed to achieve a supply at that price, steel made with green hydrogen-powered DRI and an electric arc furnace could come out to $544 per ton, according to a report published last July by Transition Asia, a nonprofit think tank focused on climate research. That's marginally less than the cost of steel from gas-powered DRI and an electric arc furnace, at $550 per ton, or blast furnace steel at $565 per ton. If the U.S. were to institute even a modest carbon price, it could reach cost parity with coal-fired steel.

But if the tax credit disappears, those numbers will be near-impossible to achieve.

Regardless of cost challenges, "it's still an attractive solution, not just because of the potential to curb climate-warming emissions but also criteria air pollutants and other hazardous air pollution tied to the production process from a blast furnace with coal.

Source: Canary Media Daily, 18 June 2025

Picture of Deep-blown 'dead man' of HKM Blast Furnace

Blast Furnace of *Hüttenwerke Krupp Mannesmann GmbH* (HKM) was built in 1973 and has a work volume of approx. 2450 m³

At the end of May 2025, HKM started the planned 38-day major shutdown of blast furnace A and successfully tapped the salamander. This cleared the way for extensive maintenance work to keep the furnace in optimal condition.

Source: Mr. Ngo Duc TuyenI of HKM shared a picture of their deep-blown 'dead man'.

Seminar on "Emerging Technologies & Market in Die Casting"

India Lead Zinc Development Association (ILZDA) organised a Seminar on **"Emerging Technologies & Market in Die Casting"** on 2^{nd} June 2025 at India International Centre, New Delhi. IIM Delhi Chapter was invited to be a Knowledge Partner.

Shri R K Vijayavergia, immediate Past Chairman of IIM Delhi Chapter chaired one of the Technical Sessions in the Seminar.

About 60 participants attended the Seminar. Some members of the Executive Committee of Delhi Chapter also attended the Conference.

Conference on "Carbon Markets & Decarbonisation"

Metalogic Projects Management Services organised a **Conference on "Carbon Markets & Decarbonisation"** at Le Meridien, New Delhi on 16^{th} June 2025. IIM Delhi Chapter was invited to be a Supporting Association in the Conference. Some members of the Executive Committee of IIM Delhi Chapter also attended the Conference.

Bharat Corrosion Meet 2025

Association of Corrosion Professionals (AOCP) along with Matcorr organised B**harat Corrosion Meet 2025** at New Delhi on 19^{th} & 20^{th} June 2025. IIM Delhi Chapter was invited to be a Knowledge Partner of the Conference.

Shri R K Vijayavergia, Immediate Past Chairman Delhi Chapter was Guest of Honour in the Inaugural Program and delivered a address in the Conference on "Recent Advancements in Metallurgical Science and Technology for Corrosion Control".

Know Your Members

Shri B D Jethra
Former Advisor
Planning Commission
Govt. of India

Shri BD Jethra graduated in Metallurgical Engineering with First Class (Honours) from IIT, Bombay in 1962. He enjoys experience of more than half a century, including 13 years' field experience in erection, commissioning and management of industrial enterprises, nine years in public sector and three years in private sector, over 27 years experience in planning and development of industries and minerals and over 10 years in consultancy. Besides being involved in the formulation, execution and monitoring of the country's Five Year and Annual Plans in the entire industries and minerals sector, including large, medium, small, village and cottage industries. He was intimately associated with all aspects of formulation, implementation and evaluation of industrial and mineral policies and programmes as well as Public Sector in India, covering, inter alia, formulation, appraisal and economic evaluation of industrial and mineral projects, monitoring the progress of implementation of projects and schemes, industrial and public sector reforms, privatization, industrial sickness, restructuring and rehabilitation, corporate governance, etc.

He was a member of several High-level Committees, Development Councils, Working Groups and Panels on different aspects of industrial planning, policy formulation, sickness, restructuring and rehabilitation of enterprises etc. He was Member- Secretary of the Eighth Five Year Plan (1990-95) and Ninth Five Year Plan (1997-2002) Working Groups on "Management of Public Enterprises". He was also Member-Secretary of the Eighth, Ninth and Tenth Five Year Plan Working Groups on Small and Medium Scale sectors as well as the "Study Group on Small Scale Enterprise" set up by the Government of India. He was also a member of the Eleventh Five Year Plan (2007-12) Working Groups on Iron & Steel and Cement.

He has been actively associated with The Indian Institute of Metals for over 50 years and is its Honorary Member. He was Chairman of Delhi Chapter during from 1986-1990 and 2018-19. He has also been very actively involved in the organization of MMMM events, the biennial Exhibition cum Conference, being organized by IIM Delhi Chapter.

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