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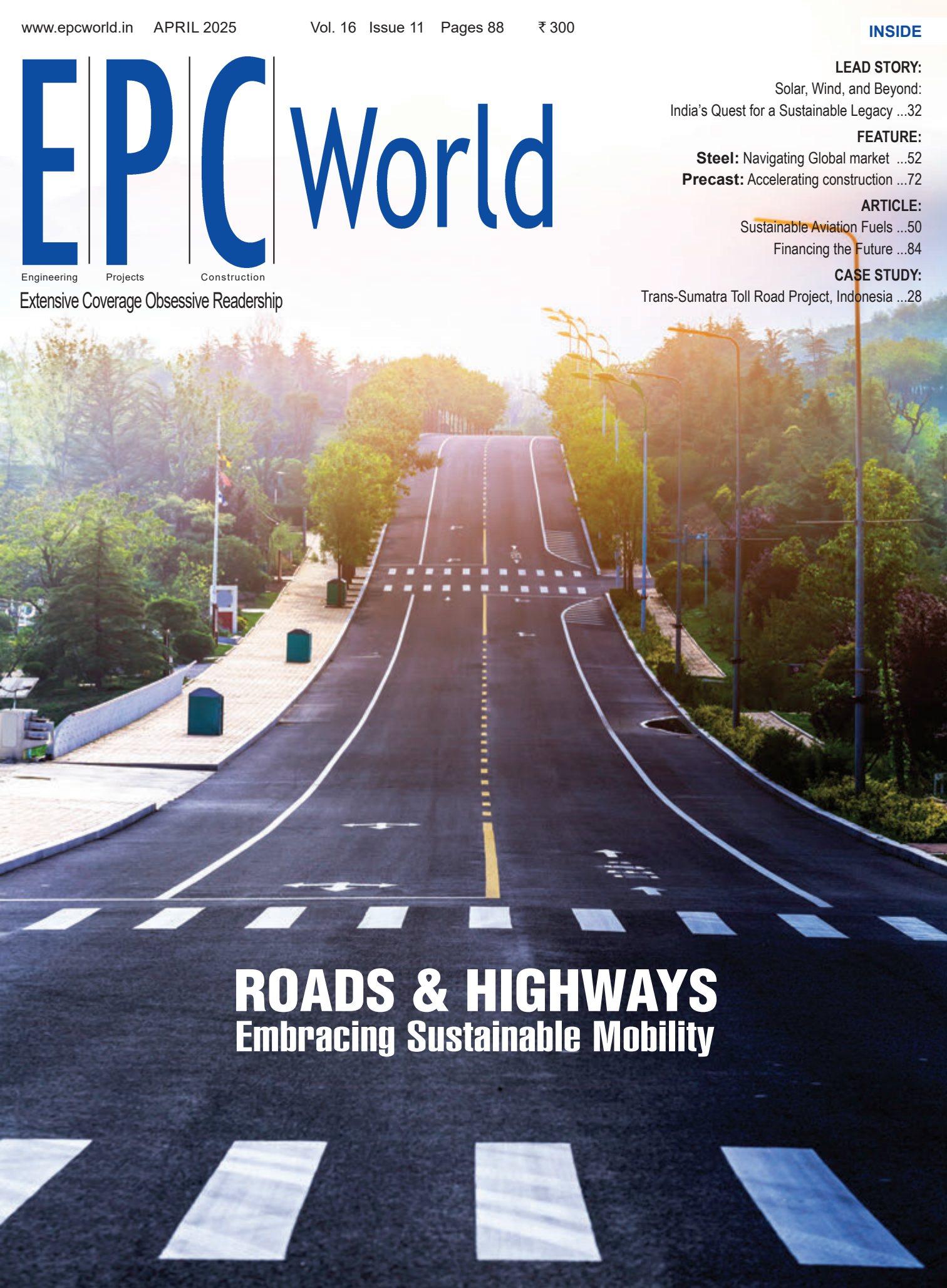
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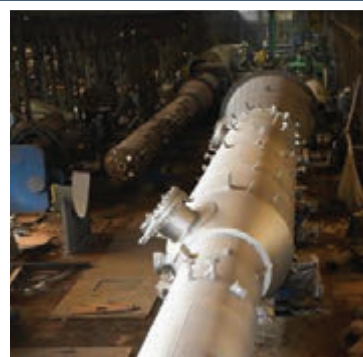
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Clinker Grinder for AHP



CHP at Wanakbori (GSECL)



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Published by Tejasvi S Sharma on behalf of EPC World Media Pvt. Ltd., 301, Hilton Centre, Sector - 11, CBD Belapur, Navi Mumbai - 400614. Tel fax: 022 62714444. Email: marketing@epcworld.in and Printed at Siddhi Offset Pvt. Ltd. 5/12, Kamat Industrial Estate, 396, Veer Savarkar Marg, Prabhadevi, Mumbai - 400 025.

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Dear Readers,

Amidst prevailing global trade uncertainty due to US President Donald Trump's reciprocal tariff measures, the RBI Governor announced a 25 basis point cut in the repo rate to 6%, aiming to boost domestic demand, lower borrowing costs, and support economic growth amid external headwinds. This monetary policy move is expected to inject momentum into key sectors, particularly infrastructure, by improving liquidity and incentivizing investment.

India stands at the cusp of a transformative infrastructure revolution, where sustainability and innovation converge to script the nation's growth story. The Roads and Highways sector, long hailed as the backbone of India's economic progress, is now embracing an environmentally conscious outlook. With a renewed focus on green construction practices and digital integration, this sector is driving connectivity and trade while laying the groundwork for a Smart, Better Tomorrow. The cover story highlights the Roads and Highways sector's growing emphasis on sustainability and its commitment to maintaining an environmentally conscious approach to pave the way for a smarter, greener future.

At the heart of this transformation lies India's ambitious renewable energy roadmap. The Lead Story explores the forces propelling India's renewable ascent, the challenges it faces, and the visionary projects that are paving the way for a sustainable future.

This edition features a deep dive into two critical trends shaping India's infrastructure landscape. First, it examines the impact of rising trade tensions and reciprocal tariff measures on the Indian steel sector—highlighting potential effects on exports, domestic prices, and input costs, while also exploring how the industry is responding through policy support, market diversification, and innovation.

Second, it sheds light on the growing adoption of precast concrete technology in construction. Driven by government initiatives and the need for speed, safety, and sustainability, precast is revolutionizing infrastructure development with its promise of standardized quality, reduced on-site labor, and faster project delivery.

In addition to these compelling features, this edition also includes analytical articles, insightful case studies, exclusive interviews, and the latest updates from the infrastructure, construction, and EPC sectors.

Enjoy the read!

Tejasvi Sharma

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The backbone of India's economic growth, driving connectivity and trade across regions – the Roads and Highway sector gears its focus towards sustainability and maintains an environmentally conscious approach for a Smart Better Tomorrow. EPC World News Bureau tracks the sector's growth pace...

LEAD STORY

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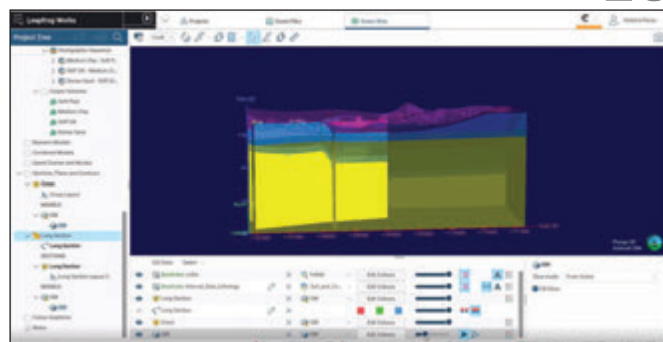


Renewable Energy

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Navigating Global market
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Elofic Industries appoints Kamlesh Koul as Chief Executive Officer

Kamlesh Koul has been appointed as the Chief Executive Officer of Elofic Industries. Koul, a distinguished leader in engineering and innovation, has been an integral part of Elofic for the past 13 years, previously holding the position of Vice President – Engineering and Sustainability. With over 25 years of rich and diverse experience, including holding key roles in prominent filtration companies across India and Japan. He brings extensive technical and leadership expertise to his new role. A prolific inventor, Koul has filed over 27 patents in the past 10 years, making significant contributions to automotive filtration technology. His work has been recognized with several prestigious awards, including the Indian Achiever Award, Bharat Sewa Ratan Award, and Pandit Kashyap Bandhu Samman Award. In addition to his corporate accomplishments, He plays a crucial role in bridging industry and academia, partnering with leading institutions in India and internationally to drive innovation and strengthen collaboration. Koul actively promotes skill development as a member of the Skill Council at Shri Vishwakarma Skill University, Palwal, Haryana.



SCHWING Stetter India Partners with MAX-truder for cost-effective precast concrete solutions

SCHWING Stetter India has announced a strategic partnership with MAX-Truder GmbH, a global leader in machinery for efficient precast concrete production in India. This partnership marks a significant step for SSI: toward entering and expanding the precast concrete segment in India with innovative, cost-effective, and technologically advanced solutions. The collaboration brings together SCHWING Stetter India's deep understanding of the Indian construction landscape and its strong legacy in manufacturing excellence with MAX-Truder's decades-long expertise in extrusion technology and specialized precast equipment. Together, the companies aim to cater to the growing demand for high-quality precast concrete products in India and increase adoption. This collaboration is poised to redefine precast construction in India by leveraging global technology and local expertise, ensuring faster, safer, and more efficient building solutions.

Welspun Michigan Engineers to upgrade Haji Ali Storm Water Pumping Station in Mumbai

Welspun Michigan Engineers (WMEL) in joint venture with Aaradhyaa & Co (WMEL-ANC JV) has been awarded a prestigious contract by the Brihanmumbai Municipal Corporation (BMC) for upgrading the Haji Ali Storm Water Pumping Station in G/S Ward, Mumbai. WMEL holds a 75% stake in the joint venture. The contract, valued at ₹328.12 Crore (with GST), includes the upgradation of the storm water pumping station, along with complete mechanical, electrical, instrumentation and automation systems and civil repair works. The project is scheduled for completion within 18 months (excluding monsoons). Additionally, the contract encompasses a comprehensive operations and maintenance (O&M) phase for 15 years.



Eicher inaugurates the first dealership for Eicher Pro X small trucks in Mumbai

Eicher Trucks & Buses has inaugurated its first exclusive dealership for the newly launched Eicher Pro X range. This state-of-the-art AV Motors' dealership facility located in Bhindarpada, Thane is designed to offer best-in-class customer experience, leveraging advanced technology to enhance every aspect of the vehicle-buying and servicing journey. Equipped with interactive digital displays, the dealership ensures customers receive in-depth insights into the Pro X range, helping them make informed vehicle decisions while experiencing Eicher's commitment to innovation and efficiency. Strategically located in Bhindarpada, Thane, the dealership is well-positioned to serve key logistics hubs, industrial areas, and business districts in Mumbai. The location makes the AV Motor's dealership a crucial access point for fleet owners and transporters looking for reliable, efficient, and connected small commercial vehicles.





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Alstom delivers the 500th electric locomotive for Indian Railways

Alstom has successfully delivered 500 electric locomotives to Indian Railways. The 500th fully India-made Prima T8 WAG12B e-locomotive was flagged off from Alstom's world-class manufacturing facility in Madhepura, Bihar. The WAG-12B locomotives are being built at one of India's largest integrated greenfield manufacturing facilities at Madhepura, under a Joint Venture between Alstom and Indian Railways. This is the largest Foreign Direct Investment project in the Indian railway sector. The facility has an installed production capacity of 120 locomotives per annum and Alstom has progressively achieved near 90% localisation. As part of its contract worth ₹3.5 billion, Alstom is supplying 800 high-powered double-section Prima T8 locomotives of 12,000 HP (9 MW) for freight service. Designated by Indian Railways as WAG-12B, these locomotives are capable of hauling ~6,000 tonne rakes at a top speed of 120 kph. To ensure high availability of India's most advanced freight locomotives and reduce maintenance cost, Alstom has also built two ultramodern state-of-the-art maintenance depots at Saharanpur and Nagpur, using predictive technologies.

Ammann India expands operations with new state-of-the-art manufacturing facility in Gujarat

Ammann has inaugurated its latest state-of-the-art manufacturing facility dedicated to the production of track pavers. This strategic expansion marks a significant milestone in Ammann India's commitment to enhancing its world-class construction equipment offerings. Further to acquiring ABG pavers last year, Ammann has now invested in a state-of-the-art facility that will focus on the production of ABG Track and Wheel Pavers with widths ranging from 7.5 meters to 10 meters as well as, compactors, and bitumen sprayers. The investment has been directed towards modernizing manufacturing infrastructure, incorporating automation, implementing sustainability initiatives, and upskilling the workforce. It incorporates cutting-edge automation features including IIoT-based Automatic Storage and Retrieval System for optimized material handling and safety as well as automated real-time data acquisition for enhanced process monitoring and quality assurance. The facility's design is centred on sustainability. Comprehensive environmental measures have been incorporated by Ammann, such as the installation of solar panels to lessen carbon emissions, IIoT-enabled energy monitoring systems, and an environmentally friendly infrastructure with LED lighting, skylights, and HVLS fans.

AESL wins transmission project in Gujarat for Green Hydrogen/Ammonia manufacturing

Adani Energy Solutions (AESL) has won a power transmission project in Gujarat, which will supply green electrons for manufacturing Green Hydrogen and Green Ammonia in Mundra, Gujarat. The project which will cost ~₹2,800 crore, will be delivered to the nation in 36 months. This project "Transmission System for Green Hydrogen/Ammonia Manufacturing Potential in Mundra, Gujarat" involves upgrading the Navinal (Mundra) electrical substation by adding two large 765/400kV transformers. Additionally, a 75 km long 765kV double-circuit line will be constructed to connect this substation to the Bhuj substation. The project will see the addition of 150 cKM of transmission lines and 3,000 MVA of transformation capacity to AESL's overall transmission infrastructure, taking them to 25,928 cKM and 87,186 MVA, respectively.

KP Green Engineering secures orders of ₹756.40 crore from diverse sectors

KP Green Engineering has secured orders worth ₹756.40 crore from diverse clients, showcasing its strong market presence and execution capabilities. The company aims to complete these new orders by the end of the financial year. In another significant development, KPGE has strengthened its capabilities by expanding into Pre-Engineered Building (PEB) solutions for industrial infrastructure, addressing the growing market demand. As part of this expansion, the company has increased its production capacity by 24,000 MT per annum in Phase 1 at its Matar facility. On the same lines, the company is committed to reach the full capacity in production by the end of the financial year. The Matar factory, which will house Asia's largest galvanising kettle, will have an overall annual production capacity of 2.94 lakh metric tonnes. Commencement of production at full fledge will result in total capacity of ~4 lakh metric tonnes per annum. The project will nearly quadruple KP Green Engineering's galvanising capacity, enabling it to meet growing market demand and shape the future of construction. KP Green Engineering specialises in diverse portfolio that includes Lattice Towers Structures, Substation Structures, Solar Module Mounting Structures, Cable trays, Earthing strips, Beam Crash Barriers and other infrastructure solution products.



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Bedi Steels files DRHP for BSE SME IPO

Bedi Steels, a manufacturer and supplier of high-quality steel and alloy ingots under the "Bedi" brand, has filed its Draft Red Herring Prospectus (DRHP) with the BSE SME platform. The company plans to raise capital through an Initial Public Offering (IPO) comprising a fresh issue of 18,24,000 equity shares, each with a face value of ₹10. Khambatta Securities is the Book Running Lead Manager for the IPO, and Bigshare Services is the Registrar to the offer. The IPO proceeds will be strategically deployed. Bedi Steels intends to utilise ₹33.31 crore for meeting the company's working capital requirements. The remaining capital will support general corporate purposes, facilitating Bedi Steels' continued growth and expansion. Operating from a state-of-the-art 13,750 square yard manufacturing facility in Doraha Village, Ludhiana, Punjab, Bedi Steels specialises in producing a diverse range of steel and alloy ingots. These ingots, essential "mother products," serve as the foundation for manufacturing various metal products like sheets, rods, bars, and wires.



Waaree Renewable Technologies debuts on the National Stock Exchange

Waaree Renewable Technologies has announced its listing on the National Stock Exchange of India, marking a milestone in the company's journey toward redefining India's clean energy future. Waaree Renewable Technologies' NSE debut is a strategic inflection point. It provides the company with wider stakeholder engagement, and enhanced capital access to drive future expansion. This includes scaling up solar capacity, exploring hybrid energy models, and expanding its footprint in both domestic and global markets. This listing not only elevates Waaree Renewable Technologies' market visibility and investor accessibility but also highlights the company's remarkable growth trajectory and commitment to building a greener, self-reliant India. With its robust track record of executing over 1.82 GW in solar EPC installations and currently managing the execution of an additional 1.7 GW of projects, Waaree Renewable Technologies has solidified its position as a trusted partner in India's renewable energy value chain.



Sudesna Biswas Bags 11th EPC World Awards for Women Contribution in Infrastructure

Sudesna Biswas, Head – Hydrology & Sr. Chief Engineering Manager of Larsen & Toubro, Transportation Infrastructure IC, expressed her gratitude upon receiving the 11th EPC World Awards for Women's Contribution in Infrastructure, stating:

"I am truly honoured to receive this esteemed recognition. This award is not just a personal achievement but also a testament to the growing impact of women in shaping India's infrastructure landscape. At Larsen & Toubro, I've had the opportunity to contribute to projects that integrate engineering excellence with environmental stewardship. I hope this recognition inspires more women to pursue impactful roles in infrastructure and help build a more inclusive and sustainable future."

Godrej Properties' Hyderabad debut sees over ₹1,000 crore in home sales

Godrej Properties (GPL), has sold homes worth over INR 1,000 crores with a total area of ~0.84 million sq ft in its project, Godrej Madison Avenue, located in Kokapet, Hyderabad. Launched in January 2025, this new project represents Godrej Properties' successful entry into Hyderabad, further strengthening its presence in Southern India. Kokapet is one of Hyderabad's most sought-after residential and commercial hubs. Godrej Madison Avenue is strategically located on the well-developed Golden Mile Road with access to reputed schools, health facilities, neighbourhood retail, and premium lifestyle offerings that further enhance its appeal among homebuyers and investors. The area also offers seamless connectivity to Outer Ring Road, Financial District, Gachibowli, and HITEC City.



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CASE India inaugurates new dealership in Nashik, Maharashtra

CASE Construction Equipment has further strengthened its presence in Maharashtra with the inauguration of a new dealership, Gulati Cranes, in Nashik. Located on Nashik Airport Road, Adgaon, the new dealership will ensure seamless access to sales, service, and spare parts for customers across Nashik, Dhule, Nandurbar, and Jalgaon. This state-of-the-art facility will offer CASE's full range of construction equipment and deliver a comprehensive customer experience. Apart from the equipment fleet, the facility is designed to meet customer needs with amenities such as a fully equipped workshop, availability of genuine parts, a training and conference room, a telematics centre, and a customer lounge. The outlet is supported by highly trained technical advisors and service engineers to provide seamless sales, service and expert guidance.

L&T Hydrocarbon Business secures ultra mega offshore contract from QatarEnergy LNG

QatarEnergy LNG has awarded an Ultra Mega Offshore Contract for the North Field Production Sustainability Offshore Compression Project (NFPS COMP 4) to Larsen & Toubro (L&T) Hydrocarbon Business (L&T Energy Hydrocarbon – LTEH) marking the largest single contract ever received by L&T. The scope of work encompasses the engineering, procurement, fabrication, installation, and commissioning of two offshore compression complexes, each comprising of large offshore platforms with compression & power generation facilities, living quarters, flare platforms, interconnected bridges, and other associated structures to be located at approximately 80 kms off the northeast coast of Qatar.

John Cockerill and IIT Bombay collaborate on steel decarbonisation, green hydrogen and defense innovation

John Cockerill Group has signed a Memorandum of Understanding (MoU) with Indian Institute of Technology Bombay (IIT Bombay). This strategic collaboration aims to drive innovation in steel decarbonization technology, green hydrogen value chain, and defense products development contributing to the growth of India's infrastructure, national security, and sustainability agenda. The MoU will facilitate joint research initiatives in steel decarbonisation technologies, green hydrogen value chain, and defense products development bringing together IIT Bombay's academic excellence and John Cockerill's cutting-edge engineering expertise. The partnership will focus on the development of new solutions to address the evolving needs of the global steel sector, especially in achieving sustainability and reducing carbon emissions. As a future perspective, this collaboration envisions support to the creation of Centres of Excellence dedicated in the future to steel technology, defense products, and green hydrogen value chain including production, storage, transportation, and usage.



INOX Air Products commissions its first Green Hydrogen Plant for Asahi India

INOX Air Products has successfully commissioned its first-ever Green Hydrogen manufacturing Plant at Asahi India Glass' (AIS) greenfield float glass facility at Soniyana in Chittorgarh, Rajasthan. AIS, India's leading glass manufacturer, have entered into a 20-year offtake agreement with INOXAP for supply of Green Hydrogen, to this facility. The Plant, powered by solar energy, will have a capacity to generate up to 190 Tons of Green Hydrogen per Annum through the electrolysis process. This will be India's first instance of use of Green Hydrogen in the Float Glass manufacturing process, paving the way for sustainable glass production. INOXAP is responsible for the design, engineering, installation, operations and a continuous supply of Green Hydrogen to the AIS facility for a period 20 years. In the first phase, 95 TPA Green Hydrogen will be supplied to AIS. As a part of the agreement, AIS has invested in the solar power plant, which is supplying renewable energy for the generation of Green Hydrogen, which would be further consumed in AIS's float glass manufacturing process.

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HCC-TPL JV to construct Pumped Storage Project at Karjat, Maharashtra

Hindustan Construction Company (HCC) and Tata Projects (TPL) in a 50:50 Joint Venture have been awarded a ₹2,470 crore contract by Tata Power Company for the construction of Bhivpuri Off-Stream Open-Loop Pumped Storage Project (PSP) 1000 MW (2x333 MW + 2x167 MW) located at Karjat, Maharashtra. The scope of work includes Civil and H&M components of the project, ie, Coffor Dam, Intake Structure including gates & screen at the existing upper reservoir of Thokerwadi, Head Race Tunnels, Penstock, Surge Shaft, Pressure Shaft, Powerhouse, Tail Race Tunnel, Lower Intake Structures including gate & screens, a new lower reservoir with GFRD Dam, adits, roads & drains, various BOP foundation and building structures. The scope will also include other appurtenant works required for completion of the project consisting of infrastructure works along with review and interface of electro-mechanical works.



Nitin Gadkari inaugurates Butibori and Hingna facility in Nagpur

GMMCO India, a CK Birla company, has announced the inauguration of its fully operational service and supply hubs at Butibori and Hingna, Nagpur. These integrated facilities feature world-class repair, rebuild, and parts distribution hubs, playing a crucial role in supporting customers across India, with a focus on Maharashtra, Madhya Pradesh, Chhattisgarh, Gujarat, and Goa. The facilities were inaugurated by Nitin Gadkari, Union Minister of Road Transport and Highways of India. Spread across 14 acres, the Butibori and Hingna facilities are strategically positioned to provide advanced service infrastructure, comprehensive component and machine rebuilding capabilities, and a high-efficiency parts warehouse - offering a one-stop solution for customer needs. At the launch of the Butibori facility, Chandrasekhar V, Managing Director, GMMCO India, stated, "This is a proud moment for us. Over the last decade, we have been growing at a steady pace, and this expansion is a testament to our commitment to a customer-first approach and operational efficiency. Our vision is to provide the right service to our customers in the shortest possible time, and the Butibori and Hingna facilities will help us achieve this goal."

Star Cement Meghalaya secures composite license for mining block in Assam

Star Cement, in a regulatory filing, has informed that it has received Star Cement Meghalaya, a Subsidiary of the Company, has been declared as the 'Preferred Bidder' for Composite License of Boro Hundong Limestone Block in e-auctions conducted by the Government of Assam. The aforesaid block is situated in District Dima Hasao (Formerly North Cachar Hills), Assam over an area of 400 hectares with estimated limestone resource of 146.75 million tonnes.



Jupiter Tatravagonka secures land for forged railwheel & axle manufacturing plant in Odisha

Jupiter Tatravagonka Railwheel Factory (JTRF), a subsidiary of Jupiter Wagons, has successfully secured land in Haldiapada, Khordha, Odisha, for its upcoming Railwheel & Axle forging plant. This marks a major milestone in the company's expansion plans, reinforcing Odisha's position as a strategic hub for high-tech industrial manufacturing. Notably, JTRF is the first railway heavy engineering industry in Odisha in the private sector. Jupiter Tatravagonka plans to invest INR 2,500 crore in phases over the next few years to develop this state-of-the-art facility. The plant is expected to produce 100,000 forged wheelsets annually and will cater to both domestic and international markets, with nearly 50% of production earmarked for exports, primarily to Tatravagonka A S, a leading Slovakian rail infrastructure company, and other European firms. This project is being implemented via the "Invest Odisha" program under the umbrella of Invest India. The land parcel has been obtained from the IDCO land bank, with statutory MOEF clearances and a clear, undisputable title. The Khordha industrial zone, just 30 km from the airport, has been specially developed by IDCO to attract top-tier MNC projects.

IndianOil signs MoU with Government of Odisha for mega petrochemical project in Paradip

Indian Oil Corporation has signed a Memorandum of Understanding (MoU) with the Government of Odisha to set up a world-class Petrochemical Complex at Paradip. With an investment of ₹61,077 crore, this marks IndianOil's largest-ever investment at a single location and a transformative step in India's petrochemical and industrial growth. The upcoming complex will house a dual-feed cracker and associated downstream units for the production of wide range of petrochemicals including Phenol, Polypropylene (PP), Isopropyl Alcohol (IPA), High-Density Polyethylene (HDPE), Linear Low-Density Polyethylene (LLDPE), Polyvinyl Chloride (PVC), Phenol, and Butadiene. These products will serve as key raw materials for specialty chemical sectors like pharmaceuticals, agrochemicals, coatings, and adhesives, significantly reducing import dependency and supporting the Aatmanirbhar Bharat and Make in India missions.

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Poonawalla Fincorp launches commercial vehicle loan business

Poonawalla Fincorp (PFL) has expanded its product suite with the launch of its Commercial Vehicle (CV) Secured Loan Business. This new offering aims to bolster the essential logistics and supply chain sectors, by enhancing transportation capabilities for CV operators. The loan covers Small, Light, and Intermediate & Heavy Commercial Vehicles from all major manufacturers, supporting both new and used vehicle purchases. Customers will also benefit from flexible, structured payment and repayment options. As part of this launch, PFL has also introduced a technology solution aligned with its risk-first approach. The solution focuses on reducing the documentation process for customers, enabling faster turnaround time and a seamless onboarding experience. By integrating with various technology partners, the company has developed assessment framework with validation from verified sources. With a strong focus on Bharat's tier 2 and tier 3 markets, PFL plans to initially enter 68 locations across 12 states in the first phase, with further plans to expand to 400 locations across 20 states through a hub-and-spoke model in the next phase. CV loans will be offered through direct-to-customer, dealers, and channel partners. The company has onboarded industry professionals to provide tailored financial solutions and enhance customer experiences.



Gyproc India Inaugurates skill training center for drywall and false ceiling trade at ITI Wada

Saint-Gobain Gyproc India has inaugurated the ITI Wada Skill Training Center, a first-of-its-kind initiative aimed at equipping students with future-ready skills in Drywall and False Ceiling trades. This marks Gyproc India's 10th Skill Training Center and its first collaboration with a Government ITI. Developed in collaboration with the Government Industrial Training Institute (ITI) Wada, this center is set to redefine vocational training by providing structured learning that bridges the gap between academic knowledge and industry requirements. With rapid advancements in construction technology and a rising demand for skilled professionals, the initiative will prepare students for high-growth career opportunities while elevating industry standards. Through theoretical instruction and hands-on training, students will gain proficiency in the latest methodologies, materials, and tools essential for success in the modern interior and construction landscape. By investing in this skill-building initiative, Gyproc India is empowering individuals and contributing to the long-term sustainability and efficiency of the industry.

SDHI signs strategic MoU with GRSE to enhance indigenous commercial shipbuilding capabilities

Swan Defence and Heavy Industries (SDHI) has entered into a strategic Memorandum of Understanding (MoU) with Garden Reach Shipbuilders & Engineers (GRSE). The collaboration is in line with the Government's vision of Atmanirbhar Bharat and reinforces SDHI's commitment to building world-class maritime infrastructure in the country. The partnership aims to jointly pursue opportunities in the construction of commercial vessels and offshore structures, with an eye on catering to both global markets and domestic maritime priorities. The association will allow Swan Defence and Heavy Industries and GRSE to combine their capabilities in design, infrastructure, and project execution to create a robust and scalable model for commercial shipbuilding. This MoU is also expected to facilitate the sharing of facilities, co-development of standard vessel platforms, and coordinated project management strategies to enable faster turnaround and greater cost-efficiency.

UltraTech Cement to acquire Wonder WallCare, a subsidiary of Wonder Cement

The Board of Directors of UltraTech Cement has approved the purchase of 100% equity of Wonder WallCare at an Enterprise Value not exceeding ₹235 crores. The Company has executed a Share Purchase Agreement with the existing shareholders of Wonder WallCare. The deal is expected to close in the next 90 days, subject to applicable regulatory approvals and compliances. This acquisition gives UltraTech, access to a new state-of-the-art 6 lac MT per annum manufacturing plant for wall putty and related products at Rajsamand - Nathdwara, Rajasthan. The plant is situated at the pithead of large high quality raw material reserves, and in close proximity to the Company's existing putty manufacturing facilities in Rajasthan. Constructed in 2022-23, this plant is one of the largest single-location putty manufacturing sites in India, with a capability to ramp up its capacities in future. This acquisition will help the Company expand its putty and Value-Added Products' production capacity, in the highly competitive and fragmented putty manufacturing market in India.



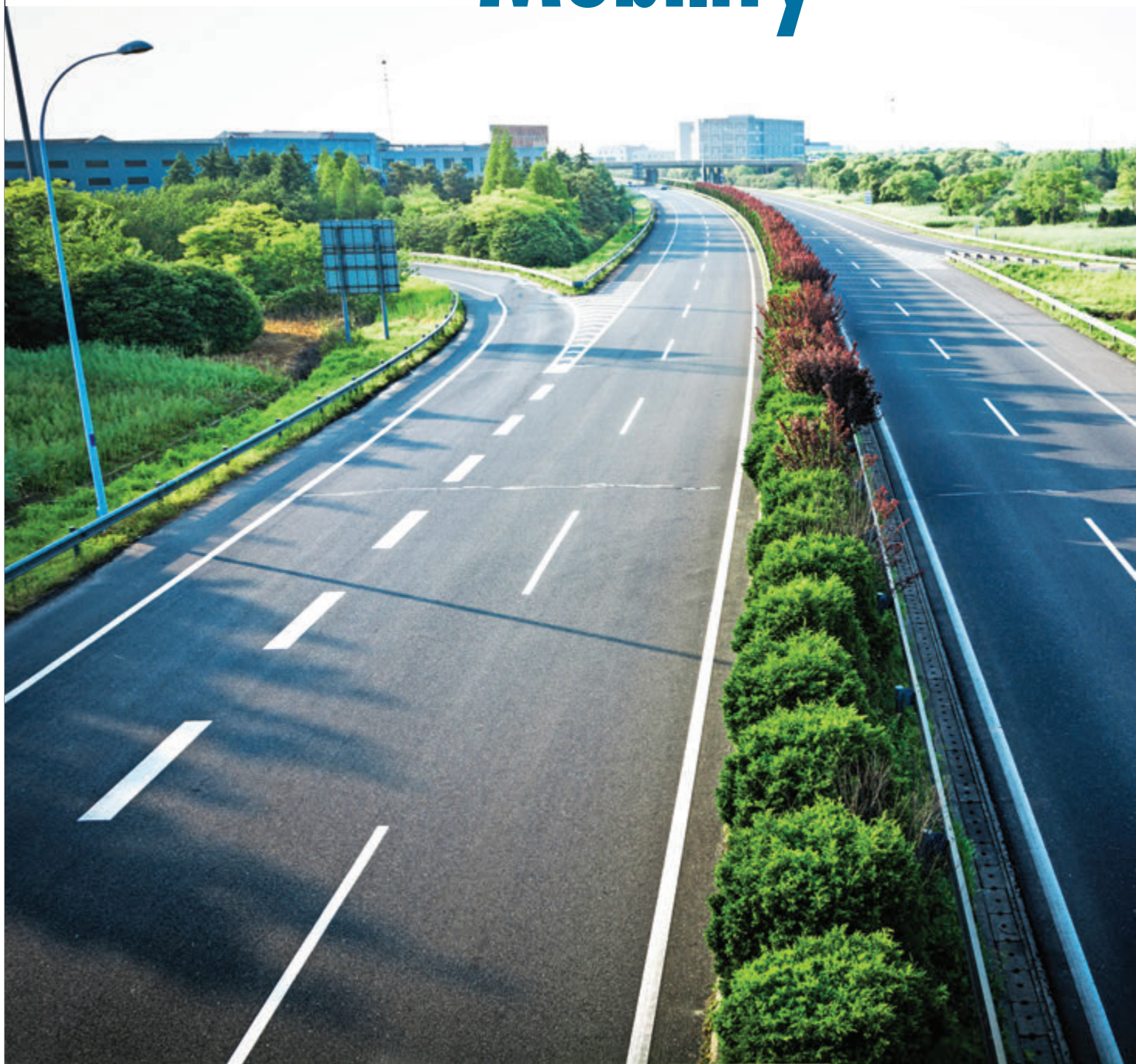
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The backbone of India's economic growth, driving connectivity and trade across regions – the Roads and Highway sector gears its focus towards sustainability and maintains an environmentally conscious approach for a Smart Better Tomorrow. EPC World News Bureau tracks the sector's growth pace...



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With one of the largest road networks in the world, India's roadways serve as the primary mode of transportation for both goods and passengers, facilitating trade, mobility, and connectivity across vast geographical regions. The sector serves as a critical component in driving India's infra momentum, and also adds to the economic development/. The sector nurtures the roots of social integration. India has one of the largest road networks in the world, spanning over 5.8 million km. Of this, around 2 per cent are National Highways, 3 per cent are State Highways and the remaining belongs to district and rural road network. Over 64.5 per cent of all goods in the country are transported through roads, while 90% of the total passenger traffic uses road network to commute.

The government's focus on expanding and upgrading the road infrastructure has resulted in significant progress in recent years, with key projects such as the Bharatmala Pariyojana and the National Highways Development Project (NHDP) aiming to enhance the quality and reach of the road network. Despite these advancements, challenges such as congestion, safety concerns, and maintenance issues remain, necessitating continued investment, innovation, and policy reforms. As India aims for sustainable growth and urbanization, the roads and highways sector stands as a vital area for development, directly influencing the nation's economic progress and the quality of life for its citizens.

Tracking the Growth Indicator

According to the officially available data from the Ministry of Road Transport and Highways, National highway construction in India increased at 9.3% CAGR between FY16-FY24. In FY24 approximately 12,349 km of National Highways have been constructed. Despite pandemic and lockdown, India has constructed 10,457 km of highways in FY22. In FY23, the Ministry of Road Transport and Highways constructed national highways extending 10,331 kms.

Under the Union Budget 2024-25, the Government of India has allocated ₹2.72 lakh crore (US\$ 32.68 billion) to the Ministry of Road Transport and Highways. National Highways Authority of India (NHAI) spent a record-breaking ₹2,07,000 crore (US\$ 24.79 billion) on the construction of national highways in the fiscal year 2023-24. This was the highest capital expenditure ever recorded, representing a 20% increase from last year.

A recent study by the market research group IBEF states that, India's road network has grown 59% to become the second largest in the world in the last ten years. India has nearly 66.71 lakh km of total road network and the National Highways network alone stood at 146,145 km in CY 2023. India had a total of 97,830 km of National Highways in 2014-15 which has expanded to 146,145 km by December 2023. In FY24 approximately 12,300 kilometer of National Highways were constructed.

A total of 202 national highway projects worth ₹79,789 crore (US\$ 9.59 billion) are at the implementation stage in the country and are 6,270 km in length. The Government of India has allocated ₹111 lakh crore (US\$ 1.4 trillion) under the National Infrastructure Pipeline for FY25. The roads sector is likely to account for 18% capital expenditure over FY25. As of July 2024, there were 826 roads projects PPP out of 1883 total projects in India.

Key Highlights

The government has set ambitious targets to augment the national highway network. Plans include upgrading 25,000 km of two-lane highways to four lanes at an estimated cost of 10 trillion, and expanding 16,000 km to six lanes with an investment of 6 trillion. These projects aim to improve traffic flow and reduce road accidents. Programs like Bharatmala Pariyojana and the



development of multimodal logistics parks are designed to enhance connectivity and logistics efficiency. Projects such as the Delhi-Mumbai Expressway and the Ganga Expressway are under development to significantly reduce travel times between major economic hubs.

The Union Minister of State for Road, Transport and Highways has stated that the Government aims to boost corporate investment in roads and shipping sector, along with introducing business-friendly strategies, which will balance profitability with effective project execution. According to the data released by Department for Promotion of Industry and Internal Trade Policy (DPIIT), FDI inflows in In a significant effort to enhance infrastructure, the Union government approved eight national high-speed corridor projects, involving the construction of 936 kilometers of highways at a total cost of ₹50,655 crore (US\$ 6.09 billion).

"Private investments in the highway sector would likely rise from around ₹20,000 crore (US\$ 2.40 billion) a year now to nearly ₹1 trillion (US\$ 12 billion) in the next 6-7 years, said "Amit Kumar Ghosh, Additional Secretary, Ministry of Road Transport and Highways in a recent media statement.

In a significant effort to enhance infrastructure, the Union government approved eight national high-speed corridor projects, involving the construction of 936 kilometers of highways at a total cost of ₹50,655 crore (US\$ 6.09 billion).

Investment in road connectivity projects including Patna-Purnea expressway, Buxar-Bhagalpur highway and an additional two-lane bridge over the Ganga in Buxar for ₹26,000 crore (US\$ 3.11 billion) along with a new 2,400 MW power plant at Pirpainti costing ₹21,400 crore (US\$ 2.56 billion).



In March 2024, Prime Minister Narendra Modi inaugurated and laid the foundation stone for 112 national highway projects across various states, with a total worth of approximately US\$ 12.04 billion (₹1 lakh crore).

In the fiscal year 2023-24 (up to July), a budget of US\$ 34.04 million (₹276 crore) has been designated for the Pradhan Mantri Gram Sadak Yojana (PMGSY).

The government has enlisted a consultant to advise on adopting new technologies like GNSS for barrier-free tolling. GNSS-based Electronic Toll Collection will be piloted alongside FAS Tag on select National Highways.

Bharat New Car Assessment Program launched for safety rating of passenger cars and empowering consumers to take informed decisions.

In August 2023, the National Highways Authority of India (NHAI) made a big step towards improving the highway user experience, with the introduction of 'Rajmargyatra,' a citizen-centric unified mobile application. This user-friendly app provides travellers with in-depth knowledge of Indian National Highways as well as an effective procedure for filing complaints.

In July 2023, Prime Minister Shri Narendra Modi dedicated a six-lane greenfield motorway part of the Amritsar-Jamnagar Economic Corridor and the first phase of the Inter-State Transmission Line for Green Energy Corridor.

Increasing the pace of development of Uttar Pradesh, the Union Minister for Road, Transport and Highways, Shri Nitin Gadkari inaugurated two National Highway projects with an investment of more than ₹3,300 crore (US\$ 396.8 million) in Lucknow on July 17, 2023.

In June 2023, National Highways Authority of

India (NHAI) introduced a 'Knowledge Sharing' platform for sharing of knowledge and innovative best practices. This effort, which is hosted on the NHAI website, will assist the authority in working with specialists and citizens who want to exchange knowledge and views about subjects including road design, construction, road safety, environmental sustainability, and related sectors. The platform will promote the exchange of best practices from all around the world and work to strengthen the nation's national highway system.

NHAI initiated its third and fourth rounds of Infrastructure Investment Trusts (InvITs) to raise over ₹20,000 crore (US\$ 2.41 billion) in FY24. As of December 19, 2023, a total of 749,639 km of road length has been constructed under PMGSY.

Another noteworthy initiative, the Gati Shakti program has consolidated a list of 81 high impact projects, out of which road infrastructure projects were the top priority. The major highway projects include the Delhi-Mumbai expressway (1,350 km), Amritsar-Jamnagar expressway (1,257 km) and Saharanpur-Dehradun expressway (210 km). The main aim of this program is a faster approval process which can be done through the Gati shakti portal and digitized the approval process completely. The Indian government launched Gati Shakti-National Master Plan, aims to lead a holistic and integrated development of infrastructure generating immense employment opportunities in the country.

Trend Driven

India's roads and highways sector is experiencing a technological transformation aimed at enhancing infrastructure quality, sustainability, and user experience. To promote environmental sustainability, innovative materials are being incorporated into road construction. The use of green cement reduces carbon emissions during production while maintaining durability. Additionally, integrating recycled aggregates, waste plastic, and other alternative materials into road surfaces enhances durability and reduces environmental impact.

When Artificial Intelligence is the buzz word in molding the development phase of economies worldwide, the roads and highway sector has also whole heartedly welcomed the inflow of new-gen technologies. A considerable push and inclination is seen towards enhancing the road safety, monitoring

and controlling features. The development of smart highways equipped with sensors, cameras, and communication technologies enables real-time monitoring of traffic flow, weather conditions, and road status. This data-driven approach enhances traffic management, improves safety, and provides drivers with up-to-date information. The state of Uttar Pradesh sets an example through the development of 'Smart Roads' in Ujjain, wherein such technologies are integrated to optimize traffic management and enhance safety.

The adoption of digital technologies, including Building Information Modeling (BIM), drone surveying, and LiDAR (Light Detection and Ranging), has streamlined road design and construction processes. To support the growing adoption of electric vehicles (EVs), India is exploring the development of e-highways. These are highways equipped with charging infrastructure and technologies to facilitate the seamless movement of EVs over long distances. The initiative aims to reduce carbon emissions and promote sustainable transportation.

Going Green

A latest development that is increasingly gaining momentum are the Green Expressways. Aimed towards ensuring sustainability and quality infrastructure growth, the Green wave is steadily grabbing spotlight. Part of an ambitious effort to improve the nation's infrastructure while also focusing on sustainability and environmental conservation. These expressways aim to reduce carbon emissions, minimize traffic congestion, and promote eco-friendly development. The idea is to integrate modern transportation systems with nature preservation, renewable energy, and eco-friendly practices.

Several NHAI expressway projects are now focusing on making highways more eco-friendly, incorporating green design elements like:

Plantation along the roadsides: To help absorb CO₂ and reduce the heat island effect.

Wildlife corridors: To reduce animal deaths due to highway accidents and to maintain ecological balance.

Waste-to-energy plants: To process waste generated along the expressway and convert it into renewable energy.

Notable among these developments are the Eastern Peripheral Expressway (EPE) – Delhi and

the Mumbai–Delhi Green Expressway. When the EPE – Delhi incorporates dedicated green spaces, tree plantations, and use of eco-friendly construction materials, rainwater harvesting systems and solar-powered streetlights; the latter has dedicated green corridors along the road, promoting biodiversity, with solar panels planned along sections of the expressway for clean energy production. The expressways design incorporates energy-efficient lighting and environmentally-friendly technologies.

Though still in its early stages of development, the trend toward sustainable infrastructure is seeing a steady and proactive growth. According to market experts, "The future of expressway design in India is likely to be a mix of high-tech solutions, renewable energy integration, and eco-conscious construction. These green corridors are vital in helping India meet its climate goals and reduce air pollution while also boosting the nation's economic growth."

The roads and highways sector in India is undergoing a transformative phase, marked by rapid expansion, modernization, and a clear shift towards sustainability. With a growing population, rising urbanization, and increasing demand for efficient transportation, India's road infrastructure is crucial to the country's economic progress. From the development of new expressways and national highways to the incorporation of green technologies, smart road systems, and eco-friendly initiatives, the sector is embracing the future of mobility.

While challenges such as land acquisition, environmental concerns, and funding remain, the Indian government's continued push for policy reforms, increased investment, and innovative solutions has paved the way for a more connected, efficient, and sustainable transportation network. The focus on green expressways, electric vehicle infrastructure, and the adoption of sustainable construction practices reflects India's commitment to reducing its carbon footprint and contributing to global climate goals.

As the sector evolves, it will not only play a critical role in improving connectivity and boosting economic growth but also in ensuring that India's road infrastructure is both resilient and environmentally responsible. The journey towards building smarter, greener roads is just beginning, and the coming years hold great promise for India's transportation future.



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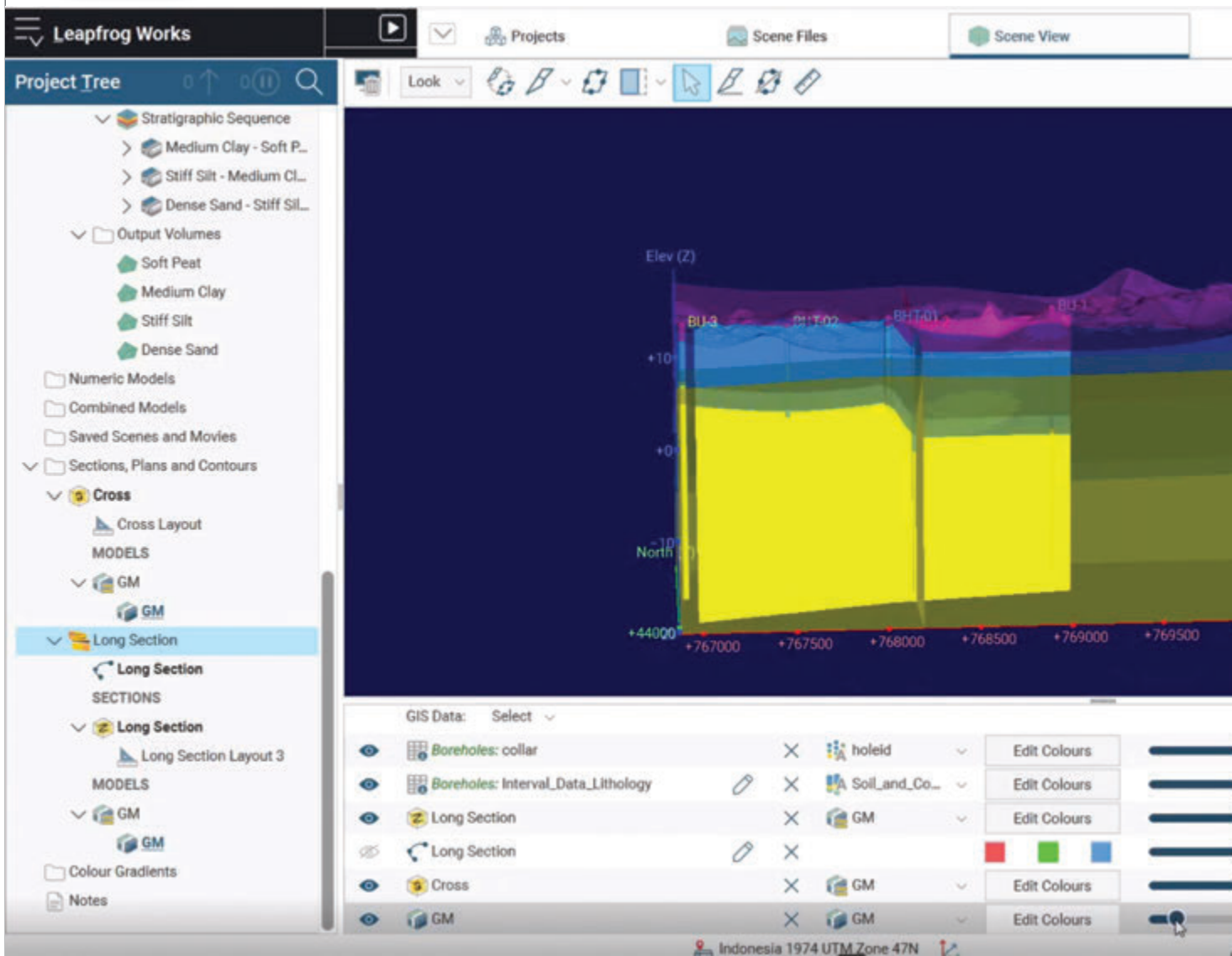
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Leapfrog Works, MicroStation, OpenBridge, and OpenRoads played a pivotal role in meeting all engineering challenges.

PT Hutama Karya adopts advanced digital technology on the USD 3.5 billion Trans-Sumatra Toll Road Project

Bentley and Seequent software helped save 120 days and avoids USD 180 million in losses

Meeting all engineering challenges

The Trans-Sumatra Toll Road is an immense expressway that will stretch the length of Sumatra, from its northern tip to its southernmost point. It has more than 25 road sections in all, totaling 2,800 kilometers. It is considered crucial to the Indonesian island's economic growth and regional integration, and will cost around USD 3.5 billion. After nearly a decade of work, the entire toll road will be completed in 2030.

Unsurprisingly, a highway that spans an entire country has some unique engineering challenges. Not least of these is navigating a constantly shifting and diverse terrain that throws up a wide range of

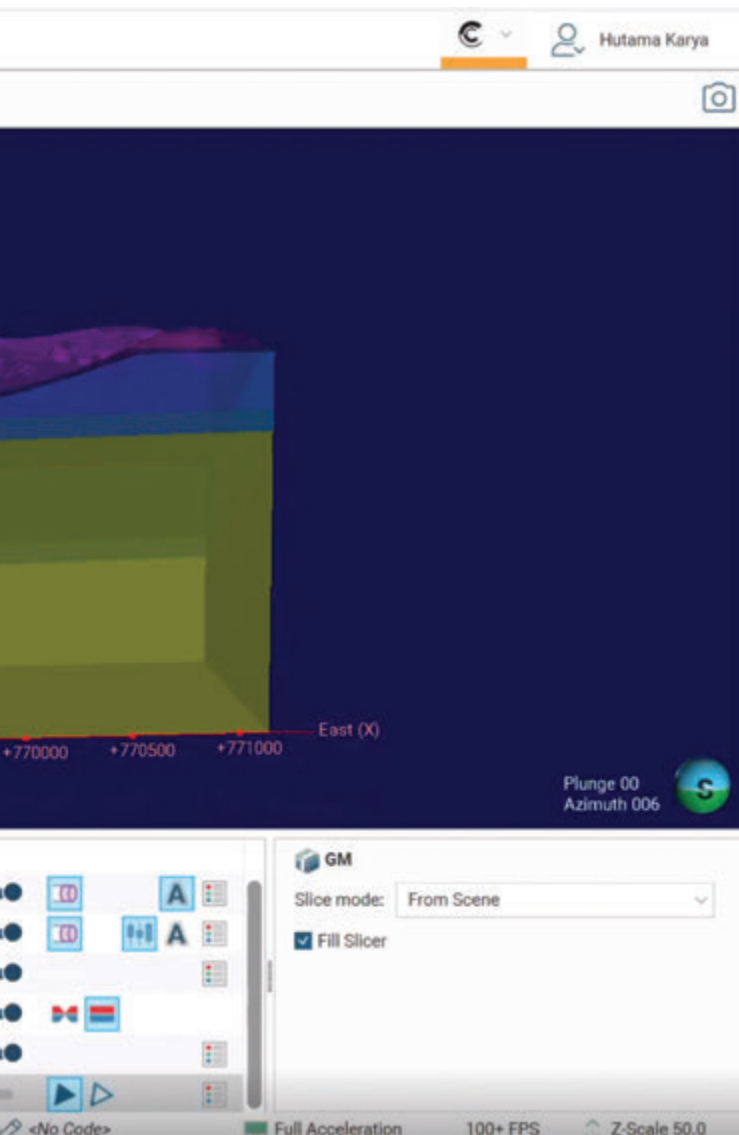


Image courtesy of PT Hutama Karya (Persero).

demanding soil conditions. And that means a huge amount of data to process and integrate.

Leading Indonesian construction, toll road developer, and operator firm PT Hutama Karya, was given the task of managing the strategic planning, design, and construction management, with specific emphasis on the geotechnical data management that would underpin efficient, durable, and cost-effective construction.

Seeking advanced digital technology

At first, Hutama Karya used traditional data management methods to tackle the scheme. However, the team struggled to cope with the sheer scale of the project.

“We explored various approaches to address these issues,” said Deska Adi Pratama, BIM officer on the project for Hutama Karya, “but managing large volumes of geotechnical data and integrating them into design decisions proved too challenging without advanced digital tools.”

Project Summary

Organization

PT Hutama Karya (Persero)

Solution

Subsurface Modeling and Analysis

Location

Pekanbaru, Riau, Indonesia

Project Objectives

- To navigate constantly shifting and diverse terrain with a wide range of demanding soil conditions.
- To process and integrate data for a 2,800-kilometer roadway.

Project Playbook

iTwin Capture, Leapfrog, OpenBridge, OpenRoads, PLAXIS

Fast Facts

- The Trans-Sumatra Toll Road is an immense expressway that will stretch the length of Sumatra, from its northern tip to its southernmost point.
- Leapfrog Works, MicroStation, OpenBridge, and OpenRoads played a pivotal role in meeting the highway’s engineering challenges.
- The new roads will encourage regional integration and support social development and community communication throughout the country.

ROI

- Leveraging Bentley and Seequent applications led to a 15% increase in productivity, translating to 6,000 work hours saved over the project duration.
- The enhanced productivity reduced project timelines by 120 days, compared to conventional methods.
- The strategic implementation of cutting-edge technology helped Hutama Karya avoid potential losses of USD 180 million.

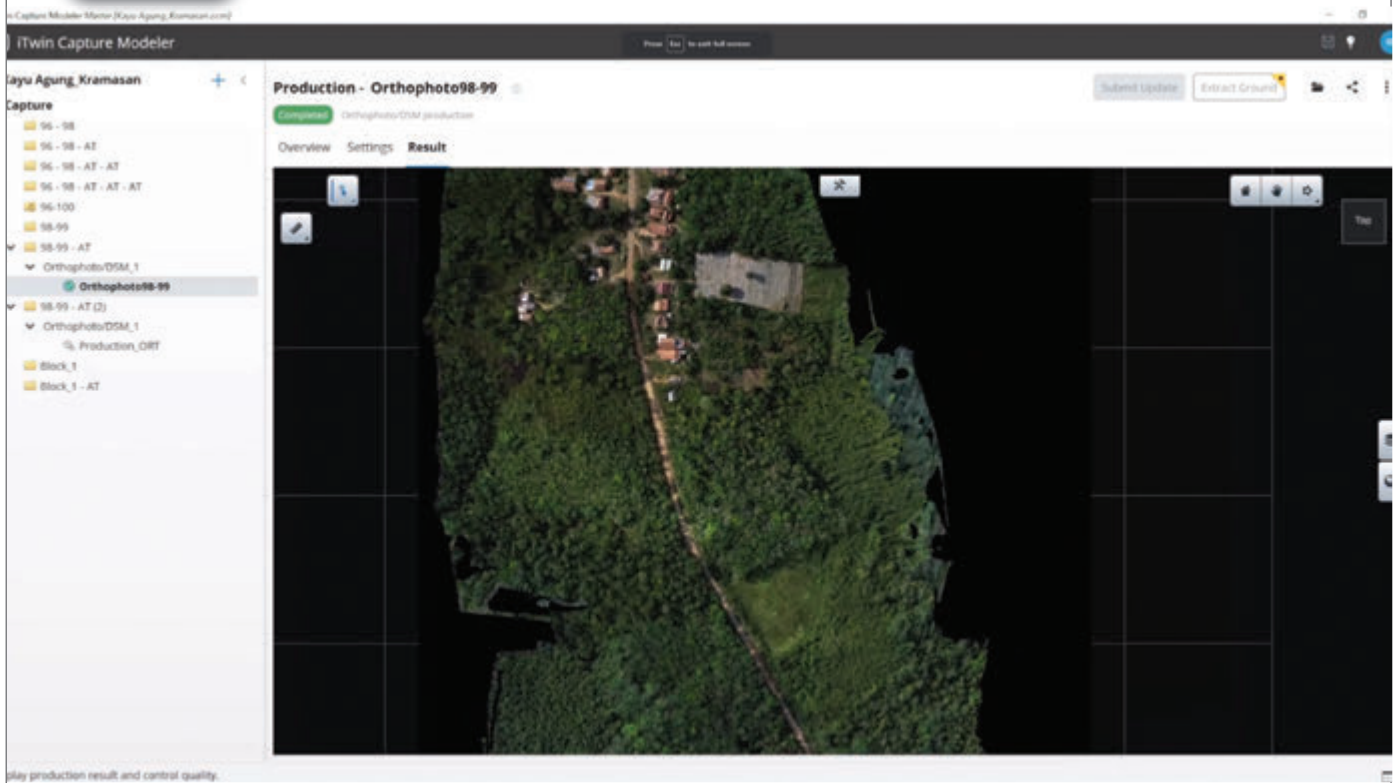


Image courtesy of PT Hutama Karya (Persero).

Leveraging Bentley and Seequent applications led to a 15% increase in productivity, translating to 6,000 work hours saved over the project duration.

By utilizing digitally synchronized tools - and ensuring a single source of truth - the entire geotechnical process became more structured and integrated

Deska Adi Pratama,
BIM Officer,
PT Hutama Karya (Persero)

After several trials, the team realized that they needed digital applications to enhance their project's efficiency.

Delivering ahead of deadline and with complex terrain

Already familiar with Bentley and Seequent applications, Hutama Karya chose them to deliver this complex project. "That decision was driven by the need to streamline data management, enable 3D modeling and support collaborative design processes," explained Pratama. The Bentley ecosystem - including Leapfrog Works, MicroStation, OpenBridge, and OpenRoads -

played a "pivotal role" in meeting the highway's engineering challenges. "Leapfrog allowed us to create accurate 3D ground models, optimising road alignments and earthworks based on detailed geological data. MicroStation, OpenBridge, and OpenRoads facilitated a model-based approach to road and bridge design, enabling rapid iteration and adaptation to changing project requirements."

The addition of PLAXIS to the solution set, in tandem with Leapfrog, was also key in providing robust geotechnical analysis of the subsurface. Across its vast and varied 2,800 kilometers, the highway exhibited an ever-changing set of soil conditions, complicating the process of achieving sure and consistent construction. The combination of Leapfrog and PLAXIS greatly simplified the compilation of soil stratigraphy, and supported the implementation of a soil improvement method. This helped avoid potential losses of around USD 185 million that could have arisen from technical failures in the construction.

To tackle the challenge of mapping difficult terrains, the highway team adopted "beyond visual line of sight" technology that used drones to scan the topography, especially in the most inhospitable areas. MicroStation and iTwin Capture processed

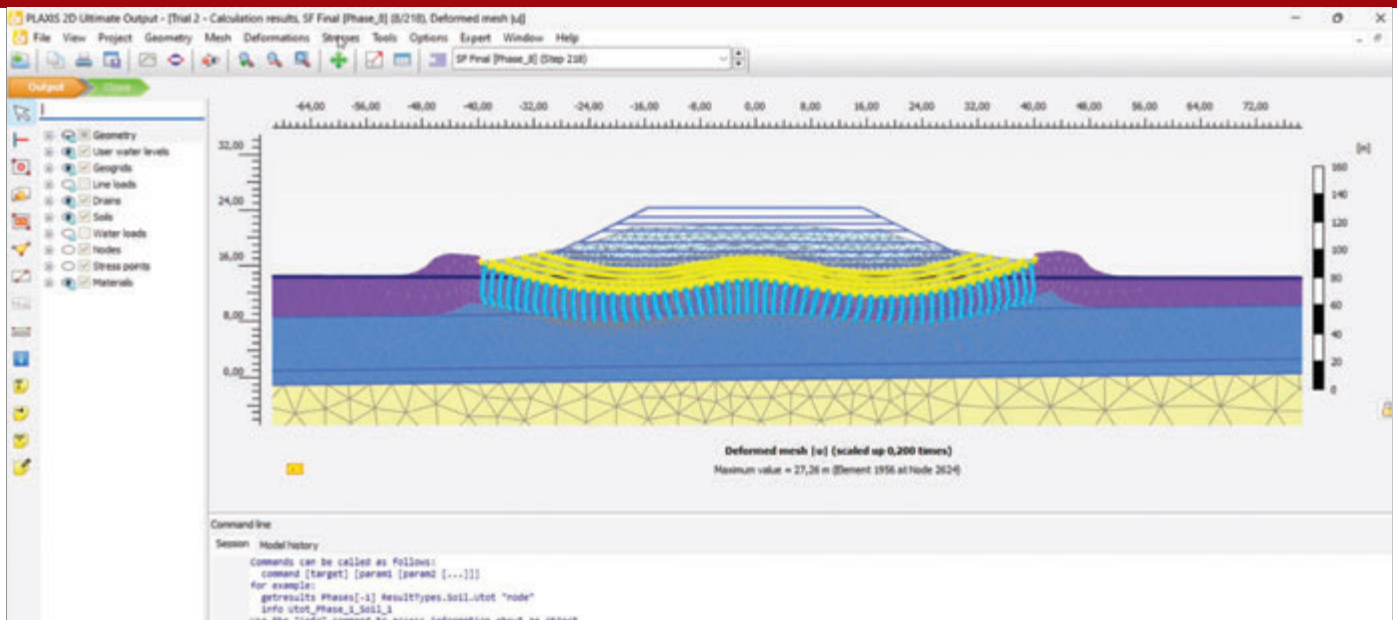


Image courtesy of PT Hutama Karya (Persero).

The strategic implementation of cutting-edge technology helped Hutama Karya avoid potential losses of USD 180 million.

lidar point cloud data and orthophotos, respectively, providing precise digital terrain models for accurate planning and design. “By utilizing these digitally synchronized tools - and ensuring a single source of truth - the entire geotechnical process became more structured and integrated. [...] We could leverage lean construction principles to minimize reworks and reduce waiting times due to efficient data sharing,” said Pratama.

Turning geotechnical data into a major infrastructure success

The Trans-Sumatra Toll Road will have far-reaching benefits for the island and its population. Many of its 60 million people still live in small towns, effectively off the grid. As well as stimulating economic growth, the new roads will also encourage regional integration and support social development and community communication throughout the country. By reducing travel time and congestion, they will promote safer and more efficient mobility, extra trade, and tourism, as well as improve access to

essential services.

The strategic implementation of cutting-edge technology has proven transformative for Hutama Karya, helping the construction giant avert potential losses of USD 180 million on the ambitious Trans-Sumatra Toll Road project. “Leveraging Bentley applications led to a 15% increase in productivity, translating to 6,000 work hours saved over the project duration. [...] This enhanced productivity ultimately reduced project timelines by 120 days, compared to conventional methods,” said Pratama.

The adoption of Seequent and Bentley applications was instrumental in delivering the Trans-Sumatra Toll Road efficiently and cost effectively. Being able to bring together the highway’s varied multidiscipline teams for real-time sharing of ideas and data sped up decision-making and kept everyone better informed. “They empowered us to navigate complex engineering scenarios, optimize designs, and address the project’s unique challenges through advanced 3D modelling and collaborative design capabilities,” said Pratama.

EPWorld



Pat McLarin has over 20 years of experience as a product manager in the research and development of geospatial hardware and software solutions for the GIS, geotechnical, and construction user communities. In his six years at Seequent, his focus has been on addressing the needs of geoscientists and geotechnical engineers in understanding and communicating subsurface conditions, and to enable collaborative decision making on civil and environmental projects. Pat currently leads Seequent’s strategy for civil infrastructure and participates in open standard development to raise the profile of the geotechnical disciplines in BIM and digital twins.

Solar, Wind, and Beyond: India's Quest for a Sustainable Legacy

India is poised for a renewable energy revolution, fuelled by strong government initiatives, private investments, and cutting-edge technology. As it targets 500 GW of renewable capacity by 2030, the country is leading the global green energy movement with innovations in solar, wind, and storage. EPC World explores the forces propelling India's renewable ascent, the challenges it faces, and the visionary projects that are paving the way for a sustainable future.



India stands at the cusp of a renewable energy revolution, propelled by an unprecedented surge in deployment and fuelled by a potent blend of public resolve and private ingenuity. In 2023 alone, global renewable investments soared to \$358 billion, with India carving out a significant share—estimated at \$10-12 billion—through a dynamic mix of government initiatives and private capital. This is no fleeting trend; it's a transformative wave reshaping the nation's energy future as it races toward an ambitious 500 GW renewable capacity by 2030.

But what drives this green momentum? How is India tackling the challenges of intermittent renewable power into an aging grid, and what cutting-edge advancements are paving the way for sustainable growth? Numerous forces are propelling India's renewable ascent—from robust policy measures and substantial investments to groundbreaking technologies like energy storage and smart grids. With notable projects lighting the path and an urgent need to secure a sustainable future, India is not just adapting to the global energy shift—it's leading it.

With a spotlight on policy measures, investment trends, notable projects, and the urgent need for renewables, India is positioning itself as a global leader in the green energy revolution.

Investment Influx: Public and Private Powerhouses

India's renewable energy sector is riding a wave of financial momentum. In 2023, global renewable energy investments hit \$358 billion, and India emerged as a key player in this arena. While precise breakdowns of India's share vary, estimates suggest the country attracted around \$10-12 billion in renewable investments that year—a figure that reflects a robust mix of public and private contributions. Historically, public sector funding, driven by government schemes and subsidies, has laid the groundwork, but private investments have surged in recent years, accounting for nearly 70% of the total in 2023, up from roughly 60% in 2020. This shift underscores growing confidence among private players—domestic firms like Tata Power and Adani Green, alongside international investors—in India's green potential.

Government initiatives like the PM-KUSUM scheme, which promotes solar pumps for farmers, and the Production Linked Incentive (PLI) scheme for solar manufacturing have catalyzed this growth. Meanwhile, private capital is pouring into solar, wind, and hybrid projects, buoyed by India's favorable policies and abundant natural resources. Compared to a decade ago, when investments hovered around \$4-5 billion annually, the current trajectory signals a seismic leap—one that's poised to accelerate as the 2030 deadline looms.

Energy Storage: The Backbone of Renewable Integration

Crucially, the effective integration of renewable sources hinges on robust energy storage. Solar and wind power, while abundant, are intermittent—shining when the sun is up or blowing when the wind permits. Energy Storage Systems (ESS) are the linchpin to smoothing out these fluctuations, ensuring a steady supply to the grid. India is making strides in this domain, with advancements in battery storage infrastructure taking center stage. Lithium-ion batteries dominate the market, but pilot projects exploring alternatives like flow batteries and green hydrogen storage are gaining traction.

The government has recognized this need, launching the National Energy Storage Mission to foster innovation and scale deployment. Recent tenders for standalone battery storage projects—such as the 1000 MWh capacity planned in 2024—signal a proactive approach. Private players are also stepping up, with companies like Reliance Industries investing in battery manufacturing to bolster domestic supply chains. These efforts aim to reduce reliance on imports and position India as a self-sufficient hub for energy storage technology.



Battery Storage Boom: Targets and Investments

The global battery storage market is projected to soar past \$190 billion by 2030, and India is keen to claim a significant slice of this pie. Domestically, the target is to deploy 50 GWh of battery storage capacity by 2030, aligning with the 500 GW renewable goal. To achieve this, investments are ramping up—both public and private. In 2024 alone, over \$2 billion was earmarked for battery storage projects, with the government offering viability gap funding and tax incentives to sweeten the deal for investors.

Initiatives like the PLI scheme for Advanced

Chemistry Cell (ACC) battery manufacturing have drawn heavyweights like Ola Electric and Exide Industries into the fray, with a projected \$5 billion in investments over the next five years. These efforts not only bolster grid reliability but also pave the way for electric mobility—a dual-purpose strategy that amplifies India's green ambitions. Compared to global leaders like China, which dominates battery production, India's focus on domestic manufacturing aims to close the gap, leveraging its vast lithium reserves and skilled workforce.

Navigating the Roadblocks

Despite the momentum, India's renewable energy sector faces persistent challenges. Grid integration and intermittency remain Achilles' heels, as the country's aging infrastructure struggles to accommodate the influx of variable renewable power. Statistics paint a sobering picture: in 2024, renewable energy curtailment—where excess power is wasted due to grid limitations—reached 3-5% in key states like Tamil Nadu and Rajasthan, up from 2% in 2022. This highlights the pressing need for grid modernization.

Beyond infrastructure, land acquisition woes and regulatory bottlenecks slow project timelines. Solar and wind farms require vast tracts of land, often sparking conflicts with local communities or delaying approvals. Financing, too, poses hurdles—while private investment is rising, high upfront costs and perceived risks deter smaller players. Addressing these obstacles is critical to sustaining India's renewable momentum and ensuring equitable access to clean energy.

Policy Initiatives: Accelerating Adoption

In response, the government is rolling out impactful policy changes to turbocharge renewable adoption. The Green Energy Corridor project, now in its second phase, is upgrading transmission lines to integrate 50 GW of renewable capacity by 2027. Subsidies under schemes like PM-KUSUM have spurred solar adoption in rural areas, while the waiver of interstate transmission charges for renewable power has slashed costs for developers.

On the pricing front, India's feed-in tariffs—fixed rates paid to renewable producers—remain competitive, though they lag behind Europe's more generous models. Carbon pricing, still in nascent stages, is gaining traction with pilot projects in states like Gujarat, aiming to penalize emissions and

India's Renewable Energy Boom: 25 GW Added in FY 2024-25, Up 35% from Last Year

In a landmark achievement for India's renewable energy sector, the Ministry of New and Renewable Energy (MNRE) reported an extraordinary addition of 25 GW of renewable capacity in the financial year 2024-25. Guided by the vision of Prime Minister Shri Narendra Modi, this milestone reflects a staggering 35% jump from the 18.57 GW installed in the previous year, underscoring the nation's relentless pursuit of a sustainable energy future.

Solar Power Fuels the Renewable Charge

The solar sector emerged as the powerhouse behind this growth, with capacity additions climbing from 15 GW in FY24 to an impressive 21 GW in FY25—a robust 38% increase. This surge propelled India past a historic benchmark, exceeding 100 GW of installed solar capacity in 2025, cementing its status as a global leader in solar energy adoption.

Domestic Solar Manufacturing Soars to New Peaks

Advancing the goal of Atmanirbharta (self-reliance), India's solar manufacturing capabilities scaled unprecedented heights. Solar module production capacity nearly doubled, rising from 38 GW in March 2024 to 74 GW by March 2025, while solar PV cell manufacturing capacity tripled from 9 GW to 25 GW. A significant breakthrough came with the launch of the nation's first 2 GW ingot-wafer manufacturing facility in FY25. Bolstered by the Production Linked Incentive (PLI) Scheme for High-Efficiency Solar PV Modules, investments totaling ₹41,000 crore have spurred this growth, creating direct jobs for approximately 11,650 individuals.

PM Surya Ghar Muft Bijli Yojana Transforms Lives

The PM Surya Ghar Muft Bijli Yojana made remarkable strides, reaching over 11.01 lakh households by March 31, 2025. With ₹5,437.20 crore disbursed as Central Financial Assistance to 6.98 lakh beneficiaries, the scheme has significantly accelerated the uptake of rooftop solar, empowering families with clean, affordable energy.

Green Hydrogen Sector Accelerates

India's Green Hydrogen ambitions gained substantial traction in FY25. Incentives worth ₹2,220 crore were granted to support 1,500 MW per annum of electrolyser manufacturing capacity, while ₹2,239 crore was allocated to enable production of 4,50,000 tons-per-annum (TPA) of Green Hydrogen. Under the National Green Hydrogen Mission, seven pilot projects received ₹454 crore to decarbonize the steel industry, and five transport-sector initiatives, backed by ₹208 crore, will deploy 37 hydrogen-fuelled vehicles alongside nine hydrogen refuelling stations.

PM-KUSUM Scheme Breaks New Ground

The PM KUSUM Scheme achieved record-breaking progress in FY25. Under Component B, installations of solar pumps soared to 4.4 lakh units—a 4.2-fold increase from the previous year. Component C saw 2.6 lakh pumps solarized, a staggering 25-fold rise over FY24. The scheme has now surpassed 10 lakh solar pumps installed or solarized nationwide. Financial outlays for PM-KUSUM skyrocketed to ₹2,680 crore, reflecting a 268% increase from the prior year and highlighting its pivotal role in rural energy transformation.

IREDA Boosts Clean Energy Financing

The Indian Renewable Energy Development Agency (IREDA) solidified its position as a key enabler of clean energy projects. In FY25, IREDA's loan sanctions grew by 27% to ₹47,453 crore, while disbursements increased by 20% to ₹30,168 crore, channeling vital funds into the renewable sector's expansion.

A Vision for Global Leadership

Union Minister of New and Renewable Energy, Shri Prahlad Joshi, hailed this progress, stating, "India may already be, or is on the verge of becoming, the world's third-largest holder of renewable energy capacity. This achievement reflects Prime Minister Modi's unwavering commitment to a sustainable, self-reliant energy ecosystem." With these milestones, India is not just meeting targets—it's redefining the global renewable energy landscape.

incentivize green energy. Compared to nations like Germany, where carbon pricing is more entrenched, India's approach is pragmatic—balancing economic growth with sustainability. These policies, coupled with ambitious targets, signal a clear intent to lead the global renewable charge.

Technology Advancements: Pioneering the Future

Emerging technologies are the beating heart of India's renewable energy transformation.

Beyond smart grids and IoT, innovations like floating solar panels, offshore wind farms, and green hydrogen are pushing the boundaries of what's possible. Floating solar, for instance, addresses land scarcity by harnessing water bodies—projects like the 600 MW installation on the Omkareshwar Dam in Madhya Pradesh showcase this ingenuity. These systems not only generate power but also reduce water evaporation, a dual benefit in water-stressed regions.

Offshore wind is another frontier. With a

coastline stretching over 7,500 km, India has untapped potential—estimated at 70 GW—off Gujarat and Tamil Nadu. The government's 2024 offshore wind policy, aiming for 1 GW by 2030, has sparked interest from global players like Ørsted. Meanwhile, green hydrogen—produced using renewable energy—is emerging as a game-changer. The National Hydrogen Mission targets 5 million metric tonnes of annual production by 2030, with pilot plants already operational in Gujarat.

Artificial Intelligence (AI) is also optimizing renewable operations. AI-driven predictive maintenance in wind farms, for example, boosts turbine efficiency by up to 20%, while solar forecasting tools enhance grid planning. These advancements collectively amplify India's renewable capacity, ensuring reliability and scalability in an increasingly energy-hungry nation.



Notable Projects

India's renewable ambitions shine through landmark projects. The Bhadla Solar Park in Rajasthan, one of the world's largest, spans 14,000 acres and boasts a 2,245 MW capacity—powering millions of homes with clean energy. Adani Green's hybrid project in Khavda, Gujarat, aims to deliver 30 GW of solar-wind power by 2030, integrating storage for round-the-clock supply. On the wind front, Tamil Nadu's Muppandal Wind Farm, with over 1,500 MW, remains a testament to the state's renewable legacy.

Smaller, innovative ventures also stand out. The Cochin International Airport, fully solar-powered since 2015, generates 40 MW—proof that renewables can thrive beyond utility-scale. Similarly, NTPC's 100 MW floating solar project on the Ramagundam reservoir in Telangana highlights how technology can overcome land constraints. These projects,

blending scale with ingenuity, are blueprints for India's renewable future.

The Need for Renewables: A Future Imperative

Why does India need renewables now more than ever? The answer lies in its dual challenge: meeting soaring energy demand while combating climate change. With a population exceeding 1.4 billion and an economy projected to grow at 6-7% annually, energy consumption is skyrocketing—expected to double by 2040. Coal still dominates, contributing 70% of power generation and making India the world's second-largest emitter of greenhouse gases. Renewables offer a lifeline, slashing emissions and aligning with the Paris Agreement's 1.5°C goal.

Air pollution, a public health crisis claiming over 1.6 million lives yearly, further underscores the urgency. Shifting to clean energy can curb smog in cities like Delhi, where particulate matter levels routinely exceed safe limits. Energy security is another driver—reducing reliance on imported fossil fuels strengthens India's economic resilience. Finally, renewables democratize power, bringing electricity to remote villages via off-grid solar, uplifting millions from energy poverty. The future demands renewables not just as an option, but as a necessity.

Smart Grids and IoT: The Future of Energy Management

Smart grids and IoT remain pivotal. Pilot projects in Maharashtra and Karnataka have cut transmission losses by 15%, while the National Smart Grid Mission's 100 million smart meter target by 2027 empowers consumers and utilities alike. Tata Power's IoT-driven microgrids in rural Bihar, integrating solar with real-time monitoring, exemplify localized innovation. These technologies tackle intermittency, enhance efficiency, and bridge the urban-rural energy divide.

India's renewable energy landscape is a tapestry of ambition, innovation, and resilience. Fueled by policy, investment, and technology—from floating solar to green hydrogen—the nation is charging toward its 500 GW target. Notable projects like Bhadla and Khavda light the way, while the pressing need to combat climate change and power a growing economy fuels the drive. Challenges persist, but solutions are taking root. As the world watches, India's green revolution isn't just a promise—it's a paradigm shift.

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Consistency in policies would help in more stability



We will be showcasing our TOPCon range of Solar modules designed for higher efficiency with long durability and high reliability at RenewX Expo 2025, says **Chirag Nakrani** Founder & Managing Director, Rayzon Solar

How can policies be developed to encourage greater private sector participation and financing in the solar energy space?

Policies driven by Government of India (GOI) in the last decade have been hallmarks of change that pushed the deployment of Solar energy on a fast-track basis and India crossed the milestone of installing 100 GW cumulative capacity. To push further deployment and enhance private sector participation now we need to focus more on making regulatory approvals easier, consistency and uniformity of policies across all states, and making low-cost funding available with lesser hassles. Consistency in policies would help in more stability in the solar market enhancing the confidence of the private sector for Investments.

What should India's roadmap look like for developing a self-reliant solar manufacturing value chain over the next 5-10 years?

Policies related to converting the Indian Solar market to self-reliant have started showing their fruits. Efforts started a few years back with a push from GoI for localisation of

the value chain and we have seen increasing capacities installed for making solar modules and now even solar cells in India. Production-linked Incentives (PLI) schemes to promote were the game changer and we expect to see a deepening of our manufacturing presence in the entire value chain of Solar modules going down to polysilicon. Going beyond PLI schemes what we would need additionally would be building robust infrastructure, a pool of skilled workforce, and strategic collaborations between the research institutes and private sectors to fast-track innovation.

How can India accelerate the adoption of newer and more efficient panel technologies?

Indian solar market is a big basket with customers from diverse segments and different affordability brackets. With the global shift happening in technology from Mono PERC to next-generation technology TOPCon, the Indian market has also started migrating towards higher efficiency solar modules. We believe that by the end of this calendar year, TOPCon will gain a major market share in India too. However, the bone of contention would be how good quality and a reliable



product gets delivered in the market. As stabilization of the solar module manufacturing process, TOPCon is tough and needs high-quality BOM, knowledge of the process, and rigor while making it.

What are the opportunities and roadmap to strengthen India's domestic solar manufacturing base?

With policy initiatives already taken by GoI, we have seen a spurt of activity especially in Solar Modules manufacturing capacity and we are almost independent in this product category with no imports required with close to 60 GW listed capacity in ALMM. We expect similar traction on other components in backward integration like solar cells, wafers, Ingots, and Polysilicon which gives immense opportunity for entrepreneurs to set up and scale businesses in India for the local market and exports. Policies like PLI are already helping establish a manufacturing base. However, something on export promotion can add further zing to an already buoyant sector.

The key uniqueness of your products & expertise that gives you an upper hand in the market space

We at Rayzon Solar, believe in and put the utmost thrust on technological innovation, superior quality, and high reliability. Keeping in mind these basic organization fundamentals

we invest heavily in state-of-the-art manufacturing equipment, a high level of automation, sourcing standard quality of raw materials quality suppliers, and most importantly our reliability testing lab setups. We follow stringent Inward quality control, In-process quality control as well as on finished goods. We consistently keep checking random samples in extended hour's reliability testing setup. This has helped us gain high trust and faith from our customers who keep consistently sourcing high-quality solar modules from us. This goodwill of our customers and partners is what gives us the upper hand in the market space.

Are you participating in RenewX Expo 2025? If yes, express your views on the platforms & strategies/product innovations planned.

Rayzon Solar always remains at the forefront in showcasing new technologies and innovative products to markets in India through various platforms like RenewX Expo 2025. This year we will be showcasing our TOPCon range of Solar modules designed for higher efficiency with long durability and high reliability. Our strategy for the event revolves around driving the conversation on renewable energy trends, sustainability initiatives, and the importance of integrating smart solar technologies to enhance large-scale projects. We look forward to contributing to the future of clean energy at this event.

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Energy storage is critical for stabilizing solar power



India's roadmap for a self-reliant solar manufacturing value chain should focus on establishing a vertically integrated ecosystem, says **ANKIT SINGHANIA**, Director - Sales & Procurement of Navitas Solar

What are the key factors driving the growth of India's renewable energy sector, and how is Navitas Solar positioned to leverage this momentum?

India's renewable energy sector is experiencing unprecedented growth, fuelled by the government's target of achieving 500 GW of renewable capacity by 2030, with solar energy expected to contribute nearly 60% of this target. Declining costs of solar technology, supportive policies like the Production Linked Incentive (PLI) scheme, and India's commitment to reducing carbon emissions under international climate agreements are key drivers. Navitas Solar, a Gujarat-based manufacturer, is positioned to capitalize on this momentum through its focus on high-efficiency solar panels and innovative solutions tailored for utility-scale, rooftop, and hybrid projects. The rise of decentralized solar systems and energy storage further amplifies opportunities, enabling rural electrification and industrial decarbonization.

What are the key strategies to reduce land acquisition and transmission bottlenecks?

Land acquisition challenges can be mitigated through agrivoltaics, which

integrates solar installations with agriculture, maximizing land use efficiency. Prioritizing barren, non-agricultural, or degraded lands for solar farms reduces conflicts with local communities. For transmission, decentralized solar systems and microgrids minimize reliance on long-distance grids, while strategic interconnections of existing microgrids enhance grid resilience. Navitas Solar advocates for policy reforms to simplify land acquisition and incentivize the use of non-arable land, aligning with sustainable development goals.

How can financing mechanisms be improved to attract more private players?

A conducive policy environment - featuring tax incentives, accelerated depreciation, and streamlined regulatory approvals - can attract private investment. Green bonds, viability gap funding (VGF), and guarantees for long-term power purchase agreements (PPAs) reduce financial risks. Public-private partnerships (PPPs) and corporate sustainability initiatives, such as ESG-linked investments, further drive engagement. Navitas Solar collaborates with financial institutions to develop blended financing models, ensuring scalable and bankable projects.



How can incentives help overcome the cost challenges of energy storage deployment?

Energy storage is critical for stabilizing solar power. Extending PLI schemes to battery manufacturing, funding R&D for advanced technologies like solid-state batteries, and mandating storage integration with solar projects (eg, 10-20% storage for new installations) can spur investment. Subsidies for grid-scale storage and time-of-day tariffs incentivize adoption. Navitas Solar's integrated storage solutions, such as modular battery systems, complement its solar offerings, ensuring reliable power during grid outages.

How can the adoption of high-efficiency solar panels be accelerated?

State and central governments can accelerate the shift to high-efficiency technologies like bifacial and TOPCon panels through subsidies, R&D grants, and mandates for their use in government projects. Collaborations with research institutions and awareness campaigns highlighting long-term cost savings are crucial. Navitas Solar's expertise in advanced technologies, including flexible and bifacial modules, positions it as a leader in this transition.

How can India strengthen its solar manufacturing ecosystem to achieve self-reliance?

India's roadmap for a self-reliant solar manufacturing value chain should focus on establishing a vertically integrated ecosystem. This involves developing domestic capacities for producing

polysilicon, wafers, cells, and modules. The government can support this through the PLI scheme, which incentivizes local manufacturing. Additionally, investing in research and development to innovate and improve manufacturing processes is essential. Creating ancillary markets for recycling and reusing solar components can further enhance sustainability.

How can the solar industry accelerate the adoption of advanced panel technologies?

India's transition to cutting-edge solar technologies demands a blend of nimble policy innovation and grassroots empowerment. Imagine a "Solar Efficiency Tier System," where subsidies escalate with panel efficiency ratings - eg, higher rebates for bifacial or perovskite-integrated modules that outperform standard models. States like Gujarat could pioneer "Tech Hubs" in industrial corridors, pairing manufacturers like Navitas Solar with research institutions to co-develop affordable, high-efficiency panels tailored to regional climates—think dust-resistant designs for arid Rajasthan or lightweight flexible panels for Mumbai's cramped rooftops. To demystify technology for end-users, deploy augmented reality (AR) tools in rural outreach programs, allowing farmers to visualize how agrivoltaic panels boost crop yields and power generation. Mandate "green building" certifications for urban projects using high-efficiency panels, creating market pull. Finally, launch a "Recycle-to-Renew" initiative, recycling old panels into raw materials for advanced modules, slashing costs while aligning with circular economy goals.



What policy measures are needed to boost energy storage alongside solar expansion?

A robust policy framework is needed to support energy storage solutions. This includes offering tax incentives, subsidies, and grants for energy storage projects. Implementing regulations that mandate the integration of storage with new solar installations can ensure a balanced and reliable power supply. Additionally, supporting research and development in storage technologies can drive innovation and cost reductions.

What role do financial institutions and corporates play in driving renewable energy growth?

Financial institutions and corporates play a critical role in scaling up solar projects by providing the necessary capital and expertise. They can offer financing solutions such as green bonds, sustainability-linked loans, and project aggregation platforms. Corporates can also invest in solar projects as part of their sustainability initiatives, leveraging their resources and influence to drive large-scale adoption. Collaborating with governments and other stakeholders to de-risk investments and create bankable projects is essential.

How can India develop a robust roadmap for expanding its solar manufacturing industry?

Strengthening India's domestic solar manufacturing base requires a multi-faceted approach. This includes enhancing manufacturing capacities for upstream photovoltaic value chain products, such as polysilicon and wafers. The government can support this through the PLI scheme and other incentives. Investing in research and development to innovate and improve manufacturing processes is crucial. Additionally,

creating a favorable policy environment that encourages private sector participation and foreign investments can drive growth.

What is the USP of Navitas Solar's Products and Expertise?

Navitas Solar stands out in the market with its commitment to quality and innovation. Our solar modules are designed with high efficiency and durability, ensuring optimal performance even in challenging conditions. We leverage advanced manufacturing technologies and stringent quality control processes to deliver reliable and cost-effective solar solutions. Our expertise in the solar industry, combined with a customer-centric approach, gives us a competitive edge in the market.

Please take us through your product portfolio?

Navitas Solar offers a diverse range of solar products tailored to meet various energy needs. Our high-efficiency solar modules are designed to deliver maximum power output with superior efficiency, ensuring optimal performance even in low-light conditions. We also provide bifacial solar panels, which capture sunlight from both sides, enhancing energy generation and overall efficiency. For unconventional surfaces, our flexible solar panels offer a lightweight and adaptable solution, making them ideal for a variety of applications. Additionally, our solar inverters are engineered for reliability and efficiency, converting solar energy into usable electricity with minimal loss. To ensure a stable and reliable power supply, even during grid outages, we offer advanced energy storage solutions, including high-performance battery storage systems. Through this comprehensive product portfolio, Navitas Solar continues to drive innovation and sustainability in the solar energy sector.

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The government should make BESS deployment mandatory in all solar projects



Financial institutions can infuse a breath of life into solar projects through investments, green bonds, loans on lower interest rates, says

PIYUSH GOYAL,
Co-Founder & CEO,
Volks Energie

Your take on expanding scope & growth potentials for renewable energy in India

The coming era belongs to the renewable energy sector! The government has clarified its stance, with the ambitious target of 500 GW of fuel capacity from non-fossils by 2030. At present, India has achieved 215 GW of renewable energy capacity. However, the coming 5 years call for massive acceleration across filling the energy generation, with a special focus on grid-scale solar deployment, energy storage solutions, and hybrid solar-wind projects. To fuel the growth, we certainly need to decentralise energy solutions. Through large-scale deployment of rooftop solar solutions or hybrid solar-BESS farms, even the remotest and most rural parts of India's hinterlands can contribute to the mounting renewable energy targets. The same would also require us to grow the energy storage systems and should see a greater adoption of more sustainable & long-lasting variants like Lithium Ion or nickel-cadmium. Furthermore, promoting new-age technologies like green hydrogen is essential to expanding the energy capacity. At Volks Energie, we have endeavoured to develop advanced energy storage solutions and hybrid solar projects.

Such undertakings are essential for India to achieve its aspirational vision of clean energy.

What are some strategies to help reduce land acquisition and transmission infrastructure bottlenecks for large-scale solar projects?

Yes, despite a clear push from the government towards renewable energy projects, land acquisition, especially for large-scale solar projects, continues to be a bottleneck. We need to come up with out-of-the-box ideas to mitigate the challenges. For instance, solar farms can be deployed on underutilised areas, such as canals, wastelands or industrial zones. This will only enhance the utility of underutilized regions while bypassing any conflict. Accelerating green energy corridors, promoting rooftop solar, solar on farmlands, etc, is another effective way. Contributing to the renewable energy goals will reduce dependence on large-scale parcels of land. Lastly, the government should come up with provisions for fast-track approvals on renewable energy projects. Past experience of successful and timely implementation of projects should also be considered for quicker approvals.

How can policies be developed to encourage greater private sector participation and financing in the solar energy space?

The policies need to offer a long-term financial incentive for the private sector to find it lucrative. Extending tax credits, ease of access to financing, and viability gap funding (VGF) are some of the measures that will enhance the bankability of such projects. To foster innovation and ensure the timely completion of projects, the government should consider performance-linked incentives that incentivise the early completion of projects. To attract more corporates, we should introduce Corporate PPAs and strengthen Renewable Energy Certificates (RECs).

What can states/central governments do to accelerate India's transition to high-efficiency panel technologies?

We should make high-efficiency panels such as PERC, TOPCon, HJT etc, mandatory for utility-scale projects. At the same time, incentivising upgrades to high-efficiency panels is another way to accelerate the transition. Promoting indigenous manufacturing, supporting research and development of advanced photovoltaic technology, bifacial or perovskite solar cells will further aid and enable the transition.

What should India's roadmap look like for developing a self-reliant solar manufacturing value chain over the next 5-10 years?



With storage emerging as a key enabler for solar, what incentives are needed to boost investment in battery technologies and other energy storage solutions?

Well, the sector certainly needs to be supported with subsidies and tax breaks, such as reducing the GST on batteries or lowering upfront costs through subsidies. To further promote the health and longevity of the sector, the government should make BESS deployment mandatory in all solar projects. This is crucial to ensure grid stability. Promoting alternate battery technologies like Ni-Cd or Sodium-Ion and flow batteries can be pivotal in reducing India's dependence on imports of Li-Ion.

Reducing our dependency on imports and achieving self-reliance is crucial for India's sustainable growth. To accomplish this, several strategic focus areas need to be prioritized. Firstly, expanding the Production-Linked Incentive (PLI) scheme is essential to promote end-to-end domestic manufacturing—starting from the extraction of raw materials to the final stages of assembly. Secondly, we must actively promote domestic mining and refining of critical raw materials such as lithium, nickel, and rare earth metals, which are vital for the clean energy and electronics sectors. Additionally, building a robust research and development (R&D)

ecosystem is key. Investing in innovation—particularly to enhance the efficiency of solar cells—will significantly contribute to our energy independence. Finally, skill development should be a top priority. Implementing skill-based training programs will help build a competent and specialized workforce capable of supporting these evolving industries.

How can India accelerate the adoption of newer and more efficient panel technologies?

To boost the adoption of newer and more efficient panel technologies, India should take a multi-pronged approach. Engaging in international collaborations is essential to facilitate the transfer of knowledge, technical skills, and cutting-edge solar technologies. Mandating the use of high-efficiency modules in large-scale solar parks and similar projects can accelerate market transformation and set new performance benchmarks. In addition, supporting pilot projects that demonstrate the feasibility and advantages of next-generation panel technologies will help build confidence among stakeholders and encourage wider adoption. Finally, fostering innovation through performance-based incentives will motivate developers and manufacturers to continuously enhance product efficiency and reliability.

What policy push is needed for energy storage to complement rising solar capacities?

Integrating energy storage with solar implementations contributes towards grid stability and reliability. Thus, a significant push for the sector would come if the government mandates energy projects beyond a certain capacity to integrate energy storage. The government may further introduce time-sensitive tariffs to promote grid storage during peak hours. Incentivising indigenous battery manufacturing that promotes India's self-reliance and reduction of imports, compensating service providers for ancillary services and support such as load balancing and frequency regulation can help further boost the sector.

What role should financial institutions and corporates play in scaling up solar projects?

Financial institutions and corporates have a very important role to play in scaling up solar projects. To begin with, these institutions can infuse a breath of life into solar projects through investments, green bonds, loans on lower interest rates, etc. Corporates can further leverage PPA to support the sector and reduce their carbon footprint. Introducing innovative financing models to help expand solar projects in the country is another crucial way in which financial institutions and corporations can help the cause.

What are the opportunities and roadmap to strengthen India's domestic solar manufacturing base?

To strengthen India's domestic solar manufacturing base, we should consider expanding PLI for Module & Battery Production. At the same time, we need to promote in-house talent and tech leaders in the space. Building a domestic ecosystem for solar and its multiple components, supporting innovation through policy support and encouraging more MSME participation in the sector is crucial for making India a manufacturing base. Furthermore, creating more export opportunities for Indian manufacturers would also make the indigenous solar manufacturing sector more profitable for businesses of varying scales and sizes.

The key uniqueness of your products & expertise that gives you an upper hand in the market space

At Volks Energie, we have had the privilege to partner with government organisations and private players alike to expand the country's solar energy and energy storage expertise. Our USP lies in our execution prowess, especially when it comes to deploying advanced storage solutions on challenging terrains such as the far reaches of Kashmir to interior parts of the North East to swamps of Rann of Kutch. We have further pioneered a Solar+Storage hybrid, which seamlessly and successfully integrates BESS in large solar integrations. We carry 10+ years of Energy Storage Expertise, deploying long-lasting Ni-Cd battery solutions, boosting 4X the lifespan compared to traditional measures.

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India should establish SEZs for solar production



We deliver clean, cost-effective energy while supporting India's net-zero ambitions, says **MANAN THAKKAR**, Co-Founder & Managing Director, Prozeal Green Power

What is your take on the expanding scope and growth potential of renewable energy in India?

India's renewable energy sector has immense growth potential, driven by ambitious national targets, technological advancements, and increasing private sector involvement. With a strong focus on solar & wind energy, energy storage, and green hydrogen, the country is well-positioned to achieve a sustainable energy transition.

What strategies can help reduce land acquisition and transmission infrastructure bottlenecks?

Reducing land acquisition challenges and transmission bottlenecks requires utilizing non-arable and low-value lands for solar parks, streamlining approvals with single-window clearances, and establishing renewable energy corridors. Public-private partnerships can further accelerate infrastructure development and optimize resource utilization.

What policies can encourage private sector participation and financing in renewable energy?

Encouraging private sector participation necessitates clear policy frameworks with stable tariffs, risk mitigation mechanisms, and payment guarantees. Promoting green bonds, priority sector lending, and a well-defined carbon credit market can attract sustainable investments and foster long-term growth.

What incentives can boost investment in energy storage?

Supporting energy storage adoption requires production-linked incentives (PLI) for battery manufacturing, time-of-day tariffs for profitability, and low-interest financing. Additionally, targeted R&D investments in advanced storage technologies will further enhance grid stability and reliability.

How can the transition to high-efficiency panel technologies be accelerated?

India can accelerate its transition to high-efficiency solar panels through robust R&D funding, global technology collaborations, and performance-linked incentives for manufacturers. Establishing pilot projects for emerging innovations will also drive faster adoption.



What is the roadmap for building a self-reliant solar manufacturing value chain?

Building a self-reliant solar manufacturing value chain requires expanding PLI schemes, promoting domestic production of inverters and trackers, and developing solar manufacturing hubs. Workforce skill enhancement and technological partnerships will also ensure sustainable growth.

How can the adoption of efficient panel technologies be accelerated?

Facilitating access to financing for new technologies, promoting standardization and certification, and implementing technology demonstration programs can accelerate the adoption of next-gen solar panels, ensuring higher efficiency and performance.

How can policy initiatives drive energy storage to complement solar capacities?

A stronger policy push is essential to integrate energy storage with solar capacities. This includes mandating storage for large-scale solar projects, offering financial incentives, supporting hybrid renewable parks, and promoting virtual power plants for efficient grid management.

What role do financial institutions and corporations play in scaling solar projects?

Financial institutions can play a pivotal role by offering green finance products and concessional loans. Corporates can drive solar adoption through long-term Power Purchase Agreements (PPAs) and investments in captive solar generation, ensuring energy cost savings and sustainability.

What are the opportunities and roadmap to strengthen domestic solar manufacturing?

To strengthen domestic solar manufacturing, India should establish Special Economic Zones (SEZs) for solar production, offer duty exemptions on raw materials, and incentivize R&D collaborations. Expanding exports of solar products can further solidify India's position as a global leader in solar manufacturing.

What are the key unique aspects of Prozeal Green Energy?

Prozeal Green Energy is a leader in developing large-scale solar & wind energy parks, offering tailored decarbonization solutions to the commercial and industrial sectors. With over 2 GW portfolio capacity, and an impeccable safety record, our experienced team of 500+ professionals delivers clean, cost-effective energy while supporting India's net-zero ambitions.

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Sustainable Aviation Fuels

The long haul to decarbonizing aviation



With over 35 million flights carrying 4.5 billion passengers in 2024, aviation remains indispensable. The sector contributes 2-3% of global emissions, primarily from burning more than 400 billion liters of fuel annually. This article explores the challenges of reducing aviation emissions, the feasibility of Sustainable Aviation Fuel (SAF), and India's potential role in its production

Air travel opens up multiple avenues for business, trade and tourism, while providing access to the most remote areas not connected by waterways, rail or road. At over 35 million flights and 4.5 billion passengers in 2024, the industry was responsible for 2-3% of the global greenhouse gas (GHG) emissions. The 400 billion litres of fuel burnt would add over 1.1 tons of CO₂. Now add other sources of emissions and pollution such as nitrous oxides (NO_x), sulphur dioxide (SO₂), particulate matter (soot), and noise. It remains the fastest way to connect people and move high-value cargo.

Can we do away with the sector in our increasingly virtually connected world? Perhaps not, since aviation offers over 87 million direct jobs across the globe, enabling trade, tourism, and diplomatic relations. India's tourism industry alone contributes over \$230 billion to our GDP. Air cargo is the only option when oxygen concentrators need to be flown in from China in a pandemic.

Challenges in decarbonising the aviation sector

Decarbonisation of the aviation sector will happen steadily but slowly. Road transport contributes 17% of the GHG emissions and will be quick to adopt EVs. The shipping industry will adopt bio-LNG and bio-methanol. In aviation, new engines (electric or hydrogen-based), better logistical planning and carbon credit markets will

drive emission reductions. The introduction of Hydrogen and electric aircrafts will need new infrastructure to be added to the airports, and tend to have a longer turnaround time to refuel/recharge the aircrafts. While short-and-medium-haul flights can be powered by electricity and hydrogen, current technology lacks the energy storage density needed for the long-haul flights.

A Lithium-Ion battery has a specific energy of 1.1MJ/kg and energy density of 1.2MJ/litre, compared to traditional Aviation Turbine Fuel (ATF) or Kerosene which are at 43MJ/kg and 35 MJ/L respectively.

Let's say, a 180 pax Delhi-Bangalore flight weighing 70 tonnes at take-off, consumes 7-8 tonnes of fuel. The electric batteries to replace ATF will weigh 70 tonnes, almost the weight of the plane itself. We will need a new battery type that has the same energy storage that kerosene offers. The energy density of hydrogen is 4.8 MJ/L at 700 bar (hydrogen has a high specific energy of 142 MJ/kg).

An aircraft being procured today will have to fly for at least another 25 years, making Sustainable Aviation Fuels (SAF) the biggest lever for the sector to meet net zero goals. We expect that SAF will contribute over 50-65% of the GHG emissions from the aviation industry.

What is SAF?

And how does it work? SAF is a drop-in fuel with properties similar to ATF, and is blended at



the airport and loaded into the wings of the aircraft. SAF is a drop-in because ATF is a complex mix of hydrocarbons (long-chain/ isomeric/ cyclic/ aromatic), and each of the SAF production pathways usually produces just one type of hydrocarbon. The production pathway chosen by the SAF manufacturer depends on feedstock available, and the blend limit can vary from 10%-50% depending on the production pathway. SAF blended with fossil fuel ATF needs no modifications to existing aircrafts, or the airport infrastructure.

The American Society for Testing and Materials (ASTM) International sets the standards, and approves production pathways for SAF and other jet fuels for use in the aviation industry. The extensive 4-tier testing process (ASTM 4054) is necessary to make the fuel suitable for the engines made by the likes of Rolls Royce/ GE/ Safran, and adopted by Airbus, Boeing, and others. Currently, 11 pathways are approved for SAF production, and 11 more are under evaluation. The ASTM committee for SAF has over 700 members, and meets twice a year to vote on the pathways under evaluation.

Production of SAF in India - Challenges and opportunities

While the permitted blend limit is 10-50%, worldwide production of SAF is at 0.1-0.2% of the global jet fuel requirement. Most of the worldwide SAF production today is via the HEFA route, which uses animal fats, tallow, virgin oils and used-cooking-oils as feedstock to produce SAF.

This may be possible in India, but we lack an organised used cooking oil (UCO) collection sector. Further, the meat industry tends to export more than offer the fats. HEFA-SAF will end up competing with the bio-diesel industry for feedstock. Given the abundance of biomass from agricultural residue and municipal solid waste, and India's booming ethanol capacity, the Ethanol-to-

jet (ATJ) pathway is a great bet. The ethanol widely available currently is mostly first-generation, made from sugar, corn and grain. A larger opportunity lies in 2G ethanol to SAF, with 2G ethanol coming from paddy straw, corn stover, cotton stalk and other crop residue. Gasification and Fischer Tropsch is another approved pathway, where biomass and municipal solid waste (MSW) is gasified to produce syngas, and syngas is turned to SAF via the century-old Fischer Tropsch process. The PtL pathway (Power-to-Liquids) converts electricity to green hydrogen, and uses captured CO₂ to produce SAF via Fischer Tropsch.

Today, the cost of production of SAF is 2.5-5 times the cost of fossil fuel ATF. The higher cost is offset by the emission savings, which can be up to 3.16 tons of CO₂ for each ton of SAF. Members of the Sustainable Aviation Buyers Alliance (SABA) include MNCs such as Microsoft, Google and Amazon, who offer to buy SAF to offset their Scope 3 emissions.

Global targets for adoption of SAF

Governments across the world have proposed mandatory SAF blending requirements. India is expected to adopt a 1% blending for international flights by 2027. The EU mandates SAF adoption with at least 2% blending in 2025, 6% by 2030, 40% by 2040 and 70% by 2050. This will translate to global SAF requirements of 23 billion litres by 2030 and over 450 billion litres by 2050. As production capacities increase, and more solar-wind options become available, the production costs will drop to meet the cost of ATF, possibly by 2040. PtL will be the key pathway when the price of hydrogen drops to under \$2000/ton.

Will this result in the end consumer paying more? Yes, but hopefully not by much. Airlines spend under 30% on fuel, so at 5% SAF blending, and SAF being 3x the cost of ATF, costs may go up 4-5% in the short-medium term.

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Navigating Global market shifts and price disruptions

India's steel industry is navigating a period of heightened uncertainty, shaped by global protectionism, trade disruptions, and a surge in cheap imports. The re-imposition of tariffs by the US and the EU's Carbon Border Adjustment Mechanism have raised new barriers for Indian exports, while domestic producers continue to battle low-cost dumping from Asian markets. Yet, amidst these challenges, India's steel sector remains resilient, backed by strong policy support and long-term growth potential



The steel industry is back in the spotlight - this time triggered by global political developments. Following his re-election, President Donald Trump of the United States has reignited his agenda of restoring what he terms “American supremacy.” As part of this broader strategy, his administration has moved swiftly to introduce a new wave of protectionist trade policies. One of the most significant steps has been the imposition of reciprocal tariffs on a range of imported goods, including steel and aluminum.

For India, this development is more than just a diplomatic concern - it's an economic one. Indian steel manufacturers, who have been ramping up production and exports to cater to global demand, now face a considerable challenge in retaining their competitive edge in the U.S. market. This move

could not only impact export volumes but also prompt a shift in trade routes, pricing strategies, and production planning. In an interconnected global economy, such unilateral decisions have ripple effects, and India's steel sector is bracing for the turbulence ahead.

Another pressing issue confronting the Indian steel sector is the dumping of cheap steel by countries such as China, South Korea, Japan, Vietnam, and Thailand. This influx of low-priced imports has significantly eroded the profitability of Indian steel manufacturers, prompting repeated appeals to the Indian government for intervention. In response, the government is actively considering anti-dumping duties on select steel products originating from these countries. A recent investigation conducted by the Directorate General of Trade Remedies (DGTR) revealed that the imports in question were indeed undercutting domestic prices and harming local producers. As a result, the DGTR has recommended the imposition of provisional safeguard duties to provide relief to the domestic steel industry. While these duties are aimed at protecting Indian manufacturers, the DGTR has also acknowledged the potential adverse impact on downstream industries, which rely heavily on steel as a key raw material. Steel is a vital input for sectors such as infrastructure, automotive, engineering, and capital goods. Any increase in the cost of imported steel could ripple across the supply chain, potentially raising the prices of end products. However, the DGTR concluded that the need to shield domestic producers from unfair competition currently outweighs the risk of short-term inflationary pressures. It's worth noting that India continues to depend on steel imports to meet certain specialized requirements that cannot be fulfilled by domestic producers due to limitations in technology and product quality.

Fuelling a \$5 trillion economy

The steel industry is a cornerstone of India's economic development, playing a pivotal role in driving the nation's growth ambitions. It contributes approximately 2 percent to the national GDP and provides employment to nearly 600,000 people directly and another 2 million people indirectly through ancillary industries such as mining, logistics, equipment manufacturing, and services. As a fundamental raw material for



infrastructure and industrial projects, steel serves as both an indicator and enabler of economic progress. The strength of a country's infrastructure is directly linked to the performance of its steel sector, and in India's case, this linkage is becoming even more critical as the country sets its sights on becoming a USD 5 trillion economy by 2025. From transport networks to utilities and real estate, steel is indispensable to infrastructure. It underpins bridges, tunnels, railways, metros, airports, power plants, pipelines, and buildings—making it a vital enabler of India's urbanization and industrial growth. India's standing in the global steel landscape is equally noteworthy. According to IBEF, India is the world's second-largest producer



of crude steel, with an output of 125.32 MT of crude steel and finished steel production of 121.29 MT in FY23. In April-December 2024, crude steel production in India stood at 110.99 MT and finished steel production stood at 106.86 MT. In FY25 (April-December), the consumption of finished steel stood at 111.25 MT. In April-December 2024 exports of finished steel stood at 3.60 metric tonnes (MT), while imports stood at 7.28 MT. In recent years, this position has been strengthened through increased capacity additions, modernization of plants, and a rising domestic demand curve fuelled by mega infrastructure projects, government housing schemes, and a resurgent automotive sector.

Q3FY25: Earnings and edges

JSW Steel reported a sharp 70.3 percent year-on-year (YoY) decline in consolidated net profit to ₹717 crore for the Q3FY25, primarily due to weaker steel prices. In the same quarter last year, the company had posted a profit of ₹2,415 crore. Sequentially, profit also dropped from ₹439 crore in Q2FY25. Consolidated revenue stood at ₹41,378 crore, down 1.3 percent from ₹41,940 crore in the year-ago period. Tata Steel's India production volume for Q4FY25 stood at 5.51 million tonnes, showing a marginal increase from 5.40 million tonnes in Q4FY24. However, on a sequential basis, output declined from 5.69 million tonnes recorded in Q3FY25. In its overseas operations, production at the Netherlands facility rose year-on-year to 1.63 million tonnes from 1.48 million tonnes, but dropped quarter-on-quarter from 1.76 million tonnes. Output from the UK plant was nil, following the shutdown of two blast furnaces at the Port Talbot steelworks in South Wales. Production at the Thailand plant remained steady at 0.31 million tonnes year-on-year and showed a modest increase from 0.26 million tonnes in the previous quarter. On the deliveries front, Tata Steel India recorded volumes of 5.6 million tonnes in Q4FY25, up from 5.42 million tonnes in Q4FY24 and 5.29 million tonnes in Q3FY25.

Steel Authority of India (SAIL) reported a 62.04 percent year-on-year decline in standalone net profit, which fell to ₹125.80 crore in Q3FY25 from ₹331.40 crore in Q3FY24. Despite the profit slump, revenue from operations rose 4.9 percent year-on-year to ₹24,489.63 crore for the quarter ended December 31, 2024. Profit before exceptional items and tax stood at ₹289.50 crore, marking a 24.67 percent drop from ₹384.29 crore in the same quarter last year. The company recorded an exceptional gain of ₹28.53 crore in Q3FY24. Total expenses increased by 6.16 percent YoY to ₹24,564.44 crore. However, the cost of materials consumed declined by 14.23 percent, amounting to ₹11,785.47 crore. EBITDA stood at ₹2,389 crore in Q3 FY25, registering a modest growth of 3.02 percent compared to ₹2,319 crore in Q3 FY24. Sales volume rose to 4.43 million metric tonnes (MT), up from 3.81 MT a year earlier. Crude steel production, however, declined slightly to 4.63 MT in Q3 FY25 from 4.75 MT in the corresponding period of the previous fiscal. Jindal Steel and Power (JSPL) reported a 51 percent

year-on-year decline in consolidated net profit, which stood at approximately ₹951 crore for Q3FY25, despite modest growth in revenue and increased production and sales volumes during the quarter. The company's consolidated revenue rose slightly to ₹11,751 crore, while adjusted EBITDA fell nearly 24 percent year-on-year to ₹2,133 crore. Net debt rose to ₹13,551 crore, compared to ₹12,464 crore in the previous quarter. Steel production during the quarter stood at 1.99 million tonnes, marking a 2.5 percent increase year-on-year. Sales volume rose 5 percent to 1.90 million tonnes. Exports accounted for 7 percent of the company's total sales for the quarter.

Navigating the headwinds

The steel industry - both globally and in India - is grappling with a mix of economic, logistical, and environmental challenges that are reshaping its landscape. At the forefront is the rise in protectionist policies across the world. The imposition of reciprocal tariffs by countries like the United States and mechanisms such as the EU's Carbon Border Adjustment Mechanism (CBAM) have disrupted traditional trade dynamics and added compliance costs for exporters. Indian steelmakers, who have been key players in global markets, are now forced to navigate shifting regulations and reduced competitiveness. Simultaneously, the problem of steel dumping from countries like China, Vietnam, and South Korea persists. Excess steel production in these nations, often sold at below-market prices, continues to erode margins for Indian producers. While India's Directorate General of Trade Remedies (DGTR) has initiated anti-dumping investigations and recommended provisional duties on some products, the issue remains a significant concern for domestic manufacturers.

Coal dependency presents another major hurdle. India imports large volumes of coking coal - primarily from Australia - making its steel production costs vulnerable to global market volatility. Rising coal prices, supply chain disruptions, and logistical delays have added to the cost burden. At the same time, the industry is under mounting pressure to decarbonize. Transitioning to green steel through technologies like hydrogen-based direct reduced iron (DRI) or electric arc furnaces (EAF) is capital-intensive and not yet widely viable, especially for mid-sized players.

The global supply chain remains fragile due to lingering effects of the pandemic, the Russia-Ukraine conflict, and tensions in the Red Sea. These factors have driven up freight charges, delayed shipments, and caused shortages of critical inputs like iron ore, scrap, and ferroalloys. Domestic logistics also face bottlenecks, including high rail freight rates, limited port capacity, and inadequate last-mile connectivity - all of which inflate distribution costs. Rising input costs - covering everything from electrodes to alloys - continue to pressure margins. On top of that, environmental regulations and net-zero commitments have increased the need for sustainable practices, pushing steelmakers to invest heavily in emissions



control and cleaner technologies. However, access to affordable long-term capital for these upgrades remains a challenge.

The industry also faces a shortage of skilled labour for operating advanced technologies, coupled with delays in land acquisition and environmental clearances that hinder expansion projects. Lastly, global economic slowdown and weak demand from key consuming sectors such as real estate and automobiles have led to softening steel prices, impacting revenue and profitability. Together, these challenges underline the need for robust policy support, faster infrastructure upgrades, and accelerated innovation to ensure the long-term competitiveness of the Indian steel sector.



Driving the growth

India's steel sector is experiencing robust growth, fuelled by a diverse set of demand drivers that span across core infrastructure, emerging industries, and national development programs. One of the most significant catalysts is the infrastructure boom, led by massive government-backed initiatives such as Bharatmala, Sagarmala, the Smart Cities Mission, and PM Gati Shakti. These ambitious programs are generating large-scale demand for structural steel, rebars, and long products used in highways, ports, urban transit, and integrated logistics networks. Simultaneously, rapid urbanization and the push for affordable housing under schemes like Pradhan Mantri Awas Yojana (PMAY) are accelerating the consumption of steel in the real estate and construction sectors. With India's urban population expected to cross 600 million by 2030, the need for housing, commercial spaces, and supporting infrastructure will continue to drive long-term steel demand.

The automotive and manufacturing sectors are also playing a transformative role. As India positions itself as a global manufacturing hub, particularly in the automotive domain, there is a growing need for high-strength flat steel and specialty alloys. The Production Linked Incentive (PLI) schemes for automobiles, white goods, and electronic components are set to further boost the usage of advanced steels. The transition towards renewable energy and electric vehicles (EVs) is creating new opportunities for steel usage. Steel is a key component in wind turbine towers, solar panel mounting structures, battery enclosures, and EV chassis, opening up avenues for innovative applications and customized steel grades. Moreover, strategic sectors such as defense and railways are emerging as high-potential growth areas. The government's thrust on indigenization in defense manufacturing and large-scale railway modernization and electrification plans are expected to significantly increase domestic steel consumption. Together, these sectors form a powerful engine of growth for the Indian steel industry, ensuring strong and sustained demand in the years ahead.

Forging ahead

While protectionist measures, dumping threats, volatile coal prices, and logistical challenges present formidable obstacles, the sector's long-term fundamentals remain strong. Backed by robust government infrastructure spending, rising urbanization, and the rapid expansion of sectors like automobiles, defense, and renewable energy, India's steel demand is poised for steady growth.

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Steel prices to be supported by safeguard duty amid global trade restrictions

India, witnessing a surge in steel imports, has responded with a provisional safeguard duty on certain flat steel products. While this move aims to stabilize domestic prices and support profitability, it also raises concerns for end-user industries. With global demand recovery remaining tepid, the Indian steel sector must navigate a complex landscape of trade policies and supply chain shifts.



The global steel industry is facing headwinds due to weak demand in most of the steel consuming nations leading to global oversupply scenario and threat of low-cost imports hurting domestic steel industry of most of the nations. As a result of which countries are imposing import restriction on other exporting nation exposing countries not imposing import restriction to risk of low-cost import thereby impacting domestic steel industry. As global demand and supply are not undergoing significant changes imposition of import restrictions is resulting in reorientation of supply chain. Recently Government of India also imposed provisional safeguard duty of 200 days on imports of certain category of flat steel products into India which provides support to the domestic steel price but at the same time increasing cost of end user industry. However, imports of steel products will also be exempt from the duty if their cost, insurance and freight (CIF) import prices meet the specified thresholds which will protect the cost increase for the end-user industry, thereby limiting the impact of duty.

Modest global demand; Oversupply to persist:

Low demand recovery in most of the steel consuming countries along with the import restriction measures adopted by some countries, the global oversupply situation is likely to persist in the near-term keeping prices subdued. Furthermore, Chinese steel producers have changed product profile by increasing the share of flat products, which are highly traded in the global market, and decreasing the share of long products due to a slowdown in the Chinese real estate sector. This has resulted in the availability of higher volumes of flat steel products, despite no increase in the overall crude steel production. Moreover, the significant increase in protection measures by several countries on steel imports has led to routing of steel into India where demand growth has been robust. This has resulted in significant increase in the import of steel into India over the past 18-24 months is on back of the sluggish demand growth in key steel-consuming countries and continuous capacity additions. The global oversupply scenario has also resulted from dependence of some large steel-producing countries highly on steel exports because their domestic consumption is low and stagnant



compared to their steel capacity unlike India where production and supply are moving in tandem.

Impact of global trade policies: The imposition of duties and tariffs by the US on steel imports from China and other countries, could lead to reorganisation of supply chain and keep the prices subdued. It will also expose other steel consuming nations like India having high demand growth under threat of low-cost imports. After the recent US government took charge in January 2025, the President Donald Trump imposed tariff hikes on steel imports from China, Mexico and Canada. This would impact the global steel trade dynamics as the countries which export extensively to the US would be subject to high tariffs. While the import of Chinese goods will also be subject to duties, the proportion of China steel direct imports to the overall US imports is small. However, the impact of tariffs on Mexico and Canada remains to be seen on global trade dynamics. Nevertheless, the protectionist policies followed by the US will certainly impact the global steel trade and could result in volatility in prices in the near to medium term.

Further European Union (EU) has also amended its steel safeguard measures to protect EU steel industry from increasing imports by decreasing tariff-rate quota volume. Also, introduction of Carbon Border Adjustment Mechanism (CBAM) from 2026 to 2032 will phase out the free allowances to EU exporters and domestic players under the EU Emissions Trading System (ETS).

India steel sector amid trade barriers: The Indian steel industry has been impacted from current global oversupply scenario and recent trade barriers by many countries which exposes India to import threat as there has been significant increase in the import of steel into India over the past 18-24 months. Steel imports into India increased by 23% yoy to 9.24 million tonnes (MnT) in 2024 and 38% yoy to 7.52MnT in 2023. Of these, low-cost imports in the form of hot-rolled steel/plate contributed 48% in 2024 (2023: 41%), cold-rolled steel contributed 4% (5%) and galvanised steel 14% (16%). To protect domestic steel industry Government of India in March 2025 has imposed proposed provisional safeguard duty (SD) of 12% on the import of alloy and non-alloy steel flat products for a period of 200 days which is likely to provide some support to the steel prices in India. This is because it will offer headroom to increase domestic steel prices up to 13.2% (SD of 12% and cess of 10% on SD) on products covered under safeguard while keep the domestic steel competitive. The move is expected to provide support to the profitability of domestic steel sector on account of higher realisations, especially for large integrated flat steel producers, leading to improvement in credit metrics and thereby providing sufficient headroom to absorb headwinds. Considering a sustained global oversupply scenario, the move may not be able to curb import volumes significantly if exporters choose to trade steel into India by declining the base price to remain price competitive, until there is an improvement in the global demand-supply balance.

Safeguard duty by India to support domestic industry: The recent move of imposing safeguard duty is likely to provide some breather to the subdued profitability of domestic steel players. Domestic steel players were facing headwinds due to the increasing import volumes of low-cost products since 3QFY24, when import had started



to increase resulting in a decline in EBITDA margin by around 200 basis point. The increase in steel realisation will improve domestic steel players' spreads, as raw material prices are unlikely to increase in the same proportion considering no change in the raw material availability scenario. The steel spreads (realisation less cost of iron ore and coal per ton of steel) are expected to improve by 15%-20% from the current level due to an uptick in the prices, while raw material prices may not increase commensurately due to a global steel overcapacity owing to a low demand. Moreover, debt levels are likely to reduce from FY25, with large industry players completing major capex to capitalise on the demand prospects for FY26.

The capacity utilisation of domestic steel industry is healthy at 80%-83% in FY24-9MFY25, and is likely to remain around 80% over FY26-27 supported by healthy domestic demand growth, expected moderation in import volumes and despite sustained planned capacity additions. The demand growth is likely to be supported by the government's continued spending on infrastructure projects such as roads, railways and ports along with expected stable growth in other end-user industries like real estate, auto and consumer durable.

The Indian Steel Sector FY26 Outlook: India Ratings and Research (Ind-Ra) has maintained a neutral outlook for the steel sector for FY26, as it expects the domestic steel demand to continue to grow in a high single digit or low double digits (FY25 estimated: 9%-11%, 9MFY25: 10% yoy, FY24: 12.4%). Consumption growth in FY26 will be driven by the government's continued spending on infrastructure projects related to roads, rails, ports, etc and expected demand growth in the end-

user industries such as construction, engineering, and automobile sectors. With the expected ramp-up of capacity utilisation across big domestic players, supply will balance demand. However, the agency expects the global demand-supply imbalance to persist on back of a modest demand recovery in some countries, supported by the pent-up demand and easing of financing conditions. Furthermore, the imposition of tariffs by many countries on the import of steel will have a persistent threat of high volume of imports into India where demand growth is relatively high.

India's steel industry is facing headwinds amid the threat of low-cost imports, keeping realisations subdued. However, recent move by government to impose provisional safeguard duty is likely to support profitability in FY26, supported by benign raw material prices. Further, the credit quality of steel manufacturers is expected to remain resilient in FY26, as most large integrated entities had witnessed strengthened balance sheets in FY21 and FY22. Although margins declined in 9MFY25, they are likely to remain stable in FY25 and improve in FY26 owing to a robust domestic demand, cost efficiencies, benign raw material prices and low leverage, despite undertaking capex, and the ability to absorb any external shocks. The agency believes the safeguard duty would also benefit small steel producers but will have a lower impact than that for large and integrated steel players.

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Twin guardrails steel India against tariff tide

Domestic demand, low export dependency supportive; steel recyclers face tighter scrap market



Strong domestic demand and lower dependency on exports are expected to steer India's iron and steel industry past the tariffs imposed by the Donald Trump administration.

Effective March 12, the US terminated the temporary exemptions for imports of steel and derivatives from its trade partners, resulting in the imposition of an ad valorem duty of 25% on all iron and steel imports.

The US gambit, coupled with an ongoing global supply glut can elicit countermeasures from trading partners, amplifying uncertainties in trade and markets, and ultimately affect economic growth.

A seven-year itch

It all began in 2018 when Trump, 15 months into his first tenure, imposed a 25% additional duty on imports of steel products, citing national security concerns.

In response, the European Union (EU) slapped its own 25% safeguard duty. Canada, the UK, Morocco, Mexico, South Africa and others undertook countermeasures as well.

Later, however, Argentina, Australia, Brazil, Canada, Japan, Ukraine, the UK negotiated favourable deals with the US over a period — the UK after Brexit — and got their levies reduced.

These arrangements led to a torrent of steel exports to the US, and left mills there a good 500-600 basis points short of their targeted capacity utilisation of 80%.

On the other hand, competitively priced imports helped end-user sectors in that country secure their profit margins despite higher overall costs and inflationary pressures.

Returning to office in 2025, Trump took a more aggressive stand vowing to “move fast and break things”.

His tariff policy shifted from being predominantly China-focussed in 2017, lassoing Canada, Mexico and the

rest of the world, citing concerns over the humongous US trade deficit, immigration issues, and illegal drug flows.

But frequent policy pronouncements followed by reversals and revisions were spawning uncertainty everywhere. To wit, the US Economic Policy Uncertainty Index spiked to 542.52 this March, compared with a 7-day average reading of 110.86 since 1985, handily surpassing peaks seen during the Global Financial Crisis of 2008 and the Covid-19 pandemic.

In February, the US government revoked exemptions granted earlier to some countries and imposed 25% tariff through a proclamation titled 'Adjusting Imports of Steel into the United States'.

Dynamics of US steel industry

In calendar 2024, the US steel sector imported ~29 million tonne (MT) of semi-finished and finished steel, accounting for ~32% of its demand.

These imports were at highly competitive prices. For instance, domestic hot-rolled steel sheet prices were 40-50% higher than China's free on board (f.o.b.) offerings during the year.

The imports to the US were largely from regional trade partners, with Canada, Mexico and Brazil accounting for more than 50%.

Approximately 80% of the imports were from countries exempted through trade deals and temporary measures such as the 25% additional duty imposed in 2018.

The re-imposition of tariffs effective March 12 ended these exemptions.

The move is expected to trigger two major changes in the US steel sector: one, imports are expected to fall, providing an opportunity for US mills to increase their utilisation levels, and two, steel scrap consumption in the US should surge.



Dynamics of the Indian steel Industry

India is the second-largest steel producer in the world. In fiscal 2024, its crude steel output was ~144 million tonne. The industry contributes 1.7% to the country's gross domestic product (GDP) and is a pillar of its economic and industrial framework.

Despite the challenges posed by global overcapacity and an uncertain economic environment, the industry has maintained robust growth driven by domestic demand stemming from the gargantuan infrastructure buildout of the past decade, and cruising automobile demand.

Over the past three years, steel demand in India has increased at a double-digit rate. The momentum is expected to continue, with fiscal 2025 demand growth estimated at 11.0-11.5%.

However, fiscal 2026 could see a slackening to 9-10%. Given global demand is estimated to grow 0.5-1% in calendar 2025, India could verily be the driver of global steel consumption in the near-term.

In fiscal 2025, India's steel imports are estimated to be 10.5-11.0 million tonne (MT) and exports at 6.0-6.5 MT.

China, because of its very competitive pricing and proclivity for dumping, has had an overhang on global steel trade dynamics for a long time. India's exports have also been affected because of the ongoing global softness in demand.

Between April and February, India's finished steel exports fell ~34% on-year. The EU was a big market with 35% share, specifically Italy, Belgium and Spain. These countries were followed by Nepal and the UAE with 11% and 9% shares, respectively.

On the other hand, total finished steel imports grew approximately 16% on year. Product-wise, hot-

rolled coils and sheets accounted for a higher share in the import basket.

Imports from South Korea were the highest with 29.5% share, followed by China and Japan with 27% and 21%, respectively.

Tariff impact on Indian steel

The direct impact of the tariff on India's steel exports is seen minimal. That's because the US accounts for only 3.3% of India's total steel exports by volume.

However, the US is the largest source of steel scrap imports by India, meeting 15% (three-year average) of the requirement. As ~70% of the steel production in the US is via recycling of steel scrap, an increase in mill utilisation levels there will reduce scrap availability for exports. This, in turn, may lead to a decline in scrap imports to India. Notably, imports account for 25-30% of total scrap demand in India.

Moreover, a combination of global oversupply, subsequent protectionist measures by major steel-consuming economies and shifting steel trade dynamics owing to US tariff action would reduce export opportunities for Indian mills, while simultaneously exposing them to competitive imports.

Safeguarding domestic steel

To protect Indian steelmakers from dumping, the Directorate General of Trade Remedies (DGTR) has recommended imposition of provisional safeguard duty on non-alloy and alloy steel flat products. A 12% ad valorem duty for 200 days has been proposed on imports of select steel products.

The move will provide much-needed relief to the domestic steel industry as it is likely to lead to a decline in net imports, thereby boosting domestic steel prices and mill utilisation.

In fiscal 2025, higher net imports had lowered domestic steel production, despite a double-digit growth in demand. Until February 2025, finished steel production increased only 5.0% on year, while domestic demand rose 11.3% year on year.

The domestic safeguard duty augurs well for large mills that are about to commission, or have recently commissioned, flat steel capacities.

With accrual reducing amid market challenges, many large mills were revisiting their capacity expansion plans. But expectations of better realisation after the imposition of safeguard duty would make them more confident.

And here is a sting in the tale, a Catch-22, as it were: while the safeguard duty will reduce the imports of finished steel, it could crank up domestic steel prices. If the price gap narrows or is negated, expect imports to surge. It will be back to square one, then.

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SEHUL BHATT
Director - Research
Crisil Intelligence

Amidst an increasingly uncertain
external environment

Safeguard Duty to act as a shock absorber

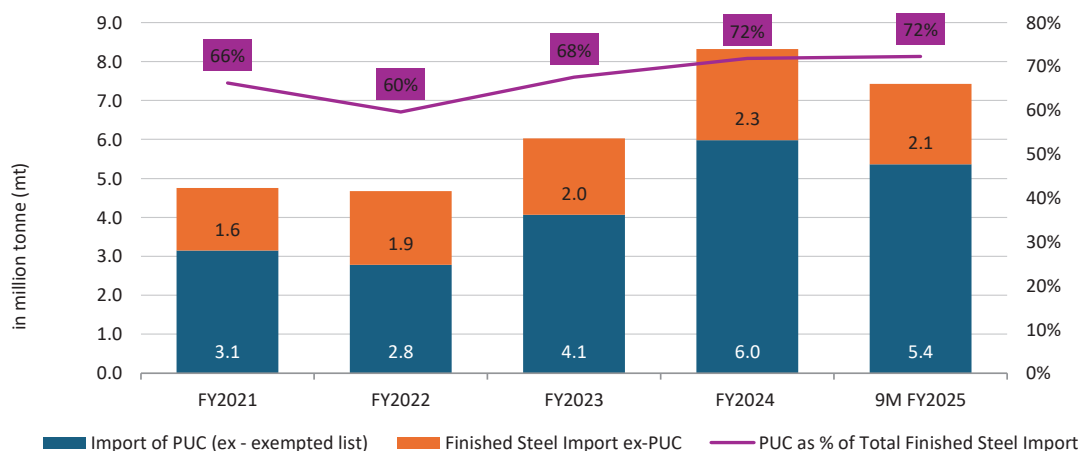


In a crucial move to protect India's steel sector from rising import pressures, DGTR has recommended a 12% Safeguard Duty on select alloy and non-alloy flat steel imports. The duty is expected to curb the influx of cheap imports, restore pricing power for domestic steelmakers, and support profitability. By balancing consumer interests with producer protection, this measure could be a vital shock absorber for the industry's ongoing expansion plans

On March 18, 2025, the Directorate General of Trade Remedies (DGTR), in its preliminary findings, recommended the imposition of a 12% Safeguard Duty (SGD) on certain alloy and non-alloy flat steel products being imported to India. This move is a significant positive development for the sector as it is expected to act as a trade barrier in arresting the surge in cheap flat steel

imports into India, especially in the backdrop of a potential global growth slowdown amidst increased trade protectionism following Trump 2.0. The SGD is expected to impact around 60-75% of India's overall steel imports. It, however, exempts certain special categories of flat steel for which adequate domestic capacities are yet to be built up. This includes electrical steel, tin plates, and stainless steel, among several other categories of special steel grades.

Exhibit: Trend in import of PUC* and finished steel



Source: JPC, Ministry of Commerce, ICRA Research; *PUC: Product Under Consideration for proposed safeguard duty



The 12% SGD proposed by the DGTR is significantly lower than the 25% initially conceived at the start of the safeguard investigations in December 2024. The DGTR has also recommended certain landed imported steel price thresholds, wherein if steel is imported to India at above those thresholds, then SGD will not be levied, in turn providing a mechanism to stop runaway steel prices. This suggests that the Government has taken a balanced approach in protecting the interest of all stakeholders, including steel consumers.

The invisible wall arresting steel imports

Finished steel imports into India reported a staggering increase of 38.2% to 8.32 million tonne (mt) in FY2024 from 6.02 mt in FY2023. This rise

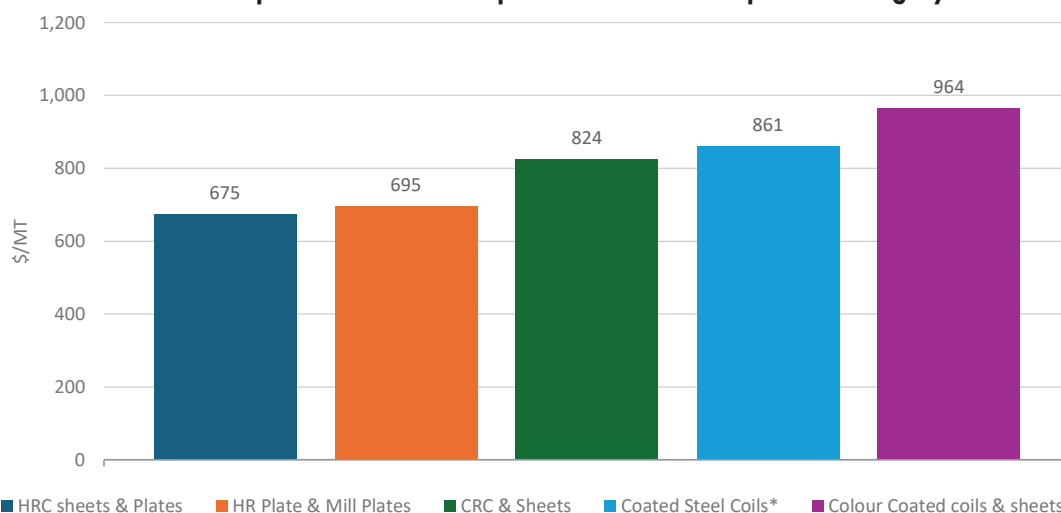
led to India becoming a net steel importer after a gap of five years. The trend continued in the previous fiscal with finished steel imports registering a 22.7% growth in 10M FY2025 and the country remaining a net steel importer again. South Korea became the leading steel exporter to India, with a share of ~30%, followed by China and Japan. The economics of flat steel import will change from hereon, and this is expected to lead to a 50% reduction in India's steel imports in FY2026 compared to FY2025.

Steel prices witness some cheer

Domestic steel prices were trading at a premium over the landed cost of imported HRC offers from China and Japan for a major part of the previous fiscal. With India being the fastest growing steel market globally and with competitive import offers, the threat of rising imports was looming large. At prevailing international steel prices, the SGD will impose a US\$ 60/MT additional levy for import of hot rolled coil, which makes it costlier over domestic offers, giving domestic steelmakers headroom to increase the prices. Chinese HRC export offers, which were trading at a discount of US\$ 35/MT over domestic offers, are expected to swing to a premium of US\$ 24/MT after the imposition of SGD.

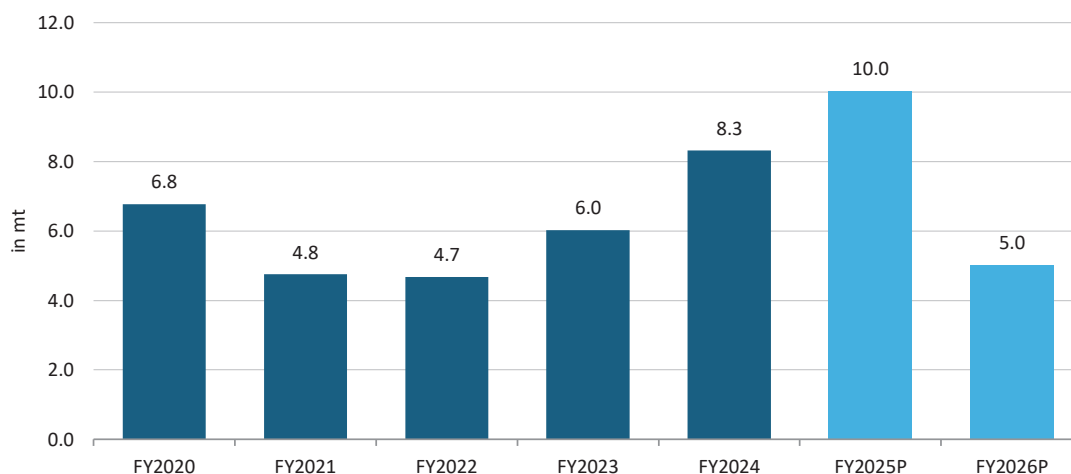
As markets were pre-empting the SGD levy, domestic flat steel prices rose by ~8-9% since mid-January 2025. This is expected to favourably impact the industry's earnings starting Q4 FY2025. Domestic steel industry's OPBDITA/MT could sequentially trend up by US \$ 25-30/MT in

Exhibit: Threshold CIF prices for SGD exemption under different product category



Source: DGTR, ICRA Research; *Metallic Coated Steel Coils and Sheets, whether or not profiled, including Galvanneal, Coated with Zinc or Aluminium-Zinc or Zinc-Aluminium-Magnesium

Exhibit: Trend in India's finished steel imports



Source: JPC, ICRA Research

FY2026, which could lead to a 300 basis points sequential improvement in the industry's operating margins in FY2026. However, after retaliatory tariffs being announced by the United States of America (USA), prospects of a global growth slowdown leading to any material downward correction in Chinese HRC prices remains a downside risk in FY2026.

Industry credit metrics and capacity utilisation rates

In FY2025/FY2026, domestic mills are targeting to add fresh capacities accumulating to 20-21 million tonne per annum (mtpa), which would entail sizeable investments. With earnings weakening in FY2025, the industry was staring at the possibility of a spike in leverage levels. However, the earnings uptrend following the SGD announcement is expected to improve the

industry's credit indicators in FY2026. Moreover, with imports slated to materially decline, and domestic demand poised to grow at a healthy rate of 7-8% in FY2026, the steel industry's capacity utilisation levels are expected to inch up from the four-year low of 78% being witnessed in FY2025 to a more comfortable level of 83% in FY2026.

Conclusion

India remains the only bright spot in the major steel-consuming hubs where demand growth remains healthy, driven by the Government's infrastructure investment-oriented economic growth model. With demand conditions remaining lacklustre in the key Asian steel-producing hubs of China, Japan, South Korea, and with many of the western economies yet to claw back to the pre-Covid level of demand, global steel trade flows were being steadily diverted to the few remaining high-growth markets like India. This

Exhibit: Domestic HRC price vs. landed cost of Chinese HRC export offers

Particulars	Unit	China (incl. SGD)	China (excl. SGD)
HRC export offers (FOB, as in third week of March 2025)	US\$/MT	465	465
Ocean Freight + Customs Duty + SGD	US\$/MT	130	71
Landed Cost of Imports	US\$/MT	595	536
Foreign Exchange Rate	Rs/US\$	87.2	87.2
Landed Cost of Imports (as in third week of May 2025 assuming no change in INR:USD rate)	Rs/MT	51,886	46,709
Domestic HRC Price (as in third week of March 2025)	Rs/MT	49,800	49,800
Domestic discount/ (premium)	Rs/MT	2,086	-3,091
Domestic discount/ (premium)	US\$/MT	24	-35

Source: Bigmint, ICRA Research

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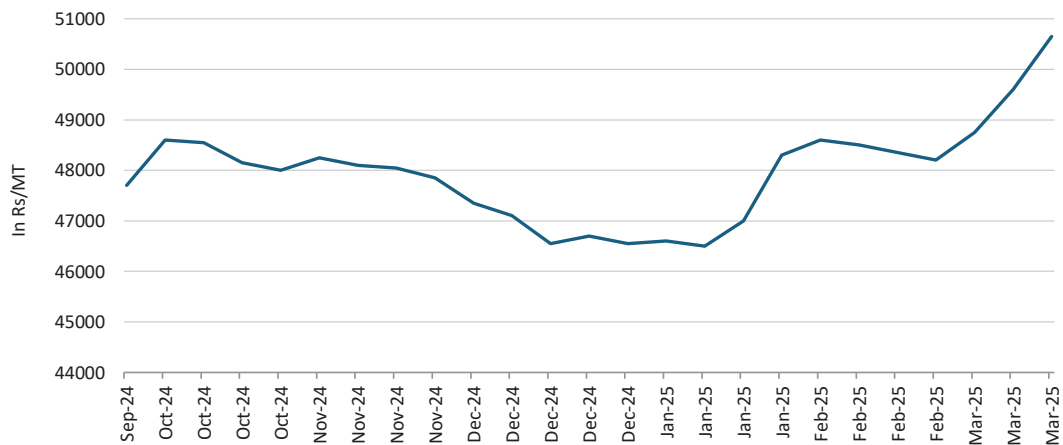
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Exhibit: Trend in Domestic HRC Prices (ex-works - Mumbai)



Source: Bigmint, ICRA Research

led to a steady decline in domestic steel prices in the last couple of years. Moreover, following the recent withdrawal of country-specific exemptions by the USA under Section 232 of the Trade and Expansion Act of 1962, around 4 mtpa of steel trade flows from Asian producers, which were being exported to the USA, could potentially have been diverted to India in part, leading to the risk of a further rise in imports in FY2026. Moreover, as global trade flows gradually readjust following announcement of retaliatory tariffs by the USA, the prospects of a global growth slowdown in the intervening period can have second order negative impacts on global steel demand. This could make the road bumpier for the steel industry

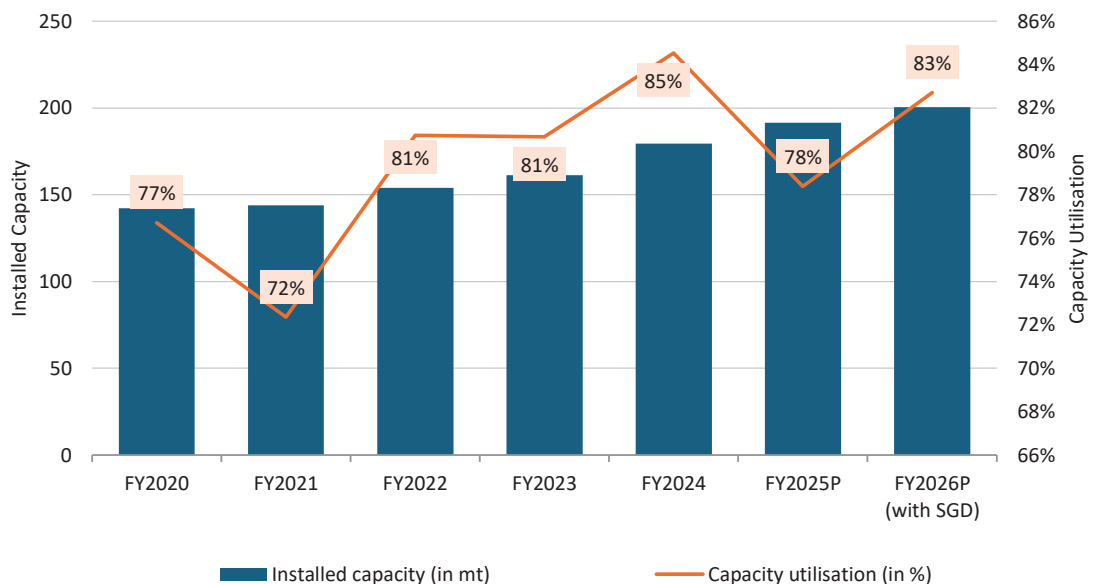
over the medium term. The latest recommendation of the DGTR alleviates some of the downside risks that the industry was staring at, giving the industry additional buffer to weather adverse external macroeconomic shocks as it embarks on an unprecedented capacity expansion plan.

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RITABRATA GHOSH
Vice President and
Sector Head
ICRA Limited

Exhibit: Trend in steel industry capacity utilisation



Source: JPC, ICRA Research

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A design-to-fabrication precast project executed completely on Tekla Structures



This case study highlights how Pinnacle Infotech continues to push the boundaries of digital construction through advanced BIM tools, such as Tekla Model Sharing and 3D rebar detailing, delivering high-quality solutions to global clients

Established in 1991 at Durgapur, India, Pinnacle Infotech has made a global presence with offices at Kolkata & Jaipur (India), USA, UK, Switzerland, Italy and UAE. As an early adopter of Building Information Modelling (BIM), the company deems that the technology is a key driver of their progress towards better construction and infrastructure engineering and has enabled them to offer the best service to architects, engineers, contractors, sub-contractors and consultants across the world.

The exceptional focus on pre-construction planning and the BIM implementation has facilitated Pinnacle to track project timelines, material costs, conflict resolutions and other elements in advance. Further this has led to an overall savings of about 30% of the actual estimate thus establishing the company as one of the global leaders in MEP designing and detailing services.

Constructing the future Visa global HQ in Mission Rock, San Francisco

The northernmost building in the Mission Rock master plan, building G, is a 13-storey building, influenced by the Devils Postpile National Monument's striped basalt columns in

eastern California. This tower will take the form of a detailed rock face with a mass of stacked blocks and vertical sheers highlighted by green terraces and a textured natural façade at street level. It will rise from a fifth-floor mesa and have wind-sheltered rooftop terraces at the top, offering views of the San Francisco skyline.

The project scope of work included BIM modeling for 300,000 sq. ft. office building, reinforcement modeling for 700+ panels, individual piece ticket, connection & GA drawings, clash co-ordination, report generation (BOM, BBS)

“Our team benefited in terms of accuracy, data integrity, revision management, quality of detailing and higher productivity by using Tekla Structures. We successfully generated coordinated models and allowed our consultant to check possible interference with building systems, leading to better project planning and reducing delay in construction. Tekla Structures played a vital role in design optimization, coordination and construction management. It was a pleasure to see that our BIM engineers worked in a coordinated manner, completing the project on time,” says Sapna Patwari, Co-Founder & Director, Pinnacle Infotech



Challenges that could have hindered the progress of the project

- Large volume of work with aggressive deadlines: The volume of the project work was large with all the precast services including concrete modeling, reinforcement modeling, co-ordination, clash detection, panel drawings, GA drawings, connection drawings, embed shop drawings, etc. Moreover, the overall project completion schedule had a deadline of just 10 months.
- Difficulty in handling structural elements: Interoperability between the design and structural model was a critical challenge for the Pinnacle team. All the precast panels were unique in shape and size. Besides that, the inclined grids and multiple uses of the structure at each level proved to be quite challenging.
- Complex concrete forms & designs: The accuracy of the concrete rebar reinforcement depends on the accuracy of modeling. In a 2D drawing, bar specifications can be incorrect. Similarly, a simple typo error might cause many inconveniences in a 2D design world.

Tekla's features that enabled the project team to deliver comfortably

"Tekla proved extremely helpful in many aspects across the whole lifecycle of the project like the auto generation of production drawings, the bar bending schedules related to it, the detailed blowouts, etc. This advanced constructible BIM software upheld the entire project, from conceptual

planning of the buildings and infrastructure to fabrication, construction, and maintenance," says Goutam Das, Project Delivery Head, Pinnacle Infotech. "With its designing, detailing, and information management capabilities, it enabled the team to identify & eliminate the critical issues (clashes) in the entire process much ahead of the on-ground or on-site construction, thus saving huge amounts of time and cost by eliminating rework & material wastage," Das added.

Last but not least, various small tools like the floor layout, stair component, etc, were of great help in further enhancing the productivity of the team. Tekla solutions empowered the project team in several other ways:

- Collaboration through Tekla Model Sharing: Tekla Model Sharing enabled efficient global collaborative modeling within one Tekla Structures model. It gave users and project stakeholders the freedom to work with the same model at the same time in different locations and time zones.



- Developing geometry & efficiencies with Tekla Structures: Using Tekla Structures, the Pinnacle team was able to produce a large number of precast elements, address critical geometries, implement MEP requirements and a lot more, quite easily and well within the specified project timeline. Tekla's features, like system components and custom components, were used efficiently & smartly to reduce the project time.
- 3D rebar detailing in Tekla: With 3D modeling and detailing, Pinnacle project team were able to deliver better drawings than the traditional drawings. There were fewer drawing errors and simple typos, such as wrong bar sizes. Less congestion in the information flow translated into a lot less cutting & bending onsite. The executing team was able to avoid on-site clashes between rebar and, for instance, steel, mechanical and electrical elements.

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Accelerating Construction

Driven by government mandates for accelerated project timelines and infrastructure modernization, precast concrete is gaining prominence as a strategic construction technology—offering standardized quality, reduced on-site labor dependency, faster execution, and enhanced compliance with safety and sustainability norms across all the infrastructure sector. With galore of infrastructure projects in the pipeline, the demand for precast concrete would soar in the coming years



As part of my daily routine, I commute to my workplace by train - like millions of others in Mumbai. On some days, I'm lucky enough to get a window seat; on others, I settle for the fourth seat or end up standing. One morning, as the train slowed near a familiar stretch, I noticed a plot of land being enclosed with metal sheets. Curious, I later found out that a major real estate project was coming up there. It was just a quick glance through the window—but enough to pique my interest.

After a week of missing that view - and a brief work trip to another city - I was back on my usual route. This time, luck was on my side again: I got the window seat. What I saw amazed me. In such a short time, the site had transformed. A building had already reached the fourth floor. The pace of construction was striking. I watched as massive concrete slabs were being hoisted and set into place with remarkable speed and precision.

The Eureka moment for me - it was precast concrete in action.

In earlier years, precast concrete wasn't widely used- perhaps because the technology was relatively new and more expensive compared to traditional construction methods. The conventional approach, which we're all familiar with, is the brick-and-mortar method. This age-old technique, the most common in India, relies on bricks bonded with cement mortar and has been the backbone of the country's building practices for centuries. It involves preparing all raw materials - concrete, bricks, steel - directly at the construction site and then constructing the structure from the ground up, piece by piece. While this method is still widely used, several modern construction technologies have also gained ground over the years. Precast concrete is one such innovation.

Expanding the horizon

Precast concrete is one of the fastest-growing construction technologies today. With stricter government regulations and tighter project deadlines, it has steadily gained ground over traditional construction methods. Its increasing adoption can be attributed to its efficiency, consistency, and speed of execution-qualities that are essential in today's fast-paced construction environment. "While traditional materials continue to have higher market adoption, precast concrete is emerging as an effective solution - delivering superior quality, reduced construction time, and a significantly lower environmental impact. Precast concrete construction is more than just an alternative - it's a smarter way to build. Precast concrete can stay relevant and competitive by embracing innovation and sustainability," says Abhijit Gawde, Head of Marketing & Business Development, Construction business of Godrej Enterprises Group.

Leading the pack

But what exactly is precast concrete, and why is it gaining such momentum?

Precast concrete is a construction product made by casting concrete in a reusable mould or "form," which is then cured in a controlled environment, transported to the construction site, and maneuvered into place. Examples include precast beams and wall panels used in tilt-up construction. In contrast, cast-in-place concrete is poured into site-specific forms and cured directly on-site - often making it more vulnerable to delays caused by weather conditions, labour shortages, or inconsistencies in materials. One of the key advantages of precast concrete lies in the controlled production environment. By manufacturing components in a dedicated precast plant, the process allows for greater quality control, uniformity, and better curing conditions, ensuring the durability and strength of the final product. Speed is another major advantage. Since components are manufactured in advance and delivered ready for installation, construction time is significantly reduced - making precast ideal for projects with tight timelines. Safety and efficiency also improve, as most production happens at ground level, minimizing on-site risks and reducing the reliance on extensive scaffolding or formwork.



Cost-effectiveness comes from the reusability of moulds. In a precast plant, moulds can be used hundreds or even thousands of times, significantly lowering the cost per unit compared to on-site casting. Sustainability is yet another benefit. Precast production generates less material waste and can incorporate eco-friendly materials like lightweight expanded polystyrene (EPS) foam, which improves thermal insulation while reducing overall panel weight. “Unlike traditional construction methods that depend heavily on on-site labour and extended timelines, precast concrete offers several key advantages. It enables faster project completion, as precast elements are manufactured off-site and quickly assembled on-site, minimizing construction delays. It also ensures cost efficiency by reducing labour requirements and minimizing material wastage, which lowers overall costs. Additionally, factory-controlled production allows for consistent quality and structural integrity. From a sustainability perspective, precast construction consumes less water and generates minimal construction waste. To further strengthen its market position, the precast concrete industry must continue focusing on innovation, automation, and increasing awareness of its numerous advantages,” says Krishan Mohan Sharma, Head of India Operations, Vollert India.

Solutions in action

Precast concrete is used in both interior and exterior applications, making it one of the most versatile construction materials available today. Its usage spans a wide range of sectors - including infrastructure, commercial, industrial, and residential projects. In infrastructure, precast concrete is commonly used for highways, flyovers, bridges, tunnels, underpasses, metro rail systems, and railway platforms. Components like girders, crash barriers, culverts, and retaining walls are manufactured offsite and quickly assembled on location, minimizing traffic disruption and project timelines. In high-rise and mid-rise residential or commercial buildings, precast elements such as wall panels, floor slabs, staircases, balconies, columns, and beams offer both structural support and design flexibility. These components can be custom-designed for architectural finishes, insulation needs, and functional integration like plumbing or electrical channels.

Tilt-up construction, typically used for warehouses, industrial sheds, logistics hubs, and data centers, is another major application. Here, large precast wall panels are cast horizontally at the site or in a nearby factory, then tilted vertically and secured in place - offering rapid assembly and significant savings in labour and time. In urban settings, precast is increasingly being used for stormwater drains, manholes, boundary walls, street furniture, and even

precast toilets and small modular structures, addressing both infrastructure and urban development goals. Its adaptability also supports innovative and green building practices. Precast can be integrated with thermal insulation, soundproofing, and energy-efficient building systems, making it ideal for modern, sustainable construction.

Unlocking market potential

Whether the priority is speed, structural integrity, cost-efficiency, or design flexibility, precast concrete consistently delivers—making it a preferred choice for developers, engineers, and urban planners alike. It’s no surprise, then, that the market for precast construction in India has witnessed significant growth in recent years. “India’s precast industry is experiencing robust growth, fueled by rapid urbanization, increased infrastructure investment, and significant technological advancements. The rising demand for faster and more cost-effective construction solutions is accelerating the adoption of precast methods across residential, commercial, and industrial sectors. Technological innovations such as automation, AI-driven production planning, and robotics are further enhancing the efficiency and precision of precast manufacturing,” says Krishan Mohan Sharma. According to a report by Grand View Research, the India precast concrete market was valued at USD 6.16 billion in 2023 and is projected to grow at a CAGR of 9.2% from 2024 to 2030. The report attributes this growth to a combination of factors, including exponential population rise, rapid urbanization, large-scale infrastructure development, growing demand for sustainable construction methods, technological advancements, and the pressing need for affordable and efficient residential spaces.

Overcoming challenges

The precast concrete industry, while rapidly evolving, still faces several challenges. One of the primary concerns is the perception of high initial investment, as establishing automated precast plants involves substantial capital expenditure. This issue is gradually being addressed through the availability of industry-specific loans and financial incentives offered by banks and lending institutions. Another persistent challenge is the limited awareness among developers and contractors, many of whom continue to rely on traditional construction methods. The industry leaders and associations are taking proactive steps by conducting awareness drives, technical seminars, and skill development workshops to highlight the efficiency, durability, and long-term value of precast construction.

Precast concrete structures are manufactured in controlled factory environments and then transported to



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the construction site for assembly. However, transportation costs - which include fuel, labour, warehousing, and handling - can be highly volatile. Any increase in these costs directly impacts the overall project budget, a burden that ultimately falls on the end user. At the site, the installation of precast components requires heavy-duty cranes, which further adds to the operational costs. Handling these components also demands strict safety protocols, as precast elements are typically large and heavy, making them prone to damage if not managed carefully. "Transportation and logistics also pose difficulties, particularly in moving large precast elements to project sites. These issues are being mitigated through optimized supply chain management and the establishment of local manufacturing hubs," says Krishan Mohan Sharma.

The precast construction industry in India is also experiencing a significant shortage of skilled labor, particularly in areas such as production, handling, and assembly of precast elements. To tackle this issue, targeted training programs and



collaborations with technical institutes are being developed to build a skilled workforce and ensure quality standards across the sector. "To enhance the knowledge and skills of labourers, we have recently launched the TUFF Knowledge Series on YouTube. This series currently focuses on training the workforce in best practices for the effective use of Autoclaved Aerated Concrete (AAC) Blocks, covering aspects such as, how AAC Blocks make construction faster and more efficient," says Abhijit Gawde. Vollert India offers hands-on training and apprenticeship programs focused on precast production and installation, ensuring practical exposure for new entrants. In addition, the company is collaborating with engineering institutes to introduce specialized courses in precast technology, bridging the gap between academia and industry needs. "To further enhance knowledge and adoption, we are conducting nationwide skill development workshops aimed at educating professionals and contractors about modern precast techniques. By investing in workforce development, we aim to create a talent

pool capable of driving the precast industry forward," says Krishan Mohan Sharma.

Scaling new heights

The precast concrete industry in India is witnessing unprecedented momentum, driven by a combination of government policy support, urbanization, infrastructure demand, and sustainability goals. One of the most significant catalysts has been government policies mandating the use of precast technology in infrastructure projects, including metro rail systems, bridges, and highways. The increased preference has, in turn, attracted investment in automated precast plants, fostering innovation, scalability, and widespread adoption across the country. With precast elements produced in controlled environments and assembled on-site, projects benefit from reduced timelines, lower labour costs, and consistent quality. Additionally, the reusability of moulds and reduction in on-site construction waste contribute to a lower carbon footprint, aligning well with India's green building initiatives and climate commitments. The government's flagship urban development programs such as the Smart Cities Mission, Housing for All, and PMAY (Pradhan Mantri Awas Yojana) have fueled demand for faster and scalable construction technologies. In urban housing, precast technology has proven particularly effective. Rapid economic growth and limited land availability have restricted horizontal development, pushing real estate towards vertical construction. In this scenario, precast has become the go-to solution for building high-rises, especially in metro cities where older structures and slums are being redeveloped into modern, multi-story complexes. In the infrastructure sector, precast technology is helping developers meet stringent deadlines. Components like girders, bridge sections, and pillars are fabricated off-site and transported for quick assembly - saving on labour, reducing waste, and ensuring consistent quality. As India's infrastructure pipeline expands - with major investments in transport, logistics parks, airports, industrial corridors, and smart cities - precast is expected to play a critical role in meeting the demand for timely, efficient construction.

Bright roads ahead

As India accelerates its push toward urban transformation, sustainable infrastructure, and timely project execution, precast concrete is no longer just an alternative - it is becoming a necessity. With strong policy backing, rising private investment, and expanding applications across sectors, the precast industry is set to play an important role in shaping the country's infrastructure landscape.

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Precast concrete remains highly relevant



We are expanding our market presence into tier-2 and tier-3 cities to drive wider adoption of precast technology, says **KRISHAN MOHAN SHARMA**, Head of India Operations, Vollert India

With traditional construction materials still dominating the industry, how can precast concrete maintain its relevance and strengthen its competitive edge in the market?

Precast concrete remains highly relevant due to its efficiency, durability, and sustainability. Unlike traditional construction methods that depend heavily on on-site labor and extended timelines, precast concrete offers several key advantages. It enables faster project completion, as precast elements are manufactured off-site and quickly assembled on-site, minimizing construction delays. It also ensures cost efficiency by reducing labor requirements and minimizing material wastage, which lowers overall costs. Additionally, factory-controlled production allows for consistent quality and structural integrity. From a sustainability perspective, precast construction consumes less water and generates minimal construction waste. To further strengthen its market position, the precast concrete industry must continue focusing on innovation, automation, and increasing awareness of its numerous advantages.

What is your take on government support for the precast industry by mandating a stipulated proportion of precast concrete usage in the infrastructure sector? How has this step benefited the industry?

Government policies mandating the use of precast concrete in infrastructure projects have been a game-changer for the construction industry. This initiative has led to increased adoption, with developers and contractors now prioritizing precast methods over traditional construction. It has also boosted investment, as more firms are setting up automated precast plants, driving innovation and scalability across the sector. Furthermore, the use of precast elements has enhanced quality and safety, ensuring compliance with stringent standards and improving the durability of infrastructure. On the sustainability front, precast construction helps reduce carbon footprints, aligning well with India's green building initiatives. With continued government support, the precast sector is well-positioned for exponential growth, particularly in urban housing, metro rail projects, and industrial infrastructure.

Please provide an overview of the precast industry in India, including the current market demand, technological advancements, and key growth drivers.

India's precast industry is experiencing robust growth, fueled by rapid urbanization, increased infrastructure investment, and significant technological advancements. The rising demand for faster and more cost-effective construction solutions is accelerating the adoption of precast methods across residential, commercial, and industrial sectors. Technological innovations such as automation, AI-driven production planning, and robotics are further enhancing the efficiency and precision of precast manufacturing. Key

substantial capital. However, this is gradually being addressed with financial institutions offering industry-specific loans and incentives. Another challenge is the lack of awareness among developers, many of whom continue to rely on traditional construction methods. In response, industry leaders are organizing awareness programs and training workshops to promote the benefits of precast.

Transportation and logistics also pose difficulties, particularly in moving large precast elements to project sites. These issues are being mitigated through optimized supply chain management and the establishment of local manufacturing hubs. Additionally, there is a



drivers of this growth include government initiatives like the 'Smart Cities Mission' and 'Housing for All', the ongoing expansion of metro rail networks, highways, and commercial infrastructure, as well as a growing preference for sustainable construction practices. With these factors in play, India's precast industry is expected to expand significantly in the coming years.

Could you outline some key challenges currently facing the precast industry in India and how industry players are overcoming them?

Despite its numerous advantages, the precast industry faces several challenges. One major hurdle is the perception of high initial investment, as setting up automated precast plants requires

shortage of skilled workers in the sector. To overcome this, training initiatives and partnerships with technical institutes are being implemented to bridge the skills gap and support industry growth.

There is a shortage of skilled manpower in precast manufacturing and construction. What initiatives is your company taking to develop and enhance the skilled workforce in this sector?

To address the skilled manpower shortage in the precast industry, we have launched several strategic initiatives. We offer hands-on training and apprenticeship programs focused on precast production and installation, ensuring practical exposure for new entrants. In addition, we are collaborating with engineering institutes to

introduce specialized courses in precast technology, bridging the gap between academia and industry needs. To further enhance knowledge and adoption, we are conducting nationwide skill development workshops aimed at educating professionals and contractors about modern precast techniques. By investing in workforce development, we aim to create a talent pool capable of driving the precast industry forward.

What sustainable materials are being utilized in precast concrete production to minimize greenhouse gas emissions, and how is your organization contributing to this effort?

The concrete industry is rapidly embracing sustainability through reduced cement usage, use of recycled aggregates, high-performance admixtures, and closed-loop water systems—all aimed at lowering carbon emissions and conserving resources. While Vollert India does not produce concrete directly, our precast mould systems are fully compatible with these advancements. We integrate piping solutions within the moulds that help accelerate curing time, thereby reducing both water and energy consumption. Additionally, our moulds are engineered for dimensional precision, which eliminates rework at the site—saving material, labour, and time. By supporting faster, more efficient, and accurate production, our mould technology directly contributes to reducing overall greenhouse gas emissions and promotes a more sustainable construction process.

Can you share insights on the role of AI, robotics, and 3D printing in enhancing precast efficiency?

Emerging technologies are revolutionizing precast manufacturing by enhancing efficiency, precision, and customization. Artificial Intelligence (AI) and predictive analytics are being used to optimize production schedules and minimize defects. Robotics and automation are improving accuracy in mold preparation, concrete pouring, and curing processes. Additionally, 3D printing is enabling the creation of customized and complex precast components while significantly reducing material waste. By integrating these technologies, the precast industry is moving towards smarter, faster, and more efficient production systems.

Have you entered into any collaboration, partnership, or joint venture to enhance innovation, sustainability, or efficiency in precast concrete production?

Yes, strategic collaborations play a crucial role in our innovation efforts. We have partnered with leading engineering institutes to conduct research on advanced precast materials. We are also working with global technology firms to integrate AI and automation into our production systems. Additionally, we collaborate with sustainability experts to develop eco-friendly concrete formulations, ensuring our processes align with green building standards. Additionally, we are working closely with major industry players such as Adani Group, L&T and TATA Group bringing cutting-edge precast technology to their infrastructure projects. These collaborations ensure that our solutions remain at the forefront of industry advancements.

What are your organization's key growth targets, expansion plans, and strategies for advancing in the precast industry this financial year, including efforts to expand the use of precast in new applications?

Our growth strategy is centered around several key pillars. We are expanding our market presence into tier-2 and tier-3 cities to drive wider adoption of precast technology. Technological innovation is a major focus, with significant investments in AI-driven manufacturing, robotics, and smart precast solutions, including advancements in Production Control Systems. We are also exploring new applications for precast concrete in areas such as modular housing, railway infrastructure, and industrial facilities.

On the sustainability front, we are enhancing eco-friendly precast formulations and adopting energy-efficient production methods. Optimized production plays a critical role in this strategy by improving efficiency in precast manufacturing through real-time data monitoring. This leads to substantial cost savings by minimizing material waste and reducing unnecessary rework. Additionally, it supports sustainability by lowering our carbon footprint through optimized energy and resource usage. Ultimately, these initiatives enable faster construction by streamlining logistics and reducing project delays. With these strategies, we aim to drive the next phase of growth for precast construction in India and beyond.

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Precast concrete construction is a smarter way to build



Precast construction ability to meet sustainability benchmarks will continue to drive its adoption, says **ABHIJIT GAWDE**, Head of Marketing & Business Development, Construction business of Godrej Enterprises Group

With traditional construction materials still dominating the industry, how can precast concrete maintain its relevance and strengthen its competitive edge in the market?

At Godrej Enterprises Group, we recognize that the construction industry is shifting towards more sustainable and efficient solutions. While traditional materials continue to have higher market adoption, precast concrete is emerging as an effective solution - delivering superior quality, reduced construction time, and a significantly lower environmental impact. Precast concrete construction is more than just an alternative - it's a smarter way to build. Precast concrete can stay relevant and competitive by embracing innovation and sustainability. Our experience with projects like, 'The Cocoon,' a 500 sq ft 3D printed office in Khalapur - installed and made fully functional in under timeframe of 40 hours, showcases how innovative project execution approaches can significantly cut construction time. Beyond speed, precast concrete solutions are becoming economically viable in the long run, offering lower operational and maintenance costs due to superior durability

and energy efficiency. As green building standards tighten, precast construction ability to meet sustainability benchmarks will continue to drive its adoption.

Please provide an overview of the precast industry in India, including the current market demand, technological advancements, and the key factors driving its growth and adoption?

The real estate and construction sector's momentum has led to an increase in new project launches, boosting the demand for sustainable building materials and technologies. Increased government spending on major urban infrastructure projects, need for faster project completion, and advancements in digital construction technologies like BIM & Lean Construction, are some of the key growth drivers for precast construction.

The Godrej TUFF brand of Construction Materials offers a breakthrough range of customised and environmentally friendly building products. We have received 'Green Pro' certification from Indian Green Building Council (IGBC) for our range of Ready-Mix Concrete (RMC) solutions, Autoclaved

Aerated Concrete (AAC) Blocks, prefabricated concrete products, such as Recycled Concrete Blocks, Recycled Pavers, U-Drains, Box Culverts, etc. Technological advancements, such as our 3D Construction Printing (3DCP) Technology, are expected to transform the real estate and construction industry. Our project, 'The Cocoon,' a 500 sq ft 3D printed office, illustrates these advancements. By applying Lean Construction principles and utilizing tools like Building Information Modelling, the construction process of 'The Cocoon' was meticulously planned and streamlined, ensuring maximum efficiency and cost-effectiveness.

Could you outline some of the key challenges currently facing the precast industry in India and how are industry players overcoming these challenges?

Despite its potential, the precast industry faces several challenges, such as higher initial costs compared to traditional methods, limited government policy support for sustainable and recycled materials, lack of standardized codal provisions promoting new precast adoption in architectural design new methods and materials for construction at the design stage.

There is a shortage of skilled manpower in precast manufacturing and construction. What initiatives is your company taking to develop and enhance the skilled workforce in this sector?

The Indian Real Estate and Construction industry is grappling with an increasing shortage of skilled labours. At Godrej Enterprises Group, we prioritize workforce development through collaboration and knowledge sharing. To enhance the knowledge and skills of labourers, we have recently launched the TUFF Knowledge Series

on YouTube. This series currently focuses on training the workforce in best practices for the effective use of Autoclaved Aerated Concrete (AAC) Blocks, covering aspects such as, how AAC Blocks make construction faster and more efficient, learn about the sustainability benefits of using AAC Blocks in your projects, etc. In future, we aim to continue to build TUFF Knowledge Series to cover more wider topics related to construction industry.

What sustainable materials are being utilized in precast concrete production to minimize greenhouse gas emissions, and how is your organization contributing to this effort?

Recently, our Recycled Concrete Materials Manufacturing Plant in Vikhroli, Mumbai has been awarded with 'Green Co' Gold Certification by the IGBC. This plant runs on 100% Green Power. Similarly, our 4 Ready Mix Concrete (RMC) batching plants in the Mumbai-MMR & Pune region have received 'Green Pro' certification from the IGBC. We are one of the first in the RMC industry to switch to 100% green energy, all our own Ready Mix Concrete manufacturing plants powered by 'GREEN POWER,' certified by the Maharashtra State Electricity Board (MSEB). We understand that every construction project is unique. That's why we offer tailor-made prefabricated concrete solutions designed to meet the specific requirements of each project. Our team of experienced engineers works closely with clients to understand their needs comprehensively. Through this collaborative approach, we develop customized prefabricated solutions that guarantee optimal performance and cost-efficiency.

We are delighted that we could be a part of prestigious Mumbai Coastal Road project, for which we have supplied 440 large precast concrete box

culverts, each weighing from 30 to 35 metric tonnes. These precast concrete box culverts have been used for the construction of storm water outfall into the Arabian Sea. The box culverts have been manufactured to withstand the harsh conditions of the coastal environment, and also the heavy traffic loading conditions. With an intent to help contribute towards sustainable development, our concrete mix design has used up to 10 % recycled concrete mix in the manufacturing of these box culverts. This aspect was incorporated into the design of these concrete structures in close coordination with the concerned project consultants and authorities. Based on our successful experience on Mumbai Coastal Road Project, we have recently bagged an order for Versova Bandra Sea Link (VBSL) project, to manufacture and supply over 3,500 precast sacrificial slabs for the Temporary Access Bridge (TAB) and 500 precast tub components for sacrificial formwork. Each component measures 8x3 meters with a 350 mm depth, designed to meet the highest standards of strength and durability. These precast components incorporate 10% Recycled Concrete Aggregates (RCA), produced at our Recycled Concrete Materials manufacturing plant at Vikhroli, Mumbai.

What are your organization's key growth targets, expansion plans, and strategies for advancing in the precast industry this financial year, including efforts to expand the use of precast in new applications?

We aim to leverage the prevailing positive market sentiments in real estate and construction industry and expand our TUFF range of sustainable construction materials, with a commitment that every solution we develop is efficient, cost-effective, and environmentally responsible for built environment.

EPC World

Financing the future

How Indian municipal corporations are raising capital for urban development



As urbanization accelerates and traditional revenue streams—such as property taxes and government grants—struggle to keep pace with rising demands, municipalities are increasingly turning to innovative financing mechanisms. In this article, Tejasvi Sharma explores how cities are bridging funding gaps and driving development through alternative models like municipal bonds, public-private partnerships (PPPs), land monetization, and green bonds. These emerging approaches are not only unlocking new capital but also reducing reliance on state support, paving the way for more resilient and self-sufficient urban growth.

Municipal corporations in India are at the forefront of managing the challenges that come with rapid urbanization. As cities grow, the demand for better infrastructure, efficient public transport, improved sanitation, and sustainable housing increases exponentially. However, the financial pressure on municipal corporations to deliver these services is immense. With limited traditional revenue streams and growing budgetary constraints, innovative financing options are emerging as a lifeline for Indian cities striving to meet the needs of their expanding populations.

The traditional model of municipal financing

Traditionally, municipal corporations in India have relied heavily on property taxes, user charges,

and government grants to finance their operations. Property tax, which is levied on residential, commercial, and industrial properties, remains a key source of income. However, collection inefficiencies and outdated valuation methods have resulted in lower-than-expected revenues. For example, according to a 2022 report by the Ministry of Housing and Urban Affairs, India's property tax collection efficiency stands at just around 60%, significantly lower than that of developed countries.

User charges for water supply, waste management, and sewage treatment have also contributed to municipal coffers. However, the reluctance to revise user charges to reflect actual costs has limited their potential as a reliable revenue source. Meanwhile, government grants and state transfers, often tied to specific schemes like the Smart Cities Mission and AMRUT (Atal Mission



for Rejuvenation and Urban Transformation), have provided critical funding but are insufficient to meet the full scope of urban development needs.

The shift towards innovative financing

Recognizing the limitations of traditional revenue models, municipal corporations in India have begun exploring innovative financing mechanisms to bridge the funding gap. This shift is not only enabling cities to undertake large-scale infrastructure projects but also enhancing their financial independence and creditworthiness.

Municipal bonds: Tapping into capital markets

One of the most groundbreaking developments in municipal finance has been the rise of municipal bonds. Municipal bonds allow local governments to raise funds directly from domestic and international investors, offering them a fixed return over a period of time.

In 2017, the Pune Municipal Corporation (PMC) made headlines when it became the first Indian city in 14 years to issue a municipal bond. The ₹200 crore bond, issued at an interest rate of 7.59%, was oversubscribed, reflecting strong investor confidence. The funds raised were earmarked for the 24x7 water supply project, which

aimed to provide uninterrupted water to the city's residents. Following Pune's success, cities like Indore, Ahmedabad, and Hyderabad have also successfully issued bonds, with the Indore Municipal Corporation raising ₹223 crore in 2023 to fund waste-to-energy projects.

"Municipal bonds have provided us with a sustainable way to raise capital for long-term projects without being dependent on government grants," said Kunal Kumar, former municipal commissioner of Pune. "It has also instilled financial discipline and accountability within the corporation."

Public-Private Partnerships (PPP): Sharing the load

Public-Private Partnerships (PPP) have emerged as a successful model for financing and executing infrastructure projects. Under this arrangement, municipal corporations collaborate with private sector players to design, build, finance, and operate urban infrastructure.

The Hyderabad Metro Rail project stands as a shining example of a successful PPP initiative. Launched in 2017, the ₹18,800 crore project was executed under a Build-Operate-Transfer (BOT) model, with L&T Metro Rail (Hyderabad) handling construction and operations. Today, the Hyderabad Metro is one of the largest metro networks in the world, carrying over 400,000 passengers daily.

"PPP projects allow us to leverage private sector expertise and capital while ensuring that public interests are protected through regulatory oversight," said a senior official from the Hyderabad Metropolitan Development Authority.

Land monetization and development rights

Municipal corporations have also turned to land-based financing to raise funds for urban development. In Mumbai, the municipal corporation has generated significant revenue by selling development rights and floor space index (FSI) to builders. The funds raised through these transactions have been used to finance public transport and housing projects. For instance, the Mumbai Metropolitan Region Development Authority (MMRDA) raised over ₹3,000 crore

through the sale of land parcels in the Bandra-Kurla Complex (BKC), one of the city's prime business districts. The funds were channeled into the construction of new metro lines and road networks, improving connectivity and reducing congestion in the city.

Green Bonds: Financing sustainability

Green bonds have emerged as a powerful tool for financing environmentally sustainable projects. These bonds are designed to fund projects with a positive environmental impact, such as renewable energy, waste management, and sustainable public transport. In 2022, the Ghaziabad Municipal Corporation became the first in India to issue a green municipal bond, raising ₹150 crore. The proceeds were used to construct a 20 MW solar power plant, aimed at reducing the city's carbon footprint and lowering energy costs. The bond was listed on the Bombay Stock Exchange (BSE) and received strong interest from institutional investors. "This is not just about raising funds; it's about creating a sustainable future for our city," said the Mayor of Ghaziabad. "Investors are increasingly looking at ESG (Environmental, Social, and Governance) factors, and green bonds provide an opportunity to align financial and environmental goals."

Tax increment financing (TIF): Capturing future value

Tax Increment Financing (TIF) involves earmarking future property tax revenue increases within a designated area to fund infrastructure improvements. Though relatively new in India, TIF has been successfully implemented in cities like Chicago and New York. In India, Surat has experimented with a modified version of TIF by designating special development zones where increased property tax revenue from new commercial developments is used to finance urban infrastructure. This model creates a self-sustaining funding loop, where infrastructure improvements lead to higher property values and increased tax revenue.

International loans and grants

International funding agencies like the World Bank and the Asian Development Bank (ADB) have also stepped in to support Indian cities in their infrastructure push. The World Bank recently

extended a \$500 million loan to the Tamil Nadu Urban Development Project, aimed at improving urban transport, water supply, and waste management across several cities in the state. "These loans come with technical expertise and performance-linked incentives, encouraging cities to adopt global best practices in project execution and governance," said a senior official from the Ministry of Urban Affairs.

Overcoming challenges and looking ahead

Despite the success of these innovative financing models, municipal corporations in India face several challenges. Political interference, administrative inefficiencies, and low creditworthiness continue to limit the scale and effectiveness of these measures. Moreover, ensuring that funds are used transparently and effectively remains a critical concern. To address these challenges, municipal corporations need to strengthen their financial management frameworks, improve credit ratings, and adopt data-driven governance models. Increasing citizen participation in budget planning and decision-making can also enhance transparency and accountability.

Conclusion: Financing the urban future

The financial landscape for municipal corporations in India is undergoing a transformation. The adoption of innovative financing models such as municipal bonds, PPPs, green bonds, and land-based financing is helping cities unlock new sources of capital and reduce dependence on government funding. While challenges remain, the success of projects in Pune, Hyderabad, Mumbai, and Ghaziabad demonstrates the potential of these models to reshape India's urban future. As cities continue to grow, the ability of municipal corporations to secure sustainable and diversified funding will determine the pace and quality of urban development in India. The future of Indian cities depends not just on visionary planning but also on smart financing.

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