PowerLine TransTech India 2025
EXHIBITION AND CONFERENCE

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TransTech India 2025 Begins

TransTech India 2025 gets off the ground today. The second edition of *Power Line*'s trade show on power transmission, featuring a three-day exhibition and conference, is bigger and better than before. The event is being officially supported by the Ministry of Power. The country's top transmission developers – Power Grid Corporation of India Limited, Adani Energy Solutions Limited, IndiGrid, Resonia and Tata Power – are also supporting the event.

The mission of TransTech India is to provide a platform for industry leaders, innovators and visionaries to showcase the latest advancements, exchange insights and forge collaborations that will shape the future of power transmission in India. The transmission sector has achieved remarkable progress over the years, evolving from a fragmented network into a cohesive and interconnected synchronous grid. The Indian grid is technologically at par with best-in-class international utilities.

The first edition, held in 2024, received a tremendous response from the industry. It had 1,500 participants from over 400 organisations. This year's event is much bigger and will attract more than 3,000 visitors from over 550 organisations, representing developers, government agencies, state transcos, system operators, regulators, technology providers, EPC contractors, financiers/investors, consultants, etc. It has representation from almost every state and every segment of the industry as well as international participation.

The exhibition, which has attracted leading technology players and equipment manufacturers, showcases cutting-edge solutions, innovative projects and noteworthy initiatives.

A high-level conference, with a stellar cast of speakers, is also being held for stakeholders to discuss key trends, developments, challenges and opportunities in the Indian transmission sector. It will feature views from top industry leaders. It will cover topics such as EPC perspective, state initiatives, O&M best practices, GRID-INDIA initiatives, as well as discussions on topics such as supply chain and procurement challenges, cross-border transmission, renewable energy evacuation, and skill development for transmission. It has dedicated technical sessions on towers, transformers, substations, AI and digitalisation, drones, and cables/conductors. The event will also feature the presentation of transmission utility awards.

TransTech India 2025 will thus put the spotlight on critical priorities in the country's power transmission sector and provide a platform for meaningful stakeholder dialogue. ■

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Global Transmission Report

Interview with Dr R.K. Tyagi

"The power sector of the future is going to be Green, Global and Digital"

Dr Ravindra Kumar Tyagi is the Chairman and Managing Director of Power Grid Corporation of India Limited (POWERGRID), a Maharatna CPSU under the Ministry of Power. In an interview with *Power Line,* Dr Tyagi shared his perspective on the state of the transmission segment, the emerging opportunities and challenges, the company's recent achievements and its priorities for future growth. Edited excerpts…

What is your view on the current state of the power transmission segment? What are the key challenges?

The expansion of India's transmission infrastructure has kept pace with its growing generation capacity. From isolated regional grids, India has developed an extensive national grid that facilitates seamless power flow across states and regions. Currently, India's transmission network ranks among the largest globally, supporting both conventional and renewable energy sources while ensuring grid stability. Investments are being channelled into modernising infrastructure, deploying advanced technologies and improving interconnectivity to adapt to the dynamic energy landscape.

The national grid is undergoing continuous expansion through the addition of transmission lines and power transformation capacity to accommodate rising electricity demand and increasing generation capacity. In parallel, advancements in high-voltage transmission and emerging technologies are enhancing the efficiency and scale of bulk power transfer.

However, some critical challenges remain, such as obtaining clearances for forest and wildlife areas, securing land for substations, and managing right of way through forests, agricultural land, urban areas and industrial zones. Moreover, the projects are affected by shortages in skilled manpower and manufacturing capacity of some equipment/items in the country. Upgrading transfer capacity to match evolving power flows and coordinating with multiple external agencies continue to be major areas of concern.

How do you view the outlook for the power transmission segment over the next decade? What are the biggest opportunities?

India's transmission network is entering a period of unprecedented growth, driven by rising electricity demand, accelerated renewable energy integration, and emerging clean energy applications. Under the National Electricity Plan, around 191,000 ckt km of transmission lines and 1,270 GVA of transformation capacity (220 kV and above) are planned to be added by 2032. Interregional transfer capacity will expand significantly, from 120 GW currently to 143 GW by 2027, and further to 168 GW by 2032, ensuring that power can move seamlessly across regions to balance generation and demand. The plan also envisions the deployment of 47 GW of battery energy storage systems (BESS) and 36 GW of pumped storage, which will play a critical role in managing renewable variability and enhancing grid flexibility.

A key future demand driver will be green hydrogen, with coastal hubs such as Mundra, Kandla, Paradeep, Tuticorin and Visakhapatnam identified as major production centres. These hubs are expected to generate an additional power demand of about 70,500 MW by 2031-32, necessitating the development of dedicated high-capacity transmission systems.

In parallel, cross-border transmission capacity is set to rise with potential extensions to Southeast Asia and the Gulf. Existing cross-border grid connectivity with Nepal, Bhutan, Bangladesh and Myanmar is proposed to be strengthened. An agreement has been signed with Nepal for the implementation of two 400 kV interconnections through the formation of joint ventures.

There is also a growing opportunity in industrial transmission, as large consumers such as hydrogen plants and data centres opt for dedicated transmission lines to ensure reliable, high-quality power supply. In the longer term, the development of ultra-high voltage corridors will further enhance bulk transfer capacity while conserving right of way, enabling the grid to keep pace with rapidly expanding generation and demand.

In the near future, we will witness the growth of 1,100 kV power transmission systems, which will form a key component of the inter-state transmission system.

What are some of the new and emerging technologies that POWERGRID is deploying?

POWERGRID is integrating machine learning (ML)-driven solutions for predictive maintenance and faster corrective action. Technologies such as AI-based defect detection, online condition monitoring and remote operation systems are helping reduce outages, lower failure rates and optimise operations and maintenance costs. The company has also received a patent for a transformer and reactor health assessment system, which enables centralised monitoring of critical assets. POWERGRID, in association with IIT Kanpur, has developed a robot for the inspection of substations. For transmission lines, drone inspections, combined with AI/ML analytics, are improving inspection accuracy and safety, while AR/VR headgear is enabling remote expert-assisted maintenance, reducing downtime and enhancing reliability.

Emergency Restoration Systems, developed with Indian partners, are improving the speed of recovery after extreme events. Also, for substations we are developing mobile GIS bays. One such bay at the 220 kV voltage level has already been developed. We are adopting advanced technologies to enhance grid stability, capacity and resilience. So far, 17 STATCOMs and 3 SVCs have been commissioned, with 10 more STATCOMs under implementation to support dynamic voltage regulation and renewable integration.

High-Temperature Low-Sag (HTLS) conductors are being deployed to increase line capacity without major right-of-way challenges. Insulated cross arms are also being developed for reducing RoW requirements.

We have entered into a master agreement with EPRI USA for collaborative research and development. We have signed an MoU with the Indian Space Research Organisation (ISRO) to develop a Spatial Decision Support System to identify vulnerable towers, monitor vegetation in challenging terrain such as the Himalayas, and train personnel in advanced mapping technologies. We are also working with IIT Madras on offshore pooling substations and undersea export power cables.

POWERGRID has established dynamic line loading on the Madurai-Tuticorin corridor for better system operation. The Company has also set up the Transmission Experience Centre, a state-of-the-art training facility with specialised workshops on AIS and GIS bays, auxiliary equipment, transmission line hardware and AR/VR-enabled simulations, providing hands-on learning for engineers. POWERGRID has been at the forefront in introducing the best technology in the grid. We are committed to leading the foray of the Indian transmission industry into Industry 4.0.

POWERGRID is also leveraging 3D printing and scanning technologies for rapid prototyping and on-site fabrication, supporting maintenance of complex systems such as HVDC, GIS and SVC. Lately, POWERGRID has started exploring the deployment of technology for construction work, including through erection of transmission towers using cranes and stringing of conductors using drones. For better monitoring, we have set up a project monitoring control centre for observing the real-time status of our projects through the use of camera/drones. AI application in project construction is being done in addition to operations and maintenance.

What have been POWERGRID's key recent performance highlights?

Our transmission system availability remained at 99.82 per cent in 2024-25, with trippings per line at 0.27, which are among the best globally. We achieved a capital expenditure of Rs 262.55 billion and capitalised Rs 90.14 billion worth of assets.

Our interregional capacity stands at 101 GW, out of the national total of 120 GW. On a consolidated basis, our total income was Rs 474.59 billion and profit after tax stood at Rs 155.21 billion during 2024-25. Our market capitalisation reached Rs 3.4 trillion on September 25, 2024. We also emerged as the successful bidder for 24 TBCB projects, including our first HVDC project under this route.

We commissioned several key projects during the year, including the world's largest digital substation at New Navsari and substations at Kurnool III, Sikar II and Navi Mumbai. Several major transmission lines were also commissioned, including 765 kV Fatehgarh II-Bhadla II, 765 kV Bhadla II-Sikar II, 765 kV Kurnool III-Kurnool New, 400 kV Neemrana – Sikar II, and 400 kV Raipur-Dhamtari. We are compressing execution timelines through innovations. For instance, the Dausa substation was commissioned in eight months from land acquisition, while the Namsai-Kathalguri line was completed five months ahead of schedule.

How do you plan to incorporate sustainability and inclusion in your business?

Sustainability remains a strong focus in all our operations. We have been publishing integrated BRSR-aligned report since 2022-23, indicating the impact of our activities on the environment. Our SF6 leakage rates are among the lowest globally.

In a first-of-its-kind initiative in India, a 132 kV transformer at the HVDC Pusauli Substation has been retro-filled with natural ester oil, significantly reducing the environmental footprint of transmission operations. In addition, the company is exploring eco-friendly alternatives to SF6 gas and phasing out diesel vehicles in favour of electric and hybrid options as part of its broader sustainability strategy.

POWERGRID, through its wholly owned subsidiary, POWERGRID Energy Services Limited (PESL), has commissioned its first large-scale solar PV plant of 85 MW at Nagda, Madhya Pradesh, marking a key step in its clean energy journey. Rooftop solar installations are being implemented across all offices to achieve 50 per cent renewable energy consumption.

A pilot green hydrogen project is also underway at the Neemrana Substation, aimed at building operational experience in this emerging area.

Towards inclusion, POWERGRID has been encouraging women employees. To this end, we have established eight "Pink" substations in various parts of the country. These substations are headed and operated by women employees, providing them with greater exposure and increased participation in the operations of the organisation. ■

Interview with Pratik Agarwal

"The sector is set to become greener, smarter and more resilient"

In a recent interview with *Power Line*, Pratik Agarwal, Managing Director, Sterlite Electric, and Chairman, Resonia Limited and Serentica Renewables, spoke about the current state of the power sector, the progress in renewable energy development, the opportunities for private participation in transmission and the overall outlook for the sector. Edited excerpts…

What is your assessment of the current state of the power sector?

Over the past year, India's power sector has entered a dynamic phase of evolution, underpinned by ambitious decarbonisation goals and accelerated clean energy adoption. The country has already achieved over 50 per cent of its installed electricity capacity from non-fossil fuel sources, five years ahead of the 2030 target.

Government-led initiatives such as the production-linked incentive (PLI) schemes for solar PV manufacturing, battery storage and green hydrogen have bolstered domestic manufacturing, enhanced energy security and reduced import dependence. The extension of transmission charge waivers for energy storage projects till 2028, coupled with a Rs 54 billion scheme to support 30 GWh of battery storage, underscores the government's commitment to achieving 500 GW of renewable energy by 2030 and the net zero carbon target by 2070.

However, several challenges persist. One major issue is the integration of renewable energy into the grid. While capacity is increasing, land acquisition, financing and grid connectivity remain hurdles. Peak demand management is another critical area.

Distribution remains a weak link. Many state-owned utilities operate under financial stress and inefficiencies in service delivery persist. Reforms, including bringing more competition into the distribution business and promoting digitalisation initiatives, are expected to improve reliability and financial health, but progress remains uneven across states.

In short, India's power sector is evolving, with renewables driving growth. Yet, addressing land, connectivity, operational and financial bottlenecks, along with strengthening distribution companies, will be crucial to determine how efficiently the sector meets the country's power demand and decarbonisation goals.

What are the key unresolved issues?

India's power sector has made remarkable progress over the past decade. However, several critical issues remain unresolved, which could influence the pace and effectiveness of India's energy transition.

A key challenge continues to be land acquisition and right-of-way (RoW) delays. Despite advances in survey technologies such as LiDAR and drone mapping, acquiring land for long-distance transmission corridors, especially in densely populated or ecologically sensitive areas, remains a significant bottleneck. Complex land-ownership patterns, fragmented land titles, and prolonged environmental and forest clearances often result in project delays and cost escalations.

Another pressing concern is the mismatch between renewable energy growth and transmission infrastructure development. While solar and wind projects can be commissioned within 18-24 months, transmission corridors, substations and evacuation lines often require three to five years to complete. This disparity frequently leads to congestion, curtailment of renewable energy and underutilisation of green assets. Strengthening interstate and intra-state transmission networks remains critical to enable efficient power flow from renewable-rich zones to high-demand industrial and urban centres.

The sector also faces challenges related to grid flexibility and energy storage shortfalls. The current storage capacity, including pumped hydro and battery systems, is insufficient to manage the variability and intermittency of renewable generation. While policies promoting battery energy storage and solar-hybrid projects are emerging, these solutions must be scaled up on priority to ensure a stable, round-the-clock renewable supply.

Regulatory and financial uncertainties further complicate transmission expansion. Ambiguities in tariff structures, interstate transmission charges and project approvals increase risks for private investors. Financing remains a barrier due to the high capital intensity and long gestation periods of transmission projects, often resulting in elevated interest costs and constrained private sector participation.

Addressing these issues will require a concerted focus on policy reforms, accelerated transmission network expansion, grid modernisation, and strategic deployment of energy storage and smart technologies.

What are the biggest opportunities for private players in the transmission segment?

India's clean energy transition and rapid economic growth are creating unprecedented opportunities for private players in the transmission segment. The planned integration of over 500 GW of renewable capacity by 2030 will require large-scale expansion of interstate transmission systems, green energy corridors and high voltage direct current (HVDC) lines.

At the same time, opportunities extend beyond project execution. The government's Make in India initiative, which focuses on localising the manufacturing of critical transmission equipment, including transformers, HVDC gear and switchgear, has opened up new avenues for private companies to invest in domestic production and supply chains.

Digitalisation and technology adoption are another promising growth area. With the rising share of renewable energy, the need for smarter, more resilient grids is evident. Private firms can lead the way in deploying advanced solutions such as predictive analytics, remote monitoring and smart grid applications to improve efficiency, reduce outages and strengthen grid stability.

What are the measures needed to enhance private sector participation at the intra-state transmission level?

India's ambitious renewable energy targets and growing electricity demand necessitate a robust intra-state transmission network that can keep pace with the expansion of generation capacity.

The adoption of tariff-based competitive bidding (TBCB) across states is a key enabler as it fosters transparency, ensures cost efficiency and encourages competition. States such as Uttar Pradesh and Madhya Pradesh have demonstrated their effectiveness, and replicating these models nationwide can accelerate intra-state grid development.

Equally important is addressing bottleneck issues around land acquisition and RoW, which remain major causes of delays and cost overruns. Establishing single-window clearance systems, creating separate war rooms for renewable energy and transmission projects, and offering structured compensation mechanisms can significantly expedite project development and reduce risks for private developers. A stable and predictable regulatory environment is also essential. Timely tariff approvals, clarity on technical standards and a robust payment security mechanism will instil greater investor confidence.

What have been the key business developments for Resonia over the past year?

Over the past year, Resonia has strengthened its position as a leading player in India's transmission sector, undertaking significant initiatives to modernise grid infrastructure and support the energy transition. Central to these efforts has been the award of the 11th transmission project under the TBCB framework for the Integration of the Ananthapur II Renewable Energy Zone (REZ) Phase I. Designed to evacuate 4.5 GW of renewable energy from Andhra Pradesh, the project exemplifies Resonia's pivotal role in integrating variable renewable energy into the national grid.

To support these initiatives, Resonia continues to invest in cutting-edge technologies that enhance transmission efficiency and grid reliability. The company is leveraging high-capacity power conductors, modern substations with integrated geographic information systems, and innovative project execution methodologies such as drone and helicrane-assisted construction.

The company has also laid out an ambitious investment road map, with a target of deploying around Rs 1 lakh crore in transmission assets by FY 2032. This translates into annual portfolio additions of Rs 10,000 crore-Rs 15,000 crore, reflecting both growth momentum and long-term commitment to India's power sector.

What are some of the advanced technologies being adopted by Resonia for project execution, monitoring and asset management?

As India's energy landscape undergoes rapid transformation, Resonia is embracing advanced technologies for project execution, monitoring and asset management to ensure a future-ready transmission network. A core focus area is integrating digital intelligence into operations. With the deployment of IoT sensors across transmission lines and substations, we enable real-time monitoring of voltage, temperature and current parameters, thereby facilitating predictive maintenance.

We are deploying dynamic line rating technologies that adjust transmission capacity in real time based on weather conditions, ensuring optimal utilisation of existing infrastructure. Coupled with AI-based load forecasting and intelligent balancing, these innovations are critical to managing the intermittency of renewables and strengthening overall grid stability.

On the project execution front, Resonia is pioneering the use of drone and LiDAR-based surveys, helicopter-assisted stringing and robotic construction methods. These innovations accelerate project timelines, minimise environmental disruption, and make it possible to build critical infrastructure even in challenging terrain.

What is your outlook for the power sector for the near to medium term?

India's power sector is poised for a decisive transformation in the near to medium term, driven by the twin imperatives of energy security and decarbonisation. Renewable energy, led by solar and wind, will remain the growth engine, supported by policy measures such as PLI schemes, storage incentives and transmission charge waivers.

However, this rapid expansion brings with it the critical challenge of grid readiness. Transmission capacity additions must keep pace with renewable deployment to avoid evacuation bottlenecks. The sector will also see greater private participation, enabled by regulatory reforms, viability gap funding and innovative financing models such as green bonds. ■

Transmission Buildout

Focus on network expansion, higher transmission voltages and advanced technologies

India's transmission network is witnessing rapid growth to cater to the country's rising power demand and expanding generation capacity. In recent years, this growth has been marked by the physical expansion of the network and the deployment of higher transmission voltages and advanced technologies to enable large-scale power transfer. Transmission system planning and operations are also evolving to strengthen grid resilience and flexibility. Overall, a strong and reliable transmission system plays a key role in transmitting power efficiently across long distances, maintaining grid stability and ensuring uninterrupted power supply.

Size and growth

As of October 2025, the total length of transmission lines at the 220 kV level and above stood at 497,552 ckt km, comprising 57,323 ckt km (11.52 per cent) at the 765 kV level, 207,970 ckt km (41.8 per cent) at the 400 kV level and 212,884 ckt km (42.79 per cent) at the 230/220 kV level. At the high voltage direct current (HVDC) level, the line length stood at 9,655 ckt km at the ±800 kV level, 9,432 ckt km at the ±500 kV level and 288 ckt km at the ±320 kV level. In 2025-26 (up to October 2025), the total transmission line addition was 3,178 ckt km. Between 2019-20 and 2024-25, the transmission line length grew at a CAGR of 2.63 per cent.

The transformation capacity across AC voltage levels stood at 1,356,638 MVA as of October 2025, comprising 345,700 MVA at the 765 kV level, 509,243 MVA at the 400 kV level and 501,695 MVA at the 230/220 kV level. Likewise, the aggregate HVDC capacity stood at 33,500 MW, comprising 18,000 MW at the ±800 kV level, 13,500 MW at the ±500 kV level and 2,000 MW at the ±320 kV level. Between 2019-20 and 2024-25, the AC transformation capacity grew at a CAGR of 6.7 per cent. Voltage-wise, the highest CAGR was recorded for the 765 kV and 400 kV levels, at around 6.4 per cent and 8 per cent respectively. HVDC transformation capacity grew at a CAGR of 5.6 per cent. The highest growth rate was witnessed for ±800 kV at a CAGR of 8.4 per cent.

During 2024-25, the total AC transformation capacity added was 86,433 MVA, while in 2025-26 (till October 2025), it was 52,625 MVA. As of September 2025, the interregional transmission capacity stood at 120,340 MW.

Key policy and regulatory developments in power transmission

In March 2025, the Central Electricity Authority (CEA) notified guidelines for a unified philosophy for the placement of phasor measurement units (PMUs) in the electricity grid. These guidelines aim to improve grid monitoring and reliability by standardising PMU installation requirements across the power transmission network.

In June 2025, amendments were introduced to the standard bidding document (SBD) for tariff-based competitive bidding (TBCB), applicable to firm and despatchable renewable energy projects as well as competitive bidding processes for procuring power from solar, wind and solar-wind hybrid projects. The key changes are a reduction in the performance bank guarantee requirement from 5 per cent to 3 per cent of the expected project cost in order to ease the financial burden on project developers; permission for distribution licensees to approach the relevant electrical regulatory commission to avoid power sale agreement validation delays; and a stipulation that non-adherence to SBDs will require prior approval from the appropriate commission.

In January 2025, the CEA amended the Manual on Transmission Planning Criteria, 2023. The updated version introduces a uniform approach to inter/intra-state transmission system planning. It ensures that the system can manage multiple load generation scenarios and contingencies, coordinates transmission system expansion with power and load growth to avoid unnecessary expenditures, and highlights the need for customers and utilities to submit network access requirements with justification well in advance.

Green energy evacuation

Adequate evacuation for renewable energy sources is a must. To integrate wind/solar at scale, the Green Energy Corridors (GEC) scheme has been launched. GEC Phase I (which began in 2015), targets the evacuation of about 24 GW across eight states via 9,767 ckt km of lines and 22,689 MVA of substation capacity. Nearly 9,136 ckt km and 21,413 MVA have been commissioned so far under Phase I – completed in Madhya Pradesh, Rajasthan, Tamil Nadu and Karnataka; and delayed in other areas due to RoW/wildlife issues. GEC Phase II, which was approved in 2022, spans seven states, including Gujarat, Himachal Pradesh, Kerala, Uttar Pradesh and Tamil Nadu, with targets of approximately 7,574 ckt km and 29,737 MVA to evacuate about 20 GW of capacity. This is being implemented by state utilities, which receive central financial assistance of 33-40 per cent of the cost, and is slated for completion by 2025-26. Phase III of the scheme, with new proposals, is under consideration.

Beyond the GEC, India is developing transmission infrastructure from large renewable energy zones (REZs) across high-resource states to cluster multi-GW solar and wind development. These zones are tied to dedicated ISTS corridors to ensure timely, large-scale green power evacuation.

Other major green transmission projects are also underway. Dedicated ISTS lines for green hydrogen/ammonia hubs have been planned to serve 19-20 GW of green hydrogen by 2030, alongside offshore wind evacuation of about 10 GW envisaged off the Gujarat/Tamil Nadu coast. In 2024, the Ministry of New and Renewable Energy (MNRE) began planning coastal transmission for about 70 GW of anticipated green hydrogen demand by 2032. These corridors are being financed by mixed sources (central grants, loans from KfW/REC/PFC, and stakeholder contributions). Overall, GEC projects have received special funding (such as Rs 6 billion in Union Budget 2025) and are monitored by the CEA/MNRE to ensure timely completion.

Growing private sector participation and PPP involvement

Tariff-based competitive bidding has grown significantly over the years, leading to reduced prices, faster project execution and greater private sector participation. As per the CEA, as of October 2025, a total of 91 transmission projects have been awarded through the TBCB mechanism. Of the total awarded projects, 46 projects, with a transmission line length of 20,662 ckt km and a transformation capacity of 185,100 MVA, were secured by Power Grid Corporation of India Limited (POWERGRID) and 45 projects were secured by private transmission service providers. As of October 2025, a total of 67 transmission projects have been commissioned through the TBCB route. Key private players in the transmission segment include Resonia (erstwhile Sterlite), Adani Energy Solutions Limited, Tata Power, IndiGrid and Apraava Energy.

Infrastructure investment trusts (InvITs) have become the flagship model for transmission monetisation, with POWERGRID and IndiGrid leading the market. The POWERGRID InvIT raised Rs 77 billion in 2021-22 by listing five lines. Notably, IndiGrid has since scaled rapidly, backed by global investors and a portfolio spanning both TBCB and brownfield acquisitions. The government is also mulling asset monetisation for state utilities, such as through acquire-operate-maintain-transfer (AOMT) models and InvITs to unlock private capital.

Future outlook

As per the CEA's National Electricity Plan (NEP)-Transmission, which outlines the transmission network requirements up to 2031-32, approximately 114,687 ckt km of transmission lines and about 776,330 MVA of transformation capacity at 220 kV and above will be added during 2022-27. The addition of about 1,000 MW of HVDC bipole capacity is also envisaged over the same period. Further, the NEP envisages the addition of about 76,787 ckt km of transmission lines and 497,855 MVA of transformation capacity at 220 kV and above during 2027-32. An additional 32,250 MW of HVDC bipole capacity is projected to be added during 2027-32. Overall, by 2031-32, transmission line length and transformation capacity are expected to reach 648,190 ckt km and 2,345,135 MVA respectively. HVDC bipole capacity is projected to be 34,500 MW by 2026-27 and 66,750 MW by 2027-32. Overall, the NEP estimates a total investment requirement of Rs 9 trillion up to 2031-32 for transmission network expansion and strengthening.

Notably, as per the CTUIL Rolling Plan (2030-31), 31,919 ckt km and 335,475 MVA of transmission line length and transformation capacity respectively are currently under construction and expected to be commissioned progressively up to 2030-31. This entails an investment of Rs 2.21 trillion. Additionally, transmission line and transformation capacity aggregating 35,343 ckt km and 294,122 MVA respectively, entailing a total cost of Rs 2.64 trillion, are under planning/approval/bidding.

Challenges and the way forward

One of the key challenges facing the power transmission segment is keeping pace with renewable energy development. With the rapid increase in renewable capacity addition, there is a growing gap between clean power generation and the availability of evacuation infrastructure. This imbalance limits renewable integration and increases the risk of stranded assets and higher delivery costs. As per industry estimates, over 50 GW of renewable energy capacity remains stranded nationwide as of June 2025. The delays in the development of transmission infrastructure are owing to a host of structural and procedural bottlenecks, including RoW disputes, prolonged land acquisition processes, restrictions on equipment procurement and multi-agency approval requirements. One of the key affected states is Rajasthan, where, as per industry estimates, 8 GW of renewable energy capacity is stranded, with nearly half of this curtailed during peak solar hours on account of delayed completion of the associated transmission system.

RoW disputes remain one of the biggest obstacles to timely project completion. Delays in land acquisition, often triggered by compensation demands exceeding state-mandated rates, have not only pushed back construction timelines but also led to steep cost overruns across several states.

Institutional and regulatory complexities have further slowed progress. With electricity being a concurrent subject, both central and state authorities play key roles in planning and regulation. While this dual framework aims to promote decentralised decision-making, it has also resulted in multiple approval layers, causing uncertainty and long delays, from project conceptualisation to commissioning.

Adding to the strain are supply-side bottlenecks, including shortages of extra high voltage transformers, conductors and other components. Import restrictions and procurement constraints have made sourcing equipment more difficult, raising both costs and timelines for developers.

Additionally, lack of skilled manpower in the transmission segment hampers project execution, leading to delays in project commissioning. It also poses hurdles in the adoption of new technologies and solutions. ■

1 NATION GRID FREQUENCY

पावरग्रिड
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POWERGRID, A Maharatna Public Sector Undertaking of Ministry of Power, Government of India, is engaged in project planning, designing, financing, constructing, operating and maintaining power transmission projects across India and undertakes operations in the Indian telecom infrastructure sector.

ET NOW BEST ORGANISATIONS FOR WOMEN 2024

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Registered Office : B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi-110016.
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Transmitting Power, Transforming Lives.

Interview with N. Venu

"The future of the grid lies in the adoption of new technologies"

In an interview with *Power Line*, N. Venu, Managing Director and Chief Executive Officer, India and South Asia, Hitachi Energy, shared his insights on the sector's recent performance, the key opportunities and challenges, the role of high voltage direct current (HVDC) and digital solutions, and Hitachi Energy's priorities in the Indian market going forward. Edited excerpts…

How do you rate the performance of the power sector during the past year or so?

India's power sector has demonstrated remarkable resilience and strong growth over the past year. The installed capacity has crossed 495 GW, of which nearly half is non-fossil, underscoring the seriousness of the government in meeting its 500 GW renewable target by 2030. Foreign investments in renewables have touched record highs, and the planned Rs 9.15 trillion investment in transmission infrastructure by 2032 provides long-term visibility. Structural demand for electrification of mobility, expansion of artificial intelligence (AI)-ready data centres, industrial growth, etc. ensures that the sector remains one of the most dynamic world over, even amid global economic uncertainty.

What, according to you, are the biggest opportunities and challenges for the sector?

The energy transition is opening up many new opportunities for India's power sector. We see rising demand as renewables scale up, industries digitalise, transport shifts to electric, and data centres expand across the country. To meet this demand, the grid needs automation and reliable service support. Solutions such as static synchronous compensators, storage and HVDC will all play a role in building corridors that can carry clean power where it is needed.

At the same time, there are some challenges. Supply chains must become more resilient, talent needs to be developed at scale, and large projects have to be delivered on time. And through it all, the sector must maintain a fine balance – making energy affordable while ensuring its sustainability and security – all this while also continuing to attract investor confidence in what remains a volatile world.

What are the opportunities for HVDC technology in India? What are the challenges in its adoption?

Since the 1990s, HVDC has played a pivotal role in the development of India's national grid, transitioning from a zonal division to a unified synchronous grid. HVDC technology facilitates long-distance power transmission with minimal losses, making it ideal for bulk power transfer.

India's HVDC future looks promising, driven by key opportunities: the growing need for bulk power transmission from remote generation sites, rising urban demand fuelling city infeed projects, the push for an interconnected DC grid to integrate renewables and expanding cross-border power agreements with neighbouring countries.

To unlock the full potential of HVDC in India, several challenges must be addressed. Extensive system studies and early access to future network models can accelerate execution. Grid planners need to factor in long-term scenarios to keep pace with evolving demand. The transportation of heavy equipment remains a logistical hurdle, requiring optimised designs and streamlined permissions. Finally, bridging the skill gap through targeted training is essential for developing HVDC-ready talent among all stakeholders.

What will be the role of emerging technologies, such as AI and digital solutions, in meeting the needs and requirements of the emerging grid?

The energy system is undergoing a fast-paced transformation. Renewables, grid-edge technologies and digitalisation will drive the evolution of future power systems. To keep pace with the energy transition, the existing network must be upgraded and modernised to accommodate the flexibility required to achieve this goal.

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The future of the grid lies in the adoption of new technologies, such as big data analytics for predictive maintenance, AI, robotics and virtual reality/augmented reality kits for improving the operations and maintenance of the transmission network.

Establishing technology standardisation is crucial to ensuring cybersecurity, reliability and safety for both consumers and utilities. The industry is currently actively developing standards and protocols to enhance cybersecurity, specifically for smart grids.

Hitachi Energy has been leveraging synergies by combining digital and energy technologies that support the global energy transition. We will further accelerate the drive for synergies, digitalisation and services, and continue to offer the deployment of both IT and operational technology at scale and with speed. To support our partners and customers in grid optimisation, we conduct root-cause analysis to identify grid issues, improve grid reliability, and optimise allocation of assets and costs, ultimately harmonising these efforts to increase the overall effectiveness of the grid.

What have been the key business highlights for Hitachi Energy in India in the past year or so?

For the full year ended March 31, 2025, our orders reached a record Rs 181.74 billion, up 228 per cent from the corresponding period of the previous year, while revenue stood at Rs 64.42 billion, with a 23 per cent increase over the same period.

We celebrated 75 years of presence in India in 2024, making significant contributions to the nation's energy ecosystem. To commemorate this milestone, Hitachi Energy India Limited hosted a year-long celebration, culminating in the mega event "EDW75" in October 2024, involving all its stakeholders. During the event, the company announced its India investment plan of Rs 20 billion for the next four to five years, to accelerate its capacity expansion plan in India.

To support its investment plan, the company initiated a qualified institutional placement (QIP) and raised Rs 25.21 billion in March 2025. The net proceeds from the QIP will be deployed in capacity expansions and other avenues to accelerate growth in its India operations.

What are Hitachi Energy's plans and priorities?

As a technology and innovation leader, Hitachi Energy is well positioned to drive the energy transition through its 2030 Plan, focused on three strategic pillars:

- Strengthening the core: Maintaining leadership in transformers, switchgear, HVDC, power quality and grid automation, especially as demand grows from renewables, data centres and e-mobility.
- Doubling down on digital and services: Investing in digital operations and smart service solutions to enhance system reliability and customer experience.
- Accelerating growth through innovation and partnerships: Driving expansion via innovation, strategic partnerships, and mergers and acquisitions to scale sustainable solutions and meet rising energy demand.

What is your outlook for the power sector?

India's power sector has a very bright future. We are seeing electricity assume a far greater role in driving growth, whether through the rapid scaling up of renewable energy, the growth of data centres, the shift towards electric mobility or even new frontiers such as green hydrogen. By 2050, the world will need four times more generation capacity, three times more power transfer and an energy mix that is 80 per cent fossil-free.

India will clearly be at the centre of this transition. What gives confidence is that the fundamentals remain strong: supportive policies, resilient demand and robust investment flows.

The sector's future will not be shaped by one technology alone. Progress will come from many solutions working together, whether it is HVDC, storage, digital grids or newer sustainable products. What gives us confidence is our long history in India, the strong base we have built here and the global expertise we can draw on. That combination puts us in a good position to support the country's clean energy journey in the years ahead. ■

Interview with Sandeep Zanzaria

"The outlook for the transmission segment remains bright"

In a recent interview with *Power Line,* Sandeep Zanzaria, Managing Director and CEO, GE Vernova T&D India Limited, shared his perspective on the performance of India's power sector and its future outlook, the key trends in the T&D segment, and major opportunities and challenges in the sector. Edited excerpts…

How would you assess the power sector's performance over the past year? Do you feel it still has the same positive momentum as the previous year?

The power sector delivered a strong performance in 2024-25. Electricity demand grew by about 8 per cent during the year, while peak power demand touched around 250 GW. The total installed capacity by the end of the year was close to 470 GW. One of the key national targets was to have 50 per cent of the installed capacity coming from renewables by 2030, and that milestone was achieved last year itself. In that sense, the sector is ahead of schedule.

There have also been early signs of carbon emissions easing. In the first half of 2025, emissions declined by nearly 1 per cent year on year. The transmission segment has become more stable and profitable, including Power Grid Corporation of India Limited, private utilities and several state utilities.

Going forward, the target of adding 500 GW of renewable energy capacity by 2030 will require a significantly stronger transmission backbone. The outlook for the transmission segment remains highly positive, alongside strong prospects for the generation sector. The government is planning to add 90-100 GW of conventional capacity by 2035 and nearly 100 GW of nuclear capacity by 2047. Since transmission is generation-agnostic, it will continue to be one of the most stable and growth-oriented segments in the coming years.

What do you see as the biggest opportunities and challenges for the sector?

In terms of opportunities, the 2032 targets outlined in the National Electricity Plan envisage investments of around $110 billion in the transmission segment. Installed generation capacity is projected to double while peak power demand is projected to rise by about 80 per cent by 2032. To address this, the plan includes the addition of approximately 20,000 ckt km of high voltage transmission lines and around 125 GVA of substation capacity each year through 2032. Looking further ahead, under the government's Vision 2047 for Viksit Bharat, installed generation capacity is expected to quadruple.

Another major opportunity lies in the continued addition of renewable capacity, which adds variability to the grid. This presents both challenges and opportunities. For technology providers, it creates significant scope to deploy advanced solutions aimed at enhancing grid stability. These include technologies such as static compensators (STATCOMs), high voltage direct current (HVDC) systems, digital solutions and forecasting tools.

Right of way remains a major bottleneck, with land acquisition for substations and transmission lines often causing significant project delays. Another emerging challenge is equity participation. Large projects such as HVDC systems require investments of Rs 250 billion-Rs 300 billion and typically span five years. While transmission has traditionally been viewed as a stable and attractive segment for post-commissioning investment, the growing scale of projects is stretching the financing capacities of stakeholders.

Finally, the irregular project flow remains a concern. The current tendering pattern – characterised by bulk tenders followed by lean periods – creates a cyclical challenge for manufacturers and EPC players.

Could you share some examples of technologies or solutions that GE Vernova is working on with clients to address these challenges?

We are working closely with our customers across multiple areas, spanning both hardware and digital solutions. On the hardware side, transformers, reactors, gas-insulated switchgear (GIS) and circuit breakers remain core offerings. On the digital front, growing grid variability and the scale of asset additions make manual data processing and decision-making unviable.

To this end, a grid digitalisation solution has been rolled out, with upgrade projects under way in the northern and eastern regions. A key initiative is the deployment of advanced digital tools at despatch centres nationwide, anchored by GridOS® – a new global platform being introduced in India. GridOS® leverages artificial intelligence and machine learning to manage variability, enable autonomous decision-making and create a self-learning grid capable of responding dynamically to renewable integration. To further mitigate transmission line challenges, we have launched a unique solution called Digital Dynamic Line Rating, which can increase transmission line capacity, reducing the need for new infrastructure and improving grid efficiency. It can also help reduce the risk of power outages by allowing transmission lines to safely operate at higher capacities.

> "A major area of opportunity lies in the continued addition of renewable capacity. For product and technology providers, this creates significant scope to deploy advanced solutions, including STATCOMs, HVDC systems, digital solutions and forecasting tools, to enhance grid stability."

On the hardware side, the focus is on high-impact technologies. In renewable-heavy regions such as Rajasthan, stability depends on supporting infrastructure. STATCOMs are critical for maintaining voltage stability, while HVDC systems enable cost-effective long-distance power evacuation and strengthen networks impacted by solar and wind variability. In addition, utility-scale battery energy storage systems are being deployed to balance supply and demand in high-renewable zones.

What is your policy wish list to address these issues?

First, a more sustainable and uniform project pipeline is essential. Instead of clubbing large volumes of projects together at one time, a steady flow of opportunities would enable the industry to plan better and allocate resources more efficiently.

Second, support is needed to address the skilled manpower shortage. The industry is making substantial capital investments to expand capacity, but talent availability remains a constraint. A coordinated effort between the government and industry on technology-oriented skill development is crucial.

Third, long-term framework agreements for critical technologies such as HVDC should be considered for a 10-15-year horizon, in line with the government's large investment plans. Such visibility would enable companies to plan capacity expansion more effectively.

Finally, more balanced terms and conditions from state utilities are needed. A more equitable approach would enable greater private sector engagement in the state segment.

What have been the key business highlights and achievements of GE Vernova T&D in the last year or so?

The key achievement has been the strong growth in revenue of 35 per cent recorded last year. Based on first-quarter numbers this year, a similar growth over last year's revenue is expected to be maintained. Profitability has been healthy and in line with shareholders' expectations, supported by strong cash flows. Notably, profit after tax has been fully converted into cash. This performance, driven by robust market demand, has strengthened the confidence to invest in new manufacturing technologies in India. These include thyristor valves and insulated gate bipolar transistors for STATCOM at Pallavaram, along with control platforms at Noida.

The outlook for order inflows this year remains equally positive. Apart from a few large projects secured last year, the aim is to maintain order inflows at similar levels this year – significantly higher than current revenue levels.

Significant orders have been secured not only in terms of projects but also equipment such as transformers, reactors, 765 kV GIS, air-insulated switchgear and grid automation systems. Capturing the HVDC market is also going to be key.

Another major achievement was securing a large export order. Exports remain a strong focus area, currently accounting for about 30 per cent of the order backlog, with new geographies being continuously added. Moreover, two significant digital orders were won for upgrading load despatch centres in the northern and eastern regions.

The company has also worked closely with the government and customers to expedite deliveries and help meet project targets. Overall, it was a very strong year – recognised and appreciated by shareholders, customers and employees alike, who take pride in the collective success of the business.

Lastly, what is your outlook for the Indian power sector, and how do you see GE Vernova T&D positioning itself going forward?

Over the next decade, India is expected to remain a strong growth story for the energy sector, with similar momentum reflected in the transmission segment.

For GE Vernova T&D India, in addition to a strong conventional AC business, significant opportunities are emerging in HVDC, STATCOM and digital solutions. These areas will play a key role in driving overall growth. On the technology front, digitalisation is a major focus. Given the shortage of skilled manpower, the company is working closely with customers to support them through advanced technology deployment. Asset performance management is being positioned as a key differentiator, helping customers optimise both capex and opex strategies.

Overall, urbanisation, rising per capita energy demand and increasing investments in industries, data centres, and green hydrogen are creating strong drivers for energy growth. These trends will naturally translate into higher demand for transmission infrastructure. Technology will play a critical role in strengthening the company's position among the top transmission players in the country. It is indeed an exciting time to be a part of this sector. ■

Interview with Manish Agrawal

"India has built one of the world's strongest grids"

In an interview with *Power Line*, Manish Agrawal, Chief Executive Officer, Conductors and Telecom Businesses, APAR Industries Limited; and Managing Director, APAR T&D Projects Private Limited, discussed the evolving landscape of India's power transmission sector. He highlighted the sector's growth momentum, emerging technology trends, execution challenges and the opportunities ahead as the grid undergoes rapid expansion and modernisation. Edited excerpts...

What is your view on the current state of the power transmission sector in India?

India's power transmission and distribution (T&D) sector is at a pivotal inflection point. Supported by forward-looking policy reforms and sustained investment, the country has built one of the world's largest and most resilient transmission networks – and is now well-positioned for its next phase of expansion.

Today, India operates a robust transmission network spanning 497,552 ckt km with a transformation capacity of 1,390,138 MVA. Installed generation capacity has crossed 500 GW (as of September 30, 2025), with nearly 250 GW from non-fossil sources. This rapid shift in the energy mix increases the need to expand transmission and substation infrastructure; without proportional growth in these backbone systems, the country risks bottlenecks in evacuating new capacity, especially renewables, and ensuring reliable, affordable power delivery.

The integration of large-scale renewable energy from solar, wind and hybrid projects has heightened the need for a flexible, efficient transmission backbone. The sector has responded with major investments in green energy corridors, high-capacity transmission corridors and advanced technologies such as HDVC systems and digital substations.

These efforts have contributed to a significant improvement in system performance. National power shortages have declined sharply from 4.2 per cent a decade ago to just 0.1 per cent last year, underscoring the effectiveness of grid strengthening efforts.

What are the biggest challenges and opportunities in the sector? What is your outlook for the sector?

Despite notable progress across the power sector, persistent shortfalls in transmission and substation expansion remain a key structural concern.

During the 13th Five-Year Plan (2017–2022), only 81 per cent of planned transmission line additions and 91 per cent of planned substation capacity were achieved. This gap has continued in recent years, with substation capacity additions meeting just 96 per cent, 91 per cent, and 77 per cent of targets in FY 2023, FY 2024, and FY 2025, respectively.

Transmission line additions have followed a similar pattern, achieving 100 per cent, 85 per cent, and 58 per cent of targets over the same period. In fact, the achievement numbers from the first half of FY 2026 also depict a lag, with 18 per cent and 49 per cent achieved on the transmission line and substation capacity addition fronts, respectively.

These delays stem from commissioning challenges, primarily land acquisition and right-of-way (RoW) issues, along with material supply constraints and other operational bottlenecks. Such lags underscore a critical risk: without corresponding growth in transmission and substation infrastructure, the country faces potential bottlenecks in evacuating new – especially renewable – generation capacity and in ensuring reliable, affordable and sustainable power delivery.

However, the Ministry of Power and the Central Electricity Authority – together with strong implementation efforts by Power Grid Corporation of India Limited and progressive measures adopted by several state utilities – are driving significant meaningful improvements across the transmission and distribution ecosystem. Their initiatives in strengthening grid planning, accelerating network expansion and promoting technology adoption are helping address systemic constraints and support India's larger reliability and modernisation goals.

Speaking of opportunities, this sector presents ample prospects as the outlook is extremely promising, driven by India's bold commitment to expand and modernise its power infrastructure at an rapid scale.

In line with this forward-looking outlook, one of the most compelling areas of opportunity lies in upgrading existing transmission assets through turnkey reconductoring solutions. As RoW remains one of the most critical challenges in expanding India's transmission infrastructure, turnkey reconductoring provides a clear, high-impact pathway to address it.

While reconductoring is being undertaken by the states, the percentage is still minuscule, thereby revealing tremendous scope for accelerated upgrades across existing transmission corridors. With planned investments exceeding Rs 9 trillion in the T&D space by 2032, the country is preparing for a massive build-out of grid capacity to meet rising energy demand and support accelerated renewable integration.

What are the new and emerging trends in the conductors space?

- **Shift toward high-ampacity, low-loss technologies:** As utilities focus on reducing line losses and enhancing grid performance, advanced conductor designs are gaining traction. In this context, APAR's high-ampacity low-loss-covered conductors, coated conductors and carbon composite conductors are gaining traction. Engineered to deliver higher current-carrying capacity with minimal transmission loss, these conductors support the development of smarter, stronger and greener power networks.
- **Specialised solutions for renewable power evacuation:** The expansion of renewable energy – often located in remote, harsh environments – is driving demand for conductors with superior environmental resilience and high ampacity. APAR's AL59-based solutions, including the AL59 Plus conductor (latest), are designed specifically for such applications. These conductors offer low losses, high corrosion resistance and long life even under extreme weather conditions.

- **Z-shaped wires and high-performance configurations:** To optimise electrical performance and increase conductor packing efficiency, trapezoidal and Z-shaped wire profiles are apt. APAR's Z-shaped conductors, featuring interlocking wires, minimise the ingress of dust, ice and moisture, significantly improving durability and reliability.
- **Reconductoring:** RoW remains one of the biggest hurdles in grid expansion. Reconductoring existing lines with higher-capacity conductors offers a cost-effective, time-efficient and environmentally sensitive alternative, often doubling transfer capacity without new land acquisition. Regulatory momentum is also strong: the Central Electricity Authority has notified the revised RoW norms for high-temperature low-sag (HTLS) conductors.
- **Medium voltage covered conductors (MVCCs) in distribution networks:** Utilities are turning to MVCCs for both new lines and reconductoring projects for distribution voltages up to 33 kV. APAR's turnkey MVCC solutions enhance distribution efficiency, minimise line losses and improve the safety and reliability of the network.
- **Integration of power and communications – optical phase conductors (OPPC):** APAR's OPPC seamlessly integrate power transmission and optical communication to deliver both data and power through a single system. OPPC eliminates the need for costly trenching or ducting by leveraging existing power lines, making it ideal for fibre-to-the-home deployments. It also enables real-time grid monitoring and provides high-speed, low-latency connectivity essential for smart grids, 5G and internet of things infrastructure – a truly sustainable and future-ready solution for next-generation networks.
- **Expansion of optical ground wire (OPGW) fiberisation across voltage levels:** Fiberisation of transmission networks remains a major trend. While many utilities have deployed OPGW at 132 kV, substantial potential exists at 66 kV and at higher voltages up to 765 kV. Live-line installation capabilities make upgrades easier without service interruptions. Rising telecom demand is also driving interest in high-fibre OPGW variants, including 96F and 144F, to support future-ready digital and smart-grid ecosystems. India has moved from 24F to 48F installations; however, in bandwidth-intensive urban areas, 96F and 144F OPGW variants offer a far more future-proof solution, with the added advantage that the per-fibre cost is actually lower than that of 48F, making them both economically attractive and technologically forward-looking.

Complementing these trends are our ESG-driven green products – CTC, PICC and ACCC-ULS conductors – which further improve transmission efficiency, reduce carbon emissions and extend asset life.

What have been the key business highlights of APAR in the past one year or so?

Over the past year, APAR has made significant achievements across financial performance, global expansion and product innovation, further strengthening its position as a leader in the global cables and conductors sector. With over six decades of engineering excellence, the company continued to set industry benchmarks in technology, quality and sustainability.

In FY 2025, APAR crossed $2 billion in annual revenue and reached a market capitalisation of over $4.2 billion, marking one of its strongest financial performances to date. The Conductors division delivered its highest-ever revenue of over $1 billion, reflecting robust demand, strong operational execution and deep customer trust.

A major highlight of the year was the expansion of APAR's premium and sustainable product portfolio. The company introduced several advanced and high-value offerings, including coated conductors, OPPC, lead connection cables, copper–magnesium (Cu-Mg) catenary wires, copper–silver (Cu-Ag) contact wires, and the newly developed 4000 and 2000 series alloy rods.

In the copper segment, APAR further strengthened its leadership by enhancing its continuously transposed conductors (CTC) capacity and broadening its high-performance copper solutions.

The company also achieved ma-

jor national milestones by becoming the largest Indian supplier of copper conductors to Indian Railways and the first Indian company to develop and supply copper conductors for the country's high-speed bullet train project.

The year also saw APAR secure several new marquee customers and win large orders across a diverse set of product categories, ranging from conventional and HTLS conductors to OPGW solutions and speciality copper products.

This momentum was complemented by a strategic expansion into new global markets. APAR deepened its presence in Europe, expanded into South America, made further inroads into Africa, and strengthened its reach across Canada and multiple Gulf countries.

What are the company's future growth plans?

As we look ahead, the outlook for APAR Conductors is exceptionally promising. With the power T&D landscape undergoing rapid transformation backed by significant investments, the opportunities before us are immense. We are strongly positioned to harness this momentum and translate sectoral growth into sustained value creation for APAR.

Our future growth strategy rests on further strengthening both our top and bottom line through a multi-pronged approach.

A core pillar of this strategy is continued investment in augmenting our manufacturing capabilities – expanding capacities, modernising facilities and enhancing operational efficiencies to meet rising global demand. Parallel to this, we are deepening our focus on new product development, research and development, and innovation, especially on high-ampacity low-loss solutions and ESG, ensuring that APAR remains at the forefront of advanced conductor technologies that enable a resilient, future-ready grid.

We are also committed to expanding our portfolio of premium and sustainable solutions, tapping emerging opportunities across reconductoring, renewable evacuation, and smart communication-enabled conductors. These product lines are central to addressing industry needs such as higher ampacity, lower losses and enhanced network reliability.

We are also accelerating our efforts in digital transformation by integrating digital tools, advanced analytics and AI-enabled systems across functions. These initiatives aim to enhance operational agility, strengthen quality control, improve forecasting accuracy and deliver faster, more reliable customer experiences. Building on this, we are sharpening our customer-centric approach, ensuring that our solutions remain closely aligned with the evolving requirements of customers and partners in India and globally.

In essence, APAR's growth roadmap is aligned with the evolving needs of the T&D ecosystem. With sector tailwinds firmly in place and our strategic initiatives gaining momentum, we are confident of delivering sustained, profitable growth while strengthening our position as a global leader in conductor solutions. ■

Modernising the Grid

Technology trends shaping the transmission segment

The road to energy transition in India depends not only on the speed of renewable energy capacity addition, but also on the transmission sector's ability to move power across regions in the country. As per the National Electricity Plan, India plans to add over 191,000 ckt km of transmission lines and 1,270 GVA of transformation capacity during the 10-year period from 2022-23 to 2031-32. The interregional transmission capacity is planned to increase to 143 GW by 2027 and further to 168 GW by 2032, from the present level of 119 GW. As the grid expands, several technology trends are shaping the sector and solving long-standing challenges related to capacity, reliability and right-of-way (RoW) constraints. Power Line provides an overview of the key technology trends across India's transmission landscape.

HVDC projects

To transmit bulk power long distances without incurring losses, the transmission system is utilising high-voltage direct current (HVDC) corridors for solar parks, wind projects, pumped hydro sites and green hydrogen zones to load centres in other states.

HVDC systems are gaining prominence for enabling asynchronous interconnection and loss-efficient power flow over distances exceeding 800-1,000 km. In 2024, Power Grid Corporation of India Limited (POWERGRID) awarded a major HVDC contract to a consortium led by Hitachi Energy India Limited and Bharat Heavy Electricals Limited (BHEL) for the design and implementation of an HVDC link to transmit renewable energy from Khavda in Gujarat to Nagpur in Maharashtra. The HVDC link will have a DC voltage of ±800 kV and a capacity of 6,000 MW, and is designed as a bi-pole and bi-directional system, with the link spanning a distance of 1,200 km. This ambitious project is part of a larger initiative to transfer power from the renewable energy zone in Khavda under Phase V (8 GW): Part A.

Another key ongoing project is Rajasthan Part I Power Transmission Limited, a subsidiary of Adani Energy Solutions Limited, for which the contract was awarded to a consortium comprising Hitachi Energy and BHEL in mid-2025. The contract will see the consortium design and deliver HVDC terminals to transmit renewable energy from the Bhadla area of Rajasthan to the industrial and transport hub in Fatehpur, Uttar Pradesh. The 6 GW, 950 km HVDC link can power approximately 60 million households in India.

Another key planned project is the 1,150 km HVDC undersea power cable linking Port Blair in the Andaman & Nicobar Islands and Paradip, Odisha. The ±320 kV, 250 MW HVDC (voltage source converter [VSC]-based) interconnection through the undersea cable will be the first of its kind in the country. Meanwhile, an HVDC overhead link between Madurai in India and New Habarana in Sri Lanka with 2x500MW HVDC terminals based on VSC technology is also being studied for cross-border interconnection.

In parallel, a major initiative has been undertaken to address hydropower evacuation from the Brahmaputra basin. In October 2025, the Central Electricity Authority (CEA) released the Transmission System Master Plan for the evacuation of power from hydroelectric projects in the Brahmaputra basin. According to the plan, the Brahmaputra sub-basins hold an exploitable hydropower potential of around 64,945 MW (projects above 25 MW). Given how far these locations are from major load centres, the plan proposes a massive transmission build-out with an estimated cost of Rs 6.43 trillion. The preliminary locations of pooling stations have been identified at sites such as Namsai, Roing, Niglok, Gogamukh, Rowta and Silapathar. In total, seven HVDC stations, each with a capacity of 6,000 MW, have been proposed to evacuate power from these sites toward major demand centres in the eastern, northern and western regions. The plan also suggests installing switchable bus reactors at the generating stations to manage reactive power and ensure stability across long corridors.

Advanced conductors

A key trend is the adoption of high-temperature low-sag (HTLS) conductors, which includes designs such as the aluminium conductor composite core, aluminium conductor composite reinforced and invar-based designs for new and reconductoring projects. These technologies are gaining traction due to their ability to provide up to three times ampacity compared to the conventional aluminium conductor steel reinforced. They also have the ability to operate in heat-prone regions like Rajasthan and Gujarat due to their higher thermal limits and low sag at elevated temperatures. India is the largest market for HTLS conductors globally. A notable deployment of HTLS conductors occurred in POWERGRID's 400 kV Bhiwani-Meerat reconductoring project, which increased the power transfer capacity by over 90 per cent without altering tower design. Similar projects are under way in Maharashtra, Andhra Pradesh and Tamil Nadu, where load growth and solar injection are concentrated along legacy lines.

Lines can also be upgraded using insulated cross arms (ICAs) as they require less footprint. The ICA can be deployed in combination with HTLS conductors to further raise the height of the conductor above the ground. At present, ICAs are not commonly used in India except in Telangana and Kerala. In Kerala, a 66 kV line was upgraded to 110 kV using composite ICA (CICA). In Telangana, the steel crossarm of the Imlibun-Bandlaguda 132 kV transmission line was replaced by CICA in 2019 to minimise RoW.

Monopoles

In July 2022, the CEA issued the Standard Technical Specification for Steel Monopole Structures to highlight the utilisation of monopole structures. Recently, they have been gaining momentum in places with space constraints. With a lower footprint, fewer component requirements and faster erection timelines, they are more attractive than lattice towers. Despite their smaller base area, monopoles can support heights of over 40-50 metres, offering a more environmentally compatible option for dense urban and semi-urban alignments. Utilities are increasingly deploying monopoles across various locations in the country to address RoW challenges and accelerate project execution. Existing towers are also being replaced with narrow-based towers. This was undertaken by Transmission Corporation of Telangana Limited in the Greater Hyderabad Municipal Corporation area for road expansion.

Digitalisation initiatives

As transmission infrastructure age, grid operators have been adopting digital technologies to improve visibility for fault detection, reliability and measuring asset performance. Transmission utilities are now deploying real-time monitoring tools, internet of things (IoT) sensors, drone-based inspections and advanced analytics to transition from time-based to condition-based maintenance regimes. Geographical information system (GIS) is being deployed by utilities for asset mapping.

One such digital innovation has been the deployment of dynamic line rating (DLR) systems to unlock additional capacity from existing lines. For example, the first 400 kV DLR project in India, implemented by POWERGRID on the 95 km Madurai-Tuticorin transmission line in Tamil Nadu, was used for evacuating wind power from southern coastal zones. It now operates with real-time, artificial intelligence-driven DLR sensors that forecast conductor capacity based on weather and line conditions. The system integrates meteorological data, satellite inputs and sensor feedback on conductor temperature, sag and vibration to dynamically update ampacity values every few minutes. The platform also incorporates a digital twin of the transmission line to simulate performance under different operating conditions.

Meanwhile, digital substations are also gaining prominence. In May 2025, POWERGRID commissioned a 765kV digital substation at Navsari in Gujarat. This extra-high-voltage substation is the first digital substation in the world at the 765 kV level, and is equipped with a remote monitoring facility that can be monitored from anywhere.

For operations and maintenance, there are asset performance management units that integrate historical supervisory control and data acquisition (SCADA) data, use live sensor feeds and weather forecasts to develop predictive maintenance schedules. Another trend is the adoption of digital twins. These are real-time, virtual replicas of physical transmission networks that can stimulate grid performance and predict contingencies. Digital twins combine SCADA, phasor measurement unit, GIS and IoT sensor data with advanced analytics and physics-based simulation to model the dynamic behaviour of the grid under various operating conditions.

Drones

Utilities have been deploying drones, infrared and thermal imaging cameras to inspect towers, conductors and insulators in areas that are otherwise inaccessible. This allows faster identification of hot spots, broken strands, corrosion and clearance violations without prolonged outages or manpower risks.

Several players entered into partnerships to scale the use of drone and robotics technologies across the transmission project lifecycle. These partnerships include applications such as GIS surveys, route optimisation, construction progress tracking and real-time inspection of assets using high-precision drone-mounted sensors.

Recently, private transmission major Resonia Limited announced plans for partnering with a drone technology company for deploying heavy-lift drones in transmission projects for streamlining survey, construction and maintenance processes, transporting materials and assisting in conductor operations, especially in remote or difficult terrains. These traditionally labour- or helicopter-intensive activities can now be executed with reduced cost and lower safety risks.

Challenges and outlook

While technological advancements are playing a crucial role in grid modernisation, their implementation in India faces several challenges. Land acquisition remains one of the most significant challenges. This often leads to delays due to compensation disputes, RoW constraints and challenges in obtaining environmental clearances. Additionally, state transmission utilities often lack the funds and creditworthiness to adopt cutting-edge technologies. Delays in tariff approvals, cost-recovery uncertainties for pilot innovations (such as digital twins and dynamic line rating), and the absence of dedicated green transmission funds have restricted progress.

The integration of digital tools also remains uneven. Many state utilities still rely on manual logs and legacy IT systems, limiting the granularity of asset health data. With cybersecurity risks rising, it is important that these systems be updated. Similarly, for HVDC projects, with capital costs often ranging from Rs 8 million-Rs 10 million per MW, it becomes a financially infeasible project.

In short, while the technology ecosystem is maturing, the real test lies in aligning institutional capacity, regulatory support and execution discipline. Bridging this gap will be critical to unlocking the full potential of India's transmission sector. ■

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Unlocking Value

CEA's framework for monetising transmission assets under AOMT

According to the National Electricity Plan (Transmission) 2024, released by the Central Electricity Authority (CEA), the country will require capital investments worth Rs 9.16 trillion in the transmission sector till 2031-32. A large share of this investment will be led by central transmission utilities such as Power Grid Corporation of India Limited (POWERGRID). As per the plan, over 50 per cent of the capacity addition will be undertaken at the state level. As a result, it is likely that state transmission companies (transcos) may be put under fiscal stress. Asset monetisation offers a solution to unlock the value embedded in operational infrastructure.

For transmission infrastructure, monetisation strategies are broadly categorised into two asset types: brownfield assets, which are already operational and revenue-generating; and greenfield assets, which require fresh capital for construction and commissioning. Among brownfield options, infrastructure investment trusts (InvITs) have gained prominence. InvITs enable public transmission utilities to pool operational projects and raise long-term capital from institutional investors. These vehicles offer investors a predictable return profile through periodic distributions, underpinned by availability-linked transmission charges. POWERGRID's InvIT, for instance, demonstrated the viability of this model by monetising commissioned assets under tariff-based competitive bidding with fixed revenues for 35 years.

Another brownfield route is the acquire, operate, maintain and transfer (AOMT) model, which allows private players to lease existing transmission assets from state utilities for a defined concession period. Under this model, the private entity takes over operations and maintenance responsibilities and earns revenue from the asset for the duration of the contract, after which ownership reverts to the sponsoring utility. To support capital recycling at the state level, the Ministry of Power issued a dedicated framework in 2022 for monetising intra-state transmission assets through the AOMT model. At the end of the agreement, the asset is mandatorily returned to the sponsoring utility at a nominal cost of Re 1.

However, financial and regulatory implications related to capital gains on asset transfers between entities, various key tax implications/considerations under each step of the transaction, and related tax incidences need to be carefully understood under this model.

To clarify these issues, the CEA recently outlined a framework for monetising public transmission assets under the AOMT model. A closer look at the concept note…

Transaction steps and options for transfer of assets under AOMT

There is a three-step transaction process, beginning with the hive-off of operational assets from the sponsoring state utility to a newly formed special purpose vehicle (SPV). The identified assets are transferred into this SPV using one of three possible mechanisms: slump sale, demerger, or direct asset transfer, with each having distinct legal and tax considerations. Once the SPV has been established, the second step involves transferring 100 per cent of its shareholding to a private investor through a competitive bidding process. The selected investor, referred to as the proposed buyer, takes operational control of the SPV for the duration of the concession period. This structure enables the private party to undertake operations and maintenance responsibilities while generating returns from the revenue streams of the monetised asset.

In the final stage of the transaction, upon completion of the concession period, the shareholding of the SPV is mandatorily bought back by the original state utility. This repurchase is executed either at a nominal value of Re 1 or at the remaining undepreciated asset value, as defined under Rule 11UA of the Income Tax Rules. The overall structure is designed to be fiscally neutral for the state while ensuring continuity of service and revenue certainty for private investors.

Key tax implications and considerations of the CEA's framework

As per the concept note released by the CEA on the tax implications of the monetisation of intra-state transmission infrastructure under the AOMT model, treatment of asset monetisation under the AOMT model is contingent upon the method used for transferring assets from the sponsoring transco to the SPV, and the subsequent sale and reacquisition of the SPV's shareholding. According to the concept note, if the hive-off of assets along with directly linked liabilities qualifies as an "undertaking", it falls within the ambit of Section 50B of the Income Tax Act, 1961, which governs the tax treatment of slump sales.

Under the first option, slump sale or the transfer of assets from the transco to the SPV is treated as a taxable transaction, with capital gains computed based on the differential between the asset's fair market value (FMV) and its cost base. If the transfer is undertaken at FMV, it is likely to result in nominal capital gains, since the consideration and cost base would be nearly identical. However, the transaction must withstand scrutiny under general anti-avoidance rules (GAAR), which could apply if the slump sale is deemed to lack commercial substance or is primarily structured to obtain a tax benefit. For instance, if assets are transferred at book value and then sold at a significantly higher price, tax authorities could invoke GAAR to challenge the structure.

In case of a demerger, the transaction may be eligible for tax neutrality under Section 2(19AA) of the Income Tax Act, provided the SPV is classified as a government entity and the demerger satisfies certain conditions. If eligible, the demerger route allows for a tax-exempt transfer of assets from the transco to the SPV. However, stamp duty implications remain and must be assessed based on applicable state laws. Any subsequent sale of SPV shares may attract long-term capital gains (LTCG) tax at a concessional rate of 14.56 per cent, assuming the holding period exceeds 24 months.

When a direct asset is transferred, it may be structured in a tax-neutral manner under Section 47(VIIAF), which exempts transfers between government entities under an approved plan. This requires explicit notification of the SPV and approval of the transaction by the central government. If these conditions are not met, the transaction will attract short-term capital gains (STCG) tax at the prevailing corporate rate of 34.94 per cent. Additionally, goods and services tax (GST) may apply depending on the nature of assets transferred.

Following the asset transfer, the next phase involves the sale of 100 per cent SPV shareholding to a private investor through a competitive bidding process. This sale is treated as a transfer under Section 2(47) of the Income Tax Act. The gains from such a transfer are taxed depending on the holding period. If the shares are held for less than 24 months, it may be the case for an STCG; otherwise, an LTCG. In most scenarios under the AOMT model, the time gap between SPV incorporation and sale is expected to be less than 24 months, thereby triggering STCG at the corporate rate. Additionally, a nominal stamp duty of 0.015 per cent is applicable on the share transfer. In some cases, a repatriation tax may also arise if the proceeds are distributed to the state government via dividends. After the repurchase around the conclusion of the concession period, if the shares are reacquired at a price significantly below their FMV, Section 56(2)(x) of the Income Tax Act may apply, treating the difference as income from other sources in the hands of the transco. To mitigate this, the note suggests that the buyback be structured at the FMV as defined under Rule 11UA of the Income Tax Rules.

Overall, the preferred route for most states may be the demerger option, given its potential for tax neutrality and lower exposure to GAAR risks. However, the tax outcome will ultimately depend on the specific structure adopted, the timelines involved, and compliance with the procedural safeguards laid out in the Income Tax Act and relevant state stamp duty regulations.

Summary of tax implications/considerations

With state transmission utilities expected to shoulder over half of the planned capacity additions by 2031-32, monetisation of brownfield assets has emerged as a critical tool for capital recycling. While InvITs have provided a successful model at the central level, the AOMT framework enables similar outcomes for intra-state infrastructure by facilitating time-bound private operation of de-risked, revenue-generating assets.

The note clarifies that the tax treatment depends significantly on the chosen transaction structure, whether slump sale, demerger or direct asset transfer, with variations in exposure to capital gains, stamp duty, GAAR risk and GST. The requirement of reacquiring the SPV at the end of the concession period adds a layer of complexity, particularly with respect to anti-abuse provisions under Section 56(2)(x) of the Income Tax Act. While each option has trade-offs, the framework provides flexibility to states to optimise for both fiscal impact and regulatory certainty. ■

Interview with Devesh Bansal

"India's power transmission sector is in a very exciting phase"

In a recent interview with *Power Line* magazine, Devesh Bansal, Director, Skipper Limited, shared his views on the state of the power transmission sector in India, the key challenges and opportunities, and the future outlook. He also talked about Skipper's product portfolio and manufacturing capabilities as well as the company's plans for capacity expansion and future growth. Edited excerpts…

What is your view on the current state of the power transmission sector in India?

India's power transmission sector is in a very exciting phase. Over the past decade, we have moved from a deficit mindset to a far more reliable grid, but the real story is what lies ahead. A combination of rising power demand, rapid urbanisation, growth in data centres and rail/e-mobility and, most importantly, the aggressive scale-up of renewables is fundamentally reshaping the transmission landscape.

We are clearly entering a capacity addition plus optimisation cycle. New high-capacity corridors, inter-regional strengthening, Green Energy Corridors and the integration of large renewable parks are all driving investment. In addition, utilities are rightly focusing on optimising right of way (RoW), improving aesthetics in urban areas and adopting more compact, technology-intensive solutions such as monopoles, HTLS conductors and digital substations.

So, I would describe the sector today as structurally strong, policy-supported and on the cusp of a multi-year capex upcycle, with execution quality and speed becoming the key differentiators.

What are the biggest challenges and opportunities in the sector? What is your outlook for the near to medium term?

The three big challenges we see on the ground are:

RoW and land constraints: RoW issues, especially in forest areas and dense habitations, continue to delay projects and escalate costs. Land values have multiplied over the past few years and compensation expectations have gone up accordingly.

Execution-planning gap: While the transmission plan is ambitious and forward-looking, actual line additions often lag targets, leading to congestion in some corridors and under-utilisation in others.

Complexity of renewable integration: Evacuating power from renewable-rich but geographically remote zones to load centres, while managing intermittency, demands smarter planning, more flexible networks and higher capacity solutions.

On the opportunity side, these very challenges are opening up attractive avenues:

- Multi-year visibility of investments in transmission lines, substations and associated infrastructure.
- Higher value engineering, including the use of compact towers, monopoles, taller structures, upgraded conductors and stronger foundations that can handle higher power flows in tighter corridors.
- Export potential, as many developing regions are going through a similar transmission build-outs, which creates a strong opportunity for Indian manufacturers with proven global execution.

Our outlook for the near to medium term (next five to seven years) is very positive. We expect sustained ordering in 400 kV and 765 kV lines, accelerated renewable energy evacuation projects, offshore wind-linked corridors in the medium term, and continued strengthening of intra-state networks. For integrated, cost-competitive players, this is not just a cyclical upturn, it is a long structural opportunity.

Could you provide an overview of Skipper Limited's product portfolio, manufacturing capacity and testing facilities for the power transmission segment?

Skipper is a fully integrated player in the power transmission space, with capabilities spanning design, manufacturing, testing and engineering procurement and construction (EPC).

Product portfolio: Power transmission and T&D

- Lattice transmission towers up to ultra-high voltage levels
- Monopoles for transmission and sub-transmission, including urban/space-constrained applications
- Distribution poles and structures
- Tower accessories and fasteners
- Hot-rolled angles and structurals (backward-integrated)
- Transmission line and substation EPC solutions

Beyond power T&D, we also manufacture telecom towers, railway electrification structures and a wide range of polymer pipes and fittings. But power transmission remains our core.

Manufacturing capacity

- Engineering (towers, poles and structures) capacity of over 375,000 mtpa, which is being progressively scaled up.
- Multiple fabrication and galvanising facilities with in-house angle rolling, CNC fabrication, galvanising and fastener manufacturing capabilities, giving us strong control over quality, cost and timelines.
- Plants strategically located with good access to ports and major project sites, helping us serve both domestic and export markets efficiently.

Testing and R&D

One of Skipper's key strengths is its world-class tower testing facility, capable of full-scale load testing of high-voltage towers and monopoles. We have successfully tested a wide range of 400 kV and 1,200 kV towers and monopoles, as well as specialised designs for global utilities.

An in-house, dedicated design and research and development (R&D) team works on the optimisation of tower and monopole designs, foundation systems and cost-efficient solutions tailored to specific RoW, wind and seismic conditions. This integrated design–test–manufacture loop allows us to offer our customers validated, reliable and economical structures.

"Our growth strategy rests on three clear pillars: capacity expansion, capability enhancement and global diversification."

What are the recent business highlights for Skipper Limited in the transmission segment?

Over the past few years, we have seen a clear step-up in our transmission business on multiple fronts:

- Healthy order inflows and order book: Skipper has secured significant orders in 400 kV and 765 kV transmission lines from leading Indian utilities as well as international customers. Our order book in the engineering segment provides strong visibility for the next several quarters.
- Strengthening our position with POWERGRID and state utilities: We continue to win repeat business on the back of execution performance, competitive pricing and integrated capabilities.
- Exports to over 65 countries: Our transmission towers and poles are now supplied to markets across Latin America, Africa, the Middle East, Europe, South and Southeast Asia, and Australia. Exports have emerged as an important growth pillar for the company.
- Moving up the value chain into EPC: Skipper has executed 400 kV transmission line projects and is building its presence in line and substation EPC. This allows us to offer customers turnkey solutions – from design and supply of towers to construction and commissioning.
- Technology and testing leadership: Our tower testing station has been used not only for our own designs but also for leading global utilities and EPCs, which is a strong endorsement of our technical capabilities.

Together, these achievements have strengthened Skipper's positioning as a reliable, global-scale partner for power transmission infrastructure.

What are the company's plans for capacity expansion and future growth?

Our growth strategy rests on three clear pillars: capacity expansion, capability enhancement and global diversification.

Capacity expansion

- We are in the process of scaling up our engineering capacity beyond the current 375,000 mtpa, with a clear roadmap to significantly expand tower and monopole manufacturing over the next few years.
- This expansion is calibrated to the visibility we see in both the domestic and export markets, with a focus on maintaining capital efficiency and healthy returns.

Capability and technology

- Continued investments in design, R&D and full-scale testing to handle more complex, higher-voltage and higher-loading structures.
- Focus on monopoles and compact solutions, which are becoming increasingly important for urban and RoW-constrained projects.
- Digitalisation of our operations – from planning to production to quality control – to improve traceability, productivity and on-time delivery.

Market and portfolio strategy

- Deepening our engagement with Indian utilities on upcoming renewable evacuation, interregional strengthening and high-voltage projects.
- Expanding our export share by leveraging India's cost competitiveness and our track record in challenging geographies.
- Scaling up the EPC and substation businesses to offer end-to-end solutions and capture a larger share of value per project.

Overall, Skipper's ambition is to be among the leading global manufacturers and solution providers of transmission structures and systems, firmly aligned with India's energy transition and the growing demand for reliable, efficient power transmission worldwide. ■

"The sector today is structurally strong, policy-supported and on the cusp of a multi-year capex upcycle, with execution quality and speed becoming the key differentiators."

OMICRON CPX 200 One Device. Infinite Possibilities.

Step into the next era of testing that puts the future in your hands

After an amazing developmental journey, we are very excited to launch our solution to current and future industry challenges: the CPX 200. This next-generation multifunctional test set comprises the CPX 200's hardware elements, the HVX10 system component, the CPXpert PC software and the CORTEX Grid data assessment platform. We've combined them all into a harmonized Ecosystem that's lighter, smarter, and more powerful than anything else in the industry. One compact system covers power transformers, instrument transformers, and switchgear testing, replacing entire truckloads of equipment with a solution that weighs under 30 kg (66 lbs). Its modular hardware lets you scale from high current to high voltage in seconds. The integrated and intuitive CPXpert software harmonizes seamlessly with the new cloud-based CORTEX Grid data assessment platform, ensuring guided workflows, one-click reporting, and unified data across the entire fleet. The result is faster setups, safer testing, and actionable insights that help service providers and utilities save time, reduce risks, and make better decisions.

Unleash the expert

The CPX 200 and its entire ecosystem were developed to solve existing and future problems. Multifunctionality, a modular structure, and its light weight help to strengthen grid stability and empower decentralized energy networks. For example, commissioning and maintenance activities are perfect applications for the CPX 200. Service providers, manufacturers, asset managers, and test field engineers all benefit from the safest test set on the market. Additionally, it's easy to transport in a backpack or flexible transport case, making it ideal for shipping.

Many companies, including ours, are facing a significant skills shortage and a heavier workload. As it's the world's smallest and lightest multifunctional test set (59% smaller than average), the CPX 200 provides greater freedom for faster, more mobile operation, letting users accomplish more under safe conditions in less time. The improvements go well beyond hardware, as the CPXpert software also helps optimize test preparation, execution, and result analysis with modernized operating features. Topped off with CORTEX Grid, acquired data is available for various evaluations and interpretations worldwide in minutes, enabling the best possible condition assessments for all your assets.

Developed with safety in mind

Comprehensive safety features that reduce the risk of electrical hazards:

- INTERLOCK key
- Workflow according to EN 50191
- Wiring instructions with connector indicator lights
- Red and green signal lights
- Emergency switching off button
- Optional external signal lamp*

*available soon

Adjustable for your requirements

Thanks to its modular hardware, software, accessories, and customized service offers, the CPX 200 can be configured precisely to your needs. You can start with a flexible, multifunctional test solution; later, it can easily be converted into a specialized testing system to meet your specific requirements.

Unleash its full potential with:

- 1000 A AC/DC with the High Current Module
- 10 kV AC/DC with the HVX10 system component
- Test frequency range: 1–600 Hz and DC

Maximum power per space

All tests can be carried out with a total system weight of less than 30 kg (66 lbs).

- CPX 200: 10.6 kg (23.3 lbs)
- High Current Module: 3.3 kg (7.4 lbs)
- HVX10: 14.8 kg (32.7 lbs)
- Better access in confined areas thanks to a backpack or carry solution.
- A lightweight system solution that eliminates heavy lifting and transport restrictions

Always ready for use

- Combined measuring channels reduce wiring efforts
- Real three-phase voltages for power transformer ratio measurements
- Color multi-touch display with automatic brightness adjustment for unmatched readability in every environment
- Guided test procedures with access to nameplate data – fast and safe for proper configurations
- Multi-asset tests via standard user interface
- Full, automatic test result documentation and evaluation – seamless and compliant
- Efficient test planning and reporting

Next-generation technology

Our solution was specifically developed to meet the growing demands of modern and future power systems.

- Developed and certified in accordance with international standards – for global application and maximum quality
- Based on modern safety and cybersecurity guidelines for maximum protection in networked infrastructures
- Ongoing support and reliable maintenance – for investment security and operation for years to come
- Perfectly developed for substation commissioning and diagnostic tests
- High-quality components for hardware and software, including perfectly engineered accessories for professional use

Let's ask the specialists about our newest development:

Michael Rädler, CPX 200 Product Manager:

You're focused on the CPX 200's hardware and accessories; what do you find most fascinating about the way the components interact?

"What I find most fascinating is how the interaction of all the components, such as the hardware, accessories, and software, blends together to create a complete, harmonious system. One thing was clear to us from the start: If it's not easy to use, it won't be acceptable. That's precisely why we were so focused on uncompromising functionality. For us, "Plug and Play" is more than just a marketing promise; it's a principle that runs throughout the entire system.

We wanted to create a clear product language that's intuitive, easy to understand and supports our customers' daily workflow. Every connector, every cable, every carry handle is the result of intense considerations, tests, and rounds of feedback. We know that nobody finds good hardware with poor accessories, or vice versa, impressive."

Lukas Klingenschmid, CPXpert Product Manager:

With your focus on software and firmware, what benefits do you see in the new system?

"I consider the new system to be a finely tuned cog with three interconnected parts: software, firmware, and hardware. Each of these areas is strong, but only when they work together do they create something that goes beyond the sum of their parts.

I'm particularly proud of the scalability and flexibility of our solution. From testing engineers in the field to installation managers in the office, CPXpert is practical and saves time for all of them. We don't just provide measurement results; we create transparency, traceability, and efficiency at all levels."

Bavley Farid, CORTEX Grid Product Manager:

CORTEX Grid, the long-awaited cloud solution that brings everything together, is part of the CPX 200 ecosystem. What are the benefits of the interaction between the CPX 200 and CORTEX Grid?

"The interaction between the CPX 200 and CORTEX Grid enables seamless data continuity from the test site to the cloud. The test data recorded with the CPX 200 is immediately standardized and merged with results from other OMICRON test systems, such as CPC 100, TESTRANO 600, CT Analyzer, and CIBANO 500, to create a uniform and comprehensive asset record. This comprehensive overview enables more in-depth analyses, efficient reporting, and added value for the data in the long term throughout the entire life cycle of an asset."

But CORTEX Grid is capable of so much more! Where is its journey headed?

"CORTEX Grid is constantly developing: It's becoming a central data platform that supports fleet comparisons, advanced diagnostics, and data-driven maintenance strategies that help customers convert decades of test data into actionable findings."

A new beginning

As the initial developmental journey nears its end, the modular concept behind the CPX 200 has only one limitation: the limits of our creativity. Our numerous ideas — some already in development — our eagerness to hear customer feedback, and our motivation and thirst for action are what keep us happily pushing ahead. Join us as we anticipate the years to come with excitement! Until then: "For those who empower. CPX 200 is made for you."

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Interview with Anurag Agarwal

"India's power transmission sector is entering a high-growth, high-complexity phase"

In a recent interview with *Power Line* magazine, Anurag Agarwal, Chief Executive Officer, Polycab India Limited, spoke about the current state of the power transmission sector in India, the key challenges and opportunities, and the outlook for the sector in the near to medium term. He also spoke about Polycab's product portfolio for the power transmission segment, including key offerings and areas of specialisation. Edited excepts…

What is your view on the current state of India's power transmission sector?

India's power transmission sector is at an inflection point, driven by a confluence of structural reforms and unprecedented infrastructure investments. The country is witnessing a rapid expansion of transmission networks, propelled by rising electricity demand, aggressive renewable energy targets and the government's strong push for electrification.

The installed power generation capacity exceeded 500 GW in 2025, with over half of it coming from non-fossil sources, with a current network of 450,000 ckt km and over 1,359 GVA of transformation capacity. Transmission capacity must grow fivefold by 2032 to support 900 GW of generation, with significant government initiatives to attract private investments of up to Rs 10 lakh crore. Peak demand is projected at 270-275 GW in summer 2025, up from 230 GW in the previous year.

In short, India's power transmission sector is entering a high-growth, high-complexity phase, offering significant opportunities for companies that combine innovation, operational excellence and environmental, social and governance (ESG) stewardship.

What are the key challenges and opportunities shaping the transmission market?

The sector is poised to grow five times by 2032, requiring an investment of Rs 10 lakh crore. Government initiatives such as "One Grid, One Nation" and tariff-based competitive bidding are attracting private and foreign investments, with over 90 per cent of new projects awarded under public-private partnership models.

Key drivers such as renewable integration, industrial expansion and energy storage plans are propelling higher growth; however, there are several sectoral challenges that can derail this growth.

Even with the addition of 8,830 ckt km to the transmission network in FY 2025, we are falling behind the target of 15,253 ckt km (a 42 per cent gap), stranding approximately 50 GW of clean energy. High capital requirements from stressed discoms, land acquisition issues and technology gaps, including high-voltage direct current (HVDC) supply constraints, pose risks to timely project execution.

What is your outlook for the transmission sector in the near to medium term?

The transmission sector is at the heart of India's clean energy transition. While the outlook is promising, with strong policy support and investment opportunities, success hinges on addressing infrastructure bottlenecks, financing challenges and technology adoption.

Modernisation via Central Transmission Utility of India Limited planning, General Network Access amendments for solar/non-solar capacity splits and production-linked incentives for domestic HVDC aim to address gaps, but faster land clearances and incentives are essential for resilience. The sector remains pivotal for 24x7 supply amid 5-6 per cent annual demand growth.

Could you provide an overview of Polycab's product portfolio for the power transmission segment, including key offerings and areas of specialisation?

Polycab's power transmission portfolio is engineered to meet the evolving needs of modern infrastructure, combining advanced technology with stringent safety and performance standards. Here is an overview of the company's key offerings and specialisations:

Extra high voltage (EHV) cables:

- Voltage range of 66 kV to 220 kV with Milliken-type conductors up to 2,500 sq. mm, aluminium-corrugated or lead-sheathed, AL-PE laminate. All products comply with IS 7098-3/IEC 60840/IEC 62067 standards.

High voltage cables:

- Voltage range of 3.3 kV to 33 kV with aluminium or copper conductors with semiconducting layers, cross-linked polyethylene (XLPE)/ethylene-propylene-rubber insulation via CCV process, armoured/unarmoured options complying with IS 7098-2/IEC 60502-2/BS 6622 standards.

Medium voltage covered conductors jointing kits and accessories:

- Voltage range of 3.3 kV to 66 kV with copper or aluminium conductors, XLPE insulation with semiconductive screens. Available with water-blocking tape and HDPE/PVC outer sheath.

Cable jointing and termination kits:

- Jointing kits: Heat-shrinkable and cold-applied kits for medium voltage and high voltage cables; designed for 11 kV, 22 kV and 33 kV systems, ensuring safe and durable connections.
- Termination kits: Indoor and outdoor terminations for medium voltage cables. Options include polymeric and heat-shrinkable terminations for harsh environments.

Polycab's investment in vertical continuous vulcanisation (VCV):

- Polycab has invested in a VCV line for manufacturing 500 kV EHV cables, which positions it among the few Indian companies capable of producing ultra-high voltage cables for grid modernisation and large-scale infrastructure.

What have been the key business highlights for Polycab in the power transmission segment in the past one year or so?

The past year has been transformative for Polycab's power transmission business, marking a significant scale-up and strategic progress:

- Strong financial growth: Our net profit surged by 49.5 per cent and revenue grew 26 per cent year on year in the first quarter of FY 2025, largely due to infrastructure expansion and renewable energy projects. The company continues to maintain a 15 per cent compound annual growth rate outlook, supported by industry growth forecasts of 21 per cent.
- Strategic investments in advanced cable technology: We commissioned new facilities in Gujarat for EHV cables, which are expected to be operational in FY 2026. We also have investments in overhead conductor segments, building additional capacity in aluminium wire rods and conductors for various value-added applications. These investments position Polycab as a supplier for next-generation transmission needs, including offshore wind and long-distance renewable integration.
- Innovations and R&D: We launched smart cables with embedded sensors for real-time monitoring, predictive maintenance and enhanced grid performance – critical for smart grid and renewable integration.
- Sustainability and ESG: We achieved a 24.2 per cent reduction in greenhouse gas emissions intensity and a 19.8 per cent increase in renewable energy use across manufacturing facilities, aligning with global ESG benchmarks. ■

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DAYANAND SWAMY KUNA (FIE, C.Eng)
President/CEO (Sales/Marketing & EPC)
+91 8329940086, +91 9960897384
dayanand.kuna@salasartechno.com

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Venue: Yashabhoomi IICC, Dwarka
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Interview with Moinul Kadva

"The transmission sector is in an advanced phase of execution and scale-up"

In an interview with *Power Line,* Moinul Kadva, Whole Time Director, KP Green Engineering Limited, discussed the state of the power transmission sector, the key challenges and growth opportunities. He also outlined the company's offerings, business developments and roadmap for expansion. Excerpts…

What are your views on the current state of the power transmission sector in India?

India's transmission sector is in an advanced phase of execution and scale-up. Demand is being driven by three converging forces: rapid renewable generation addition, the need for grid strengthening and interstate evacuation, and large-scale electrification of industrial infrastructure. The industry is healthier than it has been at any time in the past decade – order books are sizeable, financiers are active and government programmes (central and state) are prioritising transmission augmentation to remove bottlenecks for renewable integration. At KP Green Engineering, we see this as a sustained growth runway: the market is big and technically demanding, and it rewards companies that deliver quality, timely execution and dependable logistics.

What are the key challenges and opportunities shaping the transmission market?

Challenges

- Right-of-way and regulatory delays: These remain the single largest schedule risk on long corridors.
- Supply-chain volatility and commodity price cycles: Steel, galvanising inputs and freight affect margins and working capital.
- Skilled execution bandwidth: Projects require experienced engineering, procurement and construction (EPC) partners, specialised fabrication and galvanising capacity.
- Financing and payment cycles for large state/central projects: Slower receivables strain smaller vendors.

Opportunities

- Massive renewable evacuation: Solar and wind additions require new high-voltage corridors and substation augmentation, resulting in persistent order flows.
- Balance-of-plant (BoP) and EPC consolidation: Clients prefer single-window partners that can supply towers, substation structures, galvanising and logistics — exactly where integrated players add value.
- Exports and cross-border projects: Neighbouring markets are opening up, and standardised Indian engineering is becoming increasingly competitive.
- Value-added services: Pre-engineered buildings (PEBs), heavy-engineering for metros and high-mast/telecom towers increase the addressable revenue per client.

Outlook for the near to medium term

Near term (12–24 months): Robust order inflows driven by domestic renewable evacuation projects and grid modernisation. Pockets of tightness in steel and logistics will persist, but will remain manageable for organised players with captive galvanising and scale.

Medium term (2-5 years): Structural growth continues as India targets greater renewable penetration and a higher number of regional interconnections. Competitive advantage will accrue to firms that combine execution excellence, quality assurance (galvanising/anti-corrosion), technical design capability and disciplined working capital management.

The overall outlook is positive to very positive for well-capitalised, delivery-focused firms.

What are the KP Group's key product offerings and specialisations in the power transmission segment?

At KP Green Engineering, we are positioned as a single-window supplier across the transmission value chain. Our key offerings include:

- Transmission line towers: Lattice towers for 33 kV up to 765 kV applications, engineered for site-specific mechanical loads.
- Substations and switchyard structures: Foundation-mounted substations, gantries, isolator structures and switchyard steelworks.
- Galvanising and surface protection: In-house hot-dip galvanising plants for longevity and corrosion protection (a critical differentiator for durability).
- High-mast towers and mono-pole solutions: For airports, highways, ports and stadiums where lighting, surveillance and telecom coexist.
- Telecom towers and windmill lattice towers: Diversified tower manufacturing knowhow.
- Solar structures: Module mounting structures and trackers for support to power projects.
- PEBs and heavy engineering: Pre-engineered buildings and heavy engineering to contribute to India's infrastructure development.

We specialise in end-to-end project delivery – design → fabrication → galvanising → logistics → on-site erection – which is why EPC companies and utilities engage with us for large transmission and renewable projects.

What have been the key highlights of the KP Group's power transmission business in the past year?

- Material orders and scale expansion: KP Green Engineering has secured large confirmed orders across the solar, transmission and PEB segments (notably an aggregate order worth Rs 682.75 crore, announced in November 2025), demonstrating strong market traction and diversified demand across our product lines.
- Operational wins: Successful dispatch of heavy-engineering product shipments (including specialised products for metro/urban infrastructure), signalling the company's capability to service large institutional buyers.
- Investor/corporate disclosures:

Regular stock exchange submissions and published financials, showing improved utilisation and a shift in the revenue mix towards transmission and solar balance-of-plant work.

- Strengthened leadership and team: Continued build-out of an experienced leadership team focused on execution, quality and capacity expansion.

What are the company's plans to expand its product portfolio and strengthen its presence in transmission?

- Capacity augmentation, fabrication and galvanising: Continue to invest in galvanising capacity and additional fabrication shed capacity in order to control quality, turnaround and margins – this is the backbone of transmission reliability.
- Technology and design upgradation: Adopt more project-specific engineering (lighter designs, optimisation for transport and erection costs) and digital shop floor controls to reduce lead times and improve yield.
- Integrated EPC play: Move up the value chain from being a supplier to offering bundled EPC/BoP solutions in select corridors where we have repeat contacts and a logistics advantage.
- Geographic expansion and exports: Selectively target neighbouring export markets and institutional projects where Indian tower designs and galvanising offer a competitive cost-quality tradeoff.
- Adjacencies: Expand offerings in high-mast, telecom and PEBs to increase wallet share per customer and ensure smooth cyclicality across product segments. ■

Key Statistics

Growth in line length and transformer capacity

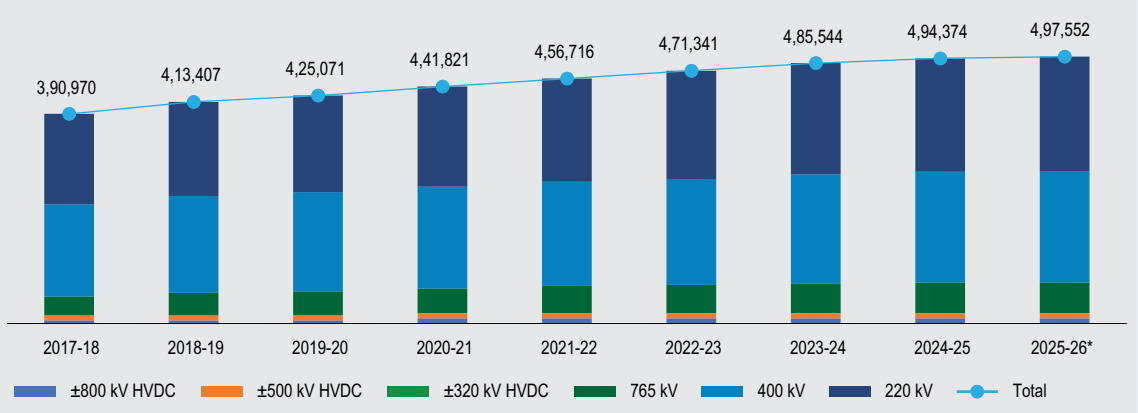
Transformation capacity, by voltage

Year	HVDC (MW)				AC transformation capacity (MVA)			
	±800 kV	±500 kV	±320 kV	Total	765 kV	400 kV	220 kV	Total
2017-18	9,000	13,500	-	22,500	190,500	282,622	331,336	804,458
2018-19	9,000	13,500	-	22,500	211,500	313,182	352,481	877,163
2019-20	12,000	13,500	-	25,500	231,000	337,772	373,621	942,393
2020-21	15,000	13,500	-	28,500	238,700	362,327	394,941	995,968
2021-22	18,000	13,500	1,000	32,500	257,200	393,113	420,637	1,070,950
2022-23	18,000	13,500	2,000	33,500	276,700	425,748	444,404	1,146,852
2023-24	18,000	13,500	2,000	33,500	294,700	457,933	464,947	1,217,580
2024-25	18,000	13,500	2,000	33,500	315,700	498,473	489,840	1,304,013
2025-26*	18,000	13,500	2,000	33,500	345,700	509,243	501,695	1,356,638

** Till October 2025*

Source: Central Electricity Authority

Transmission line length, by voltage (ckt km)



** Till October 2025*
Source: Central Electricity Authority

Interregional transfer capacity

Year	Capacity (MW)
2013-14	33,950
2014-15	46,450
2015-16	58,050
2016-17	75,050
2017-18	86,450
2018-19	99,050
2019-20	102,050
2020-21	105,050
2021-22	112,250
2022-23	112,250
2023-24	118,740
2024-25	118,740
2025-26*	120,340

** Till October 2025* *Source: Central Electricity Authority*

TransTech India 2025

Agenda: Thursday, December 11, 2025 (Day 2)

Time: 9:20 AM-9:30 AM Recap of Day 1

Recap by *Power Line*

Time: 9:30 AM-10:30 AM

O&M Best Practices

- Dr Nilesh Kane, Chief Distribution, Tata Power
- Sanil Namboodiripad, Chief Operating Officer, IndiGrid
- Sandip Maity, Senior Vice President, Design and Engineering, Resonia
- Nihar Raj, Head – O&M, Adani Energy Solutions

Time: 10:30 AM-11:10 AM

Special Session With Director Operations, POWERGRID

- Naveen Srivastava, Director (Operations), POWERGRID

Time: 10:00 AM-11:30 AM *(Parallel Track)*

Workshop by Bentley

Power Line Systems: Recent Features in PLS-CADD, Tower & PLS-POLE

Time: 11:10 AM-11:50 AM

Exhibition Viewing, Tea/Cofee and Networking Break

Time: 11:50 AM-12:50 PM

Technology Showcase

- Presentations by Kanohar Electricals, Bajel, Enline, Indore Composite, Elegrow Technology

Time: 12:50 PM-1:10 PM

Innovation in Action

- Presentation by Chandan Kalra, AVP, Resonia, and Divya Manchanda, EVP, Amber Wings

Time: 1:10 PM-2:10 PM *(Parallel Tracks)*

Cables and Conductors

- Abhishek, Chief General Manager, POWERGRID
- S.K. Jana, Senior Vice President, R&D, APAR Industries
- D. Latha Vinod, Director Projects, TGTRANSCO

Time: 1:10 PM-2:10 PM *(Parallel Tracks)*

AI and Digitalisation

- Mayank Bhardwaj, Director, Power & Utilities, KPMG
- Mahendra Kr. Kaloria, Deputy GM, POWERGRID
- Nihar Raj, Head – O&M, Adani Energy Solutions

Time: 2:10 PM-3:00 PM

Exhibition Viewing and Lunch Break

Time: 3:00 PM-4:00 PM *(Parallel Tracks)*

Transformers

- Deepak Kumar Jha, CE, Bihar State Power Transmission Company
- Abhay Kumar, Chief General Manager, POWERGRID
- Dinesh Kumar Singh, Executive Director (T&D System), DVC

Time: 3:00 PM-4:00 PM *(Parallel Tracks)*

Towers

- Arup Kalita, Chief General Manager, AEGCL
- Dayanand Swamy Kuna, President and CEO, Salasar Techno
- G.P. Payasi, Chief General Manager, POWERGRID

Time: 4:00 PM-5:00 PM

Special Session

- Special Session with S.K. Soonee, Former Chairman, Grid India

Day Two Wrap-up and Closing Remarks, and Raffle Draw

High Tea, Exhibition Viewing and Networking

TransTech India 2025

Agenda: Friday, December 12, 2025 (Day 3)

Time: 9:20 AM-9:30 AM Recap of Day 2

Recap by *Power Line*

Time: 9:30 AM-10:20 AM

Supply Chain and Procurement Challenges

- G.S. Budiyal, Director (Operations), Power Transmission Corporation of Uttarakhand
- K.K. Gupta, Executive Director, POWERGRID
- Rajan M.P., Chief Engineer, KSEB

Time: 10:20 AM-11:00 AM

Cross-Border Transmission

- Kedar Silwal, Director, Nepal Electricity Authority
- V. Thiagarajan, Senior GM, POWERGRID

Time: 11:00 AM-12:00 PM

Focus on Renewable Energy Evacuation

- Deepak Consul, Head – Grid & Connectivity, Gentari Renewables
- Manju Gupta, Executive Director, POWERGRID
- Deepak Khare, Senior Vice-President and Head of Projects, Blupine Energy
- Mahesh Vipradas, Vice-President, Sembcorp India

Time: 12:00 PM-12:30 PM

Exhibition Viewing, Tea/Cofee and Networking Break

Time: 12:30 PM-1:20 PM *(Parallel Tracks)*

Substations

- Dinesh K., Chief Engineer, KSEB
- M. Srinivasa Rao, Chief General Manager, POWERGRID
- Neeraj Yadav, Deputy President, Transrail Lighting

Time: 12:30 PM-1:20 PM *(Parallel Tracks)*

Drones

- Pradeep Singh Chauhan, Chief Manager, POWERGRID
- Kanav Kumar, Co-Founder and Director, Better Drones
- Representative from a leading EPC player

Time: 1:20 PM-2:20 PM

Special Valedictory Session: Skill Development for Transmission

- Dr Yatindra Dwivedi, Director Personnel, POWERGRID
- Srinivasan Ravi, Chief General Manager, HRD, TG Transco
- Dr V. K. Singh, Chief Executive Officer, Power Sector Skill Council
- Another HR from a leading transco

Conference Wrap-up and Closing Remarks, and Raffle Draw

Lunch, Exhibition Viewing And Networking

TransTech India 2025

Agenda: Wednesday, December 10, 2025 (Day 1)

Time: 9:50 AM-11:00 AM

Inaugural Session

- Inaugural Address by Pankaj Agarwal, Secretary, Ministry of Power
- Remarks by Pratik Agarwal, MD, Sterlite Electric, and Chairman, Resonia, and Serentica Renewables

Please note that the keynote address by Dr R.K. Tyagi, CMD, POWERGRID, originally secheduled for this session, is now likely to take place on December 11/12 [being confirmed]

Time: 11:00 AM-11:50 AM

Exhibition Viewing, Tea/Cofee and Networking Break

Time: 11:50 AM-12:50 PM

Keynote Session: View From The Top

- Manish Agrawal, Chief Executive Officer, APAR Industries
- Venu Nuguri, Managing Director and Chief Executive Officer, Hitachi Energy India
- Arun Sharma, Chief Executive Officer, Resonia
- Sandeep Zanzaria, Chief Executive Officer and Managing Director, GE T&D India

Time: 12:50 PM-1:40 PM

Technology Showcase

- Presentations by Skipper, Bentley, Andritz Hydro GmbH, Mtandt Group, Polycab

Time: 1:40 PM-2:30 PM

Exhibition Viewing and Lunch Break

Time: 2:30 PM-3:25 PM

Special Session – EPC Perspective

- Rajeev Dalela, President (Domestic & SAARC), KPIL
- Venkat Muvvala, President and Chief Business Officer - Infra & EPC Business, Jakson Group
- Akhilesh Pathak, Executive Director, PMD, POWERGRID
- Manish Shrivastav, Business Head, T&D Projects, APAR Industries
- Prashant Sinha, Chief Operating Officer, Resonia

Time: 3:25 PM-4:45 PM

Special Session: State Initiatives and TBCB

- D. Krishna Bhaskar, Chairman and Managing Director, Transmission Corporation of Telangana
- P.C. Dhyani, Managing Director, Power Transmission Corporation of Uttarakhand
- Mayur Maheshwari, Managing Director, U.P. Power Transmission Corporation
- Upendra Pande, Managing Director, Gujarat Energy Transmission Corporation
- Head of another leading state transco

State Utilities Award Ceremony

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For Sponsorship Opportunities, Contact:

Ishan Arora, General Manager – ANZ & ASEAN

Ph: +61 474 259 985 | E: ishan.arora@globaltransmission.info

Puneet Dua, General Manager – India

Ph: +91 98105 24309 | E: puneet.dua@globaltransmission.info

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