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The Indian Institute of Metals
Delhi Chapter

Jawahar Dhatu Bhawan
39 , Tughlakabad Institutional Area, M B Road
Near Batra Hospital, New Delhi-110 062

Tele: 011-29955084

@ iim.delhi@gmail.com   www.iim-delhi.com

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Editor-in-Chief : R. K. Vijayavergia

Associate Editors : R. K. Singhal

Chandana Arjun

Obituary

Shri S C Suri, Hon. Member of The Indian Institute of Metals passed away on 29th September 2025. He was ailing from sometime from age related issues.

Suri Sahab, after acquiring B.Sc. in Chemistry Honors with Second Rank in Delhi University in 1957, completed post graduate studies in Metallurgy from Indian Institute of Science, Bangalore, in 1959. He joined the then Hindustan Steel Limited (predecessor of SAIL) in 1959 at Durgapur. Subsequently, he was shifted to R&D Centre of SAIL (RDCIS) at Ranchi and then to SAIL Corporate Office at Delhi. He was also Executive Director of Centre for Engineering & Technology (CET), SAIL, at Ranchi for some time. His areas of expertise include R&D in Steel Industry, Engineering & Design of Iron and Steel Plants, Energy Optimization in Ferrous Industries, Alloy Steel Technology, also Technology and Corporate Strategy and Business Management. During his stay in SAIL, he travelled widely on several occasions to Europe, USA, UK and Japan. He superannuated from SAIL as Executive Director in September 1995. Post superannuation, he was retained as Advisor in SAIL. Later he was Consultant with MMTC and Centre for Policy Research.

Suri Sahab was actively associated with The Indian Institute of Metals since his Durgapur days. He was Hon. Treasurer of Ranchi Chapter in late seventies. He became a Life Member of IIM in 1988, Life Fellow in 1993 and Honorary Member in 2013. He was bestowed with IIM Outstanding Service Award in 2015. He was Member of IIM National Council for several terms.

He had a long association with the Delhi Chapter of IIM. He played a key role in organizing NMD-ATM of IIM in 1988 at Delhi. He was Vice Chairman of Delhi Chapter for eight terms and was Chairman during 2013-14 to 2014-15. He was closely involved in organizing various activities of Delhi Chapter, including biennial International Conferences on Minerals, Metals, Metallurgy and Material (MMMM) at Pragati Maidan, New Delhi from 2010 to 2018.

Irrespective of his designation in the Executive Committee of Delhi Chapter, he used to regularly come to the Chapter premises since 2009, oversee the on-going activities and guide office staff. For many years, he brought out monthly newsletter of the Chapter, first in physical form, subsequently in e-format.

Suri Sahab wrote a Book on "Indian Steel Perspectives 2025". He was associated with a project on India-2025. He has published over 25 papers/reports related to Iron & steel technology in various international and national journals. He authored a study on Steel Pipeline Requirements in Oil, Gas, Water and Slurry Segments. He received Vijaya Rattan Award in 2005 for Proficiency in Industry – Academia Interaction.

He had guided me very much in several tricky issues about the steel industry.

Shri Arvind Pande, Former Chairman, Steel Authority of India Limited

An outstanding technologist, Shri Suri made major contributions to SAIL in various capacities and thereby to the Indian steel industry. A sincere and committed organisation man, he was very actively involved with The Indian Institute of Metals since the 1960s and served it with distinction. In particular his service to the Delhi Chapter was commendable.

As a person Shri Suri was warm, affable and supportive.

It has been my privilege to know such a wonderful human being.

Dr. Sanak Mishra, Professor of Practice, COEP Technological University, Pune, Former Managing Director, Rourkela Steel Plant, Former President, The Indian Institute of Metals

Mr. Suri was very active, even after his retirement he continued to contribute immensely to IIM Delhi Chapter by organizing conferences as well as editing the Chapter Newsletter for long. Earlier, in his young days he was very active in Durgapur and Ranchi Chapters of IIM, besides attending the NMDs & ATMs every year.

Mr. Suri was a hard-core Steel Metallurgist and was very passionate about learning more and more about steel making and applications. He had a great skill in writing, and published a book "**Indian Steel Perspectives 2025**" that will be very useful to the future generation.

During his career he made outstanding and significant contributions to the R & D activities of SAIL.

By nature, he was always soft spoken and simple. Mr. Suri had unique talents and diverse qualities, his memories will live for long.

L. Pugazhenthy, Executive Director, Indian Lead Zinc Development Association, Former President, IIM

Extremely courteous, supportive and a friendly personality. I am indebted to him for his valuable inputs and insights on almost every aspect of the industry. As a member of IIM Delhi Chapter, Mr. Suri was instrumental in organising the annual conferences on various important topics and gave us an opportunity to interact with some of the best minds of Indian steel industry.

I will miss the company of an ever smiling, cordial and sincere personality.

Dr. Sushim Banerjee, Ex ED SAIL, Ex Director General, INSDAG

Scope 4 Emissions

Scope 4 emissions, also known as ***avoided emissions***, represent greenhouse gas reductions achieved outside of a company's direct operations and value chain, but as a result of their products or services. Essentially, it's about quantifying the positive impact a company has on reducing emissions by enabling others to do so. This concept contrasts with Scope 1, 2, and 3 emissions, which focus on direct and indirect emissions from a company's own operations and value chain.

Scope 4 can be defined as a quantification of the greenhouse gas emissions that will not be released into the atmosphere, or removed from it, as a result of adopting a particular climate technology compared to the current solution. In other words, scope 4 quantifies the climate impact of greener products or services.

- Scope 4 emissions are not emissions that a company directly creates, but rather emissions that are avoided because of the company's products or services.
- They are a way to measure and recognize the positive impact a company has on reducing overall greenhouse gas emissions.
- Examples include energy-efficient appliances, fuel-saving tires, and teleconferencing services.

Why Scope 4 Emissions Important?

- ***Highlighting positive impact:*** Scope 4 emissions help companies showcase their contribution to a low-carbon economy.
- ***Encouraging innovation:*** Focusing on avoided emissions can drive innovation in product design and services that reduce overall emissions.
- ***Enhancing sustainability:*** By accounting for Scope 4 emissions, companies can demonstrate a more comprehensive approach to sustainability.
- ***Attracting investors and customers:*** Increasingly, investors and customers are looking for companies with strong environmental performance, and Scope 4 reporting can be a key differentiator.

Examples of Scope 4 Emissions:

- ***Energy-efficient products:*** Appliances, lighting, and building technologies that consume less energy.
- ***Transportation solutions:*** Electric vehicles, efficient transportation systems.
- ***Remote work and communication tools:*** Teleconferencing and other technologies that reduce the need for travel.
- ***Low-carbon materials:*** Using recycled materials or developing products with lower carbon footprints.

Scope 4 Emission in Steel Industry

Terms ***scope 1, scope 2 and scope 3*** are now familiar in steel industry - different categories for direct and indirect climate emissions. Scope 4, a newer concept, covers how a company's services or products contribute to reducing or avoiding emissions throughout the value chain.

Reporting emissions and setting targets to reduce them has proven to be both environmentally and economically beneficial. However, it is only part of the solution if we are to achieve our climate goals. Companies can play an important role in developing and promoting products and services that avoid emissions - either by enabling emissions reductions or by offering lower-emission versions of existing products.

In the steel industry, new production technology can contribute to avoided emissions. The global average factor for stainless steel produced with current technology is 2.42 tons of CO_2 per ton of steel (75 percent recycled steel) and up to 6.82 tons of CO_2 per ton of steel (30 percent recycled steel) (*Source: Worldstainless*). With new climate technology, emissions can be significantly reduced and we can avoid millions of tons of CO_2 annually.

Climate impact of Green Steel

The use of green steel is an example of avoided emissions. The production of green steel is not emission-free, but compared to traditionally produced steel, the emissions of green steel throughout its life cycle are lower.

Why is it Useful to Measure Scope 4?

The calculation of scope 4 is currently in an early development phase, and much work remains to be done before we have a common method and standard in the industry. Nevertheless, it is very useful to highlight the climate impact of greener alternatives, as the example above shows.

The steel industry accounts for eight percent of the world's global CO_2 emissions. Increased demand for lower-emission steel is critical to the transition of the industry. To create such demand in the market, it is important that customers and end users understand the benefits of low-emission products and can trust that the climate impact is real.

Attero's e-Scrap Takeback Activity

The Indian recycling firm Attero's *Selsmart Platform* is now being used 30,000 times per month for electronic scrap drop-off arrangements.

Attero claims its Selsmart model blends convenience, door step pick-up, instant digital payout and end-to-end traceability in a way that allows anyone to schedule a pickup in a handful of computer or smartphone clicks. Attero's direct-to-consumer electronic scrap take-back platform Selsmart now is active in more than 25 cities in India and is arranging some 30,000 obsolete IT equipment pick ups or drop-offs per month. Attero, based in Delhi-NCR, claims it has "laid out a clear roadmap" to reach 150,000 monthly orders, which would help it handle some 750,000 tons of obsolete electronics in total by next March. That same forecast means Selsmart would have achieved some $57.1 million in revenue by that time. The company expects the Selsmart platform user base to grow sixfold, from 500,000 users currently to more than 3 million, by the end of this year.

Launched in mid-2024, Selsmart was introduced to solve a growing gap in India's waste infrastructure—how to get unused electronics out of homes, shops and offices, and into verified recycling channels.

Attero describes the IT and consumer electronics return supply chain in India as historically "fragmented and broken." "Selsmart addresses this challenge through a fully digitized model that integrates OEM contracts, brand trade-in programs and retail partnerships into a single, organized system".

The Selsmart model blends convenience, door step pick-up, instant digital payout and end-to-end traceability in a way that allows anyone to schedule a pickup in a handful of computer or smartphone clicks.

Attero is building, with Selsmart, infrastructure that speaks to the future. "The real value lies not just in the numbers, but in how the behavior at the ground level is shifted. Attero claims to have made it easy for people and businesses to take the right step with their old electronics. "The network being created will serve the country's growing demand for circular resources without putting additional pressure on mining or manufacturing. It is smart, local and built for scale.

Attero has also announced plans to invest to increase its ability to make recycled-content rare earth elements (REE), rising from its current 300 metric tons per year level to 30,000 metric tons of annual capacity.

Regarding Selsmart, Attero has signed up with three leading air-conditioning makers to manage their complete offline and webstore exchange programs and has partnered with two other multinational corporations to run the full trade-in process for their electronics category at the webstore level in India.

Attero also has joined with two home appliances makers to offer consumer vouchers and coupons for new sales at their brand stores both online and offline based on returns made.

The Selsmart business unit of Attero runs a network of warehouses in the cities it operates, which the firm says are positioned in high-density residential and commercial zones.

Recognizing that data security is a key concern for consumers, especially in the IT sector, Selsmart ensures secure data erasure for all collected devices before they enter the recycling process.

In addition to REEs, Attero says its patented recycling technology has been designed to recover gold, silver, cobalt, copper and lithium from discarded electronics with "world-class efficiency."

Attero describes itself as India's largest e-scrap recycling company that also has a presence in Australia, Poland, Singapore, South Korea and the United States.

Source: Recycling Today, Aug. 27,2025

Copper's Growth Story

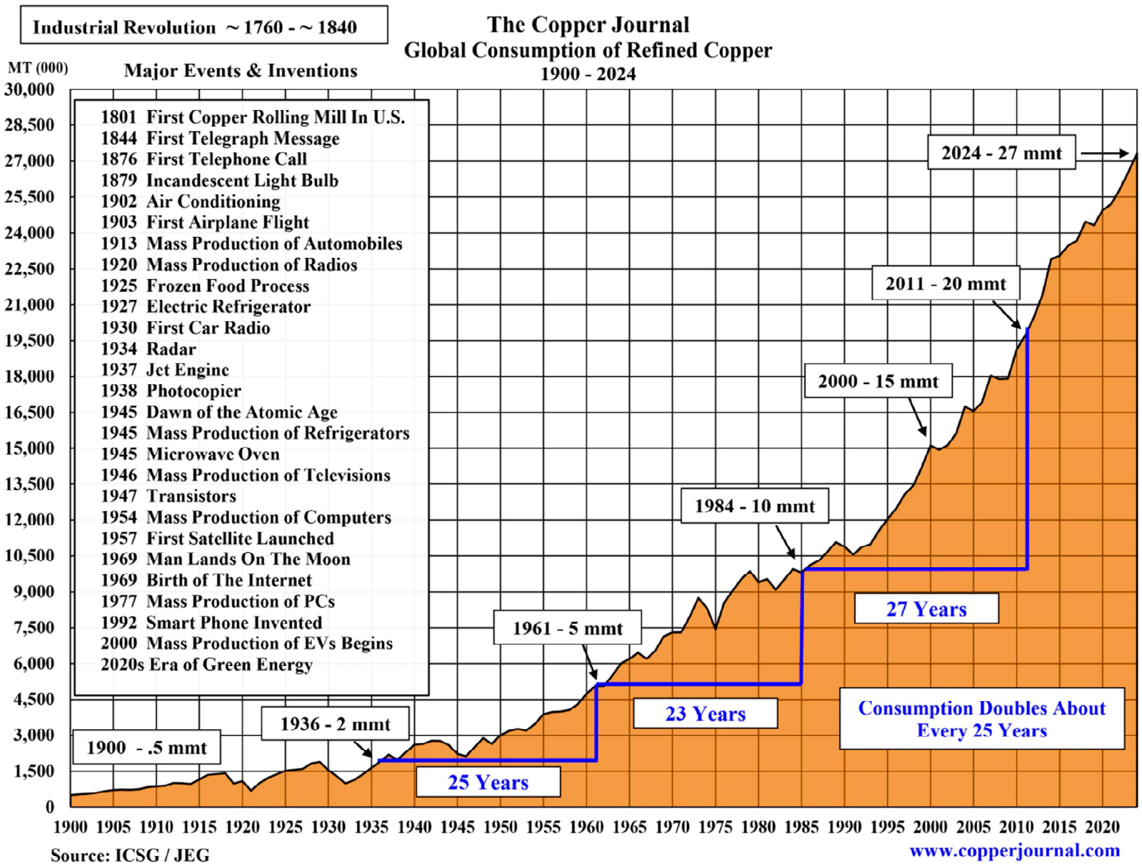
Since the 1800s, copper consumption has increased significantly, driven by new inventions and a growing population. At the turn of the 20th century, global consumption of refined copper stood at 500,000 metric tons and 1.5 billion people inhabited the world. Now, 125 years later, consumption has risen to 27 million metric tons and our population has climbed to 8.1 billion people.

It would be impossible to list all the changes that have occurred since 1900, but the Copper and Inventions chart illustrates the significant events and inventions that would not have been possible without copper.

At the top of the list is the first copper rolling mill, which was built 225 years ago in 1801. The 1800s also witnessed Samuel Morse send the first telegraph message, while

Alexander Graham Bell made the first telephone call in 1876 and Thomas Edison invented the incandescent light bulb in 1879.

Global copper production and consumption have more than doubled since 1995, with smelter production in China increasing by 11.1 million metric tons to 11.97 million metric tons—more than half the global total.



Growing Copper Consumption

Over the long sweep of time, copper consumption has increased significantly, driven by new inventions and a growing population. The industry also has seen its share of contractions, particularly during the Great Depression, when consumption of copper fell 903,000 metric tons, or 48 percent, from 1.89 million metric tons in 1929 to 989,000 metric tons in 1932. The price dropped 12 cents per pound, or 68 percent, during that period, going from 18 cents to 6 cents. While less severe, the market also has been adversely affected by recessions when global consumption declines. Past 30 years witnessed some of the most significant transition periods in the global copper market, and we remain in the midst of ongoing changes.

On the macro level, global copper production and consumption have more than doubled since 1995, and the world's population and per-capita consumption have increased significantly.

When we break down the individual components to a more granular level, it becomes more apparent how and where the industry has changed. It's worth noting that, until 2002, the United States was the world's largest copper producer at the smelting and refining levels as well as the largest consumer, accounting for approximately 20 percent of the world's total for smelting and refining.

Production: From Mining to Refining

In terms of mining, Chile was and remains the world's largest producer. The United States was the second-largest in mine production at 19 percent in 1995; however, by 2024, it was no longer among the top five.

Canada and Russia also fell off the list, replaced by the Democratic Republic of the Congo (DRC), Peru and China. Although China made up only 8 percent of global mine production in 2024, it leads in all other sectors.

At the smelter level, in 1995, the U.S. and Canada held the first and fifth positions, respectively. But, by 2024, they were surpassed by Russia and South Korea. From 1995 to 2024, smelter production in China increased by 11.1 million metric tons, or 1,360 percent, to 11.97 million metric tons, representing more than half of the global total.

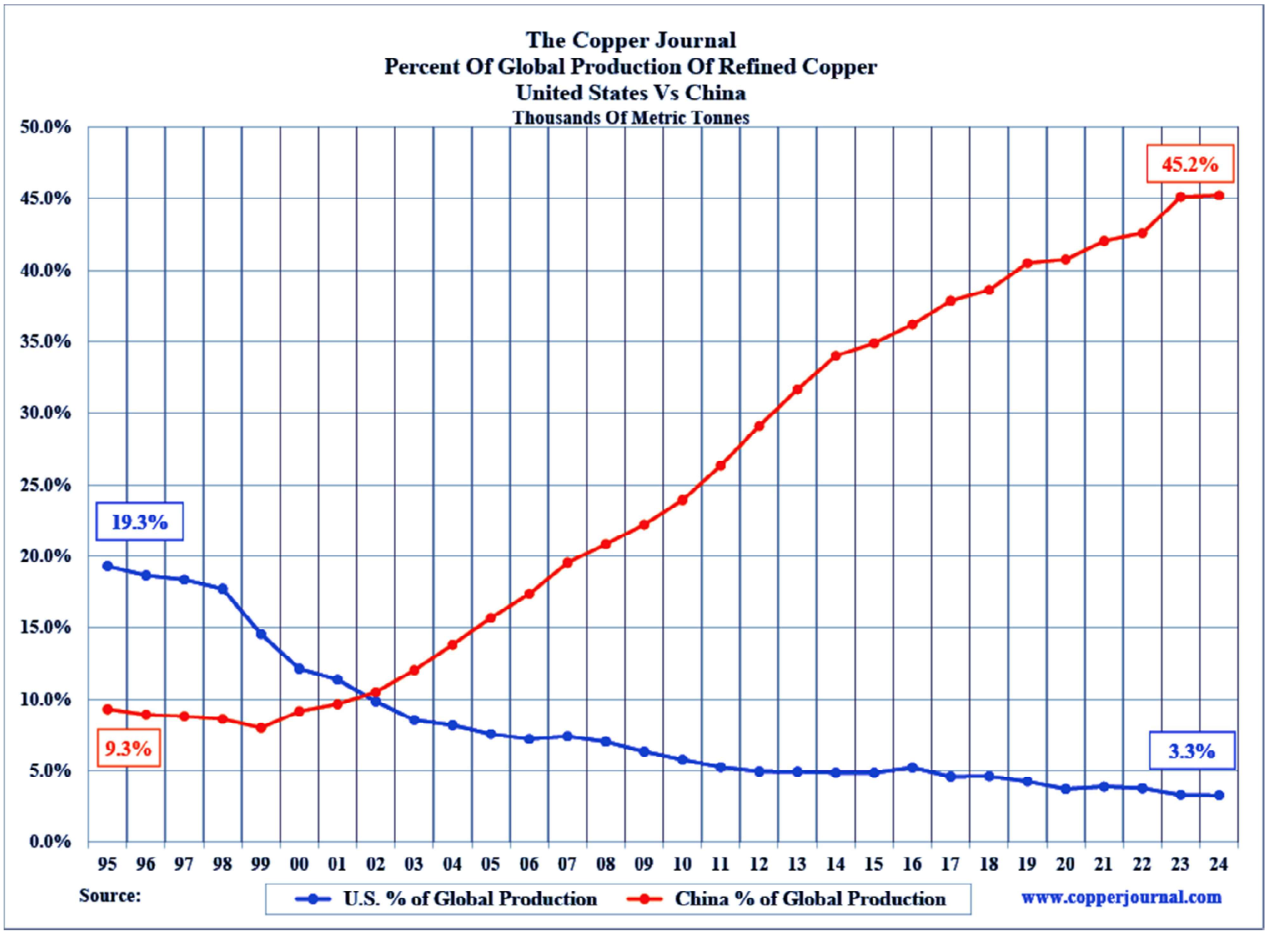
As a point of comparison, the United States has three primary copper smelters, only two of which are operating. China, on the other hand, has 55 smelters that process primary and secondary materials. Further, although the U.S. produced 1.71 million metric tons of smelted copper, or 17 percent of the world's total in 1995, that share fell to 444,000 metric tons, or just 2 percent of the total, last year.

The DRC noticeably is absent from the top five in smelting because 82 percent of its mine production goes directly to low-cost solvent extraction and electrowinning (SX-EW) refining, bypassing the smelting process.

In terms of refined copper, the United States was the world's largest producer in 1995, accounting for 2.28 million metric tons, or 19 percent of the global total. By 2024, however, the U.S. total had fallen to 903,000 metric tons, or 3 percent of the world's total.

In sharp contrast, Chinese refined production was 1.09 million metric tons, or 9 percent of the world total, in 1995, rising to 11.3 million metric tons, or by 1,040 percent, to 12.43 million metric tons, or 45 percent, by 2024.

After China, the DRC is the world's second-largest producer of refined copper, with 2.56 million metric tons, or 9 percent of the global total. It is remarkable that 20 years ago, the DRC produced just 20,000 metric tons from primary material. In 2007, it started SX-EW, with 14,000 metric tons of production.



Global Refined Copper Consumption

Since 1995, China has gone from consuming just 9 percent of the refined copper produced globally to 58 percent last year. Chinese consumption increased by 14.8 million metric tons, or 1,301 percent, growing from 1.14 million metric tons in 1995 to 16 million metric tons in 2024. The United States, on the other hand, was the largest consumer of refined copper in 1995 at 2.53 million metric tons, which accounted for 21 percent of the world's total. The country now stands in second place in terms of consumption at just 6 percent. If the consumption figures of every other country were combined, they still would not equal China's consumption. This represents a highly unbalanced copper market, where a minor economic issue in China could have major consequences for the rest of the world.

International Copper Study Group (ICSG), based in Portugal, forecasts a 2.9 percent production increase this year to reach 28.29 million metric tons. For 2026, it forecasts a 1.5 percent increase, reaching 28.71 million metric tons. Meanwhile, consumption will increase by 2.4 percent this year, reaching 28 million metric tons, while the ICSG forecasts 1.8 percent growth in 2026, with copper consumption reaching 28.52 million metric tons that year.

Considering the fact that copper was a 27 million-metric-ton market last year, the 138,000 metric ton surplus represents a relatively balanced market. However, an additional surplus of approximately 500,000 metric tons is expected between this year and next.

Oddly enough, though the assumption has been that we are facing massive deficits in the future because of the green energy transition, the hype might have exceeded reality.

According to a recent Reuters poll of price forecasts, the London Metal Exchange (LME) copper price is expected to average $4.19 per pound this year, which is not far from the $4.22 year-to-date average through April - and just a few cents greater than the $4.15 average recorded in 2024.

Source: Recycling Today, Jul 30, 2025

Temperature Measurement in Aluminium Extrusion

Accurate temperature measurement in different stages of the aluminium extrusion process plays a crucial role for profile quality. With the development of new, specialised aluminium alloys designed for high-end applications such as aerospace, automotive, and safety products, there is a need to meet complex mechanical specifications, decrease final product weight and improve process efficiencies.

In aluminium extrusion processes, different shapes of profiles are produced and multi-cavity dies are often used to extrude complex profiles. To meet the demanding requirements of the end products, operators must ensure that accurate process temperatures are achieved, with continuous and precise monitoring a must.

Why Temperature Measurement Matters in Aluminium Extrusion

Advanced infrared technology enables modern aluminium plants to meet stringent production demands without compromising efficiency or product integrity. These temperature measurements allow the optimisation of press speed and quality of extrusion by ensuring the cooling rate is correct. This makes sure the aluminium product has the required physical properties by the time it leaves the quench.

Die Temperature (pre-heat)

The preheated aluminium billet is extruded through the die, which produces the desired product shape. It is essential that the die is sufficiently heated so that it does not cool the aluminium, which would block or affect the process. The die is preheated in a die oven to ensure it is sufficiently heated – typically around 450 to 500 °C – preventing the aluminium from solidifying. It is important that the die is not removed from the oven prematurely, and that it does not cool too much between the oven and the die press. As the die is pre-heated, it is important to measure the temperature rapidly so that it does not have time to cool before being loaded into the press. Ensuring the die is sufficiently heated significantly reduces the chances of the aluminium hardening. By ensuring that the die remains within the correct thermal window, both production continuity and extrusion quality are safeguraded**.**

Extrusion

After being shaped into the desired form, the metal will still be soft and hot – typically 500 to 600 °C. At this point, accurate temperature measurement of the extruded profile is needed to control the optimum product temperature and press speed to achieve the required mechanical properties. Temperature measurements allow optimisation and control of press speed and quality of extrusion. By doing this, the required physical properties, surface finish and precise dimension tolerances are assured.

Quenching

After exiting the press, the hot extrusion is quenched to cool it. The rate and target cooling temperature affects the mechanical properties of the finished product, such as the hardness and resilience of the metal. It is also important to ensure that complex internal structures of aluminium profiles are cooled down below a critical temperature. To monitor the cooling rate through the quench process, it is necessary to measure the aluminium temperature at each end of the process, beginning with the extrusion as it exits the press. This ensures that the aluminium product has the required physical properties and precise dimension tolerances by the time it leaves the quench process.

Quenching brings the temperature of the extrusion down to lower levels – typically around 200°C – at a controlled rate. It can be accomplished by forced air convection or industrial water emulsion. Water cools at a faster rate, producing a harder product, but cooling too rapidly can affect or distort the aluminium profile. By monitoring the cooling rate of the extrusions moving through the quench, a finished product with the required properties is consistently achieved. Any structural damage to the profile from cooling it too quickly is avoided. Accurate monitoring at both the entry and exit points of the quench zone ensures cooling rates are optimised, and adjustments can be made where necessary depending on the application. Precision in this step allows manufacturers to produce aluminium that has the correct profile and is tailored to its end use, from automotive to aerospace, and more.

Source: https://www.aluminium-journal.com/

Steel: A Critical Piece of a Near-Zero-Emissions Future

Our world is built with steel. It's in our cars, skyscrapers, and wind turbines. It's a resource that we can't live without and a resource that we can't afford to keep making in the same way we always have.

Steel has many applications, but it has only two sources: iron ore and recycled scrap. Almost all steel products are a mix of these two inputs, giving products their unique material properties. Increasing the amount of scrap we use, which requires only about 10 percent of the energy needed to produce steel from ore, is an essential path to decreasing the steel sector's emissions footprint, but there is not enough scrap available to satisfy the world's demand for steel. So, we also must clean up the way we make new steel from iron ore, which currently accounts for nearly three-quarters of the steel consumed globally.

Ore-based steel is primarily made using coking coal in a centuries-old, highly polluting process. As a consequence of this and other fossil fuel use, the steel industry makes up roughly 11 percent of global GHG emissions, making it the single largest industrial emitter.

Transitioning existing fossil fuel-based steel production facilities and building new ones with near-zero emissions technology is essential to aligning the iron and steel sector with a safer climate future. This work can't afford to wait — it needs to start immediately.

The steel industry must modernize, or it risks locking in inefficient, resource-intensive technology. Technology roadmaps and transition strategies are showing us the way. We need to maximize recycling rates everywhere to accelerate the growth of scrap-based production, commission near-zero emissions ore-based production technologies like hydrogen direct reduction, and reduce overall demand for steel.

With hundreds of steel plants across the globe collectively producing over 3 gigatons of CO_2e yearly, the technology shift will require coordinated and collaborative action across public and private sectors to rapidly decarbonize the industrial commodities our society depends on.

Revitalizing steel production will yield multiple benefits, including supply chain security, bolstering national trade balances, and enabling re-investment in infrastructure without increased emissions.

As organizations aim to demonstrate progress toward achieving their climate commitments, steel producers are increasingly fielding buyer requests for product-level emissions data. To address this need, steel producers must work to enhance emissions transparency and comparability, helping refine emissions calculation, enhance data exchange, and explore ways for data to drive industry decarbonization.

China produces and consumes more than half of the world's steel, which accounts for about 17 percent of the country's carbon emissions. It is essential to advance decarbonization in this critical market.

The future of steel production could enter a new era where iron and steel making are disaggregated, creating Green Iron Corridors. Traditionally, iron and steelmaking processes are located together near access to fossil resources, and steel supply chains are dependent on the regions that supply iron ore. When iron ore reserves are co-located with renewables, a higher value iron product can be produced via green hydrogen and exported.

Demand for low-emissions steel is estimated to increase to 6.7 megatons a year by the end of this decade. Meeting consumer demand for low-emissions steel is critical to decarbonizing the sector.

Source: RMI

Steel AI Technology

The steel industry stands at the precipice of a digital revolution, where **Steel AI Technology** is fundamentally transforming how we approach manufacturing, quality control, and operational efficiency. This article explores the cutting-edge applications of artificial intelligence in steel production.

Introduction to Steel AI Technology

Steel AI Technology represents the convergence of artificial intelligence, machine learning, and traditional steel manufacturing processes. This integration is reshaping the industry by enabling unprecedented levels of automation, precision, and efficiency. From predictive maintenance to quality control, AI applications are addressing longstanding challenges while opening new possibilities for innovation.

The steel industry has traditionally been characterized by its reliance on human expertise and manual processes. However, the emergence of AI technologies has created opportunities to enhance human capabilities while reducing errors and improving safety. **Machine learning algorithms** can now analyze vast amounts of production data to identify patterns, predict equipment failures, and optimize manufacturing processes in real-time.

Modern steel plants generate enormous quantities of data from sensors, equipment monitoring systems, and production processes. These data, when properly harnessed through AI technologies, becomes a powerful tool for driving operational excellence and competitive advantage.

Artificial Intelligence Applications in Steel Manufacturing

Predictive Maintenance Revolution

Predictive maintenance represents one of the most impactful applications of **Steel AI Technology**. By leveraging machine learning algorithms and sensor data, steel manufacturers can predict equipment failures before they occur, dramatically reducing downtime and maintenance costs.

Modern steel plants deploy IoT sensors throughout their facilities to monitor critical parameters such as vibration, temperature, pressure, and acoustic signatures. AI algorithms analyze this continuous stream of data to identify patterns that indicate impending equipment failures. This approach allows maintenance teams to schedule repairs during planned downtime, avoiding costly unplanned shutdowns.

Computer Vision for Quality Control

Computer vision technology has revolutionized quality control in steel manufacturing by enabling automated defect detection with superhuman accuracy. AI-powered systems can identify microscopic defects, surface irregularities, and dimensional variations that would be impossible for human inspectors to detect consistently.

Steel manufacturers deploy high-resolution cameras and advanced image processing algorithms throughout their production lines to monitor product quality in real-time. These systems can detect various types of defects including cracks, inclusions, surface scratches, and dimensional deviations with remarkable precision.

The implementation of computer vision systems has resulted in significant improvements in product quality and reduction in waste. Companies report detection accuracy rates exceeding 98% compared to 85% with traditional manual inspection methods. This improvement translates to substantial cost savings through reduced material waste and improved customer satisfaction.

Process Optimization Through Machine Learning

Machine learning algorithms are transforming steel production by optimizing complex manufacturing processes in real-time. These systems analyze vast amounts of historical and real-time data to identify optimal operating parameters for furnaces, rolling mills, and other critical equipment.

Steel plants use AI to optimize everything from raw material composition to furnace temperature profiles and rolling schedules. Machine learning models can predict the impact of parameter changes on final product quality, enabling operators to make informed decisions that maximize yield while maintaining quality standards.

The optimization capabilities of AI extend beyond individual processes to encompass entire production workflows. Advanced scheduling algorithms, inspired by biological systems like ant colonies, can optimize production sequences to minimize changeover times, reduce energy consumption, and maximize throughput.

Digital Transformation and Industry 4.0

IoT Integration in Steel Manufacturing

The **Internet of Things (IoT)** serves as the foundation for **Steel AI Technology** by providing the data infrastructure necessary for intelligent manufacturing systems. Steel plants deploy thousands of sensors throughout their facilities to monitor equipment performance, environmental conditions, and product quality.

IoT-enabled systems collect data on parameters such as temperature, pressure, vibration, chemical composition, and energy consumption. This data is then transmitted to AI analytics platforms where machine learning algorithms can identify patterns, detect anomalies, and optimize operation in real-time.

The integration of IoT and AI has enabled steel manufacturers to achieve unprecedented levels of operational visibility and control. Companies like POSCO and Tata Steel have deployed comprehensive IoT networks that monitor everything from blast furnace operations to finished product quality, resulting in significant improvements in efficiency and cost reduction.

Digital Twins: Virtual Replicas of Steel Operations

Digital twins represent one of the most advanced applications of **Steel AI Technology**, creating virtual replicas of physical steel manufacturing processes that enable simulation, optimization, and predictive analytics. These digital models use real-time data from physical assets to mirror their behavior and performance.

Steel manufacturers use digital twins to model everything from individual pieces of equipment to entire production facilities. These virtual replicas enable engineers to test different operating scenarios, predict the impact of maintenance activities, and optimize production schedules without disrupting actual operations.

The implementation of digital twin technology has resulted in significant operational improvements. Studies show that steel plants using digital twins have achieved up to 10% reduction in energy consumption and substantial improvements in production efficiency.

Case Studies: Real-World Implementation Success Stories

U.S. Steel's MineMind AI Application

U.S. Steel has partnered with Google Cloud to develop **MineMind,** a groundbreaking generative AI application that demonstrates the practical implementation of **Steel AI Technology.** This innovative solution focuses on optimizing equipment maintenance at North America's largest iron ore mine.

MineMind leverages Google Cloud's advanced AI technologies, including Document AI and Vertex AI, to simplify complex maintenance procedures. The application provides technicians with real-time guidance for equipment repairs, helping them troubleshoot problems more efficiently and order the correct parts.

The results have been impressive: when fully operational, MineMind enables technicians to reduce work order completion time by an estimated 20%. This improvement translates to faster repair times, reduced downtime, and more satisfying work experiences for maintenance personnel.

ArcelorMittal's Comprehensive AI Integration

ArcelorMittal has emerged as a leader in **Steel AI Technology** implementation, with AI initiatives spanning over two decades. The company employs approximately 100 people in its AI division, providing support and services to ArcelorMittal units worldwide.

The company's AI applications include production scheduling optimization using bio-inspired algorithms, predictive maintenance systems, and quality control solutions. Their production scheduling algorithms, inspired by ant colony optimization, have delivered cost savings of nearly $1 million annually on individual production lines.

ArcelorMittal's predictive maintenance platform, **Sentinel,** has achieved remarkable success in preventing equipment failures. The system has maintained a 100% success rate in predicting motor and hydraulic actuator failures across pilot implementations in Canada, France, and Brazil.

Tata Steel's Digital Transformation Journey

Tata Steel has implemented comprehensive AI solutions across its manufacturing processes, resulting in significant improvements in productivity and cost reduction. The company has developed over 260 AI algorithms for real-time decision-making and operational efficiency.

The implementation of AI-driven predictive maintenance at Tata Steel has resulted in a 20% reduction in unplanned downtime and substantial cost savings. The company's digital transformation has enabled better resource utilization, improved energy efficiency, and enhanced product quality.

Tata Steel's success demonstrates the scalability of **Steel AI Technology** across large, complex manufacturing operations. The company aims to become a leader in digital steelmaking by 2025, leveraging AI to optimize yield, energy consumption, throughput, quality, and productivity.

Blockchain Technology in Steel Supply Chains Enhancing Traceability and Transparency

Blockchain technology is emerging as a powerful complement to **Steel AI Technology** by providing immutable records of steel production and supply chain transactions. This technology addresses growing demands for supply chain transparency and product authenticity.

Steel manufacturers are implementing blockchain solutions to track products from raw material sourcing through final delivery. Each transaction in the supply chain is recorded on an immutable ledger, providing complete traceability and enabling stakeholders to verify product authenticity and compliance with quality standards.

Major steel companies, including BHP Group and China Baowu Steel Group, have successfully completed cross-border trade settlements using blockchain platforms. These implementations demonstrate the practical value of blockchain technology in reducing paperwork, improving transaction efficiency, and enhancing trust among supply chain partners.

Steel Industry Consortiums

Blockchain steel consortiums are forming to leverage the collective power of industry collaboration in implementing digital ledger technologies. These partnerships enable steel companies to share resources, establish common standards, and accelerate the adoption of blockchain solutions. These consortiums focus on creating standardized approaches to supply chain transparency, product certification, and regulatory compliance. By working together, steel companies can reduce implementation costs while ensuring interoperability across different systems and platforms.

The collaborative approach has proven effective in addressing industry-wide challenges such as counterfeit materials, complex supply chain management, and regulatory compliance requirements. Consortiums provide a framework for companies to share best practices and develop comprehensive solutions.

Future Trends and Emerging Technologies

Advanced AI Applications

The future of **Steel AI Technology** will see increased integration of advanced AI capabilities including natural language processing, computer vision, and autonomous decision-making systems. These technologies will enable more sophisticated analysis of production data and more intuitive human-machine interfaces.

Generative AI technologies, similar to U.S. Steel's MineMind application, will become more prevalent in steel manufacturing. These systems will provide intelligent assistance for complex tasks such as process optimization, quality analysis, and maintenance planning. The integration of AI with emerging technologies such as 5G networks, edge computing, and advanced robotics will enable new levels of automation and real-time decision-making in steel manufacturing.

Sustainability and Environmental Impact

Steel AI Technology will play an increasingly important role in addressing environmental challenges and sustainability requirements. AI systems will optimize energy consumption, reduce emissions, and minimize waste throughout steel production processes.

Advanced AI algorithms will enable more efficient use of recycled materials, optimization of circular economy principles, and reduction of carbon footprint. These capabilities will be essential for steel manufacturers to meet increasingly stringent environment regulations and customer demands for sustainable products.

The development of AI-powered carbon tracking and reporting systems will enable steel companies to demonstrate their environmental performance and comply with emerging carbon accounting requirements.

Implementation

Getting Started with Steel AI Technology

Organizations beginning their **Steel AI Technology** journey should start with pilot projects that demonstrate clear value and build organizational confidence. Successful implementations typically begin with well-defined use cases such as predictive maintenance or quality control where the benefits are easily measurable.

Data infrastructure development is crucial for AI success. Steel manufacturers need to establish robust data collection, storage, and processing capabilities before implementing AI applications. This foundation includes IoT sensor networks, data integration platforms, and cloud or edge computing resources.

Building internal capabilities through training and collaboration with technology partners is essential for long-term success. Organizations should invest in developing AI literacy among their workforce while partnering with experienced technology providers for complex implementations.

Overcoming Implementation Challenges

Common challenges in implementing **Steel AI Technology** include data quality issues, integration with legacy systems, and organization change management. Successful companies address these challenges through systematic planning, phased implementation approaches, and strong leadership commitment. Data standardization and quality improvement are critical prerequisites for AI success. Steel manufacturers must invest in cleaning historical data, establishing data governance processes, and implementing quality control measures for ongoing data collection. Change management is equally important, as AI implementations often require modifications to established processes and workflows. Successful companies invest in training programs, communication initiatives, and incentive systems that encourage adoption of AI-powered solutions.

Economic Impact and Return on Investment

Quantifiable Benefits

The implementation of **Steel AI Technology** delivers measurable economic benefits across multiple dimensions. Companies report cost savings ranging from 5 to 15% through improved efficiency reduced waste, and optimized resource utilization.

Predictive maintenance applications typically deliver return on investment within 12-24 months through reduced unplanned downtime and optimized maintenance schedules. Quality control improvements result in reduced material waste and improved customer satisfaction.

Energy optimization through AI can reduce consumption by 10-15%, representing significant cost savings for energy-intensive steel operations. These improvements also contribute to sustainability goals and regulatory compliance.

Long-term Strategic Value

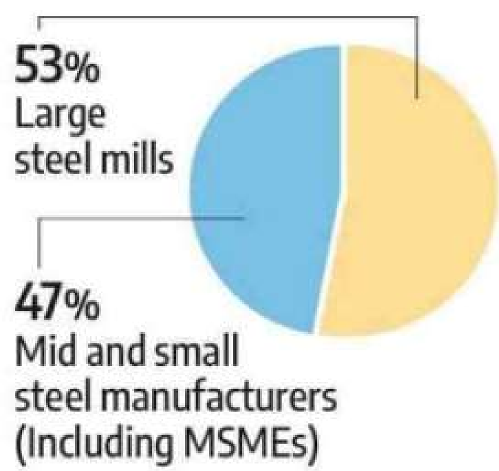
Beyond immediate cost savings, **Steel AI Technology** provides strategic advantages including improved competitiveness, enhanced agility, and better risk management capabilities. These benefits position steel manufacturers for long-term success in increasingly competitive global markets.

AI-enabled capabilities such as predictive analytics, real-time optimization, and automated decision-making provide steel companies with the agility needed to respond quickly to market changes and customer demands.

The data and insights generated by AI systems create valuable intellectual property that can inform strategic decision, product development, and market positioning.

Source: Steel Industry Newsletter, 8th August 2025

Share of Secondary Sector in Steel Capacity: 2024-25



Total Capacity: about 200.3 mt as on 31.3.25

Source: JPC Data (Business Standard, New Delhi Edition, 26.8.25)

Industrial Revolution: From Industry 1.0 to 5.0

The Industrial Revolution marks one of the most significant periods in human history. It doesn't just transform the way people work but also the way they interact with the environment. This era of change has spanned over centuries, shaping societies through multiple phases of industrial development. Each phase, from Industry 1.0 to the upcoming Industry 5.0, has brought about groundbreaking innovations. Here is a closer look at the transition from the steam engine era to human-centric technologies.

Industry 1.0 – The Steam Engine Era

The first phase of the Industrial Revolution, known as **Industry 1.0**, began in the late 18th century. It began with the adoption of steam engines, which revolutionized manufacturing processes and transportation. Invented by James Watt, the steam engine allowed factories to move away from water power and become more efficient. This innovation led to the rapid growth of industries such as textiles, iron, and coal.

Social and Economic Impact

The introduction of steam power had profound social and economic impacts. It led to urbanization, as people moved from rural areas to cities in search of employment. This shift created a new workforce and contributed to the expansion of the middle class. Additionally, steam-powered machines increased production rates, resulting in the growth of consumer markets and international trade.

Challenges and Criticisms

Despite its many benefits, Industry 1.0 also faced several challenges. Working conditions in factories were often harsh, with long hours and minimal safety measures. Child labour was prevalent, and environmental pollution began to rise due to the increased use of coal. These issues eventually led to labour reforms and the development of new regulations to protect workers and the environment.

Industry 2.0 – The Rise of Technologies

Some 100 years later, in 1870, the second phase of the Industrial Revolution, **Industry 2.0,** emerged in the late 19th and early 20th centuries. This era began with the widespread adoption of electricity and the development of assembly line production. Henry Ford's introduction of the moving assembly line in 1913 revolutionized the automotive industry. It made cars more affordable and accessible to the general public.

Technological Advancements

Industry 2.0 saw significant technological advancements, including the invention of the telephone by Alexander Graham Bell and the radio by Guglielmo Marconi. These innovations improved communication and connectivity, further driving industrial growth.

Economic Growth and Workforce Changes

The rise of Industry 2.0 led to substantial economic growth and changes in the workforce. The demand for skilled labour increased, and new job opportunities emerged in various sectors. However, this period also saw the decline of traditional crafts and the rise of factory-based employment. Labour unions gained prominence, advocating for workers' rights and better working conditions.

Industry 3.0 – The Digital Age

Stepping forward another 100 years, to 1970, the third phase of the Industrial Revolution, known as **Industry 3.0**, began in the mid-20th century. It was the era of computers, automation, and digital technology. The invention of the microprocessor in the 1970s led to the development of personal computers and advanced automation systems. Industry 3.0 saw automation through the use of computers and electronics. This was enhanced by globalisation (Industry 3.5), involving offshoring of production to low-cost economies.

Transformations in Manufacturing

Industry 3.0 brought significant transformations to manufacturing processes. Computer-aided design (CAD) and computer-aided manufacturing (CAM) enabled precise and efficient production.

Robotics and automation became integral parts of factories, reducing labour costs and increasing productivity. The rise of information technology also facilitated global supply chains and just-in-time manufacturing.

Industry 4.0 – IoT and Beyond

The fourth phase of the Industrial Revolution, Industry 4.0, began in the early 21st century. We are currently living in the fourth industrial revolution, which is based around the concept of digitalisation and includes automation, artificial intelligence (AI) technologies, connected devices, data analytics, cyber-physical systems, digital transformation, and more. The main characteristics of this era are the integration of smart technologies, such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics. These innovations enable real-time monitoring, data-driven decision-making, and enhanced automation.

Industry 4.0 remains highly relevant as it continues to drive innovation and transformation across various industries.

Transforming Industries

Industry 4.0 is transforming various industries, from manufacturing to healthcare. Smart factories, equipped with IIoT sensors and AI-driven analytics, optimize production processes and minimize downtime. In healthcare, wearable devices and telemedicine improve patient care and enable remote monitoring. The automotive industry is also witnessing the rise of autonomous vehicles and connected car technologies.

Industry 5.0

Industry 5.0 represents the next phase of industrial evolution, which is focusing on human-centric innovation. Unlike its predecessors, Industry 5.0 emphasizes collaboration between humans and machines, leveraging the strengths of both to achieve optimal outcomes.

This approach aims to enhance human creativity, well-being, and job satisfaction.

Key Features of Industry 5.0

Industry 5.0 is likely to include several key features:

- **Collaborative Robotics**: Robots and humans work together in a shared workspace, enhancing productivity and reducing the physical strain on workers.
- **Personalization and Customization**: Advanced technologies enable the production of highly personalized and customized products.
- **Sustainability and Resilience**: Industry 5.0 prioritizes sustainable practices and resilient supply chains, addressing environmental and social challenges.

The new phase of the industrial revolution is likely to transform the future of work. By fostering collaboration between humans and machines, it aims to create a more inclusive and fulfilling work environment.

Workers will be able to focus on creative and complex tasks, while repetitive and hazardous tasks are handled by robots. This shift will require new skills and emphasize the importance of lifelong learning.

The idea of Industry 5.0 goes beyond industry to encompass all organisations and business strategies to create a broader perspective than seen with Industry 4.0.

Fifth industrial revolution will focus on man and machines working together. Based upon personalisation and the use of collaborative robots, workers are free to deliver value-added tasks for customers. This latest iteration goes beyond manufacturing processes to include increased resilience, a human-centric approach, and a focus on sustainability, which we explore in more detail below.

Industry 5.0 Advantages and Disadvantages

Advantages

The main advantage of Industry 5.0 is the creation of higher value jobs that afford greater personalisation for customers and improved design freedom for workers. By allowing manufacturing processes to be handled through automation, human workers are able to focus more of their time on delivering improved, bespoke services and products.

This was already beginning with Industry 4.0, but Industry 5.0 pushes this further through improved automation and feedback to create a service-based model where humans are able to focus on adding value for end-users.

Meanwhile the increased focus on sustainability and resilience means that businesses become more agile and flexible while also having a positive impact on society – rather than simply mitigating any negative effects.

Disadvantages

It is difficult to see the disadvantages of Industry 5.0, but the challenge will lie in how organisations are able to adapt to embrace this new concept. Those that are able to become more human-centric, resilient and sustainable will likely spearhead future solutions while those who fail to keep up will fall behind. To understand this better, it is worth looking in more detail at the strategies of Industry 5.0 – namely a human-centric approach, improved resilience and a broader focus on sustainability.

Industry 5.0 Strategies

Industry 5.0 is underpinned by three strategies:

i. Human-Centric

Industry 5.0 includes a strategy that moves people from being seen as resources to being genuine assets. In effect, this means that rather than people serving organisations, organisations will serve people. So, instead of talent simply being used to create a competitive advantage and value for customers, Industry 5.0 refocuses to also create added value for workers in order to attract and keep the best employees.

ii. Resilience

As the world has become more joined-up over the years we have seen the widespread impact of global matters such as the Covid-19 pandemic and international supply shortages. Whereas many businesses look to improving efficiencies and optimising profits, these factors do not improve resilience. In fact, there is a belief that a concentration on agility and flexibility can make companies less resilient, not more.

Rather than focussing on growth, profit and efficiency, more resilient organisations would look to anticipate and react to any crisis to ensure stability through challenging times.

iii. Sustainability

Industry 5.0 extends sustainability from simply reducing, minimising or mitigating against climate damage to actively pursuing efforts to create a positive change. Sometimes referred to as 'Net Positive,' this goal aims to make the world a better place with companies becoming part of the solution rather than being a problem or simply paying lip-service to sustainability goals through 'greenwashing.'

Industry 5.0 Applications and Examples

While robots have performed dangerous, monotonous or physically exhausting work in manufacturing plants and other workplaces, Industry 5.0 extends this to allow them to work collaboratively with human workers.

For example, instead of being fenced off for safety, a new generation of 'Cobots' that are able to work safely alongside people is creating new opportunities for businesses. Human and machine workers operating side-by-side allow people to focus on value-adding processes to take personalisation of products to a new level.

For example, the medical profession could use this joined-up, cooperative approach to create devices that are tailored for an individual, such as with a diabetes app that is able to track your lifestyle and inform the manufacture of a device to suit your individual needs.

Tailoring products to suit individual needs can be extended to other industries, including electronics, automotive and more, adding a personal, human touch to extend the offerings created through Industry 4.0.

Industry 5.0: Summary

Industry 5.0 refers to robot and smart machines working alongside people with added resilience and sustainability goals included. Where Industry 4.0 focused on technologies such as the Internet of Things and big data, Industry 5.0 seeks to add human, environmental and social aspects back into the equation.

In this regard, Industry 5.0 can be seen as complementing the advances made in Industry 4.0 to support rather than supersede humans. This allows humans to intervene where required and moves away from excessive automation to incorporate critical thinking and adaptability, while still taking advantage of the precision and repeatability of machines.

When will Industry 5.0 start?
Industry 5.0 is beginning to happen now, although it still needs to gain more traction in order to flourish. Many businesses are still focused on Industry 4.0 but, as more companies move to incorporate the ideas of Industry 5.0 we should see it develop further.

Are We Experiencing Industry 5.0?
Industry 5.0 has begun, with AI-powered systems taking up repetitive tasks and allowing people to focus on more productive and value-adding tasks. Industry 5.0 is still in its early stages, with many businesses still focusing on Industry 4.0 (see above), however this is expected to change as more companies align themselves to the goals of Industry 5.0.

What will Industry 5.0 Mean for Manufacturing?
Industry 5.0, when working at a full capacity, will allow for the better automation of manufacturing processes, offering real-time data but at the same time allow people to work alongside machinery to improve processes and provide personalisation for customers.

What are some of the Challenges of Industry 5.0?
Due to the increased data streams, sensors and monitoring associated with Industry 5.0, one of the largest challenges involves energy management. This can be optimised to allow large smart devices to be connected through smarter energy consumption and energy harvesting.

Other challenges for Industry 5.0 involve perception and the willingness, ability and financial scope of businesses to adopt these new working methods.

What is the Future of Industry 5.0?

The future for Industry 5.0 includes the manufacture of robots, including industrial robots, with improved artificial intelligence and cognitive computing technologies to improve efficiencies and speed of delivery, while at the same time allowing people to focus on other areas.

How is Industry 5.0 Different from Previous Industrial Revolutions?

The difference with the Fifth Industrial Revolution is how modern technology is being used to drive cooperative working between humans and advanced technologies and AI-enabled robots to enhance workplace processes to deliver a more human-centric, resilient and environmentally aware, sustainable future.

Industry 4.0 vs Industry 5.0: What is the Difference?

There are crossovers between these two revolutions, but while Industry 4.0 was technology-driven Industry 5.0 is value-driven. Where 4.0 looked to automation and the increased focus on technology, 5.0 bring humanity back into the field, combining with technology to provide systems and processes that serve people and the world around us first.

What Industries are most affected by Industry 5.0?

Sectors such as healthcare, supply chains, and manufacturing look set to benefit from Industry 5.0 with the use of big data analysis, IoT, collaborative robots, digital twins and more alongside an increased focus on personalisation and sustainability.

Why is Industry 5.0 Important?

Industry 5.0 is important as it allows businesses and industry to actively deliver solutions for society to preserve resources, ensure social stability and address climate targets. With benefits focused on the wider world, including employees, rather than simply productivity and profit, Industry 5.0 turns connected businesses into part of the solution rather than posing potential environmental and societal problem.

What is the Industry 5.0 thesis?

The Industry 5.0 thesis emphasizes the importance of human-centric innovation and collaboration between humans and machines. It advocates for the integration of advanced technologies to enhance human creativity, well-being, and job satisfaction.

Is Industry 4.0 still relevant?

Yes, Industry 4.0 remains highly relevant as it continues to drive innovation and transformation across various industries. The integration of smart technologies, such as IoT, AI, and big data analytics, enables real-time monitoring, data-driven decision-33making, and enhanced automation.

Industry 6.0

It is a futuristic idea, where various manufacturing operations and services are provided to customers using artificial intelligence, cloud computing energy, human–robot working, big data, where satellite and industrial AI (Artificial intelligence) enabled robots would assist

2024 World DRI Production

DRI has long been a primary feedstock for many steelmakers worldwide, with production growing rapidly. Global direct-reduced iron (DRI) production reached 140.8 million metric tons (mmt) in 2024.

The worldwide total represents a 5 million ton increase, or 3.8 percent, from the previous record of 135.7 mmt set in 2023. Since 2019, global DRI output has grown by 32.7 mmt per year, or more than 30 percent.

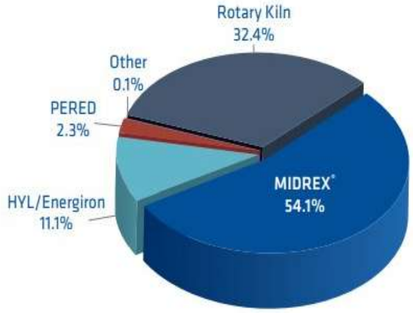
Midrex plants produced more than half the 2024 DRI total, with 76.2 mmt of output last year.

India is far and away the global leader in DRI output last year, producing 54.7 mmt, followed by Iran at 34.7 mmt. Next were Russia (8 million tons), Saudi Arabia (6.6 million) and Egypt (6.4 million).

The 3.8 percent increase in DRI output last year outpaced a 1 percent growth in overall global steelmaking.

Four new Midrex plants were commissioned last year, with three located in Iran and one in Algeria. There are more than 114 operating shaft furnaces worldwide, with a DRI production capacity exceeding 110 Mt/y.

DRI also is traded globally, and in 2024, the top five DRI importers were the United States (1.5 million metric tons), Turkey (1.2 million), India (900,000), Mexico (800,000) and Italy (700,000).



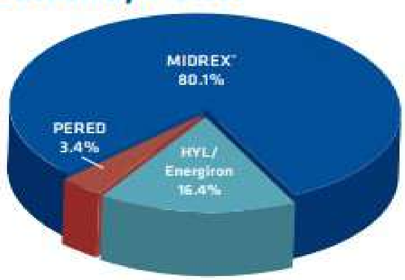
Total World Production: 140.8 Mt

	2022	2023	2024
MIDREX®	57.8%	55.8%	54.1%
HYL/Energiron	12.1%	12.2%	11.1%
PERED	2.2%	2.3%	2.3%
Other	0.1%	0.1%	0.1%
Rotary Kiln	27.9%	29.6%	32.4%

2024 Top 5 DRI Producing Nations

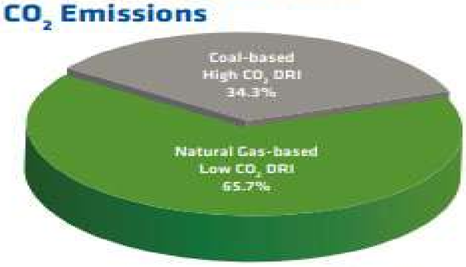
COUNTRY	PRODUCTION (Million Tons)
India	54.7
Iran	34.1
Russia	8.0
Saudi Arabia	6.6
Egypt	6.4

2024 World Shaft Furnace Production by Process

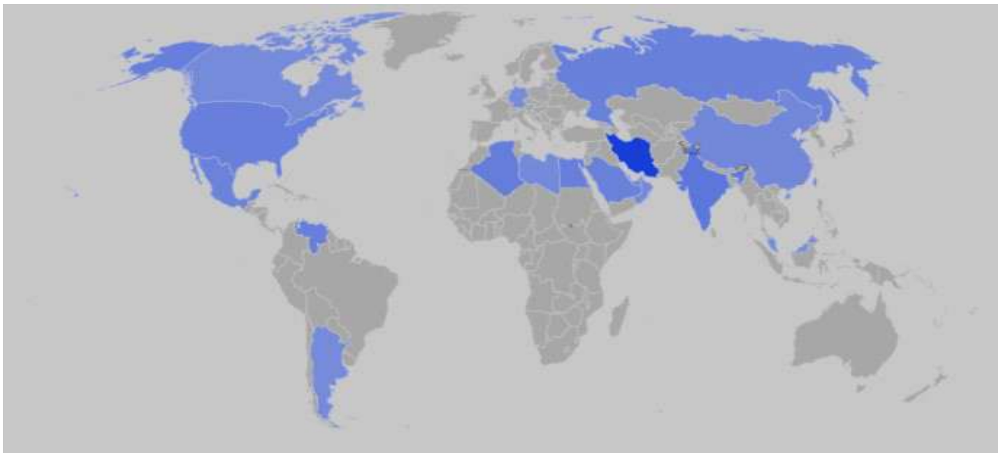


	2022	2023	2024
MIDREX®	80.2%	79.4%	80.1%
HYL / Energiron	16.8%	17.4%	16.4%
PERED	3.0%	3.2%	3.4%

2024 World DRI Production by CO_2 Emissions

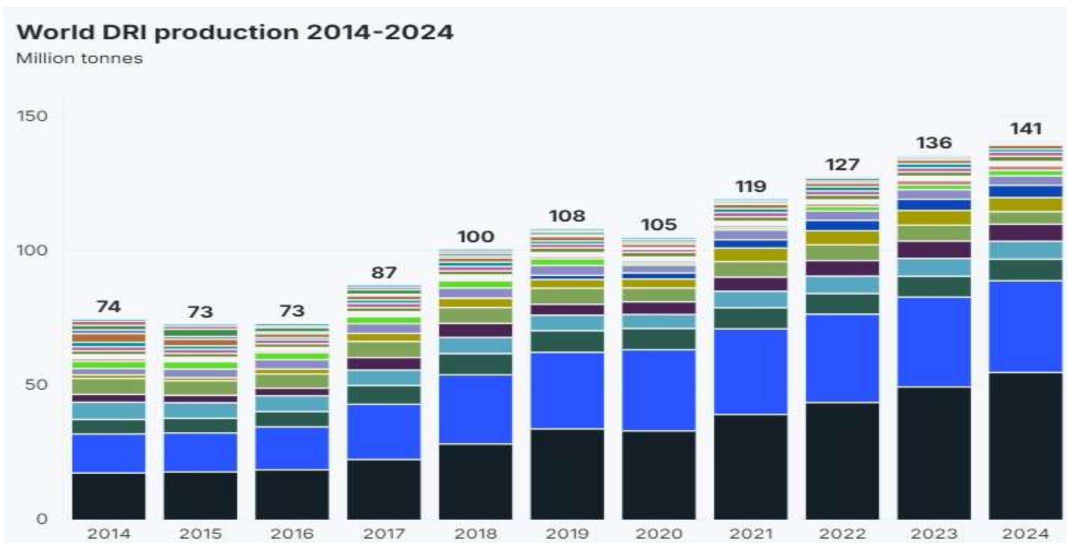


	2022	2023	2024
High CO_2 DRI	29.9%	31.5%	34.3%
Low CO_2 DRI	70.1%	68.5%	65.7%



Location of plants processing feed materials with total iron content of 60% or higher and producing DRI with metallization of 85% or higher.

*Source: **Institute for Energy Economics and Financial Analysis, (**IEEFA) Friday Week in Review, Aug., 30, 2025. {This map excludes rotary kiln (coal-based direct reduction) facilities in India, along with idle and under-construction sites.}*



*Source: **Institute for Energy Economics and Financial Analysis, (**IEEFA) Friday Week in Review, Aug., 30, 2025*

"World Steel in Figures 2025" also reports DRI production for 2024 as 1.2 Mt for China, 1 Mt for Uganda, 0.5 Mt for Kenya, and 0.1 Mt for Zambia. All figures are estimates and are not included above.

Source: 2024 WORLD DIRECT REDUCTION STATISTIC published by Midrex

Long Products Production in Mandi Govindgarh

- **Mandi Govindgarh's (MG's)Significant Footprint:** In FY25, MG's long product (LP) production reached ~6.96 MT. This represents a substantial ~11% of India's total LP production and an impressive 50-60% of North India's LP consumption.
- **Product Mix Breakdown**:

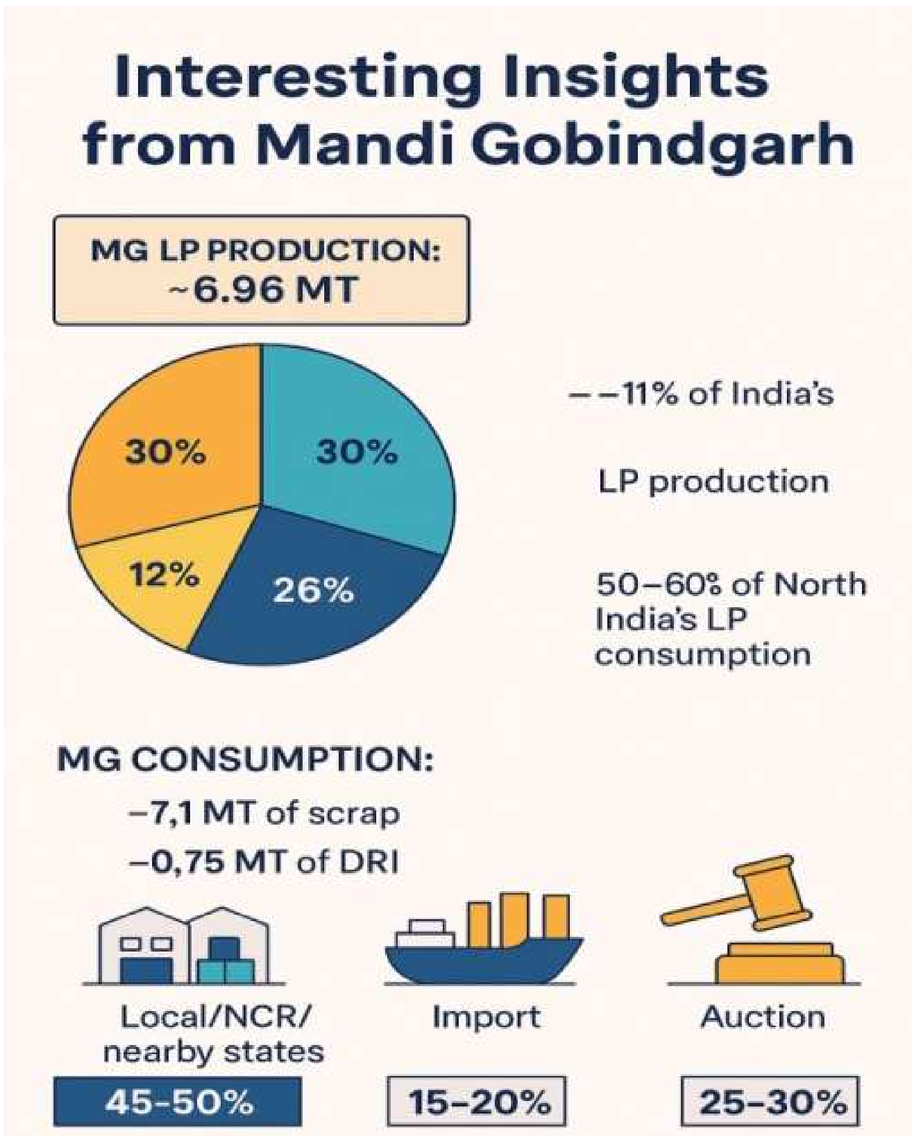
  MBQ : ~2.16 MT (30%)

Structural	:	~2.16 MT (30%)
TMT	:	~1.95 MT (26-28%)
Patra	:	~0.83 MT (12-14%)

- **Raw Material Consumption**: To achieve this, MG alone consumed roughly 7.1 MT of scrap and 0.75 MT of DRI.
- **Scrap Sourcing Insights**: The scrap supply chain for MG is diverse:

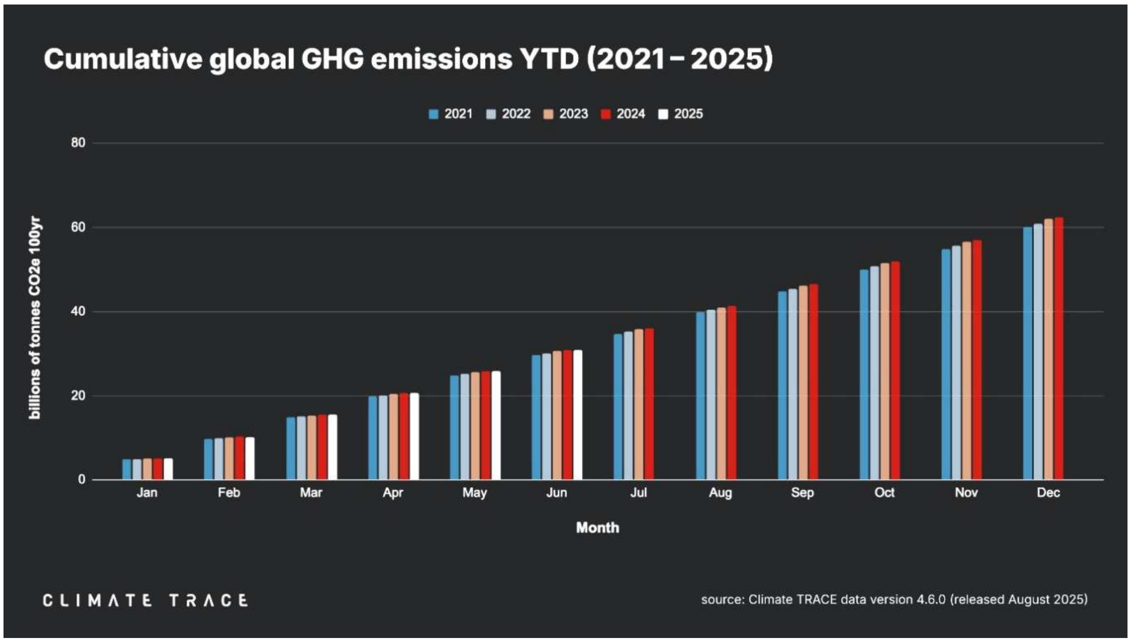
Local/NCR/Boarder States	:	45-50%
Imports	:	15-20%
Auction Route	:	25-30%

These data paint a vivid picture of MG's scale and its pivotal role in the North Indian LP market. It also highlights the intricate raw material sourcing strategies in play.



Source: Linkdin post

Climate TRACE reported that total global emissions in the first half of 2025 are 30.99 billion tonnes CO_2e. This is 0.13% higher than emissions were in the first half of 2024. Global greenhouse gas emissions for the month of June 2025 totaled 5.12 billion tonnes CO_2e. This represents an increase of 0.29% vs. June 2024. Global methane emissions in June 2025 were 34.82 million tonnes CH_4, an increase of 0.49% vs. June 2024.



Global Greenhouse Gas Emissions for the First Half of 2025

In the first half of 2025, the sector driving the most growth in emissions was fossil fuel operations, where emissions rose by 1.5% (an increase of 77.65 million tonnes of CO_2e). The United States accounted for more than half of that increase. Manufacturing emissions also rose in the first half of 2025, growing by 0.3% (an increase of 18.75 million tonnes of CO_2e), led by increases in India, Vietnam, Indonesia, and Brazil.

Meanwhile, global power sector emissions saw the biggest decline in the first half of 2025, falling by 0.8% (a decrease of 60.27 million tonnes of CO_2e), driven almost entirely by declines in China and India, where power emissions were 1.7% lower and 0.8% lower than their totals in the first half of 2024, respectively.

The first half of 2025 shows small but positive progress on decarbonization in China, Mexico, and Australia. China's emissions decreased 45.37 million tonnes CO_2e, or 0.51% compared to the first half of 2024. Mexico's emissions decreased 7.78 million tonnes CO_2e, or 1.71% compared to the first half of 2024. Australia's emissions decreased 6.56 million tonnes CO_2e, or 1.51% compared to the first half of 2024. However, some of the world's other major emitting economies, including the United States, India, the EU, Indonesia, and Brazil, saw emissions rise in the first half of 2025.

- United States emissions increased by 48.57 million tonnes CO_2e, or 1.43% compared to the first half of 2024;
- India emissions increased by 4.44 million tonnes CO_2e, or 0.21% compared to the first half of 2024;
- European Union emissions increased by 2.90 million tonnes CO_2e, or 0.15% compared to the first half of 2024.
- Indonesia emissions increased by 3.06 million tonnes CO_2e, or 0.39% compared to the first half of 2024;
- Brazil emissions increased by 9.84 million tonnes CO_2e, or 1.24% compared to the first half of 2024.

Greenhouse Gas Emissions by Country: June 2025

Preliminary estimate of June 2025 emissions in China, the world's top emitting country, is 1.46 billion tonnes CO_2e — an increase of 0.92 million tonnes of CO_2e or 0.06% vs. June 2024.

Of the other top five emitting countries:

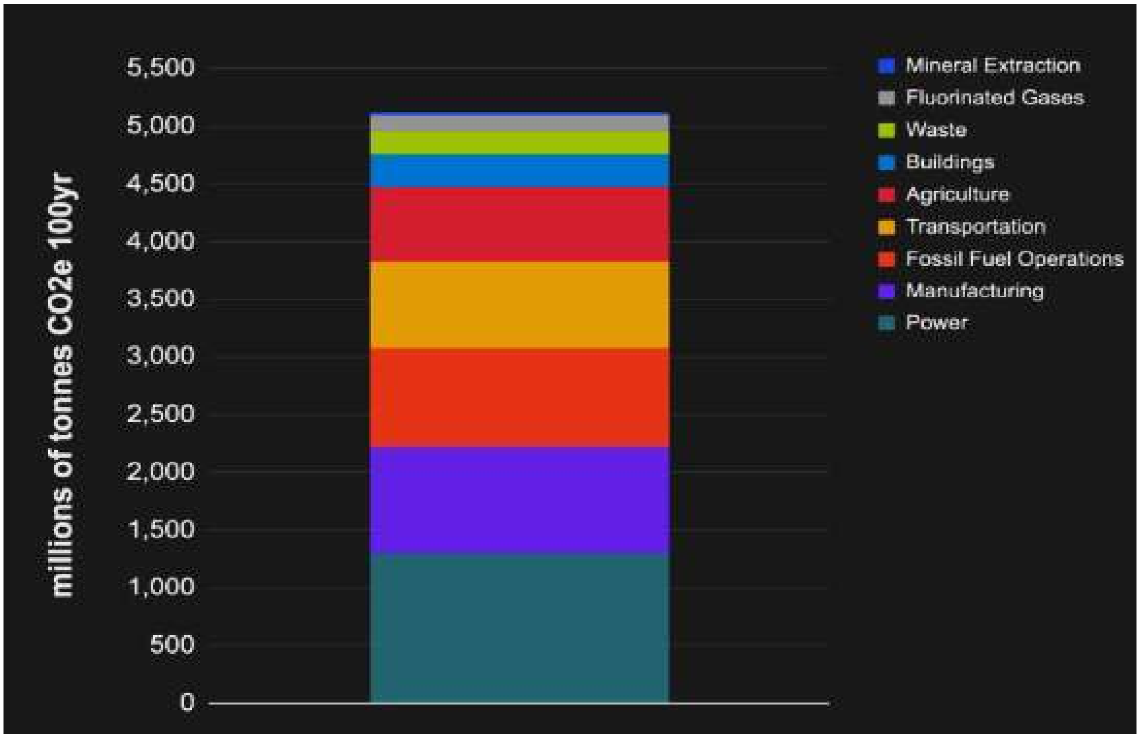
- United States emissions increased by 4.89 million tonnes CO_2e, or 0.86% year over year;
- India emissions declined by 0.11 million tonnes CO_2e, or 0.03% year over year;
- Russia emissions increased by 0.95 million tonnes CO_2e, or 0.38% year over year;
- Indonesia emissions increased by 0.43 million tonnes CO_2e, or 0.33% year over year.

In the EU, which as a bloc would be the fourth largest source of emissions in June 2025, emissions declined by 1.80 million tonnes CO_2e compared to June 2024, or 0.58%.

Greenhouse Gas Emissions by Sector: June 2025

Greenhouse gas emissions increased in June 2025 vs. June 2024 in fossil fuel operations, manufacturing, transportation, and waste, and decreased in power.

Fossil fuel operations saw the greatest change in emissions year over year, with emissions increasing by 1.85% as compared to June 2024.



Greenhouse Gas Emissions by Sector: June 2025

- Agriculture emissions were 641.40 million tonnes CO_2e, unchanged vs. June 2024;
- Buildings emissions were 285.59 million tonnes CO_2e, unchanged vs. June 2024;
- Fluorinated gases emissions were 137.71 million tonnes CO_2e, unchanged vs. June 2024;
- Fossil fuel operations emissions were 846.19 million tonnes CO_2e, a 1.85% increase vs. June 2024;
- Manufacturing emissions were 929.05 million tonnes CO_2e, a 0.02% increase vs. June 2024;
- Mineral extraction emissions were 23.22 million tonnes CO_2e, unchanged vs. June 2024;
- Power emissions were 1,297.34 million tonnes CO_2e, a 0.56% decrease vs. June 2024;
- Transportation emissions were 759.10 million tonnes CO_2e, a 0.77% increase vs. June 2024;
- Waste emissions were 197.77 million tonnes CO_2e, a 0.26% increase vs. June 2024.

Source: Climate TRACE Releases June 2025 Emissions Data, Climate TRACE Newletter, Sept. 3,2025

Know Your Members

Gaurav Verma

Academics

- B. Tech (Mechanical Engineering) from Aligarh Muslim University
- MBA (International Business) from Indian Institute of Foreign Trade
- Carbon Capture and Storage Certification from University of Edinburgh.

Experience and Expertise

Gaurav Verma has over two decades of diverse experience spanning industrial decarbonization, business development in the steel and oil & gas, and evolving clean energy sectors. He works across engineering, consulting, and business development assignments with keen focus on industrial decarbonization and clean energy transitions.

Currently heading Delhi office of MN Dastur & Company (P) Ltd., Gaurav specializes in clean energy transition through carbon capture, utilization and storage (CCUS) integration, coal gasification-based chemicals, and green hydrogen. His work involves feasibility studies, GHG emissions abatement studies, decarbonization roadmap and policy recommendations for NITI Aayog and organizations including SAIL, IOCL, ADNOC and BPCL.

Gaurav's expertise encompasses feasibility assessments, techno-commercial proposals, and stakeholder engagement for engineering projects in Steel as well as Oil & Gas sectors. Gaurav was also a Member of the Task Force, constituted by Ministry of Steel, on "Renewable Energy Transition towards Decarbonization of Steel sector".

Prior to MN Dastur, Gaurav worked with Nippon Steel & Sumikin Engineering and Paul Wurth, where he drove customer engagement in advanced steelmaking and waste-to-energy domains. He also has deep project management and engineering expertise for execution of large-scale industrial facilities.

Gaurav actively contributes to industry forums on topics like CCUS deployment, coal gasification, hydrogen economy, and pathways for green steel. His published works include papers on green steel transition, digitalization, and innovative business models for hydrogen adoption.

A Life Member of The Indian Institute of Metals, Gaurav also pursues his passion for promoting offbeat travel destinations through his blog www.lucky-vagabond.com.

Contact details:
E-mail Id: gaurav.iiftk@gmail.com;
Mob. No: 7042914069.