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THE CHIEF EDITOR'S TAKE

Dear Readers,

President Donald Trump's pursuit of American economic dominance reignited global trade tensions, prompting China to retaliate with export restrictions, including on critical rare earth elements (REEs). Despite global efforts to diversify supply, China continues to maintain overwhelming control over the REE value chain—from mining and refining to magnet production—materials that underpin high-technology electronics, defense systems, and clean energy innovations.

Amid this geopolitical and industrial recalibration, India is taking decisive steps to strengthen its rare earth ecosystem. Backed by sweeping policy reforms and its projected ascent to become the world's third-largest economy by 2028, the government is taking initiatives to bolster domestic manufacturing of rare earth magnets—critical for electric vehicles, renewable energy, and next-generation technologies. These advancements will take center stage at IME 2025, the biennial international exhibition showcasing the latest in mining, minerals, and machinery, alongside conferences exploring policy shifts, technological breakthroughs, and emerging industry trends.

Reflecting India's evolving mining landscape, this edition spotlights coal mining, a sector in transformation through automation, artificial intelligence, environmental imperatives, and progressive government policies. The story underscores the industry's complex pursuit of balancing energy security, economic growth, and sustainability.

Our feature on green minerals delves into India's pivotal role in the global energy transition—focusing on lithium, cobalt, REEs, and other critical minerals that are shaping a sustainable industrial future.

The steel industry feature examines how India is navigating a turbulent global environment marked by tariff wars and oversupply pressures. Despite market volatility, strong domestic demand, modernized production capacity, and policy momentum are positioning India to emerge as a global leader. Complementing this, our coverage of green steel explores the sector's transition toward low-emission manufacturing, driven by investments in green hydrogen, carbon capture, renewable energy, and circular production systems.

In parallel, our mining equipment report highlights the industry's rapid technological evolution—from diesel-powered machines to electric, automated, and digitally integrated systems designed to maximize efficiency, reduce emissions, and enhance safety.

This edition also brings together exclusive interviews, project insights, and in-depth analyses across India's infrastructure, construction, and EPC landscape—offering readers a panoramic view of the nation's industrial, technological, and sustainable growth trajectory.

Enjoy the read!

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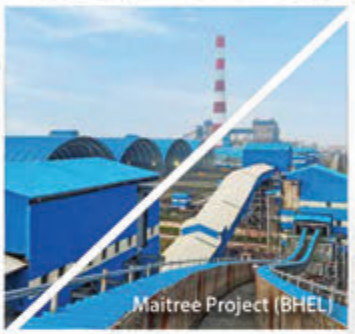
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BKT to launch advanced EARTHMAX range at IME 2025

Balkrishna Industries (BKT), a leading manufacturer in Off-Highway tyre (OHT) industry, will showcase the EARTHMAX tyres range at IME 2025, which are developed for the Indian mining sector. The event "Innovative & Responsible Mining for Inclusive Growth" is taking place from October 30 to November 2, 2025, at the Biswa Bangla Mela Prangan and Science City Ground in Kolkata, India. The display brought forth considerable interest from industry leaders, OEM partners, and mining professionals, reinforcing BKT's role as an innovator in India's changing mining landscape. BKT is presenting five of its advanced EARTHMAX tyre range which are designed to meet the different needs of both surface and underground mining. These tyres are a testament to BKT's engineering expertise and dedication to providing longevity, performance, and safety in all mining applications.

Viren Rodrigues, Head of Mining & Agri Business, BKT said, "As the mining industry in India continues to expand, we are striving to support this growth. At BKT, we believe that innovation is not just about performance, it's about progress with responsibility. Our EARTHMAX range highlights our focus on research, technology, and local expertise coming together. IME 2025 is providing us with the stage to demonstrate these capabilities and to engage with the people who are a part of the mining industry. Through platforms like IME, we are not just displaying products; we are reinforcing our role as a trusted partner to the industry."

By combining technological excellence with on-ground insights, BKT continues to design tyres that optimize performance for mining companies focused on productivity and sustainability. Through ongoing innovation, sustainability-driven practices, and close collaboration with customers, BKT is working towards advancing India's mining sector and growth narrative.

Experience the future of tire innovation with BKT at Stand M-061.

Jindal Stainless to double its slag processing capacity

Jindal Stainless is doubling its slag processing capacity with a new wet milling plant at its Jajpur, Odisha, unit. This initiative will support the company's expanded capacity operations and long-term circularity goals by recovering metal from industrial waste and conserving natural resources. It will also create approximately 140 new jobs in the region.

For this initiative, the company has partnered with Harsco Environmental, a global leader in providing innovative environmental solutions for the metal industry. Jindal Stainless is committing to a spend of USD 150 million to build and operate the plant under a 15-year partnership with Harsco Environmental, further strengthening the long-standing collaboration between the two companies in advancing circular operations. Over the agreement period, this plant will pay back the equivalent value through metal recovery from slag. This initiative forms an integral part of Jindal Stainless' long-term Environmental, Social and Governance (ESG) goals and its commitment to achieve Net Zero by 2050.

Capacit'e Infraprojects wins IIT Bombay EPC project for fast-track buildings

Capacit'e Infraprojects has secured a total contract value of ₹542.37 Crore, excluding taxes from IIT Bombay. The scope of project includes construction of Fast Track Buildings including Design Drawing, Finishing Works, Water Supply & Sanitary installations, Internal & External Electrical Installation, LAN, WIFI, CCTV, Fire-fighting system, Automatic Fire Alarm & PA System, Solar PV System, Telephone data system, Lifts, HVAC, Substation Equipment, DG set, Underground water tank and External Development, Landscaping Works in EPC Mode (Design and Build Basis) at IIT Bombay, Powai, Mumbai, reflecting the client's confidence in Capacit'e proven ability to deliver high-quality infrastructure within accelerated timelines.

Otis India to provide advanced elevator solutions for My Home Group's residential project

Otis India has secured a major deal with My Home Group to provide next-generation elevator solutions for three of their luxury residential developments in Hyderabad.

Otis India will supply 169 high-speed elevator systems engineered for performance, reliability, and premium ride experience for: My Home 99 (rising to 234 meters), My Home Akrida (12 towers) and My Home Grava Residences (seven towers, one rising to over 54 stories). Otis India has played a key role in shaping Hyderabad's luxury residential landscape through long-standing affiliations with key developers across the city and continues to strengthen its presence in Hyderabad's premium residential market, delivering solutions that match the city's growing aspirations and reflect the expectations residents have for modern living.

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Bentley Systems announces Bentley Infrastructure Cloud Connect

Bentley Systems, Incorporated has announced Bentley Infrastructure Cloud Connect, the new foundational layer of Bentley Infrastructure Cloud. Connect provides a connected data environment and unified experience for infrastructure professionals interacting with project and asset data, improving collaboration across the infrastructure lifecycle and value chain. Connect enables users to explore a big-picture view of their entire portfolio in full geospatial context, dive deep into project and asset details, and collaborate, track progress, and identify issues - all in one environment. Connect provides a secure, open, and scalable environment for engineering services firms, construction firms, and owner-operators to store and manage infrastructure files and data. It leverages Bentley's iTwin platform to ingest data from over 50 distinct file formats and integrate with a variety of enterprise systems, unifying engineering, operational, enterprise, geospatial, and subsurface data into digital twins of existing or planned assets in their full built and natural environment. Connect provides a secure, open, and scalable environment for engineering services firms, construction firms, and owner-operators to store and manage infrastructure files and data. It leverages Bentley's iTwin platform to ingest data from over 50 distinct file formats and integrate with a variety of enterprise systems, unifying engineering, operational, enterprise, geospatial, and subsurface data into digital twins of existing or planned assets in their full built and natural environment. Connect also features a unified web experience to visualize infrastructure data in full geospatial context, powered by Bentley's Cesium 3D geospatial capabilities. A dedicated mobile app enables users to stay connected to project or maintenance workflows - wherever they are.

Goodluck India's defence subsidiary secures license for artillery shells manufacturing

Goodluck India has announced that its material subsidiary, Goodluck Defence & Aerospace, has been granted an industrial license under the Indian Arms Act, 1959. The license authorizes the manufacturing of medium-caliber artillery shells for all major sizes, including 105mm, 120mm, 125mm, 130mm, 155mm, and specific 155mm variants such as HE M107, ERFB, ERFB BB, and ERFB BIT. This landmark achievement positions Goodluck Defence among a select group of distinguished suppliers in India's defence manufacturing sector and underscores the company's unwavering commitment to indigenization and technological excellence, aligning with the 'Atmanirbhar Bharat' initiative. With an initial manufacturing capacity of 150,000 shells per annum, which is planned for further augmentation at its state-of-the-art facility, Goodluck Defence is poised to commence trial production in Q3 FY26, transitioning swiftly to full-scale commercial operations. In a parallel strategic development, Goodluck India has entered a tripartite MoU with BrahMos Aerospace Thiruvananthapuram (BATL) and Axiscades Technologies to jointly bid for the Advanced Medium Combat Aircraft (AMCA) programme.

Embassy Developments delivers six long-stalled legacy projects to 3,000 families

Embassy Developments has announced the completion and delivery of six legacy projects. With Occupation Certificates (OCs) now secured, more than 3,000 families are finally moving into their homes – marking the revival of developments that once faced years of delay and uncertainty. In Mumbai and Thane, EDL has delivered three landmark projects. The Blu Estate & Club in Worli, spanning 10.8 acres with 1.4 million sq. ft. and 374 residences, received phased OCs between 2018 and 2022, with condominium association elections being scheduled to enable EDL's exit and transfer of governance to residents. Building on this success, The Sky Forest project in Lower Parel, covering 4.4 acres with 1.6 million sq. ft. and 438 residences, received its OC for Towers A2 and A3 in November 2023. Handovers are largely complete, with final transitions to resident-led management in progress. In Thane, One Indiabulls, a 2.6-acre development comprising 0.5 million sq. ft. and 388 residences, received its Phase I OC in May 2025, and possessions are currently underway. In the National Capital Region, two major developments have reached completion: Enigma in Gurugram, a 19.9-acre project comprising 1.8 million sq. ft. and 480 residences launched in 2010, secured OCs between 2018 and 2021, with final handovers expected by the end of the year; and Centrum Park in Gurugram, spread across 22 acres with 2.1 million sq. ft. and 1,025 residences, has already completed its handovers and now operates as a fully self-governed community, marking EDL's complete exit.

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EIB Global partners with India Energy Transition Fund for $300M sustainable growth

The European Investment Bank's development arm, EIB Global, is investing up to $60 million in the India Energy Transition Fund, a new greenfield infrastructure fund that will accelerate private capital investment in sustainable infrastructure and support decarbonisation efforts in India. It is the country's first energy transition fund managed by a domestic fund manager. The announcement was made by EIB Vice-President Nicola Beer and CEO of EAAA Alternatives Subahoo Chordia. The fund has a target size of $300 million and will channel equity and quasi-equity into greenfield infrastructure projects and growth-stage companies. Most commitments will go to climate action and environmental sustainability, including renewable energy, energy efficiency, transmission, battery energy storage and electric vehicles, including potentially supporting circular economy sectors such as recycling and wastewater management. By providing growth equity, the fund will help unlock projects under development, accelerate new capacity addition and support companies pioneering clean energy and decarbonisation solutions.

Blue Energy Motors launches electric heavy-duty truck with battery swapping technology

Blue Energy Motors (BEM) has launched its electric heavy-duty truck equipped with battery swapping technology. The Chief Minister of Maharashtra, Devendra Fadnavis, unveiled the truck at BEM, 10,000 capacity state-of-the-art Chakan facility in Pune. The CM also inaugurated India's first electric corridor from Mumbai–Pune. This corridor is the first step in the plan to electrify all major national highway corridors over the next three years. It marks a significant milestone in building a cleaner, more efficient freight ecosystem and advancing India's Net Zero Goal. Keeping in mind the strong demand for EV trucks, BEM had signed an MoU with the Maharashtra government to set up a new facility with a capacity of 30,000 trucks, backed by an investment of ₹3,500 crore. BEM has witnessed a strong market demand and is signing MoUs for over 10,000 Electric trucks. The advanced technology of the truck makes BEM electric trucks the lowest TCO in the industry. The key highlights of the EV trucks launched include an advanced heavy-duty electric truck with battery swapping technology, India's first electric corridor from Mumbai to Pune, and the country's first Energy-as-a-Service model for heavy-duty trucks. They offer the lowest cost of ownership, unlimited range through battery swapping, the highest payload in their category, and advanced mobility intelligence, all designed and tested specifically for Indian conditions. With this launch, Blue Energy Motors takes a significant step toward transforming India's freight sector, combining advanced technology, infrastructure, and innovation to deliver cleaner, efficient, and future-ready transport solutions.

Hinduja Renewables appoints Deepak Thakur as Managing Director and CEO

Hinduja Renewables Energy (HREPL), part of Hinduja Group, has appointed Deepak Thakur as Managing Director and Chief Executive Officer, effective from October 1, 2025. He has over three decades of diverse experience across renewable energy, infrastructure, industrial products, and electronics. Deepak has held leadership roles at multiple organizations including the Mahindra Group, Reliance, Sterling & Wilson, L&T, Honeywell, and Thermax. His experience spans the full renewable energy value chain across solar, wind, storage, and hybrid systems covering project development, EPC, O&M, upstream technology, manufacturing, and asset monetisation through InvITs. He succeeds Sumit Pandey, who has stepped down from his position. A committed advocate of clean energy and sustainability, Deepak contributed to the formulation of the National Solar Thermal Policy in 2009, helping lay the foundation for India's clean energy roadmap. He holds a bachelor's degree in Mechanical Engineering from the University of Pune and an MBA from Symbiosis Institute of Business Management.

Embassy Developments raises ₹1,160 crore via promoter warrant subscription

Embassy Developments has announced that its promoters have completed 100% warrants subscription through the final tranche of ₹67.7 crore, taking the total promoter infusion to ₹1,160 crore. The investment was made through the conversion of warrants into equity shares at a price of ₹111.51 per share. The funds are being deployed to strengthen the balance sheet, complete ongoing projects, and support future expansion plans across key markets. This infusion follows the conversion of warrants previously issued on a preferential basis. Including this last tranche, a total of ~10.4 crore rupees fully paid-up equity shares of face value ₹2 each have been allotted to the promoter group and its associated entities at a price of ₹111.51 per share, taking the promoter and promoter group shareholding in EDL to ~41.4%.

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NEI partners with iMRail to develop next-generation transit systems in India

National Engineering Industries, India's leading bearings manufacturer under the NBC brand, and iMRail Technology GmbH, a pioneer in next-generation railborne mobility solutions, have laid the foundation for a comprehensive 'Make in India' ecosystem for advanced transit systems, including low-to-medium speed Maglev, next-generation Monorail and Ropeways as well as sub-systems for such mobility solutions. Leveraging iMRail's cutting-edge technologies, the partners will deliver integrated, sustainable, and high-performance solutions to rail operators, OEMs, and urban transit developers across India and beyond. The key focus areas include the joint development and deployment of breakthrough non-conventional technologies such as Maglev, Monorail, and Ropeways; a strong emphasis on sustainability and economic efficiency through environmentally responsible solutions that enhance performance and energy use; and the integration of intelligent systems and digital innovations to redefine modern transportation.

HCC wins contract for pot shell & superstructure fabrication

Hindustan Construction Company (HCC) has secured a ₹204 crore contract from Hindalco Industries for the fabrication, supply, and erection of pot shell and superstructure as part of the Aditya Aluminium smelter expansion project in Odisha. The project forms a key component of Hindalco's large-scale initiative to enhance its aluminium smelting capacity by 200,000 tonnes per annum. HCC's advanced fabrication expertise and execution capabilities will be instrumental in delivering this complex, large-scale industrial project to international standards. The new contract reinforces HCC's growing presence in specialised private sector projects. It also reaffirms the company's commitment to supporting India's industrial growth through innovation, technical excellence, and execution reliability.

PM Modi inaugurates Navi Mumbai International Airport

Prime Minister of India Narendra Modi has inaugurated the Navi Mumbai International Airport (NMIA), one of India's most ambitious infrastructure projects and a defining milestone in the nation's aviation journey. NMIA has been developed as a landmark public-private partnership (PPP) between Mumbai International Airport (MIAL), a subsidiary of Adani Airport Holdings (AAHL), and the City and Industrial Development Corporation (CIDCO). The project represents a major stride in India's infrastructure-building vision, reflecting the Government's agenda of Viksit Bharat 2047. Envisioned as part of a dual-airport system for the Mumbai Metropolitan Region (MMR), NMIA will complement Chhatrapati Shivaji Maharaj International Airport (CSMIA). With an initial capacity of 20 million passengers per annum (MPPA), the airport will eventually expand to manage 90 MPPA, making it one of the largest passenger-handling airports in India. Designed as a multimodal hub, NMIA will be seamlessly connected to the Mumbai Trans Harbour Link, Navi Mumbai and Mumbai Metro, suburban rail networks and planned waterways. This integration will reduce travel times, enhance regional connectivity and strengthen cargo and passenger movement across the vast hinterland of western India. Inspired by the Lotus, India's national flower, NMIA's architecture blends cultural heritage with world-class design and sustainability features, creating an airport that is both rooted in Indian identity and aligned with future aspirations.

Jindal Stainless unveils lightweight, corrosion-resistant, and energy-efficient salt trailers

Jindal Stainless has unveiled the Salt Tipper Trailer at its Technical Conclave in Gujarat, the heart of India's salt industry. The integration of stainless steel in salt trailers addresses long-standing challenges of corrosion, lower durability, shorter lifespan, and high maintenance costs for salt logistics players, offering them lightweight, corrosion-resistant, energy-efficient, and sustainable solutions. The company has deployed the advanced 304 & JT (N7 as per BIS 6911 specifications) grades of stainless steel, known for their superior corrosion resistance, fire resistance, and higher strength and excellent impact, for building the trailers. Traditional materials used for this application are known to corrode within 3-4 years, leading to operational downtime and high repair costs. In contrast, stainless steel trailers are estimated to offer around 25% weight reduction, which, among other factors, can result in cost savings of about INR 25-30 lakhs over 10 years and an expected lifespan of about 15-20 years.

This launch builds on a successful pilot, following which Jindal Stainless' Tipper Trailers have already attracted strong market interest, with leading fleet and transport operators in Gujarat and Rajasthan evaluating the trailers for deployment across their combined fleet. To ensure quality and scalability, Jindal Stainless is partnering with certified fabricators and ITI-trained professionals while engaging stainless steel academies to build a skilled workforce for large-scale deployment.

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Mahindra Lifespaces wins Redevelopment Mandate for Four Societies in Malad (West), Mumbai

Mahindra Lifespace Developers (MLDL) has been selected as the preferred partner for the redevelopment of four residential societies in Malad (West), one of Mumbai's established suburban neighbourhoods. Spread across approximately 1.65 acres, the project offers a development potential of INR ~800 crore. The project is located close to Mahindra Lifespaces' ongoing redevelopment project, Mahindra Codename64, strengthening presence in the micro-market. Located just 2.6 km from the Western Express Highway, the project offers excellent connectivity to key parts of Mumbai via multiple transport modes. It is conveniently situated less than 1 km from Malad West Metro Station and around 1.5 km from Malad Railway Station. The location's proximity to prominent business hubs such as Mindspace, Malad and Bandra Kurla Complex (BKC) further enhances its appeal. Situated in an established residential area, the new development will provide easy access to a wide range of urban conveniences, including reputed schools, leading healthcare facilities, retail destinations, and business centres.

Tata Power Renewables to set up 80 MW Firm and dispatchable renewable energy project

Tata Power Renewable Energy (TPREL), a subsidiary of The Tata Power Company has entered into a Power Purchase Agreement (PPA) with Tata Power Mumbai Distribution for a contracted capacity of 80 MW Firm and Dispatchable Renewable Energy (FDRE) project.

The project will integrate advanced solar, wind and battery storage systems to enable reliable energy dispatch during peak demand, thereby strengthening grid stability.

The project, to be completed within 24 months, is expected to generate approximately 315 million units (MUs) of electricity annually, mitigating over 0.25 million tons of carbon dioxide emissions per year. A key feature of this initiative is the commitment to a 4-hour peak power supply, ensuring at least 90% availability during peak demand hours to support the growing energy needs of Tata Power Mumbai Distribution. Once commissioned, the clean energy generated from this project will be seamlessly integrated into Tata Power's Mumbai distribution network, enabling the delivery of reliable, low-emission electricity to around 8 lakh customers across residential, commercial, and industrial consumers.

L&T's Buildings & Factories vertical bags major orders in Bengaluru and Mumbai

The Buildings & Factories (B&F) vertical of Larsen & Toubro has secured major orders in India. The Business has secured an order from a reputed MNC for one of the largest proposed IT Parks with a development of 5.9 million sq. feet on a Lumpsum Turnkey basis at Bengaluru and to be delivered in two phases. The key features include 'A' grade office space development in warm shell basis with USGBC New Building – Platinum rating towards LEED Certification for sustainability. The warm shell construction includes developing six towers (Towers 1,2,3,4,5 & 6 with 14 Storeys (Common Basement of 3 Floors + Ground + 10 Floors + Terrace). The major scope of works involves civil structure works, unitised façade glazing, architectural lighting, finishes, electromechanical services (high & low sides for FPS, electrical, HVAC, PHE, elevators & escalators, ELV systems), a GIS substation, Solar PV system, LPG gas bank, WTP, STP, UG tanks, stack parking, along with an extensive scope of hardscaping, landscaping and irrigation in external development areas. The business has also secured an order from a reputed developer to construct a mixed-use development project in Mumbai. The project is to be executed within a timeline of 45 months.

RHI Magnesita commissions Robotic solution in caster operation for the Indian steel industry

RHI Magnesita has commissioned India's first-ever robotics system for caster operations at JSW Vijayanagar Metallics (JVML), a wholly owned subsidiary of JSW Steel in Toranagallu, Bellary, Karnataka. This breakthrough marks a defining moment in Indian steel manufacturing, introducing advanced automation to one of the most critical stages of steel production. Part of RHI Magnesita's holistic 4PRO solution, anchored in Performance, Partnership, People and Planet, the first ever robot installed in any Indian steel plant for caster job is designed to handle 350-ton heat-size ladles and perform essential operations, including ladle shroud change, powder feeding in the tundish, temperature measurement, tundish sampling, and probing. Equipped with the latest generation SX3 slide gate system, EMLI LadleSlag sensors, and robotic cells on the Continuous Casting Machine (CCM), the system automates critical casting processes, enhancing efficiency, safety, and quality. The technology removes direct human exposure to molten metal, extreme heat and hazardous fumes, setting new safety benchmarks in the industry.

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GlobalLogic inaugurates new office in Chennai

GlobalLogic, a Hitachi Group company, has inaugurated its new office in Chennai, further expanding its presence in India, and aimed at deepening its partnership with Global Capability Centers (GCCs). Strategically located in RMZ Milenia Business Park, Perungudi, one of the city's premier IT corridors, the new facility is designed to accommodate 500 professionals and is complemented by an additional 300-seat center in Guindy, established through GlobalLogic's integration with Mobiveil, acquired in December 2023. Together, these centers will enhance GlobalLogic's capacity to collaborate with global telecom clients, accelerate delivery timelines, and scale AI-first engineering capabilities. With over 800 employees currently based in Chennai, GlobalLogic plans to increase this number by 20% by the end of 2025, bringing the local headcount to over 1000. This growth contributes to the company's broader ambition of reaching a 20,000-strong workforce in India and a global headcount of 35,000.

Serentica Renewables to supply captive power to MRF

Serentica Renewables has signed a long-term Power Purchase Agreement (PPA) with MRF, to supply clean power under the captive power framework. A SPV was created specifically to supply RE power to MRF in which MRF has picked captive minority stake and the rest is held by Serentica. The clean energy will be supplied from a new hybrid renewable energy project with a total installed capacity of around 170 MW, currently under development by Serentica Renewables. The project will integrate both solar and wind generation to deliver round-the-clock renewable energy for MRF's manufacturing facilities across India through the ISTS (Inter-State Transmission System) network. This agreement helps in expanding company's renewable energy solutions for a large industrial clients seeking flexible and reliable clean power. The captive arrangement will allow MRF to meet its substantial electricity requirements, supporting its ongoing sustainability and net-zero ambitions.

Walplast launches HomeSure Mastertouch Waterlock Expert with ultra elastic technology

Walplast Products has launched its latest innovation, HomeSure Mastertouch Waterlock Expert, a next-generation waterproofing solution designed to protect homes from seepage, dampness, and weather temperature-induced damage. This is a premium waterproof coating engineered with Ultra Elastic Technology (800% Elongation) to deliver 10 years of assured protection for exteriors. The product is positioned with the promise "Seepage ki Samasya Gone!" and offers multiple benefits, including superior crack-bridging, a decade-long system warranty, and a surface temperature reduction of up to 8 C, which enhances indoor comfort and energy efficiency. HomeSure Mastertouch Waterlock Expert is an acrylic polymer-based elastomeric waterproofing protective coating formulated with UV-resilient acrylic polymers and reinforcing synthetic fibers. Once cured, it forms a seamless and durable membrane that delivers long-lasting waterproofing performance, excellent flexibility, and self-crack bridging ability. Specially engineered for exterior use, it is powered by Ultra Elastic Technology, which allows the coating film to elongate up to 800 percent. This property ensures the product can bridge micro-cracks caused by thermal movement and weathering, providing resilience against seepage and dampness while retaining durability and aesthetics under extreme climatic conditions.

L&T expands Its middle east footprint with key power transmission contracts

The Power Transmission & Distribution (PT&D) vertical of Larsen & Toubro has won grid infrastructure orders in the Middle East. The 400kV super grid interconnection linking the electricity networks of GCC member states has helped in efficient utilisation of generation capacity and has improved the overall grid resilience. Currently, the network of the Sultanate of Oman is connected to this interconnection through UAE's grid at 220kV. Now a direct interconnection is being established at 400 kV level for which a 400 kV Substation in UAE is crucial. L&T PT&D has won an order to engineer, procure and construct this 400 kV Substation. Another order has been secured for building a set of new 132kV substations in the Middle East to cater to the electricity demand growth. In Saudi Arabia, an order has been received for turnkey construction of 380 kV overhead transmission lines associated with integration of renewable energy power plants.

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Coal mining in India: Technology, Transformation, and the Road to Sustainable Growth

Coal mining is deeply embedded in India's economic history and present-day reality. As the largest source fueling the nation's energy grid, coal supports nearly three-quarters of India's electricity and underpins vital industries ranging from steel and cement to chemicals and transportation. Yet, India's coal sector is undergoing dramatic transformation—powered by technological disruptors like artificial intelligence and automation, driven by urgent environmental imperatives, and reshaped by ambitious government policies. The sector's journey is a captivating story of complexity: balancing development and energy security against the need for sustainability and social accountability.

The Historical Backbone of Indian Energy

Coal has been the bedrock of India's industrialization since the colonial era. Regions such as Jharkhand, Odisha, Chhattisgarh, West Bengal, and Madhya Pradesh are rich in coal, forming the backbone of the country's mining activities. For decades, the sector has provided millions of livelihoods and contributed substantially to government revenues and local economies. State-run Coal India Limited (CIL), established in 1975, became the world's largest coal producer, dominating supplies through an extensive network of mines and subsidiaries.

But with economic liberalization, shifts in global energy geopolitics, and surging population and industrial demands, the coal sector has faced significant pressure to modernize, diversify, and reconcile legacy challenges with new opportunities.

The Age of Automation and AI: Revolutionizing Indian Coal Mining

The transformation sweeping through India's coal mines is driven by a new wave of technology: automation and artificial intelligence. These are not simply incremental upgrades; they are fundamentally altering the way coal is explored, extracted, transported, and managed.

Automated Machinery and Smart Mining

The sector is rapidly deploying self-driving dump trucks, autonomous drilling rigs, and robot-assisted conveyor belts. Instead of hazardous manual labor, mining operations increasingly depend on remotely operated excavators, GPS-guided bulldozers, and adaptive ventilation systems. Automation minimizes human exposure to dangerous underground

conditions and accelerates mining cycles. Mines equipped with networked sensors can monitor air quality, detect gas leaks, and trigger automatic safety shutdowns.

AI platforms handle geological data crunching—analyzing terabytes of satellite maps, seismic readings, and ore samples to identify optimal drilling sites and minimize waste. Predictive algorithms determine the right time for maintenance, reducing equipment downtime and costly breakdowns.

Drones, Satellites, and Surveillance

Aerial drones and satellite imagery—integrated with AI analytics—enable unprecedented real-time mapping of mining sites. Operators can track shifts in topography, detect illicit activity, and monitor rehabilitation efforts without physically entering hazardous zones. These technological eyes in the sky have made it possible to ensure that mines comply with environmental standards, reclamation requirements, and safety protocols.

Safety and Uptime Impacts

Automated systems have significantly improved worker safety by removing humans from the most dangerous tasks. Fatalities and injuries from mine collapses, explosions, and exposure to toxic gases are steadily declining. AI-enabled health and safety systems alert supervisors in advance to evolving risks, whether geological shifts, machinery faults, or sudden atmospheric changes.

Labor Markets and Workforce Transformation

The adoption of AI and automation brings seismic changes to the workforce. Traditional mining jobs—such as manual drilling, blasting, and ore loading—are giving way to new roles: software engineers, data analysts, robotic technicians, and environmental scientists. Industry-supported retraining and upskilling initiatives are increasingly essential, helping miners transition to tech-enabled careers that offer improved job safety and prospects for advancement.

Despite the benefits, these shifts have triggered anxieties about job displacement and regional inequalities, especially in communities where mining has been the primary economic driver. Addressing these concerns with comprehensive reskilling programs, transparent compensation, and proactive social policies is a current industry priority.

Environmental Imperatives: The Push Toward Sustainability

If modernization through technology is one engine of change, environmental stewardship is another. Coal mining, by its nature, imposes substantial ecological disturbances—deforestation, soil erosion, water table depletion, and the generation of toxic air pollutants and greenhouse gases. A sector once associated with unchecked damage is now under relentless scrutiny from regulators, citizens, and global observers.

Land Rehabilitation and Afforestation

India's coal companies are increasingly implementing biological reclamation programs: mined-out land is recontoured and restored to its natural state or repurposed for agriculture and green spaces. Massive afforestation drives have created tens of thousands of hectares of new forest cover, serving both as carbon sinks and habitats for displaced wildlife. These efforts not only comply with legal mandates but also help win local support and international credibility.

Cleaner Mining Technologies

Technological upgrades like "blast-free" mining—using hydraulic fragmentation instead of explosives—dramatically reduce particulate emissions and noise pollution. On-site dust suppression systems, advanced water recycling, and methane capture installations are becoming standard, lowering the ecological footprint and boosting resource efficiency.

AI plays a central role in sustainability: by processing real-time sensor data from mines and surrounding areas, platforms can track pollution levels, carbon emissions, and biodiversity impacts, allowing for swift regulatory interventions and public disclosures.

Climate Commitments and Carbon Management

India is committed to achieving net-zero emissions by 2070 and increasing its installed green capacity to 500 GW by 2030. Though coal remains vital for reliability and grid stability, the sector is under strong federal direction to cut emissions and enhance cleaner operations. Methane management, coal gasification projects, and hybrid co-firing in power plants are becoming commonplace, enabling the blending of coal with renewable resources.

State-owned enterprises and private firms have actively diversified into solar and wind generation.

Vast stretches of reclaimed mining land are being repurposed for solar parks, wind farms, or sustainable agriculture. In parallel, carbon-tracking software supports transparent reporting required by both domestic and global investors.

Community Impact: Rehabilitation, Livelihoods, and Social Justice

Coal mining's relationship with local communities has long been fraught—marked by displacement, loss of traditional livelihoods, and complex social dynamics. The industry's renewed focus on responsible growth extends to community rehabilitation, reskilling, and equitable benefit sharing.

Land Acquisition and Compensation

Under new policy frameworks, mining projects must conduct transparent social impact assessments and secure informed local consent before land acquisition. Compensation packages now include not only cash payments but also resettlement assistance, alternative livelihood generation, and long-term engagement with affected people. Dedicated grievance redressal mechanisms and community participation boards are mandated in the largest projects.

Skills Development and Inclusive Growth

Reskilling programs for displaced workers and local youth are central to sector transformation. Schools, technical institutes, and vocational centers established by coal companies (often in partnership with government and NGOs) provide pathways for employment in allied industries—construction, transportation, machinery maintenance, and environmental services.

Healthcare, drinking water, and education initiatives backed by mining revenues bolster local quality of life, while employment quotas and procurement preferences for area residents create opportunities for shared growth.

Challenges in Implementation

Despite progress, challenges remain. There are persistent calls for greater transparency in compensation processes, continual improvements in rehabilitation outcomes, and stricter enforcement of community benefit provisions. Civil society, media, and international watchdogs continue to monitor progress, pushing for higher standards in social accountability.

Balancing Coal with Renewable Energy: The Path to Net Zero

India's ambitious commitments to renewable energy and climate action require a careful recalibration of the coal sector's role. Coal's traditional status as the "king" of Indian energy is transitioning toward a strategic balancing act—ensuring energy security and supporting the surge of renewables.

Hybrid and Flexible Models

Newer coal plants are equipped with hybrid operational models, enabling co-firing with biomass, solar, or wind energy. Such configurations reduce emissions, optimize fuel mix, and support grid stability. Coal gasification plants—converting coal into cleaner syngas—produce fertilizer, methanol, and synthetic natural gas for industrial use, lowering dependence on imported raw materials and fossil fuels.

AI for Grid Optimization

AI-powered systems are increasingly vital for grid management, balancing the fluctuating supply of renewables with the reliability of coal during peak demand or low renewable output. Machine learning algorithms predict energy needs, optimize coal and renewable plant dispatch, and manage ancillary services in real time—minimizing energy waste and improving affordability.

Industry Diversification

Leading coal mining firms have committed billions to solar and wind projects, battery storage installations, and electric vehicle supply chains. Mines and infrastructure assets are being repurposed for clean energy operations, transforming former environmental liabilities into future-ready hubs for sustainable development.

Policy Reforms: Investment, Competition, and Governance

The policy environment surrounding coal mining in India has experienced a gear-shift since the mid-2010s. The government's embrace of liberalization and market competition has unleashed new investment and innovation across the sector.

Commercial Coal Auctions

The launch of commercial coal mine auctions has ended state monopoly control, welcoming foreign and private players into the market. Competitive bidding ensures transparent allocation, market-determined pricing, and rapid adoption of advanced technologies. Auctions have been positively received by global investors, leading to robust mining activity and spurring economic development in resource-rich states.

Privatization and FDI

Privatization of select mines and the relaxation of Foreign Direct Investment (FDI) norms have attracted technology partners, capital, and expertise from leading mining nations. Local equipment manufacturing has received a boost under "Make in India," while technology transfer agreements drive next-generation mining capabilities.

Regulatory Reform

Single Window Clearance Portals, Star Rating Systems for mines, and digital permitting mechanisms have slashed bureaucracy and accelerated project timelines. AI-based compliance monitoring further ensures that companies stay on top of environmental, social, and technical obligations.

Critical Minerals Strategy

Recognizing the importance of minerals like lithium, cobalt, and rare earth elements for clean energy transition, policy initiatives have expanded the mining sector's focus from coal to critical minerals exploration—a move expected to position India at the heart of future energy supply chains.

The Road Ahead: Challenges and Opportunities

Coal mining in India is charting a transformative path—leveraging automation, AI, and policy innovation while prioritizing sustainability, safety, and social equity. Yet, key challenges need continued attention:

- Managing the just transition for workers and communities and closing regional development gaps.
- Maintaining competitiveness as environmental compliance costs rise and global investment shifts toward green assets.
- Ensuring timely and transparent implementation of social and environmental policies.
- Meeting ambitious climate targets while sustaining reliable energy supply during renewables ramp-up.

Navigating a Transformative Future

Indian coal mining is reinventing itself—not as a relic of the past, but as an engine of responsible and innovative growth. The sector's embrace of automation and AI is unlocking new levels of efficiency, transparency, and safety, reshaping both the nature of mining work and its relationship with the environment. Rigorous policy interventions and investments are fostering a climate of competition and opportunity that promises long-term resilience.

The journey is far from over. The coal sector's future will be distinguished by its ability to harmonize the demands of development, sustainability, and inclusive growth—a mission requiring coordination among government, industry, and communities. India's drive toward net zero, supported by digital innovation, environmental ambition, and social responsibility, offers a blueprint for other resource-based economies worldwide.

The story of coal mining in India is ultimately a story of change: technological, environmental, and human. It embodies the nation's effort to power progress while preserving the promise of a greener, fairer tomorrow. EPC World

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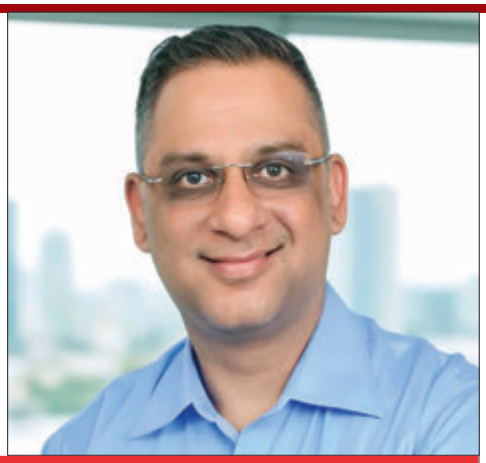

IME 2025 being a leading exhibition for the mining sector, how is your company approaching this event, and what are your expectations from it?

IME 2025 is a platform for the mining sector which is bringing together industry leaders, OEM partners, and professionals who are shaping the future of mining in India.

At IME, our priority is to reinforce BKT's position as a trusted global partner in mining and OTR tyres. We are showcasing our advanced EARTHMAX range, which has proven performance in some of the toughest mining environments worldwide. By combining robust products with digital solutions and strong after-sales service, we aim to differentiate on value rather than just price. This approach ensures long-term, sustainable growth in an increasingly competitive market.

Could you give us an overview of the tires and related solutions your company is showcasing at IME 2025, highlighting any new or innovative products?

At IME 2025, BKT will showcase a wide range of its advanced EARTHMAX tyres range engineered for the toughest mining applications, both underground and surface. Each product reflects our commitment to durability, safety, and performance in extreme operating conditions:

- **EARTHMAX SR 55 L-5S TL** – a solid performer for Load Haul Dump (LHD) machines in underground mining, designed with a smooth tread and cut-resistant compound for maximum durability in confined, abrasive environments.
- **EARTHMAX SR 468 E-4 TL** – engineered for Rigid Dump Trucks (RDTs) in large open-pit and surface mining, this giant tyre delivers excellent stability, extended wear life, and heat resistance under high-load, long-cycle operations.
- **EARTHMAX SR 53 L-5 TL** – built for wheel loaders and wheel dozers in surface mines, featuring an extra-deep tread and reinforced casing to handle sharp rocks and heavy-duty load cycles with reduced downtime.
- **EARTHMAX SR 53 L-5 TL** – specifically crafted for Low Profile Dump Trucks (LPDTs) used in underground mining, offering exceptional traction, wear resistance, and robustness where space and safety are critical.
- **EARTHMAX SR 34 E-3+ TL** – a versatile solution for mining trucks, combining a non-directional tread pattern with excellent heat dissipation and stability for enhanced performance in varied mine haulage conditions.

Together, these products represent BKT's integrated approach to mining tyres – delivering reliability, minimizes equipment downtime, ultimately leading to more efficient, uninterrupted mining operations and safety while supporting the industry's growing focus on productivity and sustainability. With our extensive EARTHMAX tyres range, we are ready to meet the unique demands of mining customers across both India and global markets.

Going forward, how do you see your participation at IME 2025 shaping your engagement with the Indian mining industry?

Our participation at IME 2025 is a strategic step in deepening our engagement with the Indian mining industry. By showcasing the EARTHMAX tyres range, we are not only presenting our latest technological innovations but also reinforcing BKT's commitment to productivity, safety, and sustainability for mining companies. EPC World

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Empowering Tomorrow

Emerging as a cornerstone of India's clean energy and industrial ambitions, the green minerals sector is driving the nation toward a sustainable future. Rising demand for lithium, cobalt, rare earths, and other critical minerals is positioning India as a key player in the global energy transition.

India's green minerals sector has emerged as a critical pillar in the country's transition toward a sustainable, low-carbon economy. With rising global demand for clean energy technologies such as electric vehicles, wind turbines, and solar panels, minerals like lithium, cobalt, nickel, graphite, and rare earth elements have gained strategic importance. Over the past few years, India has intensified exploration efforts and policy focus on these minerals, recognizing their role in achieving self-reliance in energy storage and renewable infrastructure. The discovery of lithium reserves in Jammu and Kashmir and other regions has particularly fueled optimism, signaling the beginning of a new era for India's mineral economy.

Driven by a combination of policy reforms, private investments, and global partnerships, the green minerals sector in India has seen rapid momentum in recent times. The government's focus on critical mineral exploration, along with initiatives under the National Mineral Policy and Production Linked Incentive (PLI) schemes for battery manufacturing, has encouraged both domestic and foreign participation. As industries increasingly pivot toward cleaner technologies, India's growing emphasis on securing green mineral supply chains positions it not just as a resource-rich nation but as a potential global player in the sustainable energy transition.

Market Watch

India's current market for green minerals is in a phase of dynamic expansion, driven by both internal policy shifts and global energy-transition pressures. Recent studies show that imports of critical minerals surged from about US$3.03 billion in 2020-21 to nearly US$8.01 billion in 2023-24, underlining how fast domestic demand is growing. As per the data from World Economic Forum, While India is richly endowed with resources such as cobalt ore (≈ 44.9 million tonnes) and copper reserves (~163.9 million tonnes), domestic production and processing capacity for many critical minerals remains either nascent or non-existent.

Projections by researchers indicates that the annual requirements for just a few strategic minerals for sectors like solar PVs, wind turbines, and battery storage will leap from modest levels (for instance, ~58 tonnes of lithium, ~17 tonnes of cobalt in 2025) to very large volumes by 2047 (~20,845 tonnes of lithium; ~5,914 tonnes of cobalt) without even counting electric vehicles in most scenarios.

The green minerals sector in India is witnessing a remarkable shift from a niche segment to a key growth frontier of the economy. The discovery of lithium reserves in Jammu and Kashmir and ongoing exploration for cobalt, nickel, and rare earth elements have positioned India on the path to becoming a future hub for critical mineral production. Over the past three years, demand for these minerals has accelerated in line with India's energy transition goals and rapid growth in clean technology manufacturing. The expansion of electric vehicle production, battery storage systems, and renewable energy infrastructure has created a robust domestic market for lithium, graphite, copper, and rare earths. Industry analyses and government data suggest that the value of India's critical minerals market could grow at a double-digit rate through the next decade, supported by investments in exploration, refining, and processing capacities.

The surge in demand is being propelled by several interconnected factors. India's ambitious renewable energy targets and electric mobility policies have created strong, long-term consumption prospects for minerals used in solar panels, wind turbines, and EV batteries. Policy reforms such as the amendment of mining regulations, incentives for downstream manufacturing under the

Production Linked Incentive (PLI) schemes, and the launch of the National Critical Minerals Mission have enhanced investor confidence and spurred private participation.

Additionally, rising global concerns over supply chain security and dependence on imports from a few dominant producers, notably China, have made the development of a self-reliant mineral ecosystem a strategic priority for India. Together, these trends underline the sector's evolution from resource exploration to a value-driven, innovation-led growth story—one that is crucial for India's clean energy ambitions and industrial competitiveness.

Tech Gains

Technical innovation is reshaping how India finds and evaluates green mineral deposits. Remote sensing, airborne geophysics and more accessible high-resolution satellite imagery are allowing exploration teams to map prospective zones faster and with fewer field visits. Those datasets, when combined with machine learning and geospatial analytics, help prioritize targets by predicting mineral signatures and reducing the time and cost of early-stage exploration. At the same time, more widespread use of modular, low-footprint drilling rigs and improved on-site assay technologies means that promising discoveries can be validated more

Pic Courtesy:greekcitytimes

quickly and with a smaller environmental footprint than older, heavy-machinery approaches.

On the processing and refining side, new hydrometallurgical and chemical-separation techniques are changing the economics of lower-grade deposits. Processes that use targeted leaching, solvent extraction and selective precipitation are enabling extraction of lithium, nickel, cobalt and rare earths from complex ores and secondary feed-stocks such as tailings and spent batteries.

There is also growing interest in direct-extraction methods that aim to recover lithium from brines with lower water and energy use, and in pilot-scale approaches to recover rare earths without the intense, multi-stage smelting historically required. Parallel advances in materials chemistry—better binders, coatings and purification methods for battery-grade materials—are helping domestic refiners meet the stricter quality thresholds needed by battery and electronics manufacturers.

Digitalization, circularity and manufacturing technologies are linking the upstream mineral value chain to end-use industries more tightly than before. Industry 4.0 tools — real-time sensors, digital twins, and predictive maintenance — are improving plant uptime and reducing waste, while block-chain and traceability platforms are being trialed to certify ethical sourcing and compliance with ESG norms. On the downstream side, innovations in battery chemistries (higher-energy cathodes, silicon-enhanced anodes) and advances in magnet manufacturing (precision alloying, additive manufacturing for complex geometries) are increasing demand for specific grades of green minerals and encouraging investment in domestic value-addition.

Last but not the least, recycling technologies — from mechanical disassembly to advanced hydrometallurgical recovery of critical elements from end-of-life batteries and magnets — are maturing, creating the technical basis for a circular supply chain that can both relieve raw material pressures and reduce environmental impact. Together these trends are not only improving how India finds and processes green minerals, but are also shaping a more resilient, higher-value industrial ecosystem around them.

Growth Hiccups

Despite its rapid growth potential, India's green mineral sector faces a complex set of challenges that slow its progress toward self-reliance and sustainability. One of the foremost issues is limited domestic production and processing capacity. While exploration has identified promising deposits of lithium, cobalt, and rare earth elements, commercial-scale mining and refining remain at an early stage. This gap forces India to depend heavily on imports for critical inputs, exposing the country to global price volatility and supply disruptions.

Another major hurdle lies in regulatory bottlenecks and lengthy approval processes, which often delay exploration licenses, environmental clearances, and land access. The absence of an integrated framework that connects exploration, extraction, processing, and recycling makes coordination across agencies and states difficult.

Environmental and social concerns further complicate the landscape. Mining of critical minerals requires careful management of ecological impacts, especially in fragile regions such as the Himalayas and North-Eastern states where some deposits are located. Communities living near mining sites are increasingly demanding transparency, fair compensation, and rehabilitation, which calls for more inclusive and responsible governance models.

From a technological standpoint, the sector also struggles with a shortage of skilled manpower and

research capacity in mineral processing, metallurgy, and advanced materials. Private investors remain cautious due to uncertain returns and limited data on resource quality and availability.

The stakeholder network around green minerals is wide and still evolving. The central government, through the Ministry of Mines and the Geological Survey of India, plays a leading role in policy direction and exploration funding. State governments are responsible for land allocation, local approvals, and implementation of mining projects. Public sector undertakings such as Khanij Bidesh India Limited (KABIL) and Indian Rare Earths Limited (IREL) are spearheading international sourcing and domestic processing efforts.

On the private side, mining companies, renewable energy manufacturers, and technology firms are beginning to invest in supply chain integration, while research institutions and startups are contributing to innovation in exploration and recycling. For the sector to mature sustainably, stronger collaboration among these players—supported by consistent policy, transparent governance, and responsible mining practices—will be essential.

The Path Ahead

The future of India's green minerals sector will be shaped by a combination of structural demand shifts, industrial policy, and global clean energy trends. At the heart of this transformation is India's energy transition agenda, which envisions a massive expansion in renewable energy capacity to 500 GW by 2030 and deep electrification of transport and industry.

This transition will drive exponential demand for minerals such as lithium, cobalt, nickel, copper, graphite, and rare earth elements — essential inputs for electric vehicle batteries, wind turbines, solar cells, and energy storage systems. As electric mobility adoption scales up, India's automotive sector is expected to become a major consumer of these minerals, especially with the expansion of domestic cell and battery manufacturing under the PLI schemes.

Another key demand driver will be the growth of advanced manufacturing and digital technologies. Sectors like electronics, semiconductors, and defense are increasingly reliant on rare earths, magnets, and high-purity metals for sensors, communication systems, and precision instruments.

The government's "Make in India" and "Atmanirbhar Bharat" initiatives are encouraging domestic production of such high-tech components, which will in turn strengthen demand for processed green minerals. Simultaneously, global supply chain diversification—driven by concerns over dependence on a few dominant producers—presents India with an opportunity to position itself as a reliable supplier and processing hub for critical minerals in Asia.

Infrastructure modernization and grid-scale energy storage are also expected to play a defining role in expanding mineral demand. As India builds a more resilient power grid with higher renewable penetration, large-scale battery energy storage systems will become indispensable, significantly increasing the requirement for lithium, nickel, and graphite. The emergence of new technologies—such as solid-state batteries, hydrogen fuel cells, and next-generation solar materials—could further diversify mineral use and deepen the market base. Finally, the growth of urban mining and circular economy models will open additional sources of demand and supply stability, as recycling and reprocessing of used batteries, e-waste, and magnets evolve into organized industries. Together, these forces will not only accelerate mineral consumption but also push India toward developing an integrated, innovation-driven ecosystem that supports sustainable and strategic growth in the green minerals domain.

India's green minerals sector stands at a defining moment in its evolution—poised between immense opportunity and significant challenge. With rising demand from clean energy, electric mobility, and advanced manufacturing, these minerals have become the building blocks of India's sustainable future. The country's recent policy reforms, exploration efforts, and focus on domestic value addition have laid the groundwork for a resilient and self-reliant mineral ecosystem. However, achieving this vision will require continued investment in technology, stronger collaboration among stakeholders, and a balance between growth and environmental responsibility. If pursued strategically, the green minerals sector can not only power India's energy transition but also position the nation as a global leader in the new era of sustainable industrialization. EPC World

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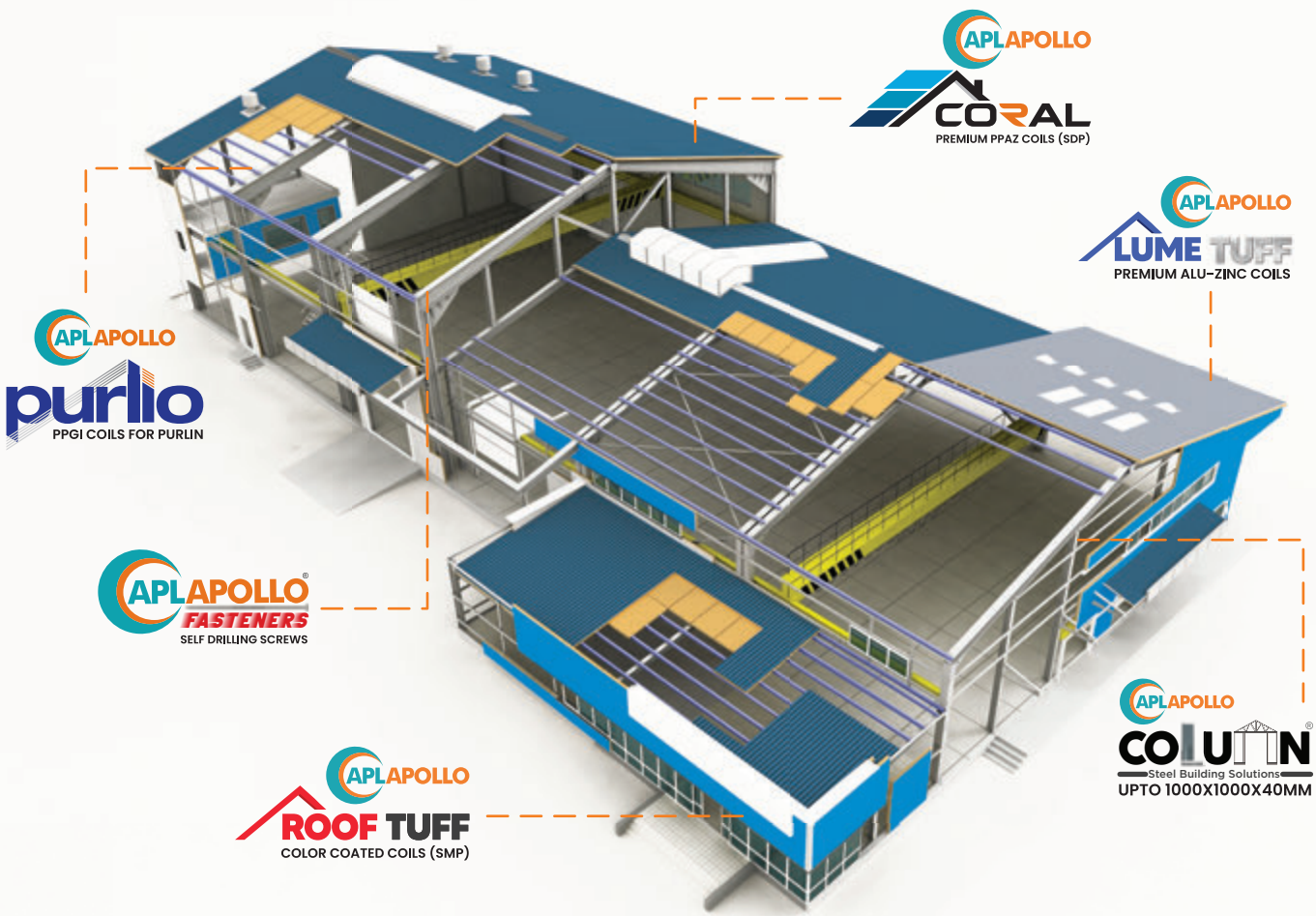

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Beneath the garden city

How L&T delivered breakthroughs on Bangalore Metro's Pink Line

Stretching 21.26 km through the heart of India's tech capital, the Pink Line of Namma Metro is redefining urban connectivity and underground engineering excellence. Executed by Larsen & Toubro, the RT-02 and RT-03 packages showcase record-breaking tunnelling, advanced digital integration, and sustainable practices. From navigating complex geology to deploying real-time analytics, L&T's precision-driven approach has set new benchmarks for metro construction in India

The Pink Line of Namma Metro is steadily progressing, poised to become a vital artery in Bangalore's urban transit network. Stretching 21.26 km, this line seamlessly links Kalena Agrahara station on Bannerghatta Road in the south to Nagawara station along the Outer Ring Road in the north. Characterized by a predominantly underground route spanning 13.92 km, the Pink Line also features a 6.98 km elevated stretch and a short 0.48 km at-grade segment. Comprising 18 strategically located stations; 12 underground and 6 elevated, the line will enhance connectivity, including a key interchange with the Purple Line at MG Road station. The contract for completing packages RT 02 & RT 03 was awarded to Larsen & Toubro (L&T). The total project length awarded to L&T is 5.64 km long. In addition, the Scope include construction of 5 underground Stations along with associated Cross passages, Entry Exit Structures and one retrieval Shaft.

L&T's execution of RT-02 and RT-03 packages on the Pink Line demonstrates advanced tunnelling methodologies under complex urban geology, integrating BIM, real-time TBM analytics, and hyperbaric interventions to deliver precision-driven underground infrastructure. The teams have set new benchmarks in safety, sustainability, and digital construction excellence for metro rail projects in India

S V DESAI,
Whole-Time Director &
Sr. Executive Vice President
(Civil Infrastructure)

BMRCL RT-02

BMRCL RT 02 is a crucial section of pink line in Bangalore which involves design and construction of underground structures of length 2.762 km from Vellara Junction station to Shivajinagar Station consist of twin tunnels of 2.1 km and 3 underground stations viz, Vellara Junction, M G Road & Shivajinagar and associated architectural works. The RT-02 alignment cuts through Mahatma Gandhi Road one of Bangalore's busiest and most iconic thoroughfares, presenting significant engineering and logistical challenges in the heart of the city.

Key Records

Successfully completed 4.4 kms of tunnelling in extremely challenging geological conditions (Granitic Gneiss & Dolerite Dyke boulders). The complexity of the terrain required hyperbaric cutterhead interventions at an average interval of every six meters. In total, 736 such interventions were carried out under two bar pressure owing to highest number of safe hyperbaric intervention among all packages in Phase two of Bangalore metro.

TBM "AVNI" completed longest tunnel 1,134 m built so far in Bangalore metro from MG road towards Rashtriya Military school within 232 days: 100 days ahead of the estimated duration, ie, 332 days.

4 nos. of Cross passages were completed within 115 days after completion of final TBM breakthrough of TBM, 65 days ahead of contractual duration.

First project is in Phase two to complete 100% tunnelling and station work.

BMRCL RT-03

Package RT 03 of Bangalore metro pink line primarily involves design and construction of underground structures of length 2.884 km from Shivajinagar Station (excluding) to Tannery Road Station (excluding) involving twin tunnels of length 2.44 km, 2 underground stations viz, Cantonment Station, Pottery Town Station and one retrieval Shaft at Tannery Road along with associated architectural works. The alignment traverses beneath densely populated urban areas, navigating a complex landscape of heritage structures including centuries-old buildings, temples, mosques, and even passes under a live Indian Railways line at Cantonment Station

Every challenge we faced was met with determination, and every success was earned through the dedication and hard work of our people on the ground and behind the scenes. Building Information Modelling (BIM) been extensively implemented in this project for design coordination which played a vital role in enhancing spatial clarity, minimizing interface conflicts and enabling informed decision-making throughout the execution phase.
This achievement reflects our organization's deep-rooted technical capabilities and our commitment to delivering infrastructure solutions efficiently

SENTHILNATHAN K,
Executive Vice President &
Head - Technical Services,
Heavy Civil Infrastructure IC

Despite complex geology and dense urban challenges, we have successfully completed tunnelling, stations and achieved record-breaking TBM mining and segment casting progress in history of Bangalore metro. Advanced digital tools like BIM, SDS, real-time dashboards, and sensor analytics enabled seamless coordination, precise execution and showcased L&T's readiness to embrace cutting-edge technologies. These achievements underline L&T's leadership in shaping next-generation urban infrastructure

N S SRIDHARAN,
Head - Underground Metros

Key Records

TBM Urja, mined and erected 18 rings (27 meters) in a single day on April 25, 2022, setting a new benchmark for single-day progress in the history of Bangalore Metro projects.

TBM Vindhya set a record throughout Bangalore metro by accomplishing drag through for 190 m and relaunch at Pottery town in just 15 days: an impressive 20 days ahead of baseline Schedule. Similarly, TBM Urja had achieved the same feat in 21 days.

Achieved the highest single-day precast tunnel ring production of 19 rings in a single day across Bangalore Metro packages using just 9 sets of moulds achieving 2 cycle/mould/day.

Successfully completed 100% first Stage concrete (4.88 km) within just 100 days of the final TBM breakthrough.

Technological advancements & digital initiatives

Advanced geophysical surveys comprising Multichannel Analysis of Surface Waves (MASW), Ground Penetrating Radar (GPR), and Cross-Hole Tomography were instrumental in determining the geological profile of inaccessible areas. These techniques enabled the identification of loose pockets and facilitated optimized planning of cutting tools, significantly reducing the risk of sinkholes and

minimizing uncertainty during tunnelling operations.

Building Information Modelling (BIM) was extensively utilized for design coordination, enabling accurate progress updates, enhanced spatial clarity, and minimizing interface conflicts across disciplines.

Segment Documentation System (SDS) by VMT is a digital solution used to monitor and manage the lifecycle of tunnel segments from rebar cage making, casting and storage to transportation and final installation. This system ensures complete traceability, enhances quality control and streamlines logistics by assigning unique IDs (through Radio Frequency Identification codes) to each segment, allowing real-time tracking and integration with construction progress data.

Integration of live dashboards and real-time sensor analytics software brought a new level of precision to TBM operations facilitating remote monitoring, data-driven decision-making, and real-time performance optimization throughout tunnelling activities.

WAR ROOM, a round-the-clock manned control center, served as the project's safety nerve center. By continuously monitoring live camera feeds, personnel swiftly identified potential hazards and promptly alert stakeholders, ensuring immediate action and enhancing on-site safety responsiveness.

Challenges mitigated during the project

The alignment traversed through heterogenous geological conditions consisting of rock, soil and mixed geology. The presence of hard Dolerite and Gabbro boulders significantly impacted tunnelling progress, resulting in damage to mixing arms in slurry pumps. Measures were taken to reduce the ingress of boulders into chamber through reducing the Opening ratio of cutter head by welding Grille Bars at 16 locations. Hot work in hyperbaric mode was carried out for the first time in India by taking all safety precautions.

Tunnelling below live Indian railway line carrying 68 trains per day was carried out Safely near Cantonment Station without any disruption through real time instrumentation markers which provided real time data and alerts regarding the settlement of ground.

TBM driving in a weak ground condition & in presence of high rise and old buildings within the Potential zone of influence in Shivaji Nagar station stretch which had potential of sinkhole formation was mitigated by carrying out Probing all along the alignment prior to tunnelling to determine the ground condition using dynamic probing rig & wherever loose strata/loose pockets were noticed, the same were consolidated through TAM grouting.

At Cantonment Station, hard rock excavation to be done for a depth of 17m, controlled blasting adopted for excavation Grade-1 hard rock. Given the proximity to residential buildings, extensive precautionary measures were implemented. High barriers, 7 meters above ground level, were erected to mitigate fly rock impact, and vibration levels were strictly controlled to remain below 5 Peak particle velocity (PPV). Additionally, techniques such as ROC drilling and the hole-split method were employed to further minimize vibration and ensure safe execution in the sensitive urban environment.

Sustainability

The challenging and heterogeneous geological conditions necessitated the use of slurry-based Tunnel Boring Machines (TBMs). In a significant step toward environmental responsibility, the water required for slurry TBM operations amounting to approximately 6.28 lakh kilolitres (both packages) was sourced from treated STP water, thereby promoting sustainable water management and reducing dependence on freshwater resources. EPC World

Steering through the trade winds?

The Indian steel industry stands at a critical crossroads. From Donald Trump's steep tariff hikes to dumping of surplus steel into India, global headwinds are mounting. Trade volatility, price pressures, and shifting supply chains threaten stability. Yet, with robust domestic demand, modernised capacity, and strong policy support, can India turn these challenges into a springboard for global steel leadership?

The Indian steel industry had been cruising steadily, buoyed by the government's protectionist measures under consideration and the early success of the Production-Linked Incentive (PLI) scheme in boosting capacity and competitiveness. But the smooth sailing was abruptly disturbed by Donald Trump who, in trademark style, has hiked tariffs on steel and aluminium imports to 50%. The move - swift and sweeping - has unsettled global trade flows, leaving Indian exporters, policymakers, and market watchers scrambling to gauge the impact. While India's direct steel exports to the US

remain relatively small, the far greater concern lies in the likely diversion of surplus steel from other exporting nations into India, a scenario that could depress domestic prices and strain margins across the sector.

Trade dynamics

According to World Steel Association, the world crude steel production for the 70 countries was 151.4 million tonnes (Mt) in June 2025, a 5.8% decrease compared to June 2024. India produced 13.6 Mt of crude steel in June 2025, up 13.3% from June 2024. According to provisional government data cited in industry reports, India's finished steel imports dropped by 27.6% in April–May compared to a year earlier, mainly due to sharp declines in shipments from China and Japan. Total imports during the two months stood at 0.9 million metric tonnes (Mt), with Chinese supplies falling 47.7% to 0.2 MT and Japanese supplies plunging 65.6% to 0.1 Mt. The decline followed the government's April decision to impose a 12%

temporary safeguard duty on certain steel imports to counter a surge in low-cost shipments, particularly from China. South Korea emerged as the top exporter to India in the period, increasing its shipments by 8.2% to 0.4 Mt. Together, China, Japan, and South Korea accounted for 74.4% of India's finished steel imports, with hot-rolled coils or strips being the largest import category. On the export side, India remained a net importer of finished steel in April–May as outbound shipments fell 18.1% year-on-year to 0.8 Mt. Galvanised sheets and coils topped the export list, with Belgium becoming India's largest customer, taking in 0.15 Mt - up 12.4% from the previous year. Exports to Italy plunged 53.7%, while shipments to Nepal and Spain rose. During the same period, domestic finished steel consumption climbed 7.1% to 25.1 Mt, supported by robust infrastructure demand, while crude steel production rose 9.5% to 26.9 MT.

The steel industry is a cornerstone of India's economic development, contributing around 2% to GDP and directly employing nearly 600,000 people, with another 2 million working in allied sectors such as mining, logistics, equipment manufacturing, and services. As a foundational material for infrastructure and industrial growth, steel is both a barometer and driver of economic progress - underpinning bridges, railways, metros, ports, airports, power plants, pipelines, and real estate. Its performance is directly tied to India's ambition of becoming a USD 5 trillion economy, where infrastructure expansion is a central pillar.

Trade trends & projections

According to ICRA, India is the world's second-largest producer of crude steel, with output reaching 137.96 million tonnes (MT) of crude steel and 132.57 MT of finished steel in FY25 (April–February). During this period, domestic consumption stood at 137.85 MT, exports at 3.60 MT, and imports at 6.07 MT. Per-capita steel consumption reached 97.7 kg in FY24, a figure projected to grow sharply as infrastructure demand accelerates. The sector's expansion has been fuelled by abundant domestic raw materials - particularly iron ore - cost-effective labour, and steady modernisation. India's steel industry is now equipped with state-of-the-art mills and continues to upgrade older plants for greater energy efficiency.

Deloitte projects that steel demand in India will grow 5%–7.3% annually over the next decade, supported by mega infrastructure projects, government housing schemes, and a buoyant automotive sector. Since 2008, crude steel production has increased by 75%, while domestic demand has grown nearly 80% - a rise largely driven by organic capacity additions. Looking ahead, annual steel production is anticipated to exceed 300 MT by 2030–31, with crude steel output projected to reach 255 MT at 85% capacity utilisation, yielding 230 MT of finished steel. Net exports are expected to hit 24 MT, and domestic consumption could reach 206 MT, with per-capita use climbing to 160 kg. This positions India not just as a global steel powerhouse, but as a critical driver of the world's future infrastructure needs.

Government Initiatives for the Steel Sector

Recognising the strategic role of steel in industrialisation, urbanisation, and infrastructure development, the Government of India has consistently pursued policy measures to strengthen the sector's global competitiveness and domestic resilience. These initiatives address challenges ranging from overcapacity and import competition to environmental sustainability and technology adoption. One of the cornerstone policies is the National Steel Policy (NSP) 2017, which set an ambitious target of achieving 300 MT of annual crude steel capacity by 2030–31, with per-capita steel consumption rising to 160 kg. The policy emphasises self-sufficiency in steel production, reducing dependence on imports of critical inputs such as coking coal, and promoting value-added

steel products. It also encourages the adoption of state-of-the-art technologies to improve energy efficiency and reduce carbon emissions.

The Production-Linked Incentive (PLI) Scheme for Specialty Steel, launched in 2021 with an outlay of ₹6,322 crore, aims to boost domestic manufacturing of high-grade steels such as coated steel, alloy steel, and stainless steel. The scheme is expected to attract investments worth over ₹39,000 crore and add 25 Mt of specialty steel capacity over five years, thereby reducing import reliance and enhancing export potential. In January 2025, the government rolled out PLI 1.1, easing investment thresholds, allowing carryover of surplus production, and reallocating unused funds from the earlier phase to spur greater participation. The revised scheme has already garnered strong industry response, with 42 MoUs signed by February 2025, signalling accelerated capacity expansion and technology adoption in the sector. To safeguard the industry against sudden surges of low-priced imports, the government has imposed temporary safeguard and anti-dumping duties on certain steel products, particularly from countries like China, Japan, and Vietnam. In April 2025, for example, a 12% safeguard duty was levied on specific flat steel products to protect domestic manufacturers from predatory pricing practices. On the infrastructure front, the government's record allocation of ₹10 lakh crore in the Union Budget 2024–25 for capital expenditure has a direct multiplier effect on steel demand. Initiatives such as the Gati Shakti National Master Plan, PM Awas Yojana (housing), Bharatmala (roads), Sagarmala (ports), and the expansion of metro rail networks are expected to significantly boost steel consumption across sectors.

Environmental sustainability is also gaining prominence. Through the Mission on Advanced Ultra-Supercritical Technology and National Hydrogen Mission, the government is pushing for greener production pathways, including the use of hydrogen-based direct reduced iron (DRI) and carbon capture, utilisation, and storage (CCUS) technologies. The aim is to align the industry with India's commitment to achieve net-zero emissions by 2070. Collectively, these measures not only provide a safety net during global market disruptions—such as the recent tariff shock from the US - but also position India's steel sector for long-term, sustainable growth on the global stage.

Decarbonisation and net-zero initiatives in the steel sector

The steel industry, one of India's most emission-intensive sectors, is undergoing a major transformation in line with the country's goal of achieving net-zero emissions by 2070. Recognising steel's significant contribution to national CO_2 emissions, the government and industry are working together to adopt cleaner, more energy-efficient production technologies. A key pillar of this transition is the National Green Hydrogen Mission, which promotes hydrogen-based direct reduced iron (DRI) to replace coking coal in steelmaking. Several pilot projects are testing hydrogen use in furnaces, marking the first steps toward large-scale green steel production. Complementing this effort, the Mission on Advanced Ultra-Supercritical Technology and energy-efficiency initiatives under the PAT scheme are driving reductions in fuel consumption and emissions intensity.

The government is also advancing carbon capture, utilisation and storage (CCUS) projects to mitigate unavoidable emissions from integrated steel plants. Meanwhile, the Steel Scrap Recycling Policy and the expansion of electric arc furnace (EAF) capacity are encouraging the use of scrap-based production, which generates far fewer emissions than conventional routes. Additionally, steel producers are increasingly integrating renewable energy sources like solar and wind for captive power, alongside waste heat recovery systems. Collectively, these measures reflect a decisive move toward low-carbon steelmaking, balancing growth with sustainability. While

challenges remain in technology costs and scalability, India's steel sector is steadily charting a pathway toward a greener, more resilient future.

Challenges and Outlook for India's Steel Sector

Despite its robust growth trajectory and ambitious policy backing, India's steel industry is not without its vulnerabilities. Price volatility is one of the most immediate concerns. International steel prices are closely tied to shifts in global demand, currency movements, and raw material supply dynamics—particularly the price of coking coal, which India imports heavily from Australia and, to a lesser extent, from the U.S. and Canada. A sudden spike in coking coal prices can erode margins for even the most efficient producers. The industry is also sensitive to freight rate fluctuations and supply chain disruptions, as witnessed during the pandemic and more recently during geopolitical tensions in the Red Sea and Eastern Europe.

Competition from low-cost imports continues to loom large. Although safeguard duties and anti-dumping measures have provided temporary relief, the possibility of surplus steel from countries like China, Japan, and South Korea being diverted to India—especially in the wake of tariff hikes by the U.S.—remains a persistent threat. Such influxes could depress domestic prices and lead to inventory pile-ups, straining working capital cycles for Indian producers. Smaller and mid-sized steel mills, which lack the financial resilience of large integrated players, would be especially vulnerable in such a scenario.

Environmental compliance poses another formidable challenge. The transition towards low-carbon steel production is capital-intensive and technologically demanding. With India setting ambitious net-zero targets, steelmakers will need to invest heavily in technologies such as green hydrogen-based direct reduced iron (DRI), carbon capture and storage (CCS), and electric arc furnaces (EAF). While leading companies like Tata Steel, JSW Steel, and ArcelorMittal Nippon Steel have already launched decarbonisation roadmaps, the broader industry—especially secondary steel producers—faces steep learning curves and funding constraints in adopting these innovations.

Workforce skill gaps also present a medium-term challenge. As the sector moves towards automation, digitalisation, and higher energy efficiency, there will be a need for large-scale upskilling and reskilling programs. Without them, the industry risks bottlenecks in implementing advanced manufacturing processes.

Yet, the long-term fundamentals remain strongly positive. India's infrastructure buildout—driven by massive investments in railways, highways, ports, and urban development—will ensure steady demand for steel across construction, automotive, engineering, and energy sectors. With sustained policy support, capacity additions, and a growing focus on sustainability, India is well-positioned not just to meet its domestic requirements but to emerge as a global hub for green and specialty steels. The sector's trajectory towards 300 million tonnes of annual production by 2030 will depend on how effectively it balances competitiveness, environmental commitments, and resilience to global market swings.

Resilience amid volatility

Looking ahead, the Indian steel industry stands at a critical inflection point. Global trade volatility, shifting supply chains, and geopolitical tensions will continue to test the resilience of domestic producers. The PLI scheme, safeguard duties, and infrastructure-led demand offer a buffer, but sustaining competitiveness will require deeper structural reforms—ranging from technological upgradation and energy efficiency to raw material security. Moreover, aligning production with low-carbon goals will be crucial as export markets impose stricter environmental norms. How India navigates this turbulent landscape will not only determine the fortunes of its steelmakers, but also shape the pace of its infrastructure build-out and, by extension, the country's long-term growth trajectory. EPC World

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Circularity is the strongest pillar of stainless steel's sustainability

India's stainless steel demand is projected to grow rapidly with urbanisation, infrastructure expansion, and manufacturing growth, says **RAJAMANI KRISHNAMURTI**, President, Indian Stainless Steel Development Association (ISSDA)

Sustainability has become a key priority for the stainless steel sector. What are your association's long-term sustainability goals, and how are you aligning them with global climate targets?

At ISSDA, sustainability is not a slogan; it is integral to the very DNA of stainless steel. Our long-term sustainability goal is to position stainless steel as India's most circular, low-carbon, and future-ready material. We are aligning our initiatives with India's national commitments under the Paris Agreement and the Net Zero 2070 roadmap, while also reflecting the global targets of the International Stainless Steel Forum (ISSF). This includes promoting low-carbon production routes, enhancing scrap utilisation, supporting the readiness of green hydrogen, and facilitating awareness of life cycle costs across user sectors. Our mission is simple: to ensure that every tonne of stainless steel produced and used in India contributes positively to the three pillars of sustainability - People, Planet, and Profit.

Steelmaking is energy-intensive and carbon-heavy. What steps are you taking to reduce carbon emissions — such as adopting electric arc furnaces, waste heat recovery systems, green hydrogen, or carbon capture technologies?

Nearly 70–75% of India's stainless steel is produced through the Electric Arc Furnace (EAF) and Induction Furnace routes, both of which are inherently less carbon-intensive than traditional blast furnaces. This gives our industry a natural head start in decarbonisation. Our member companies are increasingly investing in waste heat recovery systems, energy-efficient furnaces, and advanced off-gas treatment technologies to reduce specific energy consumption and emissions. ISSDA can also facilitate knowledge exchange with global experts on green hydrogen readiness and carbon capture, utilisation and storage (CCUS) through its International Institutional Partners, ensuring that Indian producers are aligned with the evolving decarbonisation technologies of the future.

How is your association working to transition towards renewable energy sources in steel/ stainless steel production?

Transitioning to renewables is central to ISSDA's sustainability vision. Many of our

member plants are already sourcing a growing share of their power from solar and wind installations through open access and captive models. ISSDA is encouraging member companies to adopt hybrid renewable energy portfolios, combining solar, wind, and storage, to ensure a stable and sustainable power supply. We are ready to initiate dialogues with energy developers and state agencies to facilitate green power corridors for the stainless steel clusters, if our members require ISSDA to assist them in this respect. Our broader goal is to progressively increase the share of renewables in stainless steel production, thereby reducing the overall carbon footprint per tonne of steel.

Stainless Steel is 100% recyclable. How is your association promoting recycling and scrap usage in the steel sector to build a circular economy?

Circularity is the strongest pillar of stainless steel's sustainability. The material is 100% recyclable without any degradation of quality, and on average, 80~95% of the input material used in stainless steel production globally is recycled scrap. ISSDA is actively promoting this strength by advocating for a robust stainless steel scrap ecosystem in India, including formal scrap collection and processing networks; engaging with policymakers to ensure separate HS codes and simplified import norms for high-grade stainless steel scrap; and conducting awareness programs for downstream users to highlight the long-term environmental and economic benefits of using recycled stainless steel. A well-functioning circular ecosystem will help India reduce dependence on virgin raw materials and move closer to a closed-loop economy.

What measures have you adopted to reduce water usage, manage slag and other by-products, and minimise waste in your plants?

Our member plants follow the "Zero Liquid Discharge (ZLD)" philosophy, where every drop of water is treated, recycled, and reused within the process. Closed-loop water circuits, efficient cooling systems, and rainwater harvesting are now standard practices across major stainless steel facilities. Slag and dust, which were once considered waste, are now being repurposed as construction aggregates, cement additives, and road base materials, reducing landfill and conserving natural resources. ISSDA encourages the adoption of ISO 14001-certified environmental management systems, and several of our members have achieved this standard. The focus is on minimising waste at source and viewing every by-product as a resource in transition.

The government is planning to implement green-rated steel in central government projects and centrally sponsored schemes starting FY28. How is your association preparing for this transition, and what opportunities or challenges do you foresee in meeting this requirement?

We welcome this forward-looking initiative by the Government of India. ISSDA is already in dialogue with the Ministry of Steel, Bureau of Indian Standards (BIS), and other stakeholders to align the stainless steel industry with the Green Steel framework. Our members are preparing for this transition by adopting Life Cycle Assessment (LCA) methodologies, Environmental Product Declarations (EPDs), and exploring green certification standards for their products. The opportunity lies in making stainless steel the material of choice for sustainable infrastructure, from water supply to transport, from architecture to industrial projects. The main challenge will be in creating uniform definitions, metrics, and certification pathways, which ISSDA is actively working to support.

What role do digitalisation, AI, or IoT play in improving energy efficiency, reducing emissions, and monitoring sustainability in your operations?

Digitalisation is becoming the backbone of modern steelmaking. Our member companies are deploying IoT-based energy management systems, AI-driven process optimisation, and real-time data analytics to improve furnace efficiency, reduce downtime, and track emissions. Predictive maintenance powered by AI is helping to reduce unplanned outages and energy losses, while digital twins are being used to simulate and optimise production processes before implementation. At ISSDA, we are facilitating industry workshops and case studies to share best practices in digital transformation for sustainability, ensuring that even mid-sized producers can benefit from scalable digital tools.

Looking ahead, how do you see the Indian Stainless Steel industry balancing growth with sustainability, and what role do you envision your association playing in driving this transition?

India's stainless steel demand is projected to grow rapidly with urbanisation, infrastructure expansion, and manufacturing growth. The real challenge, and opportunity, is to ensure that this growth is green, inclusive, and globally competitive. The stainless steel industry is inherently well-positioned to meet this challenge because of its recyclability, corrosion resistance, and long life cycle, all of which contribute directly to sustainability. ISSDA's role will be to act as a bridge between industry, policymakers, and end-users, promoting science-based approaches to decarbonisation, supporting research and innovation, and enabling global best practices to be localised for Indian conditions. Our vision is for stainless steel to be recognised not just as a material of strength and beauty, but as a material of sustainability and permanence, a true enabler of India's green growth story. EPC World

We integrate ESG principles into every business decision

As India aspires to become a 5-trillion-dollar economy, stainless steel will play a defining role in building a greener, more resilient future, says **KALYAN BHATTACHERJEE**, Chief Sustainability Officer, Jindal Stainless

Sustainability has become a key priority for the steel sector. What are your company's long-term sustainability goals, and how are you aligning them with global climate targets?

Sustainability is at the heart of our growth strategy. We have adopted a long-term roadmap to achieve Net Zero carbon emissions by 2050, with an interim target of 50% reduction in Scope 1 and 2 emission intensity by FY2035. Our sustainability framework aligns closely with the Paris Agreement, UN Sustainable Development Goals (SDGs), and India's Nationally Determined Contributions (NDCs). Guided by four strategic pillars - Responsible Governance, Planet Positive, Sustainable Innovation & Supply Chain, and Empowering People & Communities - we integrate ESG principles into every business decision. Through renewable energy adoption, circular material usage, responsible sourcing, and social value creation, we aim to build a climate-resilient, low-carbon stainless steel ecosystem. We are advancing decarbonisation through renewable energy integration, scrap-based production, waste heat recovery, green hydrogen, and digital energy management, supported by the company's near-term target to cut emissions by 50% by 2035. JSL's emission reduction efforts led to the avoidance of 3,18,248 tonnes of CO2 equivalent emissions, reinforcing its long-term climate ambition to achieve Net Zero by 2050. By embedding ESG metrics into our governance and investment decisions, JSL aims to build a resilient, low-carbon business model that contributes not only to India's Net Zero 2070 vision but also to global climate action goals.

Stainless Steelmaking is energy-intensive and carbon-heavy. What steps are you taking to reduce carbon emissions — such as adopting electric arc furnaces, waste heat recovery systems, green hydrogen, or carbon capture technologies?

We recognize the need to decarbonize one of the most energy intensive and carbon heavy industries. At our Jajpur facility, we have established Odisha's largest 30 MWp captive solar plant and commissioned India's first green hydrogen plant in the stainless steel sector at the Hisar unit, with a capacity of 90 NM^3/hr, reducing ~2,700 tonnes of CO_2e

annually. The feasibility study is underway for an additional 1,000 NM^3/hr green hydrogen project at the Jajpur unit, with potential CO_2e reduction of ~19,044 tonnes annually. Our production process is inherently low-carbon, driven by Electric Arc Furnace (EAF) technology, which enables the use of 72% scrap-based input, significantly cutting emissions. We have commissioned Waste Heat Recovery Boilers (WHRBs) that generate over 1.61 lakh MT of steam annually, saving about 26,700 tonnes of coal equivalent and results in an annual reduction of 44,498 metric tons of CO_2 emissions. We are also exploring carbon capture and storage (CCS) and biomass fuel substitution as part of our decarbonisation roadmap, aligning with long term Net Zero goals by 2050.

How is your company working to transition towards renewable energy sources in stainless steel production?

Renewable energy transition is one of our highest priorities. In FY25, 26% of our total power consumption was met through renewable sources, primarily solar. JSL is securing direct Power Purchase Agreements to increase its proportion of green electricity, 2 Power Purchase Agreements (PPA) of guaranteed 100 MWp power delivery each at the Jajpur and Hisar sites. The 30 MWp solar project at Jajpur, complemented by rooftop and floating solar installations, generates 44.3 million units of clean electricity annually, offsetting over 32,000 tonnes of CO_2. We have also signed Power Purchase Agreements for an additional 11 MWp of green power through JSL Super Steel. Additionally, we are actively exploring ways to expand the use of biomass as a carbon-neutral fuel across our operations – an important step in decarbonising industrial energy use. We are also investing in Waste Heat Recovery Boilers (WHRBs), which convert process heat into reusable energy, and exploring hybrid solar-wind systems and green hydrogen integration to further decarbonise our energy mix.

Stainless steel is 100% recyclable. How is your company integrating recycling and scrap usage into your production to build a circular economy?

For Jindal Stainless, circularity is not just a sustainability goal but foundation of our business model. Stainless steel is inherently 100% recyclable, and JSL has designed its production process around Electric Arc Furnace (EAF) technology, which enables large-scale use of recycled scrap as the primary raw material. Currently, over 72% of JSL's total metallic input comes from scrap and revert materials, making it one of the most resource-efficient and low-carbon stainless steel producers globally. By maximizing scrap usage, we significantly reduce dependence on virgin raw materials, lower mining-related emissions, and minimize landfill waste. To strengthen this ecosystem, JSL is expanding its scrap sourcing and processing network across India and internationally, ensuring the supply of traceable and high-quality recycled material. We are also investing in advanced scrap segregation and treatment technologies to enhance material recovery and reduce impurities. In addition, by-products such as slag and fly ash are being repurposed for cement and construction applications, and initiatives like Zero Waste to Landfill certification, by-product valorisation, and closed-loop production systems reinforce our vision of a truly circular economy. Through these initiatives, JSL is demonstrating how circular economy principles can be embedded across the value chain - from responsible sourcing and efficient production to by-product valorisation and waste recovery - creating a model of sustainable, closed-loop steelmaking for India's green future.

What measures have you adopted to reduce water usage, manage slag and other by-products, and minimise waste in your plants?

Our operations are designed on the principles of resource efficiency and Zero Liquid Discharge (ZLD). Both our Hisar and Jajpur facilities operate closed-loop water systems, recycling and reusing over 67% of total water. We have achieved 100% fly ash utilisation and repurposed over 3,08,336.9 MT of ferrochrome slag in cement and road construction applications. Continuous emission monitoring systems (CEMS), advanced dust collectors, and greenbelt development help maintain air quality and biodiversity. These measures reflect our commitment to achieving water neutrality by 2033 and zero waste to landfill by 2030.

The government is planning to implement green-rated steel in central government projects and centrally sponsored schemes starting FY28. How is your company preparing for this transition, and what opportunities or challenges do you foresee in meeting this requirement?

We see this not just as a regulatory requirement but as a strategic opportunity to lead the transition toward low-carbon stainless steel production. Our preparation is both technical and systemic. We've already embedded decarbonization into our core operations, with Electric Arc Furnace (EAF)-based production routes that leverage high recycled content, significantly reducing Scope 1 and 2 emissions. Beyond direct emissions, we're advancing cradle-to-gate product carbon foot printing across key stainless steel grades, incorporating upstream Scope 3 emissions from ferro alloys, energy, and logistics. This level of granularity is essential for credible green steel certification. To support this, we're upgrading our digital infrastructure to enable accurate traceability of key

metrices and emission intensities. We're also actively engaging with the Ministry of Steel to advocate for a stainless steel-specific taxonomy which accounts for the unique emission profile of ferro alloys and the variability across stainless grades. Without this, the current carbon steel-centric framework risks misrepresenting the environmental performance of stainless steel producers.

The policy shift opens up several opportunities. Green-rated stainless steel will become a premium offering in sectors like infrastructure, railways, and defence. It also enhances our export competitiveness while incentivizing renewable energy integration, and circularity. However, challenges remain. The absence of a tailored taxonomy for stainless steel, the complexity of emissions modelling across grades and scrap ratios, and the need for upstream supply chain alignment especially with ferro alloy producers are hurdles that require coordinated industry and policy action. We are not just preparing for FY28 we're helping shape it. Through strategic investments, rigorous disclosures, and policy engagement, we aim to ensure that stainless steel is accurately represented and competitively positioned in India's green steel future.

What role do digitalisation, AI, or IoT play in improving energy efficiency, reducing emissions, and monitoring sustainability in your operations?

Digital transformation is central to our efficiency and sustainability goals. Through Project Pragati: Smart Factory 4.0, we have deployed AI, IoT, and predictive analytics across production lines to monitor real-time energy consumption, equipment performance, and emission levels. Digital twins and advanced process control systems help optimize furnace efficiency and reduce material loss. Our Integrated Energy Management System (ISO 50001 certified) uses data intelligence to track and benchmark performance across plants. We are also leveraging blockchain and cloud-based platforms for traceability in scrap procurement and logistics, ensuring transparency and compliance throughout our value chain. In addition, we have onboarded a dedicated digital enterprise tool, Updapt, to strengthen ESG data management and sustainability reporting. The platform automates data capture, integrates with SAP, and enables GHG accounting across Scopes 1, 2, and 3. It facilitates product carbon footprint assessment, target tracking, and risk evaluation aligned with global standards (ISO, GHG Protocol, BRSR, GRI, TCFD). Updapt also provides real-time dashboards and analytics to drive performance improvement and support JSL's net-zero and compliance objectives. JSL is also onboarding an Enterprise Value Chain Digitalization Tool to automate ESG assessments across suppliers and customers, ensuring compliance with frameworks such as BRSR, EcoVadis, DJSI, and Sustainalytics. The system will provide real-time monitoring, digital scorecards, and SAP-integrated analytics to enhance transparency, supplier engagement, and sustainable value chain performance.

Looking ahead, how do you see the Indian steel industry balancing growth with sustainability, and what role do you envision your organisation playing in driving this transition?

India's stainless steel industry is entering a phase of unprecedented growth. With per capita stainless steel consumption rising from about 3.4 kg to over 6 kg by 2030, and demand expected to grow robustly with infrastructure expansion, clean mobility, and renewable energy investments, the sector is poised to play a critical role in building a modern, sustainable India. As India aspires to become a 5-trillion-dollar economy, stainless steel - the most sustainable material among metals - will play a defining role in building a greener, more resilient future. Balancing growth with sustainability will depend on how effectively the industry adopts low-carbon technologies, renewable energy, and circular practices. However, growth must be responsibly balanced with sustainability. The future of Indian steelmaking lies in green technologies, renewable energy integration, and circular material use. We are committed to leading this transformation. Our production process, based on Electric Arc Furnace (EAF) technology, already enables 72% scrap-based input, drastically reducing our carbon footprint. We are scaling our renewable energy portfolio, including large solar and wind hybrid projects, Power Purchase Agreements (PPA) for power delivery and have also commissioned India's first off-grid green hydrogen plant with a capacity of 90 NM^3/hr for the stainless steel sector. We see ourselves as a catalyst in India's transition to green steel. Our model of producing stainless steel through scrap-based EAF technology, coupled with renewable power integration and green hydrogen, offers a scalable and replicable blueprint for the industry. As India moves toward a 5-trillion-dollar economy, we aim to contribute through sustainable infrastructure materials, community partnerships, and climate leadership - creating value not just for shareholders, but for the planet and future generations. This integrated sustainability roadmap - combining energy transition, circular manufacturing, digital monitoring, and ESG governance, not only positions JSL as a pioneer but also serves as a replicable model for other stainless steel producers. By adopting similar pathways, the broader industry can accelerate decarbonisation, enhance global competitiveness, and collectively contribute to India's Net Zero 2070 vision.

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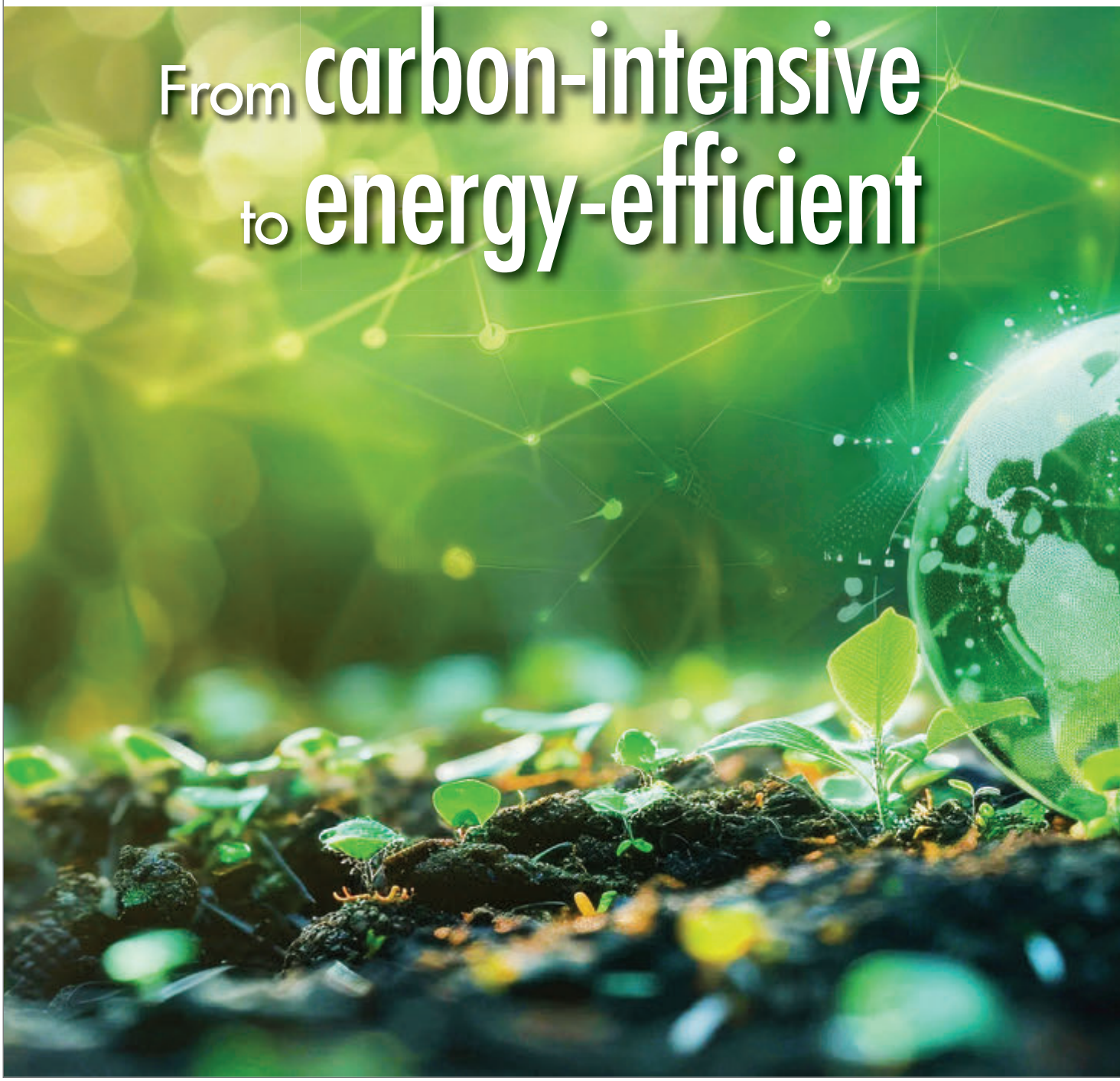
India's steel industry is moving from a carbon-heavy model to a technology-led, low-emission powerhouse. With bold investments in green hydrogen, CCUS, renewable energy, and circular production, Indian steelmakers are driving the shift toward green steel. Backed by progressive government policies, this transformation is positioning India at the forefront of global sustainable steelmaking

From carbon-intensive to energy-efficient



The Earth faces a grave crisis as environmental degradation accelerates at an alarming rate. The warning signs are all around us — rising global temperatures, melting glaciers, erratic weather patterns, and the gradual depletion of the ozone layer that once protected the planet from harmful ultraviolet radiation. Climate change, one of the most urgent global challenges of our time, is evident in prolonged droughts in some regions and unprecedented rainfall and flooding in others. This growing environmental imbalance is largely driven by the relentless release of greenhouse gases (GHGs), which trap heat in the atmosphere and disrupt the delicate equilibrium of our planet. India, far from being a passive observer, has emerged as a proactive leader in addressing climate change. At COP21 in Paris (2015), the country pledged to reduce the emissions intensity of its GDP by 33%–35% by 2030 compared to 2005 levels. Since then, India has taken decisive steps to curb carbon emissions across industries, with the steel sector playing a particularly pivotal role.

The steel industry is one of the most energy- and carbon-intensive sectors globally, accounting for nearly 7–9% of total GHG emissions. In India, steel production relies heavily on fossil fuels, particularly coal, to achieve the extreme temperatures required for smelting and reducing iron ore. Coal is used not only as a fuel but also as a chemical reducing agent, removing oxygen from iron ore — a process that releases substantial amounts of CO_2 and other greenhouse gases. Given its emissions footprint, decarbonising steel production is critical for India's climate goals.

Recasting steel sustainably

To address this challenge, the steel sector is adopting a range of low-carbon technologies and sustainable practices. Green hydrogen is emerging as a transformative solution, replacing coal as a reducing agent in Direct Reduced Iron (DRI) processes. Unlike conventional blast furnaces, hydrogen-based reduction emits only water vapour, eliminating CO_2 emissions from this step. Several Indian steelmakers are piloting hydrogen-based technologies and partnering with renewable energy producers to ensure a steady supply of green hydrogen. Waste heat recovery systems are another key focus, capturing and reusing thermal energy released during high-temperature operations such as sintering and rolling. This recovered energy is converted into electricity or used to preheat raw materials, reducing fuel consumption and overall carbon intensity. Alongside this, Carbon Capture, Utilisation, and Storage (CCUS) technologies are being deployed to trap CO_2 emissions before they enter the atmosphere. Captured carbon can be stored underground or utilised in sectors such as cement production and enhanced oil recovery, effectively closing the emissions loop.

The industry is also strengthening its circular economy practices. Scrap recycling, resource optimisation, and the use of electric arc furnaces (EAFs) powered by renewable electricity provide lower-carbon alternatives to traditional blast furnaces. Direct Reduced Iron (DRI) combined with EAFs allows greater use of scrap metal and alternative fuels, reducing dependency on virgin iron ore and fossil fuels. Beyond these core measures, additional initiatives are being implemented to further reduce the sector's carbon footprint. Many steel plants are integrating renewable energy sources like solar and wind power into their operations. Advanced process optimisation tools, AI, and digital twins are being employed to monitor energy consumption and furnace performance in real time, improving efficiency and reducing wastage. Several companies are also experimenting with biomass-based carbon substitutes, such as biochar, as partial replacements for coking coal.

Emerging low-carbon ironmaking technologies, including smelting reduction processes like COREX, FINEX, and HIsarna, are being adopted to replace or reduce coke ovens and sinter plants — traditionally the most polluting units in steel production. These technologies can lower CO_2 emissions by 20–50% compared to conventional blast furnaces. In parallel, steelmakers are greening their supply chains, sourcing low-emission raw materials, optimising logistics, and prioritising rail transport over road to cut transportation-related emissions. Environmental sustainability extends beyond carbon. Indian steel producers are implementing zero liquid discharge (ZLD) systems, wastewater recycling, and solid waste utilisation, using by-products like fly ash and slag in cement or road construction, further reducing the sector's environmental footprint. Collectively, these measures demonstrate a comprehensive, multi-pronged approach, signalling a decisive shift from a high-carbon past to a low-carbon, innovation-driven future. These initiatives position the Indian steel sector as a crucial player in the country's broader climate agenda, aligning with India's vision of achieving net-zero emissions by 2070. The combination of green hydrogen adoption, energy efficiency, carbon capture, circular economy practices, renewable integration, and innovative low-carbon technologies sets the stage for a more sustainable steel industry — one that not only meets India's industrial needs but also contributes significantly to global climate goals.

Strengthening green governance

The Indian government has played a proactive role in supporting the steel sector's transition to a low-carbon future. Under the National Steel Policy (2017), India aims to increase domestic steel production while emphasising energy efficiency and environmental sustainability. The government has introduced incentives for adopting energy-efficient technologies, including financial support for waste heat recovery, renewable energy integration, and modernisation of blast furnaces. Through the Perform, Achieve, and

Trade (PAT) scheme under the National Mission on Enhanced Energy Efficiency (NMEEE), steel plants are encouraged to achieve specific energy-efficiency targets, with the option to trade excess savings, creating both environmental and economic benefits. The Production-Linked Incentive (PLI) Scheme for Specialty Steel further accelerates the sector's sustainability transition by providing financial incentives based on incremental production of high-value, low-carbon steel products. The scheme encourages investments in modern, energy-efficient technologies, the adoption of electric arc furnaces (EAFs), scrap-based steel production, and green steelmaking processes such as hydrogen-based DRI. By linking incentives to output, quality, and sustainability criteria, the PLI scheme not only boosts domestic specialty steel production but also actively supports the sector's shift toward low-carbon operations.

A key focus of government policy is the promotion of green hydrogen development. India has announced ambitious targets to produce green hydrogen at scale using renewable energy, creating hydrogen corridors and hydrogen hubs that steelmakers can tap into for cleaner DRI production. Policies supporting large-scale solar and wind energy projects, combined with these hydrogen initiatives, aim to ensure that steel plants have access to reliable, carbon-free energy and reducing agents, accelerating the transition to zero-carbon steelmaking. The government is also fostering the adoption of Carbon Capture, Utilisation, and Storage (CCUS) technologies through research grants, pilot projects, and regulatory support, while regulations promoting scrap-based steel production encourage circular economy practices across the sector. The industry, through bodies such as the Ministry of Steel, Steel Research and Technology Mission of India (SRTMI), and in partnership with institutions like CSIR-NML and IITs, is investing heavily in R&D for breakthrough low-carbon steel technologies. International collaborations under frameworks such as Mission Innovation and the Clean Energy Ministerial are also fostering technology exchange, ensuring India remains at the forefront of sustainable steelmaking.

Steelmaking goes green

Indian steelmakers are increasingly translating government policies and global climate commitments into actionable, technology-driven sustainability initiatives. JSW Steel, India's largest private steel producer, has taken a lead through its flagship sustainability programme, Project SEED (Sustainable Energy Environment and Decarbonisation). Implemented across its Vijayanagar and Dolvi plants, the initiative focuses on reducing emissions through waste heat recovery, energy efficiency upgrades, increased scrap usage, and renewable power integration. In 2025, JSW advanced this strategy with the construction of a 3,800-tonne green hydrogen plant at Vijayanagar, part of its roadmap to cut CO_2 intensity by 42% by 2030 and achieve carbon neutrality by 2050. Complementing these efforts, JSW has partnered with Carbon Clean and BHP to trial CycloneCC modular carbon capture technology, aiming to capture up to 100,000 tonnes of CO_2 annually—potentially one of the largest such deployments in steel manufacturing. Jindal Steel & Power (JSPL) is also making significant strides in decarbonisation. At its Angul facility in Odisha, the company is developing a green hydrogen

plant capable of producing 4,500 tonnes of hydrogen and 36,000 tonnes of oxygen annually, supported by 3 GW of captive renewable energy. Expected to be operational by December 2025, the project is designed to replace coal in Direct Reduced Iron (DRI) processes, sharply lowering the plant's carbon footprint. In addition to these individual company initiatives, India is playing an active role in international collaborations. A BHP-led consortium, involving JSW Steel, ArcelorMittal Nippon Steel India, and other Asian industry leaders, has launched a pre-feasibility study for creating regional Carbon Capture, Utilisation, and Storage (CCUS) hubs. This cross-border effort aims to design scalable infrastructure to decarbonise "hard-to-abate" sectors such as steel, ensuring long-term competitiveness while meeting climate goals. Collectively, these developments signal a turning point

for India's steel sector—from being a high-carbon growth engine to positioning itself as a future-ready, low-emissions manufacturing hub. The push toward green hydrogen, CCUS, and renewable energy integration will not only reduce the industry's environmental impact but also enhance its global market positioning in an era where low-carbon steel is gaining strategic importance.

Tata Steel has undertaken several initiatives to curb emissions and enhance energy efficiency across its operations. The company has implemented waste heat recovery systems at its plants, capturing high-temperature energy from processes such as sintering and rolling to generate electricity and preheat raw materials. As part of its global decarbonisation strategy, Tata Steel's Netherlands facility is pioneering the use of hydrogen-based Direct Reduced Iron (DRI)

technology. This process replaces coal with green hydrogen in shaft furnaces to produce DRI, which is then converted into steel using electric arc furnaces. The shift not only eliminates carbon dioxide emissions from the reduction process but also yields water vapour as the primary by-product, marking a major step towards sustainable steelmaking.

Challenges in Decarbonising

Despite significant progress, the Indian steel sector faces multiple challenges in its journey toward low-carbon production. A primary hurdle is the high capital intensity of green technologies such as hydrogen-based DRI, electric arc furnaces (EAFs), and carbon capture systems, which require substantial upfront investments and long payback periods. The availability and cost of green hydrogen remain critical constraints, as large-scale production depends on affordable renewable electricity and dedicated infrastructure. Integrating renewable energy into energy-intensive steel operations is also complex, given the sector's demand for continuous, high-temperature processes. Another challenge lies in the technological readiness of low-carbon processes. While pilot projects show promise, scaling hydrogen DRI, CCUS, and smelting reduction technologies to commercial levels requires significant innovation, operational expertise, and robust supply chains. Limited scrap availability and quality in India constrains broader adoption of EAF-based steelmaking, while evolving regulatory and policy frameworks must provide stable incentives, carbon pricing mechanisms, and clear standards for green steel production.

The sector also faces the task of balancing emission reduction with global competitiveness, as premature adoption of expensive low-carbon technologies could impact profitability. Finally, manpower and skill development is a critical challenge. Advanced technologies demand highly skilled personnel capable of operating, monitoring, and maintaining sophisticated systems, alongside proficiency in renewable energy integration, digital tools, and carbon management. Upskilling existing workers and developing new talent through training programs and industry-academia collaboration is essential to ensure smooth and safe operations. Addressing these challenges requires coordinated action among industry, government, and research institutions, as well as international collaboration to share knowledge, scale technologies, and mobilise investment, ensuring India's steel sector remains both sustainable and globally competitive.

Advancing sustainable future

Decarbonisation of the steel sector is no longer optional—it is an urgent necessity. Without decisive action, the industry risks becoming unsustainable, both environmentally and economically, in a world that is rapidly shifting toward low-carbon production. The path is clear: India must embrace green hydrogen, renewable energy, carbon capture, and circular economy practices to transform its steelmaking processes. Investments in advanced technologies, energy efficiency, and workforce skill development will be critical to ensure this transition is both effective and scalable. The future of India's steel industry lies in producing green steel that meets global standards for sustainability and competitiveness. EPC World

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Interarch strengthens its Gujarat presence with new state-of-the-art manufacturing facility

Interarch Building Solutions, one of India's leading pre-engineered steel building (PEB) solution providers, marked a major milestone in its growth journey with the groundbreaking of its new state-of-the-art manufacturing facility in Kheda, Gujarat. The ceremony was followed by a thought-provoking "Interarch Dialogues" panel discussion that brought together the brightest minds from architecture, engineering, and construction to discuss 'Steel in New Age Industries- Data Centres, Semiconductors & Renewable Energy'.

The new state-of-the-art manufacturing facility, being developed on a 12-acre site, will further strengthen Interarch's footprint in Gujarat and enhance its ability to serve high-growth sectors across western and central India. With an installed capacity of 40,000 MT in its first phase and an investment of ₹70 crore, the facility will set new benchmarks in efficiency, automation, and performance. Strategically located near prominent ports it will also support exports, extending Interarch's global reach.

The event witnessed the presence of Arvind Nanda, Managing Director, and Gautam Suri, Whole Time Director, along with the entire Interarch management team and leading industry stakeholders.

Commenting on this landmark moment, Manish Garg, CEO, Interarch Building Solutions, said, "The groundbreaking of our Gujarat facility is a significant milestone for Interarch. Gujarat, with its strong industrial ecosystem in semiconductors, EVs, and allied sectors, provides the perfect foundation for our next phase of growth. This expansion not only completes our pan-India manufacturing presence but also reinforces our commitment to building the future in steel and contributing to India's economic strength."

A Dialogue of Ideas and Innovation

Following the ceremony, Interarch Dialogues- Ahmedabad Edition brought together leading architects, consultants, PMC professionals, steel manufacturers, builders, and industry stalwarts for an engaging exchange of ideas. The discussion delved into the transformative role of steel in modern infrastructure, and more so in new age sectors like data centres, semiconductors, and renewable energy.

From insightful interactions to power-packed panel discussions, the energy in the room was electric. The event showcased Interarch's leadership in executing some of India's most prestigious projects- from the country's first semiconductor chip manufacturing facility to one of the largest lithium-ion giga plants and major infrastructure for global brands like Adani, Asian Paints, Reliance Energy, and MG Motors.

Celebrating Collaboration and the Future of Steel Construction

It was inspiring to witness the entire fraternity of architects, consultants, and construction partners come together under one roof- united by a shared vision of innovation and collaboration. Together, they celebrated the progress of the Indian steel construction industry and envisioned the next chapter of building a stronger, smarter India.

With its new facility in Kheda, Interarch continues to push the boundaries of what's possible in steel construction- driving efficiency, sustainability, and excellence in every structure it creates. EPC World

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Why India Prefers 'Energy Diversity' Over Transition

India's Tier II and III cities are rapidly transforming into vibrant hubs of commerce, real estate, and infrastructure. Driven by decentralisation, digital adoption, and rising investor confidence, these non-metro cities are witnessing growth in IT parks, co-working spaces, healthcare, and data centres—positioning them as key drivers of India's next economic leap

Faced with rapid economic and population growth, India is investing tremendously in renewable and nuclear energy, as well as in the development of its oil fields and refining capacity. While the country has set a 'Net Zero' goal for 2070, energy security and the ability to provide affordable power to its 1.5 billion inhabitants remain the main priorities.

How to supply reliable, affordable energy to 1.5 billion people while keeping emissions under control? This question is at the heart of India's energy policy. While many Western countries focus primarily on energy transition, the country must pursue energy expansion to meet demand sustainability.

This need has led to a dual track: building new renewable and nuclear capacity, and developing domestic oil and refining infrastructure, alongside stricter environmental regulation.

Technology plays a central role to ensure that this strategy succeeds. Improved project delivery, greater plant reliability and accurate emissions tracking are key to ensuring this strategy achieves both economical and environmental gains and positions India as an energy superpower.

The rapid rise of India's energy demand

India's energy consumption has increased by 20% since 2019, reaching 36.2 quadrillion BTU. That makes it the world's third-largest energy consumer, behind the United States and China. Government projections expect another 35% rise over the next decade.

The country's share of global greenhouse gas emissions has also grown - from 6.7% in 2019 to 7.8% in 2023. India has set a net zero target for 2070 and aims for half of installed electricity capacity to come from non-fossil sources by 2030.

This objective requires major investment in renewables. Solar capacity has recently surpassed 100 gigawatts, on par with Germany. Hydroelectric

power is expected to rise by 50% by 2032, from 42 to 67 gigawatts. Nuclear capacity, currently 8 gigawatts, is also expanding, with six new reactors under construction.

Betting on oil and gas expansion

At the same time as it boosts green energy, the country is also placing a major bet on oil production and refining.

Part of the reason is the growth of domestic demand: India will account for one-third of the global increase in oil consumption between now and 2030, according to the IEA. In addition, India imports more than 80% of the oil it consumes, making domestic production a strategic concern.

But India's ambitions go beyond meeting domestic demand. The country has positioned itself as a major exporter of refined products, supplying Europe, Asia and the Middle East with over $80 billion of petroleum fuels, lubricants and petrochemicals annually.

This meeting of domestic needs, strategic concerns and economic ambitions has led to expand domestic oil production, with the country opening more than one million square kilometers to exploration in October 2024, with a tender for 16 blocks launched in February. The government is reforming its regulations to attract international players, largely absent from exploration and production. The Oilfield (Regulatory and Development) Amendment Bill, for example, simplifies environmental and land-use authorizations, frequent causes of delays in oil and gas projects.

A matter of R&D

India is also seeking to make oil production cleaner, using advances in technology and applied research to limit environmental impact.

One example of this approach is Hexagon R&D India. Based in Hyderabad, the site is home to 2,100 engineers working across sensors, software and autonomous systems for energy and industry. It is the largest global research centre of Hexagon, whose technologies support more than half of all oil and gas processed worldwide.

This local presence has allowed Hexagon to support Indian clients in connecting their engineering, construction and maintenance systems. When data is centralised, changes in design or execution can be reflected accurately in

digital models and documentation -reducing errors and delays. Tools such as HxGN EAM also help operators track emissions, optimise maintenance and reduce waste across the lifecycle of a plant.

In this domain, one of the areas producers are increasingly zeroing in on is the reduction of methane emissions. Methane, a gas with 28 times the warming potential of carbon dioxide, is a byproduct of oil and gas production that often escapes through leaks, venting or flaring, and has become a key target for emissions monitoring and control. Indian operators including ONGC have announced targets to reduce flaring and curb methane leaks, and monitoring tools are playing a growing role in supporting these goals.

The crucial role of refineries

A crucial theater for India's ambitions to grow energy supply without growing its emissions will be the country's 23 refineries, which are crucial nodes in its energy system.

As the backbone of India's energy system, refineries are critical to ensuring energy availability. Any disruption can quickly lead to shortages. Maintenance must be scheduled carefully to avoid holiday periods, when demand peaks. In October 2024, which included the Diwali festival, diesel consumption rose by 20% compared to September.

To keep pace with demand, India is investing heavily in refining capacity, ranking second globally behind China. But increasing output is only part of the strategy.

The country is also investing in digital tools to improve reliability and maintenance planning. Numaligarh Refinery, the leading public facility in eastern India, is digitalising its operations, aiming to establish a digital twin as the definitive source of operational data.

The making of a global energy superpower

This focus on better data also supports tighter regulation. Refineries have undergone major upgrades to produce fuel compliant with Bharat Stage VI standards, which cut sulphur content to 10 parts per million - on par with the Euro 6 norm.

As India takes on a larger role in global energy markets, this shift serves two goals.

For policymakers, it signals the country's readiness to meet global expectations on environmental and operational standards. For energy companies, particularly multinationals expanding their footprint in India, it offers a model of how fossil fuel operations can evolve alongside renewables.

With a large and growing population, vast geography and limited electrification in key sectors - electric vehicles still represent just 2.5% of new car sales - India's energy needs will remain high. The government is not seeking to replace fossil fuels outright but to manage them more efficiently while scaling up alternatives. If it succeeds, India will become a laboratory for energy diversity, where fossil and renewable sources operate side by side to meet demand, reduce emissions and serve as a powerful foundation to the country's economic growth.

Can India meet the challenge of providing net-zero electricity to one-fifth of the world's population? The country has set the ambitious objective of achieving carbon neutrality by 2070 and, by 2030, bringing the share of non-fossil energy to 50% of installed electrical capacity.

This goal involves the development of renewable and low-carbon energy sources. India has recently passed the threshold of 100 gigawatts of solar capacity, equaling Germany. Hydroelectric power is also expected to experience rapid growth, with the goal of increasing its installed capacity by half, from 42 gigawatts today to 67 by 2031–2032. Finally, nuclear energy, which currently represents 8 gigawatts or barely 2% of installed capacity, should also see this figure increase by half, thanks to six reactors under construction.

The energy transition tested by strategic independence

At the same time, to meet the needs of its population, India is also accelerating its offshore oil exploration.

In the recent period, energy demand has risen sharply, driven by population and economic growth, urbanization, industrial expansion and the development of a more energy-intensive middle class. Its total primary energy consumption has increased by 20% since 2019, reaching 36.2 quadrillion Btu. This already places the country third in the world, behind the United States and China, and it is expected to grow by another 35% over the next ten years, according to government forecasts.

The result: in a world where consumption is expected to increase by 1.2 million barrels of oil per day by 2030, India alone accounts for a third of that increase, according to the IEA.

Yet the country imports more than 80% of its oil, mainly from OPEC+ countries, the rest being supplied by the one million barrels per day of domestic production. The increase in domestic field developments, described by Minister of Petroleum and Natural Gas, Hardeep Singh Puri as a 'hundred-billion-dollar opportunity,' is therefore as much a matter of strategic independence as it is of trade balance.

The objective of increasing domestic production has led to opening more than one million square kilometers to exploration in October 2024, with a tender for 16 blocks launched in February. The government is reforming its regulations to attract international players, largely absent from exploration and production. The Oilfield (Regulatory and Development) Amendment Bill, for example, simplifies environmental and land-use authorizations, frequent causes of delays in oil and gas projects.

India also hopes to chart a path toward a more environmentally respectful oil extraction, notably through stricter environmental standards for fuels and refined products - for example, the Bharat Stage (BS) VI emission standards, aligned with European Euro 6/VI norms.

The hope for high-tech, greener oil extraction

On the production side, India faces a dual imperative. On the one hand, the country wants to move quickly to accelerate the exploration of its oil resources while global demand is at its peak. The country is already the third-largest exporter of refined products, with Europe among its main clients.

At the same time, it wants to avoid increasing its carbon footprint, as India's share of global greenhouse gas emissions has already risen from 6.7% in 2019 to 7.8% in 2023.

Energy players are counting on technological solutions to resolve this equation. For example, new exploitation projects now typically include digital twins from the design stage, intended to centralize information and measure greenhouse gas emissions throughout the lifecycle of future facilities.

A key target is methane emissions, a greenhouse gas responsible for a third of emissions in the energy sector, whose warming potential is considered 28 times greater than that of carbon dioxide. Several major players in the sector, including state-owned giant ONGC, have expressed their intent to tackle their methane emissions and to reduce harmful practices such as gas flaring.

Refinery reliability under scrutiny

Another key focus of government attention: the country's twenty-three refineries. Unlike Western countries, the growth in hydrocarbon demand comes from consumers rather than businesses. The country's development and the rise of the middle class have led to a surge in two main uses: transport (cars, motorcycles) and domestic consumption (especially for cooking).

As a result, Increasing Environmental Regulations

This greater traceability of information also aims to meet regulations that are developing to align with Western standards: oil distributors have massively invested in modernizing refineries to produce BS6-compliant fuel, with reduced sulfur content (10 ppm compared to 50 ppm under the BS4 standard), aligned with the Euro 6 norm.

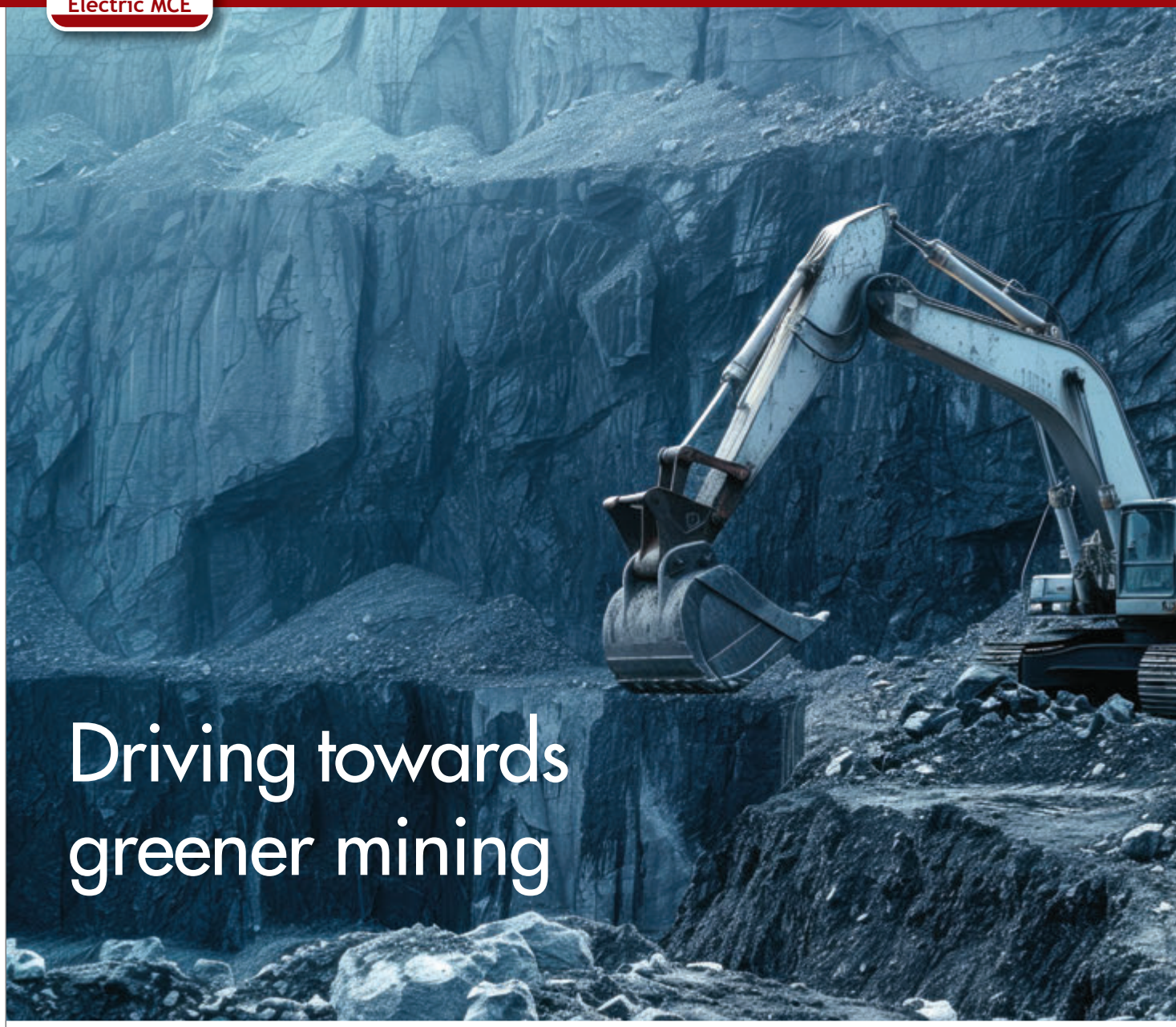
As India plays an increasingly important role in the global energy industry, this alignment serves a dual purpose.

For public authorities, it is about proving that India is a major energy player, capable of aligning with the best environmental and operational practices and serving the entire world.

For major industry players - and particularly global giants who are increasingly present in India - the aim is to show that an alternative path exists to the decline of fossil fuels and their replacement by renewables.

With its growing population and economy, vast geography, and energy uses that are hard to replace with electricity - electric vehicles, for example, account for only 2.5% of new car sales - India faces significant energy challenges. To meet them, it intends to embody the perfect laboratory of 'energy diversity,' where fossil and renewable energies coexist sustainably as an alternative to the energy transition. EPC World

PRAVEEN NAKKELLA
Director Pre-Sales
Hexagon, Asset Lifecycle Intelligence



Driving towards greener mining

India's mining sector is at the cusp of a transformation as the country accelerates its shift toward electric and low-emission equipment. With diesel-powered mining machinery contributing significantly to operational costs and efficiency challenges, manufacturers are increasingly introducing electric and advanced alternatives to optimise performance and productivity in mines

The environment is degrading at a rapid pace, and the effects of this degradation are already visible across the world. Climate change, one of the most pressing global challenges, manifests itself in unpredictable weather patterns — severe droughts in some regions and unprecedented rainfall in others. A major cause of this environmental imbalance is the continuous emission of greenhouse gases (GHGs) into the atmosphere.

According to a report by the European Environment Agency, transport accounted for about a quarter of the EU's total CO_2 emissions in 2019, with road transport alone contributing nearly 72% of that share. In the United States, the Inventory of U.S. Greenhouse Gas Emissions and Sinks (1990–2022) reported that transportation accounted for the largest portion—around 28%—of total GHG emissions in 2022. In India, studies estimate that vehicular pollution contributes between 8% and 14% of the country's total greenhouse gas emissions, making the transport sector one of its most significant emitters. At COP21 in Paris (2015), India committed to reducing the emissions intensity of its GDP by 33%–35% by 2030, compared to 2005 levels. The country has since advanced a multi-pronged climate strategy aimed at achieving net-zero emissions by 2070, increasing non-fossil fuel energy capacity to 500 GW by 2030, and cutting GDP carbon intensity by 45% within the same timeframe. In alignment with these goals, India is also developing a national carbon market and accelerating the transition to electric mobility.

Powering mining transformation

To promote the adoption of electric vehicles (EVs), the government has rolled out a range of initiatives and regulatory frameworks. These include stringent fuel and emission standards (Bharat Stage VI norms), financial incentives under the FAME I and II schemes, and production-linked incentive (PLI) schemes for advanced chemistry cell batteries and automotive components. Moreover, the government is investing in public transport electrification, encouraging biofuel use, and supporting the creation of EV charging infrastructure across highways, cities, and industrial clusters. The Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME) scheme was launched under the National Electric Mobility Mission Plan (NEMMP) 2020. While the first phase focused on incentivising electric two-wheelers, three-wheelers, cars, and buses, FAME II, introduced in 2019 with an outlay of ₹10,000 crore, expanded its support to include charging infrastructure and public transport electrification. Complementing this, the Production-Linked Incentive (PLI) schemes for the automobile, auto components, and advanced chemistry cell (ACC) battery sectors are strengthening domestic manufacturing and innovation. Together, they aim

to reduce import dependence and make electric mobility technologies more cost-competitive. Large-scale initiatives such as the Green Energy Corridor (GEC) and the National Infrastructure Pipeline (NIP) are ensuring stable renewable power supply and enabling EV-ready infrastructure across industrial and construction zones.

At the state level, governments are actively aligning their policies with national goals. Delhi, Maharashtra, Tamil Nadu, and Karnataka offer subsidies, tax exemptions, and incentives for EV manufacturers, fleet operators, and buyers. States like Gujarat and Rajasthan are promoting EV manufacturing clusters, while Andhra Pradesh has started encouraging the use of electric machinery in public infrastructure projects. These regional initiatives are accelerating market readiness for electric mobility and associated technologies. The rollout of Bharat Stage VI emission norms, the proposed Battery Swapping Policy, and the expansion of charging networks through public-private partnerships by agencies such as NTPC, EESL, and CESL are collectively setting the stage for the wider adoption of electric construction and off-highway equipment in India.

Rise of electric MCE

The mining industry, long regarded as one of the most energy-intensive and emission-heavy sectors, is undergoing a quiet but powerful transformation. To support government's sustainable initiatives and contribute to a cleaner environment, mining and construction equipment (MCE) manufacturers in India have increasingly begun introducing machines that are either fully electric or compliant with BS-VI (CEV Stage V) emission norms. This shift reflects the mining industry's commitment to sustainability, reducing emissions, and responding to increasing regulatory and societal pressures for cleaner and more environmentally responsible mining practices.

Mining equipment manufacturers are taking proactive steps to drive this transformation. BEML has launched the indigenously designed and developed BRS21 electric rope shovel, a 720-tonne, high-capacity machine equipped with a 21-cubic-metre bottom dump bucket for large-scale overburden removal in open-cast mining. Powered by a Siemens IGBT-based AC drive system, the fully electric BRS21 offers superior performance, safety, and sustainability - eliminating exhaust emissions and saving around 189 tonnes of CO_2 annually per machine. Daimler India Commercial Vehicles has unveiled the all-new BharatBenz Construction and Mining range, featuring its advanced HX and TorqShift series models. Built to meet the rising demand for reliable, high-performance heavy-duty trucks, the new range is aimed at large contractors seeking to modernise ageing fleets and boost productivity in challenging construction and mining environments.

CASE Construction Equipment has launched its first BS (CEV) Stage V-compliant machine from its Pithampur facility, marking a step toward cleaner, greener construction machinery in India. The upgraded portfolio includes vibratory compactors (952 NX, 450 NX, 1107 NX) and advanced loader backhoes (770 NX, 770 NX Magnum, 851 NX), all powered by FPT F28 engines meeting the latest emission norms. The machines offer enhanced fuel efficiency, productivity, and safety, with operator-focused

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features such as digital instrument clusters, ergonomic controls, and improved visibility.

Volvo Construction Equipment (Volvo CE) is at the forefront of electrifying India's mining and construction machinery, offering a diverse and rapidly expanding electric portfolio. At the heart of this push is the EC500 Electric, India's first grid-connected 50-tonne electric excavator, designed for high-capacity mining and infrastructure projects with zero-emission performance. JCB India was among the first manufacturers to introduce electric equipment for the construction and mining sector. As early as 2022, the company launched its fully electric excavator, the JCB 19C-1E. This zero-emission machine is powered by four lithium-ion batteries, providing enough energy to

operate a full day on a single charge, making it ideal for urban and environmentally sensitive construction and mining sites. JCB is also developing next-generation electric and hybrid machines, as well as hydrogen-powered prototypes, demonstrating a clear commitment to sustainable construction solutions. By combining advanced battery technology, efficient drivetrains, and reduced operating costs, JCB's electric portfolio enables contractors to meet stringent environmental standards while maintaining high productivity.

Schwing Stetter India has focused on electrifying its concrete and heavy-duty equipment to meet growing sustainability demands in construction and mining. The company's Electric Shotcrete Machine, introduced in 2024, delivers zero-emission operation, lower noise levels, and precise control, making it ideal for tunneling, mining, and large-scale infrastructure projects. By replacing diesel engines with electric powertrains, the machine not only reduces onsite pollution but also enhances energy efficiency and lowers operational costs.

Technology aiding sustainability

Technology too has taken a significant leap in helping reduce the environmental footprint of construction and mining operations. Modern electric and hybrid MCE comes equipped with telematics and IoT-enabled monitoring systems, allowing operators to optimize machine performance, track energy usage, and reduce idle times. Intelligent control systems further enhance efficiency by ensuring that machinery operates only when needed and scheduling charging during off-peak hours, reducing both energy consumption and greenhouse gas emissions.

Advanced battery management systems monitor battery health, temperature, and charge levels, ensuring that machines deliver maximum productivity while consuming minimal energy. Some machines also employ regenerative braking and energy recovery technologies, capturing otherwise lost kinetic energy and converting it back into usable power. Electric motors themselves are inherently more efficient than conventional diesel engines, converting a higher proportion of stored energy into actual work, which significantly lowers energy wastage.

By combining these technological innovations, construction equipment not only reduces carbon dioxide and other harmful emissions but also lowers operating costs, improves productivity, and makes urban and industrial construction sites cleaner and quieter. This convergence of electrification and smart technology is enabling India's construction industry to align more closely with sustainability goals and regulatory standards, driving a new era of environmentally responsible infrastructure development.

Navigating the challenges

While electric MCE promises cleaner, more efficient operations, the sector faces several challenges in India that could slow widespread adoption. One of the primary hurdles is charging infrastructure. MCE often operates at temporary or remote sites, such as highways, urban

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redevelopment zones, and industrial projects, where access to reliable, high-capacity electricity is limited. Most sites rely on grid connections that may be unstable or insufficient to charge multiple machines simultaneously. Extended charging times for heavy-duty equipment can affect project timelines, particularly on critical infrastructure projects. Additionally, the lack of standardised charging protocols across manufacturers complicates operations for contractors managing mixed fleets. To overcome these issues, initiatives such as on-site renewable microgrids, battery-swapping solutions, and EV-ready industrial parks are being explored, while public-private partnerships aim to strengthen industrial charging networks. Another significant challenge is the

shortage of critical components, including lithium-ion batteries, semiconductors, and electric drivetrain parts. Global supply chain disruptions and geopolitical uncertainties have caused delays, higher costs, and limited availability of key components. Lithium-ion batteries, essential for electric MCE performance, remain in high demand globally, and domestic production is still growing. To address these constraints, the government's Production-Linked Incentive (PLI) scheme for Advanced Chemistry Cell (ACC) batteries aims to boost local manufacturing, while manufacturers are exploring alternative chemistries and modular battery solutions.

High initial costs also limit adoption, particularly for small and mid-sized contractors. Electric machines are more expensive upfront than diesel models, even though lower operating and maintenance costs can offset this over time. Concerns about battery life and replacement costs persist, as do issues related to technical expertise and training; many operators are still unfamiliar with electric MCE operation, charging protocols, and preventive maintenance. Performance perceptions further challenge adoption. While electric MCE excels in urban and medium-duty applications, contractors sometimes question its efficiency for high-capacity tasks such as large-scale earthmoving or mining. Standardisation and compatibility issues, regulatory uncertainty, limited resale markets, and environmental considerations around battery disposal further compound the challenges facing the sector.

Greener mining takes centre stage

The future of electric MCE in India is set to be transformative, driven by technological innovation, government incentives, and rising environmental consciousness. Advances in battery technology promise longer operating hours, faster charging, and reduced lifecycle costs, making electric machinery increasingly viable for contractors across sectors. Expanding charging infrastructure, including on-site microgrids, public-private partnerships, and industrial EV hubs, will ensure seamless operations even in remote or large-scale projects. Manufacturers are also investing in hybrid solutions, smart telematics, and IoT-enabled systems to optimise energy use, monitor performance, and reduce idle times, lowering both operational costs and emissions. Stricter emission norms and sustainability requirements for infrastructure projects mean that electric MCE is likely to become the preferred choice.

Furthermore, scaling up domestic battery production under initiatives like the PLI for Advanced Chemistry Cells will reduce import dependence and make electric machinery more cost-competitive. As awareness grows among contractors, policymakers, and developers, adoption is expected to accelerate.

The coming years could witness a fundamental shift in mining practices, where electrification, digital technologies, and sustainable operations converge, enabling cleaner, quieter, and more efficient extraction processes while reinforcing India's commitment to environmentally responsible mining.

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The mining sector is on the threshold of a new era in tyre management

Our products are focussed on improving mining productivity, while adopting the highest levels of safety for the operations, says **RITESH PURANIK**, Chief General Manager, Off the Road Tires (Mining & Solutions), Bridgestone India

How is Bridgestone driving value creation and sustainability in the off-the-road (OTR) tyre segment for the mining industry?

At Bridgestone, our goal, as a sustainable solutions company, is to co-create with our customers to AMPLIFY VALUE through our products, solutions, and expertise that helps deliver our business aspirations. Bridgestone Off-The-Road offers a robust lineup of innovative tyres engineered with compounds suited for various surfaces and applications. Bridgestone OTR tyres are designed with intelligent technologies to help customers in their quest for reliable performance and improved productivity. Designed with smart tech inside for hard work outside, Bridgestone Master core tyres are built to take on mining applications – with innovative core technology and proprietary design improvements for enhanced performance and lasting wear, enabling customers to discover up to more durability, faster speeds and increased load capacity. Bridgestone, I Track – Global Next Generation Comprehensive Mining Monitoring System delivers customers real time data regarding live temperature, pressure of tires along with vehicle position, speed and accelerometer data which helps our customers make data driven decisions & improve their operational productivity.

How is Bridgestone supporting the transformation of India's mining sector through its advanced product and solution offerings?

The mining industry is constantly evolving, and the Indian mining landscape is undergoing a shift with digitalization and adoption of new technologies. With rising demand for coal & critical minerals, there is a stress on mines to extract more. Our products are focussed on improving mining productivity, while adopting the highest levels of safety for the operations. As Bridgestone's best-in-class mining tire, Master Core is the foundation of the company's mining solutions business. The tire is engineered for ultra-high durability, based on a combination of unique technologies that include a new type of steel cord and other advanced materials, structure and process engineering. The tyres can also be customized to various mine sites and operations. Master Core tyres can be optimized for a number of performance attributes including faster speeds,

increased payload and maximized uptime. Our Next Generation Mining Solution – Bridgestone I Track, helps customer make data driven decisions with 24X7 live data about important tyre parameters such as temperature and pressure, combined with vehicle operational data such as GPS position, mine site Geo Fence & Accelerometer data which provides insights into haul road conditions, driver behaviour and downtime, all of which enables customer to optimize their operations and 'move more with less'.

How are digital technologies like IoT, AI, and telematics integrated into your tyres, and how do they boost performance, safety, and efficiency?

The use of digital technologies has become vital in analysing tyre performance, and the mining segment is no different. Bridgestone I Track is the leading IoT enabled TPMS solution for the ultra-large class mining dumpers which provides real time data on tyre temperatures, pressures & insights into haul road conditions. We make use of hardware devices such as sensors, receivers and processors which collect & analyse vital tyre and vehicle data which is accessible to customers over a webpage Dashboard. Bridgestone I Track has proven abilities of improving tyre performance, mine site safety & productivity while resulting in customer savings. Bridgestone iTrack also provides the customer with detailed KPI reports and data insights through analytics. Our system can also be integrated with other solutions which the customer may be using, such as mine dispatch systems, OEM provided systems or other 3rd party systems. Bridgestone iTrack, with proven integration capability & highest level of sensor/system availability, is the most suitable & reliable partner for solutions project. In addition, by continuously feeding back data and knowledge obtained by the company's solutions offering, Bridgestone will further improve its product portfolio, expand its service offering and strengthen the company's tyre wear and durability prediction technology. This will enable Bridgestone to continue to provide even greater value to society and customers.

Sustainability is becoming a key focus. How are your tyres designed to support sustainability, efficiency, and reduced environmental impact in mining operations?

With the mission of "Serving Society with Superior Quality", Bridgestone since its foundation in 1931 has continued to grow by turning various changes into opportunities. Based on our mission and guided by our vision – "Toward 2050, Bridgestone continues to provide social value and customer value as a sustainable solutions company"- we are accelerating our transformation, with our corporate commitment, the Bridgestone E8 Commitment, as the axis of the Bridgestone way of value creation that embodies our vision and mission. Bridgestone is striving to realize a sustainable society and simultaneously build a foundation of sustainable value creation across the value chain. Our sustainable procurement initiatives are grounded in our Global Sustainable Procurement Policy and align with our goal of using 100% sustainable materials by 2050. Bridgestone is focussing on sustainable procurement of natural rubber, a key raw material in tyre manufacturing and an essential renewable resource for producing high quality tyres. However, as demand for natural rubber continues to rise, it is beginning to be viewed as a threat to global deforestation. Therefore, efforts towards sustainability of natural rubber are recognized as crucial management issue for business continuity. We have proactively collaborated with our suppliers to enhance supply chain traceability to ensure governance and compliance to ever-changing business conditions. Moving forward, we will continue to build fair, "win-win" partnerships through diligent and steady efforts practicing Genbutsu-Genba (Respect for Being On-Site) that ultimately results in sustainable use of natural rubber. We remain dedicated to creating sustainable value through growth with quality.

Going forward, how do you see your engagement with the Indian mining industry?

The mining sector is on the threshold of a new era in tyre management, driven by digital innovations. The integration of AI, data analytics, and advanced sensor technology is transforming the way tyres are monitored and maintained, promising significant improvements in safety, efficiency, and environmental impact. Telematics and fleet management software play a pivotal role in modernising mining tyre safety. These systems collect data from various sensors embedded in mining vehicles and tyres, transmitting it to a central system where fleet managers can access it remotely. With this data, fleet managers can monitor tyre pressure, wear, and temperature, as well as other operational metrics in real time.

Bridgestone, as a sustainable solutions company, will be central to that transformation through Dan-Totsu tyres, next-generation mining solutions, and on-field expertise that help customers 'move more with less'. Our aim is to enhance customer value by increasing operational efficiency and maximizing economic returns, while generating social benefits through lower CO_2 emissions and improved resource productivity. Bridgestone has also designed upskilling initiatives training tyre for people who work in the mining area. Together these efforts help build a Bridgestone-led mobility ecosystem. EPC World

We plan to connect all major and upcoming data hubs

Fibre is the only medium capable of handling the massive surge in data traffic driven by AI, cloud computing, IoT, and other next-gen technologies, says **ANKIT GOEL**, Founder and Chairman, Space World Group

What was the inspiration behind launching Constl under the Space World Group, and how do you see robust digital infrastructure - especially fibre connectivity - playing a critical role in advancing India's AI ambitions and digital economy?

The inspiration came from our belief that digitization is fundamental to economic growth in today's world. As India moves toward becoming a digitally empowered nation, the demand for a strong digital infrastructure is more critical than ever. Powering this infrastructure will require a high-capacity connectivity backbone - one that can seamlessly connect the entire ecosystem. Fibre is the only medium capable of handling the massive surge in data traffic driven by AI, cloud computing, IoT, and other next-gen technologies. However, as we looked closer, we saw a glaring gap in the quality and scalability of the fibre infrastructure being laid across the country. These networks were installed years ago and have degraded over a period of time, rendering it inadequate to meet the demands of today's high-speed data applications and AI workloads. This is where we saw a strategic opportunity to address this critical gap and build fibre networks that are not only high-quality but also built to scale with India's digital and AI ambitions. Fibre optic networks can support the massive surge in bandwidth needed for cloud platforms, edge computing, and diverse digital services with ultra-high capacity and low latency. Constl is driving this change by developing scalable, high-quality fibre infrastructure that empowers seamless data transport, enabling India's AI, cloud, and digital ecosystems to thrive.

Constl is positioned as a purpose-built, AI-ready fibre network. What sets it apart in terms of features and capabilities that make it ideal for AI workloads, and how does it overcome the key limitations typically found in traditional fibre networks?

AI workloads require extremely low latency, high bandwidth, and high performance. To address this, our network is being designed with the shortest, most direct routes between key AI hubs - acting like expressways that enable data to travel faster and more efficiently. This ensures the quality of service and speed necessary for AI applications. Additionally, multiple ducts and fibre pairs are being laid to

future-proof the infrastructure, allowing it to scale as demand increases. Reliability and resilience are at the core of our design. AI workloads primarily run in data centres, and these facilities demand uninterrupted connectivity to function effectively. To ensure this, every major data centre in India is connected through multiple diverse routes, with a minimum of three separate exit paths. This robust routing minimizes the risk of outages and guarantees the high availability that AI applications require. Our commitment to reliability goes beyond routing. We use the latest fiber technology capable of delivering high bandwidth over long distances, and our fiber is buried deep underground to protect against accidental cuts and environmental disruptions. There's no compromise on design or quality - we build with resilience in mind, every step of the way. Constl is built for the future not just to keep up with AI, but to enable and accelerate it. We are not only establishing robust long-haul connections but also actively connecting and densifying metro networks. This comprehensive approach supports massive AI deployments by ensuring high-capacity, low-latency connectivity across both inter-city routes and urban hubs.

Can you walk us through the core design principles behind Constl's network architecture, and explain how the AI-enabled orchestration platform enhances network management? Are there any real-world use cases or outcomes you can share from its deployment?

Constl's network architecture is built on strong design principles focused on reliability, performance, and scalability - critical for supporting today's digital and AI-driven applications. Our fibre is laid at a depth of more than 2 meters, significantly reducing the risk of accidental cuts and ensuring high network uptime. Each data centre is connected through minimum three diverse exit paths, offering robust redundancy and fault tolerance - so if one path fails, others can seamlessly take over without service disruption. We use next-generation fibre that adheres to high quality standards, capable of scaling to extremely high bandwidths. With fibre loss maintained at less than 0.28 dB, our infrastructure ensures optimal performance for bandwidth-intensive and latency-sensitive applications. Our use of high-quality fibre makes the network ideal for real-time, mission-critical workloads. Additionally, we plan and deliver unique, low-latency routes that ensure data travels the shortest and most efficient paths across the network. Complementing this physical layer is our AI-enabled network platform, which brings intelligence to network management. It provides real-time analytics to help customers monitor and optimize network performance and supports bandwidth-on-demand services tailored to meet the unique and dynamic bandwidth requirements of each customer. Looking ahead, we are exploring ways to offer even greater flexibility by enabling customers to select their own network routes -introducing the concept of build-your-own-service. This empowers enterprises to design connectivity solutions that align precisely with their performance, resiliency, and geographic needs.

Since its launch in December 2023, Constl has connected over 50 data centres across India. Which regions or cities are currently prioritized, and what are your plans for expansion in the near future?

We're currently focused on connecting major digital and AI hubs like Mumbai, Chennai, NCR, and Hyderabad, both through intercity long-haul and intracity metro fibre networks. A key part of our strategy is strengthening the south corridor, as we see significant AI-related growth and data centre investments emerging in that region. Looking ahead, we plan to connect all major and upcoming data hubs, along with critical cable landing stations that are set to play a big role in driving future bandwidth demand - Vizag and Kolkata being prime examples. Our goal is to create a truly pan-India, AI compatible network that supports the country's growing digital infrastructure needs. As the data centres move to Tier 2 locations, we also have plans to connect these locations to enable edge ecosystem in the country.

How have key industry stakeholders - such as hyperscalers, ISPs, CDNs, and enterprises - responded to Constl's offering? Are there any notable partnerships, client deployments, or success stories you can share?

We are actively working with nearly all major hyperscalers, content providers, and leading telcos in the country, powering their backbone networks according to their unique requirements. Our partners value the low latency, high-quality new fibre infrastructure, and unique route options we provide, which directly enhance the quality of service for their critical applications. Notably, Constl is the first network provider in India to offer 400G client interfaces, and we are already powering massive capacities up to terabits and beyond for some of the country's largest hyperscalers. This underscores our commitment to delivering cutting-edge, scalable

connectivity solutions that meet the evolving demands of the digital economy.

Constl promises near-100% network uptime through architectural resilience. Could you elaborate on the redundancy strategies - such as multiple paths, diverse exits, and failover mechanisms - that make this possible?

Constl is built with resilience at its core, and our aim of delivering near 100% network uptime is backed by a robust set of redundancy strategies. Every data centre we connect has a minimum of three diverse exit paths, with some having as many as four, ensuring there's no single point of failure. Beyond this, we leverage a combination of our own infrastructure and utility partner routes to add further layers of protection. For example, on the critical Mumbai–Chennai corridor, we've established three completely separate paths, offering triple-layer redundancy. This integrated design of path diversity, real-time re-routing, and deep network intelligence allows us to offer an exceptionally reliable, always-on infrastructure - essential for supporting mission-critical and latency-sensitive applications.

In a rapidly evolving fibre infrastructure market, what sets Constl apart from traditional telecom operators and data transport providers? How do you define your competitive advantage?

Our network is purpose-built - specifically designed for high-capacity, bandwidth-intensive customers like hyperscalers, CDNs, cloud providers, and large enterprises, rather than for retail or mobility users. Our architecture focuses on express routes, optimized for ultra-low latency and high performance, which is critical for today's AI-driven and data-heavy applications. We take a strategic and thoughtful approach to network design, constantly evaluating and identifying unique routes that do not overlap with existing telco infrastructure, ensuring both diversity and reliability. Another key differentiator is scalability as we deploy multiple ducts, with each duct dedicated to different use cases, allowing us to grow alongside our customers' evolving needs.

Do you have a dedicated R&D arm? Are you exploring synergies with technologies like edge computing, 5G/6G, or satellite integration to complement your fibre backbone?

We have an engineering and product team who continuously evaluate new technologies and plan and design the network. Their focus is not only on building a high-performance fibre backbone but also on exploring new solutions that bring greater automation, scalability, and value to our customers. Apart from that, we have a software team who is working on developing a service orchestration platform where we can enable multiple use cases like bandwidth-on-demand, build-your-own service giving power in the hands of our customers. By default, we are connecting 5G/6G infrastructure as we are a provider to large telcos. Looking ahead, we are actively expanding towards edge locations and are also exploring how our fibre backbone can integrate with satellite communications infrastructure, particularly by connecting ground stations to enable seamless, hybrid connectivity solutions.

What are your growth objectives over the next 2–3 years in terms of network footprint, customer acquisition, and revenue?

Over the next 2–3 years, our focus is on building a truly neutral, pan-India fibre infrastructure that not only supports the needs of today's large-scale digital players but also prepares for the next wave of growth. While we continue to deepen our presence in Tier 1 cities, a key priority is to expand into Tier 2 cities, which are becoming increasingly important with the rise of edge computing and decentralized data infrastructure. In terms of customer growth, we're moving beyond hyperscalers to also cater to CDNs, Gaming companies, FinTech, and other latency-sensitive industries that require high-performance, low-latency networks. Our broader goal is to create a scalable, intelligent, and flexible fibre platform that powers India's evolving digital economy while opening new revenue opportunities across a diverse set of enterprise customers.

Looking further ahead, how do you envision Constl evolving over the next 5–10 years in India's digital infrastructure landscape?

Looking ahead over the next 5–10 years, we envision Constl becoming the only truly neutral, pan-India digital infrastructure provider that seamlessly connects the entire ecosystem - data centres, edge locations, cloud platforms, ground stations, and more through a high-speed, ultra-resilient fibre backbone. As India's digital economy grows, the demand for low-latency, high-capacity, and always-on connectivity will only accelerate, and Constl aims to be at the heart of this transformation. Our goal is to build an intelligent, scalable, and future-proof network that not only supports emerging technologies like AI, edge computing, 5G/6G, and satellite communication, but also serves as the foundation for innovation across industries. Ultimately, Constl will play a central role in enabling India's shift to a fully connected, digital-first economy. EPC World

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Smart construction materials: Impact on concrete durability and sustainability

"Meeting the needs of the present generation without compromising the ability of future generations to meet their needs."

Smart construction materials are revolutionizing the concrete industry by combining innovation, efficiency, and sustainability. Engineered to adapt, respond, and enhance performance, these materials not only improve the durability of structures but also reduce carbon emissions and embodied energy. Their application supports low-carbon construction, promotes circular economy practices, and extends the service life of modern concrete infrastructure

According to recent trends of rising Global Warming Potential (GWP), which are influenced by both cement and concrete, the use of smart construction materials helps to reduce GWP and promotes sustainable construction practices.

What is the Durability & Sustainability of the concrete structures?

Durability and sustainability are closely related properties of hardened concrete: if durability increases, sustainability also increases, and vice versa. However, high-performance concrete requires both durability and sustainability to be at a higher level to meet the targets specified by structural designs. It is important to note that high-strength concrete does not necessarily mean it will be more durable than conventional concrete; instead, high-performance concrete should consistently perform as more durable. The sustainability of a concrete structure largely depends on its durability properties, although periodic maintenance can also enhance both durability and sustainability. Moreover, it has been demonstrated that timely maintenance or repair work improves durability and sustainability, positively affecting the service life of concrete by reducing the deterioration of the top surfaces of panels or slabs.

The **sustainability** of concrete structures

depends on three key factors: (1) economical execution, (2) environmental considerations, such as reducing CO_2 emissions through the maximum use of Supplementary Cementitious Materials (SCMs), and (3) societal aspects, including making informed decisions prior to construction. When all three factors are achieved and the concrete meets the durability requirements specified in the contract or project specifications (SPEC), the structure can be considered truly sustainable.

Smart Construction Materials - also known as intelligent, adaptive, or responsive materials - are engineered to sense, react, and adapt to changes in their environment without external control. Unlike traditional materials, they do not just passively endure stress or degradation; they actively respond to it. Thanks to these properties, the use of smart construction materials can significantly enhance both the durability and sustainability of concrete.

The following materials can be considered as Smart Construction Materials:

- AAC Blocks – Reduce carbon emissions and simplify construction.
- GFRC Bars – Replace traditional TMT bars; they are lightweight and have higher tensile strength.
- Cementitious Materials (SCMs) – Reduce clinker content and carbon emissions while enhancing concrete properties compared to OPC alone.
- Low-Carbon Binders – Help lower the GWP of concrete production.
- Recycled or Reused Aggregates – Promote a circular economy and optimize material usage.
- Innovative Chemicals/Additives/Admixtures – Facilitate placement and improve both fresh and hardened concrete properties.
- Innovative Cements (LC3, PLC, Composite Cement) – Modify concrete properties and reduce CO_2 emissions per ton of cement.
- Nano-Materials (Graphene, CNT, CNF, Colloidal Silica) – Enhance the mechanical properties and durability of hardened concrete; also serve as effective repair materials.

Autoclaved Aerated Concrete (AAC Blocks) are considered smart materials due to their high efficiency. They are made with fly ash, lime, cement, and aluminium powder, often incorporating industrial by-products. AAC blocks are lightweight, thermally insulating, and help reduce the dead load on structures. They also have lower embodied carbon compared to traditional clay bricks or dense concrete blocks, and their larger size and improved workability make construction easier.

Glass Fiber Reinforced Concrete (GFRC Bars) are considered smart materials, though this is only partially accurate. They are not yet widely adopted in the market as replacements for TMT bars. GFRC is typically used in panels, cladding, and architectural elements rather than as direct reinforcement. For replacing steel reinforcement, glass fiber reinforced polymers (GFRP) or carbon fiber composites are more suitable. These alternatives offer corrosion resistance, high tensile strength, and lightweight properties, but require careful design due to different failure modes and bond characteristics.

Supplementary Cementitious Materials (SCMs) are considered smart materials and are highly in demand today, playing an important role in decarbonizing concrete. Materials such as fly ash, GGBFS, silica fume, calcined clay, and metakaolin reduce clinker content and enhance durability by lowering the permeability of concrete. They also improve chloride and sulphate resistance, increase long-term strength, and boost overall durability. SCMs are a key component of low-carbon concrete strategies and are particularly important for marine durability.

Low-carbon binders are considered smart materials and are technically essential for achieving net-zero commitments, serving as a major tool for decarbonization. They include geopolymers, alkali-activated materials, LC3, and blended cements, and can reduce the global warming potential (GWP) by 30–50% compared to OPC. These binders are often used in combination with carbon capture technologies, optimized mix designs, and digital modeling to predict and enhance performance.

Recycled or reused aggregates are considered smart materials and are increasingly adopted to reuse concrete aggregates from construction and demolition waste, municipal waste, pavement dismantling, and returned or rejected concrete, also serving as a tool for decarbonization. They support the circular economy and waste valorization. Recycled concrete aggregates (RCA) can retain approximately 85% of the compressive strength of natural aggregates. However, challenges include higher water demand, variable quality, and the need for pre-treatment.

Material Type	Sustainability Benefit	Technical Note
AAC Blocks	Low carbon, thermal insulation	Excellent for non-load-bearing walls
GFRC Bars	Lightweight, corrosion-resistant	Better suited as panels; GFRP better for bars
SCMs	Reduces clinker, enhances durability	Essential for marine and aggressive environments
Low-Carbon Binders	Major GWP reduction, through the less carbon emission from concrete	Includes LC3, geopolymers, blended systems
Recycled Aggregates	Circular economy, enhanced the waste reduction through the re-usages	Needs quality control and mix adjustments
Innovative Admixtures	Enhances fresh/hardened properties	Key for placement ease and durability
Nano-materials applications	Enhances fresh/hardened properties of concrete, known as nano-enhanced concrete	Increase the service life & used as most successful repairing materials
LC3 / PLC / Composite Cements-innovative cements	CO_2 reduction, tailored performance	Validated by global research and field trials

Innovative chemicals, additives, and admixtures are considered smart materials. They include superplasticizers, viscosity modifiers, shrinkage reducers, crack-healing agents, nano-silica, colloidal silica, waterproofing admixtures, and pumping aid admixtures. These materials enhance workability, control setting, and improve both durability and mechanical performance. They are crucial for high-performance concrete, self-consolidating mixes (SCC), and applications in extreme environments.

Innovative cements, such as LC3, PLC, and composite cements, are considered smart materials. They are technically robust and serve as an important tool for decarbonization. Limestone Calcined Clay Cement (LC3) can reduce CO_2 emissions by up to 40%, improves durability, and uses abundant materials. Portland Limestone Cement (PLC) incorporates up to 15% limestone, thereby reducing clinker demand. Composite cements blend multiple SCMs to achieve tailored performance and enhanced sustainability.

Nano-materials such as nano-silica hydrogel and colloidal silica are considered smart construction materials for both construction and repair works. Additionally, graphene, carbon nanofibers (CNF), carbon nanotubes (CNT), nano-silica, and nano-calcined clay are among the most significant game-changing materials. The application of nano-materials is an essential aspect of smart construction, as they enable innovative construction techniques, enhance mechanical properties, and increase the service life of concrete compared to traditional OPC-based systems.

Conclusion

The application of smart construction materials in industrial projects can significantly enhance both the durability and sustainability of designed concrete structures. As discussed above, these materials help reduce carbon emissions and embodied energy, contributing effectively to the decarbonization of construction activities. EPC World

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We serve as a single point of accountability

Consistency stems from standardized processes, centralized expertise, and technology-driven oversight, says **SAARANG GANAPATHI**, CEO, Embassy Services

HEmbassy Services operates with both owned assets and client properties — how does IFM help you deliver consistency across such a large and diverse portfolio?

Consistency stems from standardized processes, centralized expertise, and technology-driven oversight. Established in 1995 by Embassy Group to manage its owned properties, ESPL has, over the past 30 years, built a deep reservoir of knowledge and experience. This foundation enables us to anticipate challenges and implement best practices across a wide spectrum of property types. Today, across our 130 million sq ft portfolio spanning 13 states, we uphold the same rigorous KPIs, SOPs, and quality benchmarks in our client properties as we do within Embassy-owned assets. Our procurement strength and wide network of vendors nationwide help negotiate better rates, access specialized partners, and ensure consistent service delivery across geographies. Combined with our backward-integrated subsidiaries TFCM and Paledium, this ensures operational reliability, scalability, and accountability, whether it's a commercial, residential, or specialized asset.

What are the key benefits that clients realise when they move from single-service contracts to an integrated facility management model?

Clients benefit from streamlined operations, optimized costs, and measurable improvements in quality. As a developer-owned real estate management company, ESPL brings end-to-end knowledge of buildings - whether it's our residential developments, where we've been involved since construction, or large commercial parks where we ensure strict compliance with building and workforce standards. Seamless coordination is driven by centralized governance, standardized SOPs, and the SSG's technical oversight. Backward integration with TCFM and Paladium ensures full control over workforce deployment and security, while our strong procurement and vendor network guarantee consistent quality across the country. We serve as a single point of accountability, offering an integrated approach that minimizes vendor fragmentation, reduces administrative overheads, and eliminates operational inefficiencies. This enables predictive

management and proactive decision-making. By managing all technical, soft, and specialized services - including fit-outs and refurbishments - under one umbrella, we deliver streamlined, accountable, and high-quality outcomes across every property. With ESPL, clients also gain access to comprehensive, one-stop solutions - from energy advisory and interior fit-outs to refurbishments and asset upgrades - ensuring operational excellence and enhanced asset value.

How are digital tools and platforms enabling better integration of services in IFM?

Digital tools form the backbone of our IFM delivery. IoT-enabled sensors, AI-driven analytics, mobile apps, and cloud dashboards allow real-time monitoring of assets, centralized reporting, and predictive maintenance across technical and soft services. For example, housekeeping and landscaping workflows, and energy consumption can all be tracked on a single platform, ensuring seamless coordination and measurable outcomes, even across large multi-location portfolios.

How IoT, data analytics, or AI are being used in Embassy Services' IFM model to optimise costs and improve sustainability?

We leverage IoT sensors and AI-powered analytics to monitor energy, water, and waste across properties. Predictive maintenance of MEP systems reduces downtime and operational costs, while energy management analytics optimizes HVAC, lighting, and renewable energy systems. Data insights also guide procurement, vendor selection, and resource allocation, enabling cost-effective operations while supporting sustainability goals. For clients opting for asset upgradation or refurbishments, these insights allow us to design interventions that enhance efficiency and long-term ROI.

Embassy Services has earned ISO and British Safety Council certifications. How do these global standards strengthen your IFM offering?

Being certified by respected bodies such as ISO and British Safety Council validate our commitment to quality, safety, and operational excellence. Both ESPL and TCFM are ISO-certified companies, holding ISO 9001 (Quality Management), ISO 14001 (Environmental Management), ISO 41001 (Facility Management), and ISO 45001 (Occupational Health & Safety). We are also the proud recipients of the Sword of Honour. These certifications provide global benchmarks for processes and operations, reinforce client confidence, and ensure that our IFM delivery adheres to the highest international standards across technical services, soft services, security, and workforce management.

How is IFM helping reduce energy, water, and waste footprints across managed properties?

Sustainability is embedded in all aspects of our operations. Through energy-efficient systems, renewable energy solutions, water management, and waste reduction programs, we help clients lower their environmental footprint. Real-time IoT monitoring and analytics allow for data-driven interventions, optimizing resource consumption while reducing operational costs. For projects like asset refurbishments or interior upgrades, we integrate sustainability principles, ensuring green operations, long-term efficiency, and compliance with ESG mandates.

Many of the assets you manage are LEED and IGBC certified. How does IFM contribute to maintaining and upgrading these green credentials?

Maintaining green certifications requires continuous monitoring, proactive maintenance, and strategic upgrades. Through IFM, we embed sustainability in daily operations, energy management, water conservation, and waste management. For refurbishment or fit-out projects, we apply eco-friendly materials, energy-efficient designs, and smart building technologies, ensuring properties not only retain their LEED/IGBC ratings but also enhance performance over time, aligning with clients' ESG objectives.

Do you see IFM evolving into sector-specific solutions like healthcare and airports, or remaining cross-industry — and what is your long-term vision for Embassy Services' role in shaping its future in India?

Integrated Facility Management (IFM) is evolving to address sector-specific demands particularly in residential, healthcare, data centers, and specialized commercial assets while continuing to deliver cross-industry excellence. Our Specialized Solutions Group (SSG) enables customized, compliant, and high-performance solutions across technical operations, security, energy advisory, and refurbishments. In the long term, our goal is to lead India's IFM landscape as a one-stop solution provider that blends deep expertise, advanced technology, robust procurement, and a strong sustainability focus. Backed by our ISO certifications, the prestigious Sword of Honour, backward integration, nationwide vendor network, and diversified service capabilities, we consistently deliver world-class outcomes across sectors, geographies, and client portfolios - setting new standards in quality, efficiency, and asset value enhancement. We remain fully committed to backward integration and are focused on becoming a full-stack, end-to-end service provider redefining industry expectation. Through this integrated model, we aim to empower our clients in achieving their ESG and sustainability goals while ensuring operational excellence at every level. EPC World

The right shoes can save lives: Preventing workplace slips, trips, and falls with proper footwear

Slips, trips, and falls remain among the leading causes of workplace injuries worldwide, contributing to both non-fatal and fatal incidents. This article highlights the critical role of proper safety footwear in preventing such accidents. From meeting technical standards and matching workplace conditions to ensuring comfort and durability, well-selected shoes not only protect employees but also promote health, reduce fatigue, and enhance overall workplace productivity

All over the world, slips, trips, and falls are still ranked among the top causes of injuries at work.

Recent data from the U.K. Health and Safety Executive (HSE) shows that slips, trips and falls made up 31% of all non-fatal workplace injuries reported by employers under RIDDOR in 2023-24. Further, slips, trips and falls on the same level accounted for nearly 18,500 reported cases in that period. Also, a recent trial among NHS employees in Great Britain assessing 5-star GRIP-rated slip-resistant footwear found that such footwear reduced slip incidents by 37% and reduced falls resulting from slips by 49%.

In 2023, employers reported 2,569,000 total recordable injury or illness cases in private industry, of which 450,540 involved falls, slips, or trips. In the same year, there were 5,283 fatal work injuries in the U.S.; of these, 885 deaths were due to falls, slips or trips.

The extent and supply of the proper slip resisting footwear - the specific hazards and the situation in the workplace can go a long way towards cutting the risk considerably. The safety shoes of high quality that fit well and stay comfortable during long working hours not only have the potential to increase safety but also to promote workers' general health and efficiency.

The following are the tips for the right safety footwear selection

Get the technical details right

Footwear is the major barrier against slips; however, not all are constructed the same. Technical specifications are the first thing you should understand with so many choices available. Always make sure that the product meets the safety standards that have been set. For example, the standard EN ISO 20345:2011 certifies footwear meeting the requirements of the slip resistance test. Those products that pass this test are identified with certain letters which show that they have met the conditions required for testing. In Germany, the safety features of such shoes are defined in DIN EN ISO 20345. Since standards are subject to change, it is very important to check that the manufacturer is in line with the most recent updates to ensure the highest level of protection.

Match footwear to workplace conditions

Before choosing the proper slip-resistant shoes employers must first assess the work environment. The behavior of the materials changes depending on the surfaces or substances to which they are exposed. For example, the terms "oil-resistant" and "slip-resistant" denote different features - oil resistance stands for the sole's strength, while slip resistance does not guarantee that it will be able to grip an oily surface. Identifying the contaminants that cause slip hazards and the surfaces on which these hazards exist and then asking suppliers for the right solutions would be a simple yet effective method.

Conduct a workplace risk assessment

The type of footwear offering the most protection can be identified through a detailed safety audit. They should incorporate the types of contaminants, flooring materials, and actual conditions in the workplace rather than depending only on lab test results. The true test of a shoe's performance in the actual work environment is the prevention of accidents that are efficient.

Don't compromise on quality

The giving of premium-quality footwear is an investment that pays back in the long run. Durable, comfortable and injury preventive, well-made shoes are the trifecta that is sought by every user. Footwear that permits breathability, while also keeping the wearer's feet dry is even more comfortable in the long hours of work. One can easily say that although cheaper alternatives might save money at the beginning of the road, quality footwear lasts longer and performs better. Finding out if suppliers offer repair services can also play a role in lengthening the life of the product and thus lowering the total replacement expenses.

Leverage new technology

The old safety footwear has been transformed by today's technology. The core of today's designs are lightweight, puncture-resistant midsoles, and nanocarbon toe caps which, while being just as safe as steel, are more flexible and comfortable to wear. These technological breakthroughs allow for less tired legs and so the workers can keep their efficiency and comfort throughout the day.

Prioritize employee health

Extended periods of standing may bring about such cases as plantar fasciitis, which is characterized by painful heel inflammation and fatigue. Turning a blind eye to this will only aggravate the discomfort and the chances of accidents will grow. Biomechanically supported footwear that is designed in such a way that the foot's natural shape is maintained is the one that causes the least amount of tiredness and promotes good posture. Not only is the comfort improved but also the health risks in the long run are being minimized.

Key takeaway

Top-notch, well-selected safety footwear that play an important role in accident prevention (slips, trips, and falls), worker health, and productivity are available. The employers should combine optimal slip resistance, the use of durable materials, and the design of ergonomic to make shoes that are safe and comfortable for their teams after undertaking the detailed assessment of risks in the workplace and selection of footwear. EPC World

SURESH TANWAR
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