



Towards a Reliable, Resilient Power System

STRATEGIC CONFERENCE

Hydrogen, Ammonia and Green Molecules: Building competitive industrial value

The session titled “Hydrogen, Ammonia and Green Molecules: Building Competitive Industrial Value Chains for India and the World” was moderated by Kapil Bansal, Partner and Energy Transition Co-Lead, EY India, and featured remarks by Abhay Bakre, Mission Director, Green Hydrogen Mission, Ministry of New and Renewable Energy (MNRE); Sangeet Jain, MD, Lanzatech; R.R. Sonde, Professor, IIT Delhi, and Chairman, Hydrogen Valley, Jodhpur; B.C. Tripathi, Vice Chairman, AM Green Ammonia; and S. Shaswattam, ED, NTPC, and Head, NETRA. They highlighted the evolving landscape of the green hydrogen and ammonia sectors, with a focus on policy support, technological innovation, commercial viability and demand creation to build scalable industrial value chains. Edited excerpts...

Abhay Bakre emphasised that the National Green Hydrogen Mission is an ambitious initiative, supported by India’s strong progress in scaling renewable energy over the past decade, particularly solar and wind. Green hydrogen is a highly versatile technology, as it can be converted into multiple forms, such as ammonia and methane, for use across sectors.

On the supply side, there are limited challenges, as renewable capacity expansion and transmission infrastructure are already being addressed. Electrolyser manufacturing is also progressing, with costs declining and domestic production being incentivised under the mission.

However, the main challenge lies on the demand side. While some demand exists, such as blending in refineries and replacing grey ammonia with green ammonia in fertiliser units, there is a need to expand demand across more sectors. The mission is addressing this through incentives, standards and pilot projects. Cost is unlikely to be a long-term concern, and with technological readiness and growing confidence, large-scale adoption is expected. The overall objective remains to create demand and build industry confidence in order to shift towards renewable-based green energy.



B.C. Tripathi noted that two to three years ago, during the early discussions around the energy transition, Europe was seen as a key emerging market, with expectations of strong demand and investment flows, including from India. However, with the evolving global dynamics, the energy transition has experienced some slowdown, reducing the earlier momentum. As a result, the anticipated scale of demand has not materialised, particularly due to geopolitical and energy policy developments worldwide. This has created uncertainty within the industry regarding the pace and timing of project development and investments.

Despite this, the future outlook is positive, as the current situation is temporary and that momentum will return as scale and economic viability improve. However, demand growth remains a key concern, and more work is needed to build industry confidence. On the domestic front, he observed that existing efforts are not yet at a scale sufficient to achieve economic viability. Earlier strategies were focused on tapping export demand first and gradually developing the domestic market. However, there is now a need to rethink this approach and accelerate domestic demand creation without waiting for global markets to fully mature.

This is particularly important given India’s high dependence on imported natural gas, with significant supply coming from imports at varying and often high prices. In this context, it is critical for India to move faster in developing its domestic green hydrogen and ammonia ecosystem.

While oil prices may stabilise relatively quickly, gas prices are likely to remain elevated for the next two to three years. Since ammonia production is heavily dependent on natural gas, this will continue to result in higher costs for gas, ammonia and nitrogen in India. In light of these factors, there is a need to revisit and refine the strategy, with a stronger focus on accelerating domestic demand creation.

Sangeet Jain highlighted that innovation is playing a critical role in advancing cleaner energy pathways. A key focus is on improving processes that enable the production of clean hydrogen while simultaneously enhancing value through effective carbon capture. Further, attention was drawn to the need to diversify carbon feedstocks. Instead of relying solely on conventional sources, efforts are being made to utilise various forms of waste, including industrial waste, agricultural waste and other carbon-rich residues. These waste streams present an opportunity to be converted into useful inputs through advanced processing techniques.

One such approach involves gasification, where solid waste is converted into syngas, consisting primarily of carbon monoxide and hydrogen. In combination with green hydrogen, these processes can be used to produce fuels such as ethanol.

S. Shaswattam opined that coal and coal-based power will continue to play an important role in India’s energy mix. This is primarily because coal remains the country’s most abundant and reliable domestic re-

source. At the same time, global developments, particularly after the Ukraine conflict, have influenced the way countries are approaching emissions and energy transitions. There is increasing focus on carbon capture, utilisation, and storage as a key pathway to manage emissions while continuing to use existing energy resources. It was emphasised that captured carbon dioxide should not be viewed merely as a by-product but as a resource that can be utilised across multiple applications.

It is positive trend that renewable energy capacity has scaled up significantly, and this will be used for the production of green hydrogen. This hydrogen, when combined with captured carbon dioxide, can open new avenues for producing fuels, chemicals, fertilisers and other value-added products.

R.R. Sonde remarked that while technology challenges in the hydrogen sector can be addressed, the larger issue lies in making these technologies commercially viable. From a commercial perspective, one of the key challenges identified is securing reliable and affordable round-the-clock or firm despatchable renewable energy. Access to a consistent power supply at competitive tariffs remains a major hurdle, and significant effort is currently being directed towards resolving this issue.

Cost competitiveness was identified as another critical factor. Efforts are being made to bring down the cost of hydrogen production to viable levels through partnerships involving both private and public stakeholders. In this context, carbon credits were highlighted as an important enabler. It was suggested that a structured and possibly mandatory framework for carbon credits could significantly improve project economics and accelerate adoption.

AI for Power and Power for AI: Revolutionising performance, upgrading distribution and elevating grid intelligence

The session on “AI for Power and Power for AI: Revolutionising performance, upgrading distribution and elevating grid intelligence” explored the convergence of artificial intelligence (AI) and electricity systems to enhance grid performance, distri-

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bution efficiency and intelligence. It was moderated by Prabhav Sharma, Partner, McKinsey and Company, and featured insights from Gerhard Salge, Global Chief Technology Officer, Hitachi Energy; Dr Kwok Wai Ma, Senior Director, Industrial and Infrastructure, Infineon Technologies; Jogendra Behera, Head, Policy, Regulatory and Non-Utility Markets, Apraava Energy; and C.Y. Chung, President, IEEE Power and Energy Society.

Gerhard Salge highlighted the importance of viewing AI in a broader technological context rather than limiting it to narrow definitions such as generative AI. He noted that India has made remarkable progress over the past decades in building one of the largest synchronised power systems globally, with strong reliability and resilience. At a more granular level, developments in states such as Rajasthan demonstrate how the grid is already managing high levels of variable renewable energy, particularly solar, where supply frequently exceeds demand during daytime hours. He emphasised that this achievement is underpinned by advanced technology and deep operational know-how. A key enabler is the intelligent control of converters, which plays a central role in managing power flows in systems with high renewable penetration. Beyond power flow management, maintaining voltage and frequency stability presents an additional layer of complexity, requiring sophisticated control of power electronics.

Salge pointed to grid-forming technologies as a critical solution, which can be deployed within converters or in combination with energy storage systems such as batteries or supercapacitors. These technologies are inherently data-driven and evolve over time, allowing systems to adapt to changing grid conditions. He clarified that grid-forming capability is not a one-time installation but must be implemented appropriately in line with grid transition requirements. He also noted the increasing convergence of transmission and distribution systems, with bidirectional power flows becoming more common. This transformation, supported by intelligent and adaptive technologies, is shaping the future of grid stability and operations.

Dr Kwok Wai Ma highlighted the fundamental transition of the global grid from traditional copper-and-iron systems to a power electronics-based grid. He noted that this shift has been

under way for the past 20-30 years, driven by the rapid growth of renewable energy sources such as wind and solar, advancements in transmission technologies such as high voltage direct current, and increasing electricity demand from electric vehicles (EVs). He added that these applications are predominantly converter-interfaced, characterised by fast response times and reliance on power electronics for grid interaction, unlike conventional synchronous systems.

He further observed that while these parameters allow converters to become smaller, lighter and more efficient, they present a significant challenge because the traditional grid is not sized for such fast, solid-state converters. Ultimately, Dr Ma concluded that while power semiconductors drive innovation across size, weight and cost, they also create a pressing need to automate the work of these new grid members

C.Y. Chung highlighted that automation is essential for advancing modern power systems, functioning through a closed loop of sensors, communication and control. However, he mentioned that the application of this loop depends on specific regional goals, such as focusing on self-healing to reduce power loss or managing complicated systems involving distributed energy resources and storage.

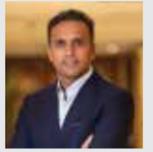
He explained that automation cannot operate in isolation and must be co-designed alongside generation, transmission and digital networks to be cost-effective. He noted that while promoting EVs reduces pollution, climate change cannot be addressed if the underlying generation still relies on coal-fired power. To fully utilise automation, he emphasised the necessity of a robust architecture for the entire system and the integration of intelligence through AI, particularly for modelling power system components and creating digital twins using real-time information.

Finally, Chung summarised three critical pillars for the industry: the architecture of the entire power system, the empowerment of automation with intelligence, and the importance of scalability. He pointed out that scaling successful projects requires a focus on standardisation and interoperability to ensure long-term success across different regions.

Jogendra Behera noted that the industry is currently tackling the challenge of finding suitable use cases for AI that

What excites you the most about the power sector today?

“ This is a truly exciting time to be in the power sector. In the next five to seven years, India will build more transmission than almost any other country. And the private sector will deliver half of it. India is one of the first countries to have been consistently building its transmission network by adopting the TBCB method, back in 2010. It is because of this that we have not one, but about 15-20 players in the country contributing to portions of the grid. Over the last several years, the government has been doing everything possible to make the 500 GW mission happen. The proactive build-out of the grid is a part of the solution. The speed of transmission build-out will drive the speed of renewable penetration. ”



Pratik Agarwal, Managing Director, Sterlite Electric, and Chairman, Resonia and Serentica Renewables

bring adequate return on investment (ROI). He mentioned that established use cases already include the forecasting of generation, which is vital for the grid and developers, particularly for managing demand-side management as regulations tighten. He also pointed out that internet of things-based predictive maintenance is being used to reduce operations and maintenance expenses and extend asset life.

He further explained that as the industry moves toward hybrid projects with aggregated technologies, AI will help decide when to charge and discharge batteries. He noted that AI would also assist in resource management and navigating complicated market segments to determine participation and pricing. While he mentioned that pilot cases have shown significant changes and good ROI, he observed that moving from a pilot to an operationalised model at scale remains a challenge. He emphasised that for a successful transition, AI must be embedded into existing systems to ensure continuous data flow. He noted that since situations are dynamic, models require continuous calibration.

Nuclear Power for Energy Security: Delivering scalable and reliable clean power

The session on “Nuclear Power for Energy Security: Delivering scalable and reliable clean power” featured remarks by Ranjay Sharan, President, Nuclear Energy Business, Reliance Industries Limited; K. Shanmugha Sundaram, Chairman, NTPC Parmanu Urja Nigam Limited, and Vice Chairman (ASHVINI), Director, Projects, NTPC; Dr Thierry Advocat, Nuclear Counsellor, Embassy of France; and Prateek Agarwal, ED, Corporate

Planning and Corporate Communication, Nuclear Power Corporation of India. The session was moderated by Chris Gadomski, Lead Analyst, Nuclear, BloombergNEF. The session focused on the development of nuclear energy projects, technological aspects, safety concerns, supply chain management and financing mechanisms in India as well as globally.

Ranjay Sharan highlighted India's growing confidence in its nuclear programme, reflected in more ambitious capacity targets, policy reforms and increasing openness to private sector participation to meet rising energy demand. He noted that the perception around nuclear energy is gradually improving, supported by government messaging on energy security and climate benefits, although safety concerns persist for some stakeholders.

On the technology front, he observed that large nuclear reactors face greater challenges compared to small modular reactors (SMRs) in terms of cost, deployment timelines, flexibility and project risk. While large reactors benefit from economies of scale, their megaproject nature often leads to cost overruns and delays, making SMRs a potentially more adaptable option to meet evolving grid requirements. SMRs offer greater scalability, siting flexibility and the potential for alternative cooling options, which can help reduce water stress.

He noted that India regards nuclear energy as clean due to its near-zero operational CO₂ emissions and its growing role in providing low-carbon baseload power. As India aims for significant nuclear capacity expansion by 2047 under the Viksit Bharat strategy, the nuclear energy segment is expected to witness growth in the future.



K. Shanmugha Sundaram highlighted the role of nuclear energy in India's energy transition, noting that the government views it as a clean, reliable baseload source critical for energy security, the Viksit Bharat vision and the net-zero target for 2070. The sector is focusing on capacity expansion through indigenous technologies, alongside the gradual exploration of private sector participation.

Recent legislative reforms such as the SHANTI Act, 2025 support nuclear energy by modernising regulations, enabling private investment and ensuring safety while retaining state control over sensitive areas. The act repeals the Atomic Energy Act 1962 and the Civil Liability for Nuclear Damage Act, 2010 to create a unified framework for scaling nuclear capacity. It permits private companies, joint ventures and approved entities to build, own, operate and decommission nuclear plants/reactors under licence and allows up to 49 per cent FDI/minority equity. It also strengthens the institutional framework by granting the Atomic Energy Regulatory Board statutory powers for licensing, inspections, enforcement and lifecycle oversight (construction to waste).

Sundaram also highlighted the key challenges faced by India's nuclear power plants including multi-layered clearances, chronic project delays, land acquisition and public opposition.

Dr Thierry Advocat noted that France relies on nuclear power for a large share of its electricity, making it one of the largest producers and a net exporter of Europe. He highlighted France as

a leading example of scalable nuclear energy for decarbonisation, in contrast to intermittent renewables.

He also underscored efforts by French startups to accelerate the development of advanced modular reactors, and secure government backing to design compact, factory-built nuclear systems for industrial heat and electricity. Further, collaborations with global partners are positioning France as a hub for next-generation nuclear technology amid Europe's energy transition.

Prateek Agarwal highlighted that India's nuclear fleet is predominantly based on pressurised heavy water reactors (PHWRs), reflecting a strategy focused on self-reliance, the use of natural uranium and alignment with the three-stage nuclear programme. He noted that the PHWR supply chain is highly localised, supported by indigenous manufacturing under NPCIL and DAE oversight. PHWRs account for the bulk of operational capacity, leveraging domestic resources in the context of historical import constraints.

He added that India's SMR development is still at an early stage, facing challenges related to regulatory readiness, design validation, supply chain development and private sector participation. Regarding the project pipeline, Agarwal noted that NPCIL is targeting a significant capacity expansion by 2031-32, building on the current base and scaling further towards 2047 through a mix of PHWRs and light water reactors. The pipeline includes reactors under construction, fleet-mode projects and planned additions.



Unified Power for a New India: Aligning centre-state strategies for energy transition and acceleration

The panel titled "Unified Power for a New India: Aligning centre-state strategies for energy transition and acceleration" featured a discussion among Shripad Yesso Naik, Minister of State for Power and New and Renewable Energy, Government of India; R.M. Dhavalikar, Minister for Power, Government of Goa; Gaurav Gupta, IAS, Additional Chief Secretary, Energy Department, Government of Karnataka; Narendra Bhooshan, Additional Chief Secretary, Energy and Additional Resources of Energy Department, Government of Uttar Pradesh; Chowna Mein, Deputy Chief Minister, Arunachal Pradesh; Arun Goyal, Former Member, CERC and Former Secretary, Government of

India; and Neville Dumasia, Partner and Leader, Industrials and Energy, EY India (moderator). The panellists highlighted the importance of deeper coordination between the central and state governments to support India's evolving power sector and clean energy transition. The discussions focused on strengthening policy alignment, improving financial sustainability in the distribution segment and enabling infrastructure expansion to accommodate the rapid growth of renewable energy. Edited excerpts...

Shripad Yesso Naik noted that India's power sector has undergone a major transformation over the past decade, with significant expansion in generation capacity, improvements in infrastructure and stronger operational performance across the value chain. However, the next phase of the transi-

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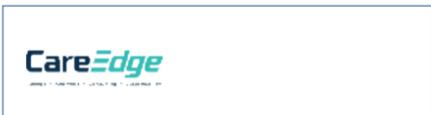
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tion will depend more on addressing structural gaps in alignment and implementation. A key challenge identified is the financial sustainability of the distribution segment, where persistent inefficiencies continue to affect investor confidence, renewable energy integration and the overall credibility of the power market. Distribution sector reforms are a fundamental requirement for scaling future investments and ensuring long-term sector stability.

The need for consistent implementation of renewable purchase obligations and other policy commitments at the state level was also highlighted, as these mechanisms translate national energy transition goals into on-ground action. Since electricity is a concurrent subject in India, effective coordination between the central and state governments remains essential, particularly in areas such as planning, regulation, infrastructure development and enforcement. Strengthening institutional mechanisms and policy frameworks will therefore be critical to aligning national ambition with state-level execution. Looking ahead, the next phase of India's energy transition is expected to be driven by innovation and emerging technologies such as energy storage, green hydrogen, electric mobility and distributed energy resources, and supported by policies that enable investment, decentralised solutions and long-term system reliability.

R.M. Dhavalikar highlighted that Goa's power sector operates in a distinctive context characterised by high electricity demand, limited land availability for large-scale generation and a continued reliance on power purchased from outside the state. Despite the absence of significant state-owned generation capacity, the state has maintained strong operational performance by improving efficiency and reducing distribution losses through better management practices and institutional reforms. Goa also stands out for its high per capita electricity consumption and strong performance on sustainability indicators, earning top rankings in the Sustainable Development Goals assessment by NITI Aayog. Significant efforts have been made to strengthen power infrastructure through the undergrounding of distribution networks across several urban areas, enhancing reliability and resilience. Looking ahead, the state aims to ensure that its power supply infrastructure remains capable of meeting future demand in a reliable and sustainable manner.

Gaurav Gupta opined that constructive engagement between the central and state governments has played an important role in shaping India's evolving power sector strategy. Regular consultations and coordinated planning have contributed to the development of long-term resource adequacy planning, which aims to ensure both energy security and a smooth energy transition. Through this collaborative process, states have been actively involved in assessing their future energy needs and aligning procurement strategies with national goals, with technical oversight from the Central Electricity Authority. This improved clarity in planning has enabled several states to accelerate renewable energy adoption and move

ahead of earlier timelines for integrating clean energy capacity.

He also noted that states are increasingly preparing for higher renewable penetration through both large-scale and distributed renewable energy solutions. At the same time, the importance of long-duration storage technologies was emphasised, particularly pumped storage projects, which can provide multi-day balancing support to the grid. However, the development of such projects often faces environmental and forest clearance challenges, which require careful coordination between multiple government agencies. Efforts are currently underway to streamline these processes and facilitate project development. Overall, the interaction between the centre and states was described as increasingly collaborative, helping align planning, policy and implementation while supporting India's broader clean energy transition objectives.

Narendra Bhooshan emphasised that strong policy direction and strategic guidance from the central government are critical for advancing India's clean energy transition and ensuring coordinated progress across states. Recent national policies supporting solar, bioenergy and other clean energy technologies have helped establish a clear framework that states can build upon through their own policy initiatives and implementation mechanisms. Programmes such as the PM Surya Ghar: Muft Bijli Yojana and PM-KUSUM were cited as examples of initiatives driving the large-scale deployment of distributed solar energy across the country. He also emphasised the need for better coordination on issues such as transmission development, grid flexibility and energy storage as renewable penetration increases. Concerns were also raised regarding inter-state transmission system charges, as higher transmission costs can affect the competitiveness of renewable power procurement. Looking ahead, emerging technologies such as green hydrogen and biomass-based energy solutions were identified as potential opportunities, with expectations that supportive policies and technological progress could help reduce production costs and strengthen their role in India's evolving clean energy landscape.

Chowna Mein pointed out that Arunachal Pradesh holds significant potential for renewable energy development, particularly in the solar and hydropower sectors. In the context of the national vision of Viksit Bharat, it was emphasised that the country must effectively harness its abundant natural resources to support long-term economic growth and energy security. The development of renewable resources must be supported by robust transmission infrastructure to ensure seamless power evacuation and integration with the national grid. Strengthening transmission networks was therefore highlighted as a key priority for enabling the efficient utilisation of renewable energy resources and supporting balanced, sustainable development across regions.

Arun Goyal observed that achieving India's energy transition and capacity



expansion targets will require significantly greater participation from the private sector across the power value chain. For private investment to scale, a clear and stable policy and regulatory framework is essential. While the overall policy direction from the central government has been supportive, ensuring regulatory alignment between the centre and states remains critical, particularly in areas such as grid management and system operations. The need for states to align their grid codes with the central grid code prepared by the Central Electricity Regulatory Commission was highlighted as an important step towards maintaining system reliability as renewable energy capacity expands. A major concern identified was the financial sustainability of distribution companies, which remains the weakest link in the power sector. Persistent gaps between the cost of supply and realised revenues continue to affect the sector's financial health and limit private sector participation in the distribution sector. Strengthening the financial viability of discoms is essential for ensuring long-term investment, sector stability and effective utilisation of generation and transmission infrastructure.

Electrification at Scale: Power trading systems and growth trajectories for a low-carbon future

The session "Electrification at Scale: Power trading systems and growth trajectories for a low-carbon future" featured a panel comprising Sonam Tobjey, Chief Executive Officer, Bhutan Power Corporation Limited; Harish Saran, Managing Director (MD), Hindustan Power Exchange; Neha Aggarwal, MD, Arunachal Pradesh Power Corporation Private Limited; Shailendra Shukla, MD, Mobility Group, India, Eaton Industrial Systems; and Vishal Vij, Head, Energy Services, Tata Power Trading Company Limited. The session was moderated by Krithika P.R., Program Lead, International Council on Clean Transportation.

Sonam Tobjey highlighted the growing significance of cross-border power cooperation in shaping regional energy security. He noted that India's expanding electricity trade with neighbouring countries such as Nepal, Bangladesh and Bhutan has evolved into a more structured and sophisticated framework, strengthening both technical integration and diplomatic ties. This cooperation, he observed, is central to reducing systemic risks and building a more resilient regional grid.

Reflecting on Bhutan's journey, he

pointed out that early collaborations with India, particularly in hydropower development, were constrained by limited financing options and access challenges. However, the landscape has changed significantly over time. Today, Bhutan is interconnected with India through multiple transmission links, enabling deeper operational and commercial engagement.

A key recent development, he emphasised, is the opening up of the Indian power market to Bhutan. This transition from a purely bilateral arrangement to market-based participation marks a major shift, offering new avenues for optimising surplus clean energy. He described this as a game changer for Bhutan's power sector. Looking ahead, Tobjey stressed the need for greater harmonisation of systems and policies to fully utilise the region's clean energy potential, particularly as generation capacity continues to expand.

Neha Aggarwal emphasised the growing pressure on distribution utilities arising from increasing electricity demand and the accelerating adoption of electric vehicles (EVs). She noted that India's power demand is expected to grow at 6-6.5 per cent annually, with EV penetration emerging as a key driver. With EV adoption projected to increase from about 7.6 per cent currently to 30 per cent by 2030, this transition is expected to add nearly 10-12 GW of additional load to the grid.

She highlighted that EV charging demand is likely to be concentrated during peak evening hours, driven largely by commercial and passenger vehicle usage in urban clusters. This, she pointed out, will significantly strain already stressed distribution networks. To address this, discoms will need to undertake substantial infrastructure upgrades, including strengthening transformers, augmenting feeders and expanding substation capacity.

Aggarwal also underlined the importance of load management strategies. She noted that a single fast EV charger can add a load of 25-50 kW, comparable to that of multiple households, making demand aggregation a critical concern. In this context, she stressed the need to shift EV charging to off-peak hours through mechanisms such as time-of-day tariffs. This would help align demand with solar generation, improve load curves and support India's renewable energy and net-zero targets.

Harish Saran highlighted the transformative role of power exchanges in

India's electricity market since their introduction in 2009. He noted that, prior to this, consumers were largely dependent on short-term bilateral arrangements with limited flexibility. The emergence of power exchanges has enabled greater flexibility while also providing critical price signals essential for an efficient and competitive market.

He observed that, with ongoing regulatory changes, power exchanges are expected to play an increasingly significant role, similar to their counterparts in advanced markets. Turning to EVs, Saran pointed out that adoption has been slower than initially anticipated, partly due to structural limitations in the current framework. At present, EV consumers rely primarily on discoms, which typically offer uniform tariffs across the day, limiting their ability to benefit from price variations in the market. He emphasised that, with the increasing share of solar generation, there is a clear opportunity to leverage lower daytime tariffs.

Shailendra Shukla presented the user-side perspective of EV adoption, emphasising its importance in India's energy security, given that a significant share of the country's oil requirements is met through imports. He noted that while global benchmarks indicate much higher EV penetration levels, adoption in India remains relatively modest. He identified key bottlenecks constraining faster uptake, foremost among them the lack of adequate charging infrastructure. Even where infrastructure exists, interoperability remains a concern, with variations across vehicle types, charging systems and geographies limiting seamless usage. Additional challenges relate to vehicle range and charging time, though these are expected to improve with technological advancements.

On the solutions front, Shukla highlighted the role of integrated energy management approaches, such as building-as-a-grid solutions, which enable the optimised utilisation of renewable and grid power. He underscored that digitalisation will be central to the energy transition, working in tandem with physical infrastructure development.

He also pointed to the need for more streamlined user interfaces, noting the absence of a unified platform for locating and accessing charging infrastructure. Addressing these gaps through coordinated technological and market-driven solutions, he noted, will be critical to accelerating EV adoption in India.

Vishal Vij highlighted the growing complexities in grid management arising from the rapid expansion of solar PV capacity. He noted that increasing rooftop and distributed solar installations are leading to reverse power flows, while distribution infrastructure upgrades have not kept pace with this growth. This imbalance, he pointed out, raises concerns around how utilities will manage evolving demand and system stability.

He emphasised that as EV adoption grows, questions around the "greenness" of power consumption are becoming more prominent. Ensuring that renewable energy can be reliably traced and delivered to end consumers remains a challenge. In this context, he underscored the need for innovative market mechanisms



such as virtual power purchase agreements and other emerging contractual structures to bridge this gap.

Vij also highlighted the importance of integrating advanced solutions, including vehicle-to-grid technologies and battery energy storage systems, to enhance grid stability and manage intermittency. He noted that while multiple solutions are being explored, including aggregator-based models and artificial intelligence-driven approaches, challenges remain due to the relatively small and dispersed nature of loads. He stressed that achieving sectoral goals will require coordinated progress across generation, transmission and distribution, supported by enabling policies, technology adoption and sustained capital investment.

Financing Global Power Transition: Converting ambition into bankable projects

The session titled "Financing Global Power Transition: Converting ambition into bankable projects" explored the critical shift from technological challenges to the urgent need for massive financial mobilisation and the creation of robust investment ecosystems in the energy sector. It featured insights from Parminder Chopra, Chairman and Managing Director, Power Finance Corporation (PFC); Dr Katan Hirachand, Chief Executive and Chief Country Officer, Societe Generale; Shashank Joshi, Deputy CEO, MUFG India, and Head of Global Corporate Banking, India, MUFG Bank; Ravisankar Ganesan, Director, Finance, Power Grid Corporation of India; and Kaniaru Wacieni, Senior Investment Director, Africa 50. The session was moderated by Dr Marko Lackovic, MD and Senior Partner, BCG.

Parminder Chopra highlighted the key enablers for financing, including favourable policy measures, predictable long-term revenue streams, robust contractual design and risk allocation, and aligning financing tenures with asset life. She emphasised that bankability extends beyond individual projects and must be built across the broader ecosystem.

She noted that a green taxonomy could be a game changer for India's energy transition. For this, the industry must identify priority areas and establish a common framework for policymakers, lenders and investors to define what qualifies as "green". The taxonomy is expected to influence capital flows, with preferential funding likely for green projects.

Dr Katan Hirachand observed that India has made impressive strides in energy penetration, moving beyond basic renewables to complex hybrid round-the-clock and green energy projects. He noted that the track record of timely project delivery and backward integration, such as with solar module and wafer manufacturing, has garnered significant confidence from international banks. India possesses a unique global model where developers manage everything from project anchoring to engineering, procurement and construction, which helps manage delivery risks. He noted that beyond the state-agency model, growth is visible in the commercial and industrial sector and the uncontracted merchant power market, which is crucial for meeting peak demand.

Shashank Joshi noted that the current global policy environment and international commitments are creating strong momentum for financing on-ground decarbonisation. He noted that MUFG has committed over \$3 billion in the past three years towards renewable energy, storage and supply chain projects, while also supporting green energy platforms to scale India's market. However, he emphasised that from a lender's perspective, key risks remain around evolving technologies and transmission readiness, which are common across the financial sector. He pointed out that project delays are often inevitable in large infrastructure developments and stressed the need for mechanisms to compensate such delays to maintain investor confidence. Joshi also underlined the constraints posed by limited domestic long-term capital and the resulting dependence on global financing. He suggested that stronger institutional frameworks, potentially through a central coordinating agency, could help streamline processes, improve risk allocation and unlock larger pools of global capital for long-term debt financing.

Ravisankar Ganesan emphasised that while India's renewable energy capacity is expanding rapidly, transmission infrastructure remains the critical backbone of the power sector. He noted that the intermittent and unpredictable nature of renewable energy poses significant challenges for grid stability and operations. Managing variability, ensuring frequency and voltage stability, and integrating large volumes of renewable energy require both technological innovation and sustained investment in

transmission systems. He highlighted that India's regulatory framework has played a key role in building investor confidence, particularly through stable tariff structures, periodic reviews and assured returns on equity. These mechanisms have enabled significant growth in transmission infrastructure and supported long-term financing. Ganesan also pointed to the growing importance of battery energy storage systems as a complementary solution to transmission, enhancing grid flexibility and efficiency. Policy initiatives such as viability gap funding and regulatory incentives are further supporting deployment, enabling better resource utilisation and attracting diversified funding for future infrastructure needs.

Kaniaru Wacieni pointed out that the challenges of financing energy and infrastructure projects in Africa closely mirror those seen in other regions, including India. He noted that Africa faces an annual infrastructure financing gap of around \$100 billion, underscoring the urgent need to scale up bankable projects. Key issues include ensuring appropriate risk allocation, strengthening credit structures, and maintaining consistent and predictable policy environments, particularly around tariffs and contractual frameworks. He emphasised the importance of moving beyond individual project development towards programmatic approaches, including standardised contracts and power purchase agreements, to accelerate project delivery at scale. Wacieni also stressed that mobilising private capital is essential, given the limitations of public funding. In addition, he highlighted the significant untapped potential of domestic capital, particularly pension funds, which currently allocate only a small share to infrastructure. Unlocking this capital can lower financing costs and improve affordability while ensuring long-term, sustainable investment outcomes.

Energy Storage Revolution: Scaling to enable 500+ GW renewable power systems

The session titled "Energy Storage Revolution: Scaling to enable 500+GW renewable power systems", was moderated by Marius Mordal Bakke, VP and Head of Solar and Storage Research at Rystad Energy, and included Pratyush Thakur, Investment Director and Country Head, Blueleaf Energy; Dr Vishal Mittal, Founder and CEO, Delectrik Systems; Chris Fitzgerald, Group Director for International Affairs, Octopus Energy Group; and Madhusudhan Rao, Founder and CEO, Oorja Energy as panellists. The discussion focused on one core point: storage is becoming central to grid integration, market design and demand management.

Pratyush Thakur pointed out that storage is still slotted into a supporting role, even though the power system is already shifting from pure deployment to grid integration. India is adding about 20-25 GW of renewables every year, but transmission is not keeping pace. There is already a large capacity of renewable projects which have not signed PPAs, showing the importance of grid integration. The country's 500 GW non-fossil fuel target will not be sustainable without storage.



Besides harnessing daytime solar to meet evening demand, batteries can provide capacity support, frequency response and grid balancing. If the market pays for these services, deployment will rise faster. India must move more activity into the spot market.

Dr Vishal Mittal noted that the key challenge in the renewable sector is not generation, as power from the sun, wind and hydro can be harnessed by many countries with self-sufficiency. The hard part is storage expansion. Cost comparisons of battery technologies is still too fragmented, with original equipment manufacturer tariff quotes varying widely. The larger lesson is that the sector should build a market first and manufacturing second. Policies, in fact, should focus first on creating demand, then on scaling local supply.

Chris Fitzgerald said the real value in storage comes from the combination of assets with software optimisation and trusted despatch. Storage is only as useful as the digital layer behind it, because that is what allows assets to be coordinated, forecast and monetised. Batteries are not only about shifting electricity from day to night - they can deliver services that support the grid in real time, and in some cases can even use AI and forecasting tools to anticipate outages before they occur. According to him, flexibility can be built through coordinated digital control, not only through new physical capacity.

Madhusudhan Rao noted India's load profile is different from that of many Western economies because demand is concentrated in large urban pockets and cooling demand

is rising fast. He cited Delhi as an example where the peak electricity load is rising and said that with more air-conditioning and electric vehicles, the evening gap will only widen. In this setting, thermal storage can absorb surplus electricity and shift cooling demand away from the grid. Comparing costs directly, thermal storage can be far cheaper than battery storage. Moreover, there are projects in Delhi where cooling loads are already being shifted away from direct electricity use. Hence, storage policy should not be limited to electrochemical systems. Thermal storage should be treated as part of the same planning framework, especially for commercial buildings and urban cooling.

India's Global Clean Energy Supply Moment: Transforming "Make in India" into "Make for the World"

The session on "India's Global Clean Energy Supply Moment: Transforming 'Make in India' into 'Make for the World'" focused on India's growing role as a global manufacturing hub amid shifting clean energy supply chains. It highlighted the need for advanced grid infrastructure, quality-driven procurement and globally aligned standards to support renewable integration and enhance export competitiveness. The session featured remarks by Pankaj Agarwal, Founder and CEO, Panitek Green Ventures; Atul Choudhari, CTO, Tata Consulting Engineers Limited; and Sunil Das, Director, Hyosung T&D India, and was moderated by Abhishek Shah, Partner, Renewables and Energy Storage, KPMG.

Pankaj Agarwal noted that India's clean energy manufacturing market is experiencing rapid growth driven



by government incentives such as PFI schemes and Budget 2026 priorities, positioning the country as a global hub while reducing import dependence. Key sectors include solar modules, batteries, wind components and other components, with significant capacity expansions but some delays in incentives.

He added that India's clean energy manufacturing growth is poised to drive substantial cost reductions through scale, localisation and reduced import reliance. This is expected to lower the levelised cost of electricity and equipment prices, enhancing project viability. He emphasised that while India's clean energy recycling sector is emerging with supportive policies and initiatives, it remains nascent with limited operational capacity to handle growing waste volumes.

Atul Choudhari noted that traditional manufacturing has evolved into self-correcting, intelligence-driven ecosystems with real-time anomaly detection, adaptive controls and end-to-end supply chain visibility. India can integrate smart sensors, edge computing, robotics and Industry 4.0 from the outset, positioning itself as a scalable exporter of premium clean energy tech worldwide. This is expected to elevate India beyond its reputation as a fast, cost-effective supplier to a reliable, scalable global partner capable of delivering advanced clean energy technologies worldwide.

Choudhari further highlighted the critical role of testing norms, international standards and equipment sustainability in India's clean energy sector to ensure quality, reliability, safety and global compliance amid rapid scaling. On new technologies, he believes that the digital twins technology will revolutionise the clean energy ecosystem design by simulating 3D/4D/5D models with real-time physics-based performance before physical construction. This is expected to improve product quality, performance predictability, bankability, on-time delivery and post-commissioning reliability, positioning India for smart manufacturing exports that global markets increasingly demand over conventional methods.

According to **Sunil Das**, India's transmission and distribution sector has undergone a rapid transformation in recent years, largely driven by the sharp increase in renewable energy deployment. While renewable energy expansion has accelerated across the country, it has also introduced new

challenges related to grid stability and integration.

Das highlighted the growing focus on advanced transmission technologies to address these challenges. Higher voltage transmission systems, particularly at the 765 kV level, are being increasingly deployed to enable efficient bulk power transfer. At the same time, flexible grid support solutions such as STATCOMs as well as high voltage direct current systems are gaining prominence. Further, battery energy storage systems are gaining traction, driven by the intermittent nature of renewable sources. He noted that multiple tenders are being issued by POWERGRID, the Solar Energy Corporation of India and various state utilities, reflecting the increasing emphasis on renewable integration and grid stability. Looking ahead, initiatives aligned with the Viksit Bharat 2047 vision are expected to significantly expand renewable capacity, creating sustained demand for advanced transmission and distribution solutions. He also pointed to emerging trends such as digitalisation and unmanned substations, which are set to shape the future of the sector.

Das also spoke about the need for greater emphasis on quality and reliability in procurement processes. He pointed out that India's tendering framework continues to be largely driven by the lowest-cost or L1 approach, often through reverse auctions. In contrast, global markets tend to prioritise quality-based evaluation and lifecycle performance. This poses a disadvantage for manufacturers investing in higher-quality products.

TECHNICAL CONFERENCES

Financial Models and Risk Management (Finance, Regulatory and Policy)

The technical session on "Financial Models and Risk Management" was chaired by Ashvini Kumar, Technical Co-Chair, CIGRE India, and featured a discussion among Trusha Biswas, Head of Technology and Quality, Tata Power Company Limited; Preethi C.C., Deputy Executive Engineer, NLC India Limited; Himanshu Mittal, Manager, Powergrid Corporation of India Limited; Ruchi Shukla, Head, Energy, Multi Commodity Exchange of India Limited; and Kaarthika Maheswaran, AGM, Engineers India Limited. The session examined the key barriers to green finance adoption, and highlighted the role of cross-border and regional financing frameworks, electricity

market risk management and artificial intelligence (AI) to improve cost estimation for power generation projects.

Green finance is critical to the energy transition, but its adoption remains constrained by structural barriers. These include economic and financial challenges such as high uncertainty, misaligned incentives, limited market mechanisms and reliance on energy savings for project viability. Regulatory and institutional gaps, including fragmented regulations, weak policy frameworks and institutional lock-ins, further impede progress. In addition, societal and behavioural factors, such as negative public perception and resistance to change, along with technological and market constraints such as high upfront costs, lock-in effects and limited technology maturity, continue to slow adoption.

In the context of cross-border power links with neighbouring countries such as Nepal, Bhutan, Bangladesh and Myanmar, interconnections based on high voltage alternating current, high voltage direct current and even subsea cable systems involve high upfront capital expenditure and long payback periods. In this context, green finance instruments such as green bonds, multilateral development bank loans and blended finance are particularly relevant because they can provide long-tenor capital that matches asset lives of 25-40 years. Such financing can help align transmission expansion not just with power trade objectives but also with climate goals.

AI can improve cost estimation in power generation. Cost estimation is not merely a budgeting exercise but a



strategic tool influencing investment decisions, regulatory approvals, technology selection, project financing and risk mitigation. Conventional costing approaches are increasingly inadequate in today's volatile environment because they rely heavily on historical benchmarks, static cost databases and fixed contingencies, while failing to fully account for commodity volatility, supply chain disruptions, exchange rate movements and correlated project risks.

In contrast, an AI-based framework treats cost as a dynamic probability distribution rather than a fixed value. It begins with data integration and preprocessing, followed by predictive machine learning using variables such as installed capacity, technology configuration, geography, terrain, grid complexity and execu-

tion strategy. This is complemented by time-series forecasting of key cost drivers, including commodity prices, equipment costs, logistics rates, labour indices and exchange rates.

Overall, the sessions underscored that the financing of future power systems will require a more integrated approach spanning policy, markets, risk analytics and digital tools. Whether in scaling green finance, supporting cross-border transmission links, or improving cost estimation for generation projects, the focus is shifting towards frameworks that are more dynamic, data-driven and risk-aware.

Digital and Resilient Grid Operations (Transmission and Grid Operations)

The session titled "Digital and Resil-

ient Grid Operations (Transmission and Grid Operations)" featured Anil Sharma, General Manager (GM), BSES Yamuna Power Limited; Manish Patel, GM, Siemens Energy India Limited; Akshay Sharma, Manager, Power Grid Corporation of India Limited (POWERGRID); Anand Nayak, Manager, POWERGRID; and Karan Katariya, Research Scholar (PMRF), IIT Kharagpur as panellists. The session discussed key gaps and challenges in digital grid operations, including limitations in digital learning platforms such as the lack of procedural realism, physical context representation and human-equipment interaction, as well as gaps in existing virtual reality (VR) platforms like limited end-to-end validation, competency measurement and scalable content availability.

The panel also highlighted challenges in urban distribution networks such as increasing operational complexity due to fixed overhead and underground systems, limited feeder automation, frequent third-party cable damages, legacy SCADA systems with poor data integration, and incomplete real-time visibility – leading to slower fault detection, longer outages and higher operational complexity.

Additionally, the discussion covered the role of artificial intelligence (AI)-enhanced fault isolation in identifying minimum fault zones, optimising switching decisions using real-time data and improving restoration readiness, along with the potential of VR-based training to enable structured learning, gamified experiences, validated task sequencing and performance-based evaluation for

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Governance and Policy for Energy Transition (Finance, Regulatory and Policy)

The session's panellists comprised Pankaj Pandey, Executive Director, POWERGRID; Santosh Kundu, General Manager, Damodar Valley Corporation; Sachin Yadav, Manager, POWERGRID; Anand Kumar Singh, Adviser to the Supreme Court of India; and Dr Prabodh Baipai, Professor, IIT Kanpur.

The session brought out key insights on the evolving institutional, regulatory and operational landscape required to support a low-carbon energy future. A central theme of the discussion was the growing need for integrated and harmonised systems, both at the domestic and international levels, to enable efficient energy transition. The panel highlighted that as electricity systems evolve over time, coordination across grid operations, connectivity standards and regulatory mechanisms becomes critical, particularly in the context of expanding cross-border energy trade and the vision of interconnected regional and global grids.

A major insight was the importance of regulatory frameworks in enabling energy markets. The discussion emphasised that beyond physical infrastructure such as generators, load centres and transmission lines, robust market rules, trading regulations and long-term agreements are essential to facilitate power exchanges. The transition toward integrated grids was seen not only as a means to improve energy access but also to enhance grid stability, optimise resource utilisation and reduce balancing requirements across regions.

The session underscored India's growing role in regional energy cooperation, particularly through cross-border electricity trade with neighbouring countries. It was noted that such collaborations can improve energy security, enable efficient utilisation of resources like hydropower and contribute to affordability. However, challenges such as high infrastructure investment requirements, lack of regulatory harmonisation and geopolitical uncertainties were identified as key barriers to deeper integration.

Integration of New Energy Resources and Flexibility (Transmission and Grid Operations)

The technical session on "Integration of New Energy Resources and Flexibility" was chaired by Dr Manohar Singh, Associate Professor, Punjab Engineering College. The session featured Abhishek Gupta, Head, Appliances and International, Energy Efficiency Services Limited; Karthik Patolla, Chief Manager, Grid Controller of India Limited; Vikash Yadav, Manager, Power Grid Corporation of India Limited; Anuj Verma, Manager, NTPC Limited; and Stuti Gandotra, Senior Manager, Wartsila India Private Limited. The session examined demand flexibility as a system resource, the institutional and digital foundations needed to scale it, and the growing importance of advanced renewable forecasting in high-penetration grids.

Demand flexibility must move from the periphery to the centre of grid planning, not merely as a pilot concept but as a critical system resource that can modulate or shed consumer load in response to grid conditions. Its applications include peak shaving during supply stress,

load shifting to align with daytime solar generation, and real-time modulation to stabilise frequency amid variable renewable output.

However, urban and commercial and industrial pilots remain constrained by structural barriers, including bespoke hardware and protocols, weak measurement and verification systems and limited incentives, the absence of capacity accreditation and weak discom-level financial drivers. Utilities and independent power producers must prioritise flexibility not only for operational reliability, but also to hedge against price spikes, mitigate losses from negative prices, reduce portfolio risk and unlock new revenue streams.

There is a need for a unified digital foundation to scale demand-side flexibility. The current approach, characterised by ad hoc utility-level contracts, bespoke communication systems and weak or unverified baselines, needs to evolve towards a standardised, interoperable digital marketplace supported by open protocols and grid-scale virtual power plants. The proposed scaling pathway envisages an immediate goal of establishing the digital marketplace, a 2027 milestone of discovering 1 GW of potential, and an ultimate 2030 goal of integrating 5 GW of flexibility into daily wholesale and ancillary service markets. This would also enable aggregator-led virtual power plants across multiple discoms. This shift would require regulatory innovation aligned with technical capability.

Integrating renewable energy at scale remains a key challenge. India's power system is increasingly exhibiting duck curve characteristics, leading to higher curtailment risks and growing stress on transmission infra-

structure, including delays in the roll-out of high voltage direct current corridors. In this context, battery energy storage systems can serve as a strategic complement – and in some cases a partial alternative – to transmission expansion. Storage can help reduce renewable curtailment, enable faster deployment, relieve congestion and support frequency regulation. At the same time, traditional deterministic and statistical forecasting models are becoming less effective in high-solar systems. This is driving a shift towards machine learning and deep learning-based approaches that can better capture variability and uncertainty.

Overall, renewable integration is no longer just a question of adding generation capacity. It now depends equally on flexibility, digital coordination, market design, storage economics and forecasting sophistication. As India moves towards higher renewable penetration, the ability to build scalable flexibility platforms, deploy storage strategically and improve forecast accuracy will be essential for maintaining grid stability, reducing system costs and making the power sector more responsive to dynamic operating conditions.

SPECIAL PROGRAMMES

Industry 4.0 Technologies in the Transmission Sector

The special session on "Industry 4.0 Technologies in the Transmission Sector" featured a discussion among industry experts on the role of advanced technologies such as digitalisation, artificial intelligence, geospatial tools and adaptive protection systems in transforming transmission networks. It featured opening remarks by Dr D. Sai Baba, Additional Secretary, Ministry of Power, Government of India; Dr R.K. Tyagi, Chairman and Managing, POWERGRID; and Professor Ashok Jhunjunwala, Chairman, Immersive Technology and Entrepreneurship Labs, and Institute Professor, IIT Madras, Immersive Technology and Entrepreneurship Labs (ITEL), which was followed by presentations and discussion among industry experts.

India's power sector has undergone a significant transformation over the past decade, evolving from a focus on access and adequacy to that on scale, reliability and surplus capacity. With over 0.5 million km of transmission networks and an inter-regional transfer capacity exceeding 120 GW, the country today operates one of the world's largest synchronous grids. As the system continues to expand, the focus is gradually shifting from capacity addition to improving efficiency and resilience, and enabling smarter grid operations.

This transition is being driven by multiple emerging trends. Rapid growth in renewable energy, increasing electrification across sectors, rising adoption of electric vehicles, and new demand from data centres and green hydrogen are reshaping power system requirements. As a result, transmission networks must not only expand, but also become more flexible, responsive and reliable to handle dynamic and non-linear demand patterns.

Technology is playing a central role in enabling this shift. Digitalisation is improving grid visibility, supporting faster decision-making



and enabling better utilisation of existing assets. Advanced tools such as artificial intelligence and data analytics are increasingly being used for forecasting, planning and real-time system management. At the same time, geospatial technologies are enhancing how utilities plan and operate networks. By combining satellite data, mapping tools and digital platforms, utilities can better track assets, optimise transmission routes, monitor infrastructure and respond more effectively during disruptions.

However, the growing share of renewable energy is also introducing new operational challenges. Unlike conventional power systems, where faults are easier to detect due to clear electrical signals, renewable-based systems behave differently. This makes fault detection and system protection more complex. In addition, the lower system inertia adds further uncertainty to grid behaviour. In response, there is a shift towards more flexible and intelligent approaches such as adaptive protection systems. These systems can adjust their settings in real time based on network conditions, improving reliability in dynamic environments. Faster detection methods and data-driven decision-making are also becoming essential to ensure stability in increasingly complex grids.

Alongside this, large-scale infrastructure expansion continues, with significant investments planned in transmission systems. Addressing challenges such as right of way constraints and ensuring efficient project execution remain key priorities. Capacity building, particularly in digital

and cybersecurity skills, is also critical to support this transformation. Looking ahead, India's power system is expected to grow significantly in both size and complexity, with installed capacity projected to more than double by 2035. Managing such a system will require widespread adoption of advanced technologies, including automation, smart monitoring and predictive maintenance. The future grid is likely to be more self-reliant, data-driven and resilient, capable of supporting the country's clean energy ambitions while ensuring reliability and efficiency at scale.

Stationary Energy Storage India (SESI) 2026

Stationary Energy Storage India (SESI) 2026, organised by the India Energy Storage Alliance (IESA), brought together several industry leaders, including S.C. Saxena, Chairman and Managing Director, GRID-India; Sivakumar Vepakomma, Director, Power Systems, Solar Energy Corporation of India Limited; Mahadevan Srinivasan, Head, BESS (Renewables IC, India), Larsen & Toubro; Naveen Munjal, Director, BDGC, Apraava Energy; Vinayak Walimbe, Managing Director, IESA and Customized Energy Solutions; Debmalya Sen, President, IESA; and Venugopal Rao, Chairman and Managing Director, Pacedigitel. The speakers shared insights on the battery energy storage systems (BESSs) in India.

The discussions focused on the challenges faced by the sector including safety, supply chain dependence and long-term reliability of projects. These issues are now shaping how

storage projects are deployed, priced and regulated.

Battery fires are not only a cell-level problem; they are a system-level risk. Several global incidents have highlighted this problem. Suppression alone is not enough if heat keeps building inside the pack. Once thermal runaway starts, the system can generate more heat than it can dissipate, and that can push the failure from one cell to the next. Off-gassing adds another layer of risk because the gases can be toxic and dangerous for workers and firefighters. Residual energy is also a serious issue because re-ignition can happen after a delay of hours, days or even weeks. That means battery safety has to be designed around containment, detection, cooling and post-fire monitoring, not just fire suppression.

As a result, standards frameworks are not only becoming more structured, but also more demanding. Several standards from the Bureau of Indian Standards are now in place. These standards now cover hazard identification, risk analysis, risk evaluation, exposure control, warning communication, quality requirements and remote software upgrades. This is important as BESSs are now more digital and more connected than before.

The business reality is even sharper. India is entering a storage-led transition, and the speakers agreed that BESSs will play an extremely important role as renewable power expands. India's demand is rising fast, but the cell ecosystem supply chain is not yet fully domestic. This creates a direct exposure to price swings. Cell prices

have fluctuated significantly over the past 24 months. This volatility creates direct margin pressure because project bids are often fixed 12-18 months before delivery, and cell prices can shift sharply during that period. The result is margin compression for developers and engineering, procurement and construction players. This means that L1-based procurement is pushing the market towards the lowest initial price rather than the most durable system. This creates a structural risk because the buyer is often locked into a 20-year performance obligation while the seller is only pricing for current market conditions.

Project execution shows that storage is now moving from theory to industrial practice, but the supply chain is still fragile. Projects built on greenfield land take longer than expected to reach the commissioning stage. Engineering approvals, container handling, customs clearances and hybrid energy management system integration are the key factors causing such delays. Therefore, success is not only about output; it also depends on logistics, customs, transport, container handling and service readiness.

Domestic manufacturing is advancing, but it is still uneven. Companies are now commissioning facilities in the 5-7 GWh range. Some are also exploring future chemistries such as lithium iron phosphate. However, the deeper challenge remains: India still needs a more complete cell and materials ecosystem, clearer domestic content rules and stronger lifecycle accountability. Without these, energy storage risks becoming a high-volume import business. ■

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Balancing the Grid

CEA roadmap for scaling up pumped storage

The Central Electricity Authority (CEA) has released a report titled “Roadmap to 100 GW of Hydro Pumped Storage Projects (PSPs) by 2035-36”, outlining a strategic pathway for scaling up pumped storage capacity over the next decade. The report reviews the current status of PSP development in India and identifies the policy, regulatory, institutional and infrastructure interventions required to enable the timely and financially viable addition of 100 GW of capacity.

This roadmap comes at a time when India’s power sector is undergoing a rapid transition driven by the large-scale expansion of renewable energy. Non-fossil fuel-based installed capacity is projected to reach 500 GW by 2030, 701 GW by 2035, and 2,187 GW by 2047. As renewable penetration increases, the power system will require significantly higher levels of flexibility, balancing power and long-duration energy storage to ensure reliable and secure grid operations. Moreover, the resource adequacy studies conducted by the CEA for all states indicate that all-India storage requirements will rise sharply, from 62 GW by 2029-30 to 161 GW by 2034-35, and further to 476 GW by 2046-47.

In this context, PSPs emerge as a critical, large-scale solution for meeting future storage needs at a reasonable cost. Beyond energy storage,



PSPs also provide essential grid services such as frequency regulation, voltage support and inertia, thereby strengthening overall system reliability and resilience.

The roadmap

Under the roadmap, the CEA envisages the commissioning of PSPs with an aggregate capacity of 100,810 MW by 2035-36, including 11,620 MW of projects currently under construction.

Investment requirement

The development of upcoming PSPs will require a substantial investment of approximately Rs 5,813.16 billion, based on an average cost of Rs 0.06

billion per MW. This investment is spread over a four-year construction period: 20 per cent in the first year, 30 per cent in both the second and third years, and the remaining 20 per cent in the final year. Such phased spending helps manage cash flows, supports timely procurement and ensures steady progress across different stages of project execution.

Requirement of turbine and generators

The scale of PSP development will also drive a significant increase in demand for turbines and generators. For projects already under construction, turbine-generator packages have been placed. Overall, a consolidated assessment across all project categories covers a total of 321 units. This includes 117 units (30,000 MW) already in operation, 175 units (45,000 MW) under survey and investigation (S&I), and 29 units (6,580 MW) for projects that have received CEA concurrence but are yet to commence construction. The unit sizes range from 100 MW to 400 MW, except for an 80 MW unit at the Indira Sagar-Omkareshwar PSP.

On the construction front, more than 15 civil contractors are currently engaged, or have previously been engaged, in hydroelectric and PSP projects nationwide. To encourage competition and strengthen domestic manufacturing capacity, qualification requirements were relaxed on January 8, 2026. Under the revised norms, manufacturers with proven experience in executing vertical centrifugal pumps of specified capacity and successful model testing of reversible fixed-speed Francis pump turbines can participate, supporting timely project execution and domestic capability building.

Transmission system for evacuation of power from PSPs

Transmission infrastructure for 35.6 GW of pumped storage capacity has already been planned for commissioning by 2031-32, as incorporated in the National Electricity Plan (Transmission) released in October 2024. Additional transmission requirements are being firmed up based on inputs from developers through pre-detailed project report (DPR) and DPR submissions. Once finalised, PSP

developers must seek connectivity from Central Transmission Utility of India Limited or the respective state transmission utilities.

As of November 30, 2025, transmission systems have been finalised for 73 projects, covering a combined capacity of 100,810 MW, based on the National Electricity Plan and project-level data submitted by developers.

Further policy recommendations and the way forward

To address the challenges faced by developers in PSP development, the CEA has proposed a set of policy interventions.

A key recommendation is to allow developers to carry out compensatory afforestation on degraded forest land at twice the area of forest diverted, rather than limiting developers to non-forest land. This approach could be supported by creating a national-level land bank with GIS-based mapping, a centralised inventory of degraded land, and robust monitoring mechanisms. Given their relatively low environmental footprint, PSPs may be permitted within eco-sensitive zones and within a 10 km aerial distance from protected areas where eco-sensitive zones are not notified. A differentiated regulatory approach for renewable energy projects could also relax restrictive provisions applicable to the Western Ghats. For off-stream PSPs, exemptions from catchment area treatment and soil and moisture conservation plans may be considered, as sedimentation and soil-related concerns are already addressed under existing watershed development measures.

Further procedural simplifications could ease project implementation. Increasing the permissible document upload size on the PARIVESH 2.0 portal would allow the submission of complete project documentation. Draft resettlement and rehabilitation plans could be accepted at the FC-II stage, with final approval mandated before construction and supported through periodic compliance reporting. Similarly, Forest Clearance – Stage II (FC-II) may be granted based on identification of non-forest land, with transfer or mutation treated as a post-clearance compliance condition. Submission of an approved mining plan could be deferred at FC-II, subject to a developer undertaking to submit the plan before actual mining begins. Forest diversion proposals for linear and non-linear components could be processed independently, enabling the early development of essential infrastructure such as roads and construction power, with full clearance required only for main construction activities. Construction on non-forest land should be permitted without delay, even when projects involve both forest and non-forest land. For tunnels deeper than 50 metres where the forest land above remains unaffected, that land should not be counted as diverted, and net present value charges should apply only to ar-

CEA's pumped storage expansion plan

| Year | Year-wise capacity addition (MW) | Year-wise cumulative capacity (MW) | Investment (Rs billion) |
|---------------|----------------------------------|------------------------------------|-------------------------|
| Up to 2024-25 | – | 4,745 | – |
| 2025-26 | 2,680 | 7,425 | 189.72 |
| 2026-27 | 2,920 | 10,345 | 340.14 |
| 2027-28 | 1,600 | 11,945 | 630.78 |
| 2028-29 | 6,350 | 18,295 | 806.22 |
| 2029-30 | 13,500 | 31,795 | 876.9 |
| 2030-31 | 21,190 | 52,985 | 817.86 |
| 2031-32 | 8,800 | 61,785 | 650.46 |
| 2032-33 | 14,590 | 76,375 | 630.72 |
| 2033-34 | 11,880 | 88,255 | 453.96 |
| 2034-35 | 5,700 | 93,955 | 277.2 |
| 2035-36 | 11,600 | 105,555 | 139.2 |
| Total | 100,810 | | 5,813.16 |

Note: Based on DPR finalisation, some additional projects may be commissioned from 2031-32 onwards.

Source: Central Electricity Authority

Status of PSP development (as of December 2025)

| Status | On-stream PSP | | Off-stream PSP | | Total PSP | |
|---------------------|----------------|---------------|----------------|---------------|----------------|---------------|
| | Projects (no.) | Capacity (MW) | Projects (no.) | Capacity (MW) | Projects (no.) | Capacity (MW) |
| In operation* | 8 | 4,595.6 | 2 | 2,580 | 10 | 7,175.6 |
| Under construction* | 4 | 4,100 | 6 | 7,520 | 10 | 11,620 |
| DPR concurred | 1 | 1,000 | 6 | 10,080 | 7 | 11,080 |
| Under examination | 1 | 640 | – | – | 1 | 640 |
| Under S&I | 2 | 1,500 | 52 | 73,440 | 54 | 74,940 |

*Three of the four units (4 x 250 MW) of the Tehri PSP, aggregating 750 MW, have been commissioned in June, July and December 2025. Accordingly, the Tehri PSP falls under both “under construction” and “in operation” categories

Source: Central Electricity Authority

eas with surface disturbance, such as tunnel portals, access roads and construction sites.

Additionally, early coordination among the Ministry of Environment, Forest and Climate Change, the National Tiger Conservation Authority and the National Board for Wildlife should be ensured at the start of the approval process to identify any overlap with protected areas or wildlife corridors. In parallel, a centralised online system for submission and processing of Forest Rights Act certificates, along with the proactive resolution of gram sabha rights by state governments at the project allocation stage, would prevent delays later. Off-stream PSPs may also be considered for inclusion under the White category, recognising their minimal environmental impact and enabling a simpler and faster environmental and forest clearance process.

From a financial perspective, while the cost of battery energy storage systems (BESS) has been declining, the capital cost of PSPs remains relatively high at around Rs 0.05 billion-Rs 0.06 billion per MW, affecting their competitiveness. Targeted financial support, particularly in the form of viability gap funding (VGF), and reducing the cost of pumping power would significantly improve the economics of PSPs and make them more attractive for discoms and other consumers under competitive tariff structures. The government has already extended VGF to BESS, which has helped accelerate adoption and reduce costs. Extending similar support to PSPs would be a logical next

Status of PSP development

Operational

As of December 2025, the CEA has identified 250 PSPs with a total potential capacity of 269,345.6 MW, covering both on-river and off-river sites. Despite this large potential, only 10 projects have been commissioned so far, contributing 7,175.6 MW to the grid.

Of these, eight are on-stream projects with a combined capacity of 4595.6 MW across five states. These include Tehri in Uttarakhand (750 MW); Ghatgar (250 MW) and Bhira (150 MW) in Maharashtra; Srisailem LBPH (900 MW) and Nagarjuna Sagar (705.6 MW) in Telangana; Kadamparai in Tamil Nadu (400 MW); and Kadana (240 MW) and Sardar Sarovar (1,200 MW) in Gujarat. In addition, two are off-stream projects with a total capacity of 2,580 MW. These include the Pinnapuram PSP in Andhra Pradesh (1,680 MW) and Purulia in West Bengal (900 MW).

At present, the two PSPs in Gujarat having a combined capacity of 1,440 MW are not operating in pumping mode.

Under construction

In addition to operational projects, there are 72 PSPs with an aggregate capacity of 98,280 MW at various stages of development. Of these, 10 projects totalling 11,620 MW are currently under construction, comprising four on-stream and six off-stream projects.

The four on-stream projects under construction include the 250 MW Tehri PSP, which is partially operational, with three of its four units commissioned as of December 2025; Kundah

Stages I, II and III (500 MW, expected by June 2026); Upper Sileru (1,350 MW, expected by February 2029); and Shara-vathy (2,000 MW, expected by December 2029). Further, the six off-stream projects under construction are Chitravathi (500 MW, October 2026), Gandikota (1,000 MW, March 2029), Bhivpuri (1,000 MW, January 2028), MP30 Gandhisagar (1,920 MW, December 2026), Saundatti (1,600 MW, December 2027), and Bhavali (1,500 MW, December 2028).

DRP concurred and PSPs under examination

The CEA has concurred the DPRs for seven PSPs with a combined capacity of 11,080 MW. These include the 1,000 MW Turga on-stream PSP in West Bengal, and six off-stream projects: 1,680 MW Kandhaura in Uttar Pradesh; 600 MW Upper Indravati in Odisha; and 1,800 MW Shirwata, 1,500 MW Pane, 3,000 MW Karjat (Saidongar 1) and 1,500 MW Tarali in Maharashtra. In addition, the 640 MW Indira Sagar on-stream PSP in Madhya Pradesh is currently under examination.

Under S&I

The capacity under S&I is significant at 74,940 MW across 54 PSPs. Of this, two on-stream projects account for 1,500 MW, while the remaining 52 are off-stream projects totalling 73,440 MW. Notably, 39 of the 52 off-stream projects are closed-loop PSPs, which circulate the same water repeatedly between two off-river reservoirs for storage and generation. The increasing share of closed-loop projects in the project pipeline indicates a growing preference for this configuration, as it helps address site availability and water-related constraints associated with river-based projects.

step in India's journey towards long-term energy security.

Overall, the CEA's roadmap firmly positions pumped storage as a cornerstone of India's future power system. As renewable capacity expands rapidly, the need for reliable, long-du-

ration storage and grid-balancing resources will intensify, making PSPs indispensable for ensuring system stability and resource adequacy.

While recent policy, regulatory and environmental reforms have improved the development ecosys-

tem, timely execution will be critical to achieving the targeted 100 GW by 2035-36. Faster clearances, coordinated transmission planning and targeted financial support will be key to translating intent into capacity on the ground. ■

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Building Capacity

Strengthening the transmission network

India's transmission sector is scaling up at an unprecedented pace to keep up with rising electricity demand and the rapid expansion of generation capacity, particularly from renewable sources. Network growth is no longer limited to adding line length, but increasingly focuses on higher voltage levels and the adoption of advanced technologies to facilitate bulk power transfer over long distances. At the same time, transmission planning and operations are becoming more forward-looking to enhance system resilience and operational flexibility.

Segment size and growth

As of January 2026, the total length of transmission lines at the 220 kV level and above stood at 501,766 ckt km, comprising 59,891 ckt km at the 765 kV level, 208,639 ckt km at the 400 kV level and 213,861 ckt km 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. During 2025-26 (up to January 2026), the transmission line addition target was set at 12,506 ckt km. Against this, 7,392 ckt km was achieved during the period (59 per cent of the annual target).

The transformation capacity across AC voltage levels stood at 1,416,376 MVA as of January 2026, with 356,200 MVA at the 765 kV level, 518,828 MVA at the 400 kV level and 507,848 MVA at the 230/220 kV level. Likewise, the aggregate HVDC capacity stood at 33,500 MW, with 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. During 2025-26 (up to January 2026), the transformation capacity addition target was set at 109,127 MVA. Against this, 86,433 MVA was achieved during the period (72 per cent of the annual target).

TBCB update

Tariff-based competitive bidding (TBCB) has grown significantly over the years, leading to faster project execution and greater private sector participation. As per the Central Electricity Authority (CEA), as of December 2025, a total of 84 transmis-



sion projects were awarded through the TBCB mechanism. Of the total awarded projects, 43 projects, with a transmission line length of 21,634 ckt km and a transformation capacity of 180,600 MVA, were secured by Power Grid Corporation of India Limited, and 41 projects were secured by private transmission service providers.

As of December 2025, a total of 74 transmission projects were commissioned under the TBCB route. Key private sector players in the segment include Resonia Limited, Adani Energy Solutions Limited, Tata Power Company Limited, the IndiGrid Infrastructure Trust and Apraava Energy Private Limited.

In addition, several new entrants, such as Sekura Energy Limited, Renew Transmission Ventures Private Limited, Resurgent Power Ventures Private Limited, G R Infraprojects Limited, Dineshchandra R. Agrawal Infracon Private Limited, Megha Engineering and Infrastructures Limited, Reliance Industries Limited, H.G.

Infra Engineering Limited, Shivalaya Construction Company Private Limited and Techno Electric & Engineering Company Limited, have entered the transmission market.

Key policy and regulatory developments

In January 2026, the Ministry of Power (MoP) released the Draft National Electricity [NEP] Policy, 2026 to replace the 2005 policy. The draft placed strong emphasis on a flexible and consumer-oriented transmission system, with priority on strengthening intra-state networks and planning for open access-driven power flows. It assigned the CEA the responsibility for preparing rolling five-year and 10-year transmission plans, based on which Central Transmission Utility of India Limited and state transmission utilities were required to draw up capacity expansion plans addressing generation growth, congestion, redundancy and right-of-way (RoW) constraints.

In December 2025, the CEA released a Rs 6.42 trillion master plan to evacuate nearly 76 GW of hydropower and pumped storage capacity from the Brahmaputra basin. The plan proposed a phased transmission build-out of about 31,397 ckt km of lines, including 21,000 ckt km of HVDC corridors, and around 109,935 MVA of substation capacity to integrate the north-eastern region's hydro potential with the national grid. The first phase, scheduled up to 2035, covered about 9,922 ckt km of lines and 41,760 MVA of capacity, while the remaining was planned for implementation thereafter.

In September 2025, the Central Electricity Regulatory Commission

notified the third amendment to the Connectivity and General Network Access Regulations, introducing procedural and compliance reforms. The amendments included provisions for the reallocation of unutilised ISTS bay capacities, revised renewable connectivity norms, stricter land and financial closure requirements, expanded eligibility for smaller renewable generators, and enhanced compliance monitoring by load despatch centres.

In March 2025, the MoP issued revised RoW compensation guidelines for transmission lines, introducing a two-part structure with 100 per cent land value for the tower base area and pro-rata compensation for the line corridor, based on the higher of the circle rate or the preceding year's average sale deed rate. The norms apply only to future projects where work has not commenced, and compensation has not been disbursed. In January 2026, the supplementary guidelines were amended to fast-track valuation by mandating the appointment of three valuers on the same day and the selection of two reports by lottery to fix the reference market rate. If the variation between the two is within 20 per cent, their average is adopted; otherwise, the rate is capped at 10 per cent above the lower valuation or derived from the average of the two lowest valuations.

Technology implementation

The transmission segment is increasingly deploying advanced technologies to move bulk power efficiently over long distances, with HVDC corridors emerging as the backbone for evacuating renewable energy from solar parks, wind zones, pumped hydro projects and green hydrogen hubs

Targets and achievements in transformation capacity and transmission lines*

| | Target | Achievement |
|--------------------------------------|----------------|---------------|
| Transformation capacity (MVA) | | |
| Central sector | 60,820 | 41,005 |
| State sector | 33,882 | 27,298 |
| Private sector | 14,425 | 10,560 |
| Total | 109,127 | 78,863 |
| Transmission lines (ckt km) | | |
| Central sector | 5,385 | 3,187 |
| State sector | 4,324 | 3,276 |
| Private sector | 2,797 | 929 |
| Total | 12,506 | 7,392 |

*Up to January 31, 2026
Source: CEA

to distant load centres. Key developments include the 6 GW, 950 km Rajasthan-Uttar Pradesh HVDC link being executed by a Hitachi Energy-Bharat Heavy Electricals Limited consortium, a planned undersea HVDC cable between the Andaman & Nicobar Islands and Odisha, a proposed India-Sri Lanka HVDC interconnection, and a large-scale HVDC-led transmission build-out for evacuating hydropower from the Brahmaputra basin under a Rs 6.43 trillion master plan.

Advanced conductor technologies are gaining traction, particularly high-temperature low-sag conductors that offer significantly higher ampacity and better performance. India has emerged as the largest market for these conductors, with reconductoring projects enabling substantial capacity enhancement on existing lines without tower modifications. Utilities are also selectively adopting insulated cross-arms, often in combination with advanced conductors, to increase voltage levels, improve clearances and reduce RoW requirements in constrained corridors.

To address land and space constraints, utilities are increasingly deploying steel monopole structures and narrow-based towers, which require smaller footprints, enable faster construction and are better suited for urban and semi-urban areas. Monopoles are now being used across several states to overcome RoW challenges and support infrastructure expansion alongside urban development.

Digitalisation is reshaping transmission operations and maintenance, with utilities deploying real-time monitoring systems, internet

of things sensors, drones, geographic information system (GIS) platforms and advanced analytics to shift from time-based to condition-based maintenance. Dynamic line rating systems are being used to unlock additional capacity from existing assets through artificial intelligence (AI)-driven, real-time assessment of conductor capability, while digital substations with remote monitoring are enhancing operational efficiency at extra high voltage levels.

For renewable energy evacuation, these digital tools improve the real-time visibility of variable generation and enable more accurate forecasting and congestion management. Enhanced grid analytics and dynamic capacity assessment help minimise curtailment and maximise the utilisation of existing transmission corridors, thereby facilitating the smoother integration of large-scale solar and wind capacity into the grid.

The use of digital twins is expanding, enabling grid operators to simulate network behaviour, anticipate contingencies and optimise planning and operations by integrating supervisory control and data acquisition systems, phasor measurement units, GIS and sensor data. Drone-based inspections and robotics are becoming mainstream for surveying, construction monitoring and asset inspection, reducing safety risks, costs and outage requirements.

Renewable energy evacuation

Adequate transmission evacuation remains critical for large-scale renewable energy integration, with the Green Energy Corridor (GEC) scheme

forming the backbone of green power evacuation. GEC Phase I, launched in 2015, targets about 24 GW across eight states through 9,767 ckt km of transmission lines and 22,689 MVA of substation capacity, of which around 9,136 ckt km and 21,413 MVA have already been commissioned. While Phase I has been completed in states such as Madhya Pradesh, Rajasthan, Tamil Nadu and Karnataka, progress in other regions has been affected by RoW and wildlife-related challenges.

GEC Phase II, approved in 2022, covers seven states, including Gujarat, Himachal Pradesh, Kerala, Uttar Pradesh and Tamil Nadu, and aims to evacuate around 20 GW through about 7,574 ckt km of lines and 29,737 MVA of capacity. The phase is being implemented by state transmission utilities with central financial assistance of 33-40 per cent and is scheduled for completion by 2025-26.

Further, GEC Phase III is currently at an advanced planning and preparatory stage, with the government working on its scope and state-level coverage. Discussions with states are under way, and initial project preparations have begun, indicating movement towards implementation. However, the phase is not yet fully rolled out or under nationwide construction.

Beyond the GEC framework, transmission development is being aligned with large renewable energy zones to support multi-gigawatt solar and wind parks through dedicated ISTS corridors. In parallel, dedicated green transmission is being planned for emerging segments such as green hydrogen and ammonia, with ISTS lines envisaged to support about 19-

20 GW of green hydrogen capacity by 2030, offshore wind evacuation of about 10 GW, and coastal transmission infrastructure for nearly 70 GW of green hydrogen demand by 2032.

Outlook

Looking ahead, transmission expansion is set to accelerate in line with generation growth and renewable energy integration. As per the CEA's NEP (Transmission), about 114,687 ckt km of transmission lines and 776,330 MVA of transformation capacity at 220 kV and above are planned during 2022-27, followed by another 76,787 ckt km of lines and 497,855 MVA of capacity during 2027-32. HVDC capacity additions are expected to scale up sharply in the latter period, reflecting the growing need for long-distance bulk power transfer.

Looking ahead, transmission expansion is set to accelerate in line with generation growth and renewable energy integration. By 2031-32, the transmission network is projected to reach about 648,190 ckt km of line length and 2,345,135 MVA of transformation capacity, supported by HVDC bipole capacity rising to nearly 66,750 MW. To enable this expansion and system strengthening, the NEP estimates a cumulative investment requirement of about Rs 9 trillion up to 2031-32.

Project execution visibility remains strong, with significant transmission capacity already under construction and a large pipeline of schemes under planning and bidding, indicating sustained investment momentum and robust growth prospects for the transmission sector over the medium term. ■

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A Maturing Market

Renewable energy financing trends

India's renewable energy financing ecosystem has entered a phase of scale, diversification and institutional maturity, supported by stronger policy backing, higher budgetary allocations, rising foreign direct investment (FDI), expanding institutional lending and active public market participation. Capital pools have deepened across debt and equity, while a growing initial public offering (IPO) pipeline has created an additional avenue for fund mobilisation. At the same time, ease of doing business has improved, reflected in rising foreign participation, diversified funding sources, new corporate entrants and deeper market activity across asset classes.

Against this backdrop, Renewable Watch reviews the key debt, equity and IPO trends, as well as ease of doing business opportunities that have shaped India's renewable energy sector in FY 2025-26...

Financing trends

Debt

Debt financing has emerged as a critical enabler of renewable energy growth in India, with both domestic and global investors increasingly opting for structured debt solutions. As per Renewable Watch Research, since FY 2025-26, \$8.63 billion has been channelled through 47 debt deals. Over the past three months October-December 2025, collectively, \$3,338.02 million has been secured in debt financing. Under the debt financing category, which covers loans, bonds and non-convertible debentures, development financial institutions (DFIs) formed a major source of overall funding (26 per cent) in the third quarter (Q3) of FY 2025-26, followed by industry (24 per cent) and commercial banks (22 per cent). Bond markets (15 per cent) are playing an increasingly important role in renewable financing as compared to previous quarters.

The funding mix highlights the growing participation of public and multilateral institutions alongside private lenders. PSU non-banking financial institutions such as REC Limited; DFIs such as the Asian Development Bank (ADB), the Japan Bank for International Cooperation (JBIC) and the National Bank for Financing Infrastructure and Development (NaBFID); and commercial and international banks such as Standard Chartered Bank and Sumitomo Mitsui Banking Corporation have also been the key financiers of renewable energy projects over the past year.

Some of the major debt deals that were signed since FY 2025-26 include NTPC Limited's \$750 million loan from Bank of Baroda and HDFC Bank to expand renewable energy capacity and for installing flue gas desulphurisation systems; ACME Solar's \$440.13 million loan from State Bank of India to develop a 400 MW firm and despatchable renewable energy (FDRE) project in Rajasthan; Khorolchhu Hydro Power's \$540.94 mil-

lion loan from PFC Limited to finance the 600 MW Khorolchhu hydropower project; Brookfield's \$840.15 million loan from REC Limited to finance its hybrid renewable energy project in Kurnool, Andhra Pradesh; and ACME Solar Holdings' \$528.73 million loan from PFC, NaBFID and Yes Bank to finance and refinance renewable energy projects (FDRE and solar-plus-storage). These transactions over the past year indicate that both PSU and private developers are securing large, long-tenor loans, underscoring their critical role in renewable funding.

Beyond volume, the nature of financing has also evolved over the quarters. In Q1 FY 2025-26, most financings were expansion-led and greenfield-oriented. By Q2, refinancings begin to appear more clearly, and in Q3, it becomes prominent, including transactions by Adani Green Energy and repeat financings by ACME Solar Holdings.

Technology allocation also changed through the quarters. While solar remained the dominant asset class across quarters, hybrid and FDRE projects gained visibility, particularly in Q2 and Q3. Battery energy storage system (BESS) financing emerged in Q2 through transactions such as those by IndiGrid, while hydro and bioenergy deals featured in Q3. This diversification indicates improving lender confidence in more complex and despatchable renewable configurations, reflecting policy and grid integration priorities.

Equity

Private equity has continued to commit sizeable sums to scale capacities and consolidate portfolios. In FY 2025-26, equity funding totalling \$4,342 million across 49 deals has been tracked by Renewable Watch Research. Transactions span acquisitions, stake purchases on renewable energy platforms, rights issues, qualified institutional placements (QIPs) and corporate joint ventures.

In Q1 FY 2025-26, the trend was clearly growth-capital-driven. Large equity infusions, such as NexGen Energia's \$1 billion raise and the Indian Renewable Energy Development Agency's (IREDA) QIP of \$234.7 million, indicate strong investor appetite for expanding platforms and strengthening balance sheets. Meanwhile, Q2 marked a shift towards a more diversified deal mix. While equity funding remained strong, there was a noticeable rise in acquisitions and strategic stake sales. Transactions such as SolarArise's \$160 million acquisition, Statkraft's acquisition of Serentica Renewables (in the \$223 million-\$253 million range), and Ib vogt's acquisition (\$137 million-\$160 million) highlight growing secondary market activity and increased participation by global infrastructure and private equity funds. In Q3, the \$550 million acquisition of Vayona Energy stands out as one of the largest deals of the year. ReNew's \$190 million acquisition of a 300 MW solar project

by Sembcorp Industries and Vibrant Energy's \$200 million acquisition by Inox Clean Energy further reinforce the shift towards strategic asset ownership. Recently, in January 2026, Inox Neo Energies Limited acquired 250-300 MWp of operational solar projects from SunSource Energy.

While solar continues to command structural dominance, the sector is gradually broadening, indicating increasing diversification within India's renewable energy investment landscape. Meanwhile, storage and energy solutions, such as Waaree Energy Storage Solutions (\$14 million) and VFlowTech (\$20.5 million), are attracting capital, but ticket sizes remain comparatively smaller. Meanwhile, the generation versus manufacturing split also reveals an important pattern. High-value transactions (\$150 million and above) are largely concentrated in generation platforms and project acquisitions. Manufacturing and equipment deals, while frequent, mostly fall in the \$30 million-\$160 million band. This suggests that while supply chain localisation is gaining traction, asset ownership continues to command the largest capital allocations.

IPO

The IPO landscape for renewable energy companies in the first three quarters of FY 2025-26 reflects strong fundraising intent, but selective execution. In Q1, IPO issuances worth \$1,185.97 million were tracked in the pipeline through draft red herring prospectus (DRHP) filings, indicating healthy market confidence at the start of the fiscal year. The momentum intensified in Q2, when the pipeline rose sharply to \$2,343.3 million – the highest across the three quarters – signalling aggressive filing activity and strong capital market interest in the sector.

However, actual capital mobilisation through IPO issuances was significantly lower than the pipeline figures. In Q2, companies raised \$383.86 million in fresh issue capital (excluding offer for sale). This suggests that while many companies initiated listing plans, only a fraction progressed to execution within the same quarter. Meanwhile, in Q3, the pipeline moderated sharply to \$641.31 million, indicating a slowdown in fresh DRHP filings compared to Q2. Despite this, actual capital raised remained strong at \$356.65 million (fresh issue, excluding offer for sale). This implies improved conversion of pipeline into executed deals and stronger transaction closure during the quarter.

Ease of doing business drives clean energy capital

India's renewable energy financing landscape reflects a marked improvement in ease of doing business, particularly when viewed through the lens of foreign capital participation. Policy liberalisation has played a foundational role. Since November 2022, 100 per cent FDI has been permitted under the automatic route

for renewable energy generation and distribution projects. This regulatory shift has translated into tangible capital flows, with FDI rising 50 per cent year on year in FY 2023 and FY 2024, and total inflows reaching approximately \$4 billion in FY 2025. The steady increase from under \$1.4 billion in FY 2019 to \$4 billion in FY 2025 signals structural investor confidence rather than episodic interest.

Some of the major foreign debt deals that were signed since FY 2025-26 include BluPine Energy's \$280.8 million deal from Standard Chartered for an FDRE project in Karnataka. Furthermore, to finance clean energy projects, PFC mobilised \$401.05 million from JBIC. The trend continued in Q3 FY 2025-26, with ReNew raising \$331 million from ADB to finance a wind-solar hybrid and BESS project in Andhra Pradesh. Moreover, Adani Green secured \$250 million from DBS Bank, DZ Bank, Rabobank, and Bank SinoPac to refinance existing debt.

Meanwhile, some of the major foreign equity deals that were signed since FY 2025-26 include IREDA's \$234.7 million QIP from several institutional investors, including Société Générale and Morgan Stanley. Moreover, SolarArise's \$160.4 million acquisition by Neo Infra Income Opportunities Fund, and Statkraft's \$222 million-\$253 million acquisition by Serentica Renewables highlight strong global strategic interest in Indian renewable platforms. The most significant transaction in Q3 was the \$550 million acquisition of Vayona Energy by a consortium led by TPG and Mavco Investments, representing one of the largest foreign-backed renewable transactions during the period. Moreover, ReNew secured \$190 million from Sembcorp Industries for the acquisition of a 300 MW solar project.

Parallel to rising foreign participation, the improving ease of doing business is evident in the growing entry of diversified domestic players. Companies including the Aditya Birla Group, Reliance Industries Limited and Indian Oil Corporation Limited, which were traditionally outside the clean energy domain, are now allocating substantial capital to renewables, signalling that the sector has matured into a mainstream business opportunity. Together, these trends suggest that ease of doing business in renewable energy financing is improving, supported by policy liberalisation, institutional maturity and expanding investor confidence.

The way forward

Going ahead, renewable financing in India is expected to be shaped by three trends: rising refinancing and balance sheet optimisation as assets mature; greater capital allocation towards hybrid, FDRE and storage-linked projects; and sustained participation from global lenders and diversified domestic conglomerates, strengthening long-term capital availability. ■

Industry Bytes

“ What excites me most about the power sector is the pace at which it is evolving. Today, the sector stands at the intersection of policy, innovation, finance and sustainability. With increasing renewable energy integration, rising demand and growing market complexities, one key outcome has been heightened price volatility and uncertainty. To address this, MCX Electricity Futures plays a critical role by providing market participants with a robust tool for risk management. These instruments enable better financial planning and help stakeholders align with their budgeted costs and profit margins. While designing electricity futures, our focus was on building something that serves the entire ecosystem. We actively engaged with market participants, regulators and the broader value chain of stakeholders to develop a solution that contributes to a more efficient, resilient and sustainable power sector. The power sector continues to evolve every day, supported by progressive regulations and strong government intent. As India moves towards the vision of Viksit Bharat, the growth of the power sector will be integral to that journey.

Ruchi Shukla, Head, Energy, MCX

This is a really exciting time to be in the power sector. We are currently witnessing a major energy transition, with a gradual phase-out of fossil fuels and a significant rise in the role of renewables. At the same time, ongoing energy security concerns, partly influenced by global events such as the Gulf War, are increasing the urgency to make electricity the primary source of energy. With the upcoming summer season, peak demand is expected to reach new highs.

To meet this demand, there is a strong need for the ministry and all stakeholders to accelerate power generation. This can be achieved by expediting the commissioning of projects that are scheduled to come online within the next 6 to 12 months.

Aditya Pyasi, CEO, Indian Wind Turbine Manufacturers Association

The vision of Siemens is to leverage technology to resolve everybody's problems, and help in energy transition through digitalisation and innovative technologies.

Narendra Tare, Director, Power Utilities, Smart Infrastructure Sales, Siemens

We are currently in an unprecedented phase in the power sector, where the entire energy ecosystem is undergoing rapid transformation. The large-scale integration of renewable energy, ongoing grid strengthening, the rise of electric mobility and the exponential growth of data centres are all driving significant increases in energy demand. This shift is reshaping the transmission, distribution, and generation landscape, making it an especially exciting time for the sector. Transmission, in particular, is set to play a critical role – not just in India, but globally as well – in enabling this accelerated energy transition. Without robust transmission infrastructure, these changes would not be possible.

From our company's perspective, our key focus areas revolve around supporting this transition effectively. First, we aim to offer products and solutions that enable evacuation of higher capacity with lower transmission losses. Second, we are focused on building adequate manufacturing and delivery capacities to support infrastructure needs in a timely manner. Third, and importantly, we strongly advocate for optimising existing transmission corridors through reconductoring. This approach can significantly enhance capacity within the same right-of-way and in a much shorter timeframe, making it a highly efficient solution for countries undergoing energy transitions.

Manish Aggarwal, CEO, APAR

A structural shift is underway in the power sector, with a clear focus on renewable energy and energy storage. In India, both power generation and consumption are expanding rapidly, driving significant new capacity additions.

Solar installations are increasing at scale, creating demand for transformers and other critical components. Wind capacity is also growing, alongside emerging storage solutions, including mechanical and electrical batteries. This rapid transition is bringing in new technologies, components and design requirements.

For us, the opportunity to develop products for these next-generation applications is particularly exciting, and we look forward to contributing to this evolving landscape in the years ahead.

Niral Patel, MD and Chairman, Atlanta Electricals Limited

The power sector today is extremely exciting, particularly from a growth and demand perspective. From a manufacturing standpoint, especially in the transmission and distribution segment, we are witnessing significant momentum both in India and globally. The surge in demand is being driven by multiple factors, including the rapid expansion of data centres, the growth of renewable energy, and the ongoing upgradation of existing infrastructure. This creates a strong and sustained demand outlook for the sector. Looking ahead, I believe that over the next decade, companies with a clear vision and strong execution capabilities will find immense opportunities to grow, while also contributing meaningfully to the nation's development.

Akshat Bhatnagar, Vice President, Sales and Business Development, DICABS

Our focus is on adopting an integrated approach to infrastructure, analytics and policy alignment and ensuring a resilient, efficient and adaptive transmission network for APTRANSCO's ever-evolving, complex power system. We believe that strong grids build strong nations.

Srinivas K., Chief Engineer, APTRANSCO, Government of Andhra Pradesh

The Bureau of Energy Efficiency's objective is to reduce the energy intensity of India by implementing various important schemes such as Standards & Labelling; Perform, Achieve and Trade; and ADEETIE.

Shailender Singh, Assistant Director, Media; and Anil Sharma, Consultant Media, Bureau of Energy Efficiency

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Snapshots from Day 2



Snapshots from Day 2



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- Anil Kumar Jadli, Director, HR, NTPC
- Marco Montefiori, Co-Founder, Chair and Chief Growth Officer, Energy Plexus Institute
- Ashutosh Goel, MD, Allied Engineering Works Private Limited

10:50 - 11:40

Beyond decarbonisation: Circular energy systems integrating energy efficiency, resource circularity and carbon trading markets

Moderator: Saurabh Gupta, Partner, Smart Grids and Regulations, KPMG

- Krushna Chandra Panigrahy, Director General, Bureau of Energy Efficiency
- Dr Sanjay Kumar, Chief Policy Adviser, Climate Parliament
- Mikiko Tanaka, Head, Subregional Office of South and Southwest Asia, Economic and Social Commission for Asia and the Pacific (ESCAP)

11:40 - 12:30

Coal gasification and clean thermal technologies: Empowering communities in a transforming economy

- G. Kishan Reddy, Minister of Coal and Mines, Ministry of Coal, Government of India
- Shivam Srivastava, Director, Fuel, NTPC Limited
- Praveen Gupta, Member, Thermal, Central Electricity Authority
- Dr Peeyush Kumar, MD, BCGCL and Director, Coal Gas India Limited
- Naveen Ahlawat, Head, Sustainability and Decarbonisation, Jindal Steel Plant

12:30 - 13:20

Power ecosystem co-innovation: Utility-start-up collaboration at the national and global scale

- Rahul Lamba, Co-Founder, The Energy Company
- Abhijit R. Abhyankar, NTPC Chair Professor, Electrical Engineering Department, IIT Delhi
- Neelashi Shukla, Head of Cleantech Equity Investments, Stride Ventures
- Rajiv Kumar Porwal, Director, System Operation, GRID-India

TECHNICAL CONFERENCE: EXHIBITION HALL 1 AND HALL 2

Time: 10:00 – 12:00

Policy, Efficiency and Innovation in Generation Technologies

- Jaydeep Naha, GM, Siemens Energy India Limited
- Dharendra Kumar Dwivedi, Head of Project, NHDC Limited (a JV between NHPC Limited and the Government of Madhya Pradesh)
- Geethalakshmi D., Senior General Manager, Tata Consulting Engineers
- Sugandha Chauhan, Deputy Manager, Tech, REC Limited
- Shilpa Bindal, Senior Consultant, GridAxon Inc.

SPECIAL PROGRAMMES

Location: Suryamukhee and Moulshree, 4th Floor, Room 401+402

Time: 10:30 - 13:00

Session on States

- **Session Title:** Delhi and Gujarat

Location: Palash A and B, Grand Ballroom (GBR)

Time: 10:00-17:00

2nd International Conference on Carbon Markets

Location: Amaltas A, Convention Centre

Time: 10:00-11:30

Powering India and Harnessing of Hydro Potential of Northeast India: Strategies Required

Moderator: Dr Bhupendra Kumar Singh, Chief Energy Security, Confederation of Indian Industry

- Mohammad Afzal, Joint Secretary, Ministry of Power, Government of India
- Bhagwan Sahay Bairwa, Chief Engineer, Central Electricity Authority, Government of India
- Suprakash Adhikari, Director, Technical, NHPC Limited
- Saji S., HVDC Country Lead India, Hitachi Energy
- Abhay Kumar, Executive Director, Power Grid Corporation of India Limited
- Arun Sharma, CEO, Resonia Limited
- Ranendra Sarma, Former Director, Technical, NEEPCO Limited

Location: Mogra Hall A and B, 4th Floor, Convention Centre

Time: 10:00-11:30

Behind the Meter Storage of DRE

Moderator: Jagabanta Ningthoujam, Principal and Director, RMI

- Alok Kumar, DG, AIDA
- Ayush Mishra, Co-Founder and CEO, AmpereHour Energy
- P. Ravi Kumar, Chairperson, KERC
- Abhishek Ranjan, SVP and CEO, BSES Rajdhani
- Pramod Kumar Singh, Senior Director, AEEE
- Dr Mallela Venkateswara Rao, Chairperson, WBERC
- Vishu Mahajan, JMD, TNPDC

Location: Location: Hall Parijat, 2nd floor, Convention Centre

Time: 12:00-13:30

Youth Session: Skilling, Entrepreneurship Building and Sustainability: Powering the Workforce of 2047

- Ghanshyam Prasad, Chairperson, Central Electricity Authority
- Nirmal Shani, Project Director, DMG Events
- Arpit Sharma, CEO, Skill Council for Green Jobs
- Anish Mayank Aind, HR Leader, Voltas, Reliance Industries and Aditya Birla Group
- Dr Rimjhim Agrawal, Global Head, AI and Analytics for Utilities, Jade Business Services LLC
- Prof. Bhim Singh, Chair, ANRF, IIT Delhi
- Ashim Goswami, Board Member, Dotryder Private Limited, Professional Chartered Coach, International Coaching Federation
- Saravanan Balamurugan, Chair, CIGRE India

Location: Amaltas Hall A, Basement 1, Convention Centre

Time: 10:00-11:30

Reinventing Power Systems: The Startup Revolution in Electricity

- Sunita Verma, Scientist G and Group Coordinator, Ministry of Electronics and Information Technology, Government of India
- Shubhra Thakur, Director, Policy and Markets, APAC and Country, Director, India, Long Duration Energy Storage Council
- Dr Abhijit R. Abhyankar, PhD, Fellow, INAE, NTPC Chair Professor, Electrical Engineering Department, IIT Delhi
- Akhilesh Kumar Dixit, CEO, EESL
- Mohak Mangal, Co-Founder and CEO, Pravah

Bharat Electricity Summit 2026

AGENDA: SATURDAY, MARCH 21, 2026 (DAY 3)

SPECIAL PROGRAMMES

Location: Hall Amaltas A, Convention Centre

Time: 10:00 – 18:00

CABLETECH 2026

- Sheri Dhalke, VP (R&D), Polywater
- Jaise Mathew, Product Manager, Cable Infrastructure, Megger India Private Limited
- Maurice Alphonso, Plexchem Technologies Pte Ltd, Singapore
- Dillip Kumar Puhan, Joint Director, Cables & Diagnostics Division, Central Power Research Institute (CPRI), Bengaluru, India
- Yogendra S. Tiwari, VP, Technical, Universal Cables Limited
- Dr Moumita Naskar, Scientific Officer, CPRI, Regional Testing Laboratory
- Kaibalya Kumar Khuntia, Manager, New Product Development, KEC Asian Cables Limited
- Jagdish Sandhanshiv, Knowledge Cluster
- Nayan Degda, Director, PCA Technologies Private Limited
- Pratik Kumar Nayak, Manager, Quality, Shakun Polymers Private Limited (Part of Alphagary, an Orbia Business)
- Gorachand Sahoo, Asst. Manager, Design and New Product Development, KEC Asian Cables Limited
- Hemanta Chandure, DGM, Adani Electricity Mumbai Limited
- Priti Misra, C.C Reddy, Indian Institute of Technology, Ropar
- Lijo Joseph Oliprakkattu, Application Engineer, Technical, Trident Techlabs Limited
- Sandeep Singh Tagore, Student, IIT Ropar
- Neha Kumari, Ph.D. Scholar, High Voltage Engineering, IIT Ropar
- Bere Sivananth Kumar, CPRI
- R. Arunjothi, Joint Director, Power Systems Division, CPRI, Bengaluru, India
- V. Vaidhyanathan, Engineering Officer, CPRI, Bengaluru, India
- Patthi Chandrasekhar Reddy, Engineering Officer, Short Circuit Laboratory, CPRI, Bengaluru, India

Location: Amaltas B, Convention Centre

Time: 10:00 – 12:00

Women in Electricity: Current and Courageous

- **Chief Guest:** Meghana Bordikar, Minister of State, Energy, Govt. of Maharashtra
 - **Guest of Honour:** Pankaj Agarwal, Secretary, Power, Government of India
 - **Guest of Honour:** Dr R.K. Tyagi, CMD, Power Grid Corporation of India Limited
 - **Guest of Honour:** Dr. Yatindra Dwivedi, Director, Personnel, POWERGRID
 - **Guest of Honour:** Naveen Srivastava, Director, Operations, POWERGRID
 - **Guest of Honour:** Vamsi Rama Mohan Burra, Director, Project, POWERGRID
- Moderator:** Tanushree Bhowmick, Partner, India WePower, World Bank
- Parminder Chopra, CMD, PFC Limited
 - S. Usha, Director, Market Operations, Grid-India
 - Dr Tal Katz, CIGRE WiE Chair, Isreal
 - Dechen Dema, Director Transmission, BPC, Bhutan
 - Anamika Bhargava, Global Head, L&T Semiconductor, India
 - Dr Tripta Thakur, Vice Chancellor, VMSBUTU, Dehradun
 - Bani Varma, Director, IS&P, BHEL, India
 - Manju Gupta, Executive Director, POWERGRID, Chair, CIGRE WIE, India
 - Neo Mapapanyane, Chair, CIGRE WIE, South Africa
 - Dr Vibha Dhawan, DG, TERI, India
 - Kristina OZGAN, Chief Adviser, Rosseti, PJSC

Location: Parijat Hall, 2nd Floor, Convention Centre

Time: 10:00 – 12:00

Africa50 - Power to All: One Africa-One Grid

Location: Mogra Hall A and B, 4th floor, Convention Centre

Time: 10:00 – 18:00

Vendor Development Programme

Location: Hall Amaltas B, Convention Centre

Time: 14:30 – 17:55

Legal and Regulatory Framework in the Power Sector

Moderators: Manju Gupta, Executive Director, POWERGRID; Chair, CIGRE WIE, India; Rahul Mishra, Partner, Bain & Company; Sambit Patra, Partner, Bain & Company

- Harish Dudani, Member, Law, CERC
- M.G. Ramachandran, Senior Advocate, Supreme Court of India
- Sh. Surender Babbar, Member, Delhi Electricity Regulatory Commission
- Ajay Kumar Singh, Member, Technical, Chhattisgarh State Electricity Regulatory Commission
- Padma Jaiswal, Special Secretary, Government of NCT of Delhi
- Ramesh Babu Veeravalli, Member, CERC
- Hemant Verma, Chairperson, Tripura Electricity Regulatory Commission
- Raj Kumar Chaudhary, Chairperson, Joint Electricity Regulatory Commission for the UTs of J&K and Ladakh
- Lt. Gen. Rana Pratap Kalita, Retd., Chairperson, Assam Electricity Regulatory Commission
- Vivek Ganodwale, Member, Law, Chhattisgarh State Electricity Regulatory Commission
- Ravinder Singh Dhillon, Member, Finance, CERC
- D. Sai Baba, Additional Secretary, Ministry of Power
- Ghanshyam Prasad, Chairperson, Central Electricity Authority
- R.N. Singh, Member, Delhi Electricity Regulatory Commission
- Sushanta Kumar Ray Mohapatra, Member, Technical, Odisha Electricity Regulatory Commission

Location: Palash A and B, Grand Ballroom (GBR)

Time: 10:00 – 18:00

2nd International Conference on Carbon Markets

Location: Suryamukhee and Moulshree, 4th floor, Room 401+402

Time: 10:30 – 18:00

Session on States

- **Session titles:** Andhra Pradesh, Maharashtra, Uttar Pradesh, Haryana and Odisha.

Bharat Electricity Summit 2026

AGENDA: SATURDAY, MARCH 21, 2026 (DAY 3)

STRATEGIC CONFERENCE: HALL BRAHMAKAMAL

Time: 10:00 – 10:50

OSOWOG market mechanisms for high-renewable energy integration and global energy integration

Moderator: Dr Satish Kumar, President and Executive Director, Alliance for an Energy Efficient Economy

- Dr Vibha Dhawan, DG, The Energy and Resources Institute
- Hitendra Dev Shakya, MD, Nepal Electricity Authority
- Dr Puneet Chitkara, SVP, Strategy, India Energy Exchange
- Ashish Khanna, DG, International Solar Alliance

Time: 10:50 – 11:40

Next-generation transmission infrastructure and operations: Real-time optimisation, automation and system-strength management

Moderator: Dr Subir Sen, Director, Technical, Tripura State Electricity Corporation Limited

- Naveen Srivastava, Director, Operations, Power Grid Corporation of India Limited (POWERGRID)
- Sandeep Zanzaria, CEO, GE Vernova T&D India Limited
- Akilur Rahman, CTO, India and Market Innovation Lead, South Asia, Hitachi Energy
- Samir Chandra Saxena, Chairman and MD, GRID-India
- Dr Ram Prasath Manohar, IAS, MD, Karnataka Power Transmission Corporation Limited

Time: 11:40 – 12:40

Re-engineering transmission delivery: RoW innovation and infrastructure execution

Moderator: Umang Shah, MD and Partner, BCG

- Dr D. Saibaba, Additional Secretary, Ministry of Power, Government of India
- Eng. Kipkemoi Kibias, Ag. MD and CEO, Kenya Electricity Transmission Company Limited

- Upendra Pande, MD, Gujarat Energy Transmission Corporation Limited
- Mayur Maheshwari, IAS, MD, UPRVUNL and UPPTCL
- Kanwaljeet Singh Kukreja, Global VP, Infrastructure Segment, Energy Management, Schneider Electric

Time: 12:40 – 13:20

Pumped hydro renaissance: Unlocking long duration storage for renewable dominance

Moderator: Prateek Aggarwal, Programme Lead, Council on Energy, Environment and Water

- M.G. Gokhale, Member, Hydro, Central Electricity Authority (CEA)
- Suprakash Adhikari, Director, Technical, NHPC Limited
- Shubhra Thakur, Director, Policy and Markets, APAC and Country Director, India, Long Duration Energy Storage Council
- Ankur Vashishta, Head, Pumped Storage Projects, JSW Energy
- Shouvik Dey, VP, Voith Hydro

Time: 14:30 – 15:20

Building intelligent grid systems: From smart metering and ADMS-DERMS platforms to next-generation TSO-DSO coordination

Moderator: Satyendra Nath Kalita, Director, Regulatory Affairs, All India Discoms Association

- Anil Rawal, CEO and MD, Intellismart Infrastructure Pvt. Ltd
- Madan Mohan Chakraborty, MD and CEO, GridCrest Technologies Private Limited, Kaynes Group
- Abhishek Ranjan, CEO, BSES Rajdhani Power Limited
- Hemant Jain, Member, Grid Operation and Distribution, Central Electricity Authority (CEA)

Time: 15:20 – 16:10

Powering the digital economy: Clean energy for data centres and emerging digital infrastructure

Moderator: Ashim Sharma, Senior Partner and Business Unit Head, NRI (Nomura Research Institute) Consulting and Solutions

- Sarit Maheshwari, CEO, NTPC Green Energy Limited
- Venkat Mynam, Senior Engineering Director, Schweitzer Engineering Laboratories, Inc.
- Simon Evans, Director, Global Digital Energy Leader, Arup
- Dr Lawrence Jones, Co-Founder and President, Energy Plexus Institute

Time: 16:10 – 17:00

Scaling alternative fuels in India's power mix: Unlocking flexibility and economic potential

Moderator: Gaurav Gulati, Partner, Kearney

- Rajinder Singh Ahuja, CEO Power, Vedanta Limited
- Vikas Kikan, CEO, Beyond Drilling
- Suresh Kumar Narang, Director, Nabha Power Limited
- Chandramouli Kasina, ED, Safety, Sustainability, Environment and Ash Utilisation (SSEA), NTPC Limited

Time: 17:00 – 17:50

Hydropower reimaged: Advancing innovation and resilience for future clean energy system

Moderator: Imanol Arbulu, Partner, Energy Practice, Kearney

- Bhupender Gupta, Chairman and MD, SJVN Limited
- Sanjay Kumar Singh, Director, Projects, NHPC Limited
- Dr Enrique Cifres, Hon. VP, International Commission on Large Dams
- R.K. Chaudhary, Chairperson, Joint Electricity Regulatory Commission, UT of J&K and Ladakh
- Arun Kumar, Professor, IIT Roorkee

TECHNICAL CONFERENCES: EXHIBITION HALL 1 AND HALL 2

Time: 10:00 – 12:00

Renewable and Clean Energy Generation

- Sujay Karmakar, CGM, NETRA, NTPC Limited
- Jaganath Pani, Senior Manager, NHPC Limited
- Pranay Pranay, Manager, NETRA, NTPC Limited
- Dinesh Mistri, B.Tech 4th Year Student, Department of Electrical Engineering, Dumka Engineering College
- Aryan Dhiman, M.Tech, Electronics and Communication Engineering (Research), University Institute of Technology (H.P.U.), Shimla

Time: 10:00 – 12:00

Grid Decentralisation and Modernisation

- Sumedh Agarwal, Director, Smart and Resilient Power and Mobility Alliance for an Energy Efficient Economy
- Roshan Yadav, DGM, NTPC Limited
- Sonal Mahapatra, Team Lead, PSCC, TP Central Odisha Distribution Limited
- Rajiv Pharia, CGM, RDSS, PFC Limited

Time: 13:00 – 15:00

Energy Efficiency and Sustainability

- Ramandeep Singh, Practice Head and COO, Mercados Energy Markets India Private Limited
- Ketan Khanna, Senior Manager, ARVOS Ljungstrom Energy India Private Limited
- Dr Rajendra Kumar Saini, Senior Manager, NTPC Limited
- Goutam Khankari, Senior Manager, Damodar Valley Corporation
- Tania Guha, Senior Manager, Engineers India Limited
- Vinod Kotra, Senior Manager, Secure Meters Limited

Time: 13:00 – 15:00

Digital Technologies and Business Models

- Neeraj Tiwari, Senior Manager, NTPC Limited
- Abhishek Martand, GM, IT, Madhya Kshetra Vidyut Vitaran Company Limited, Bhopal
- Hemanth Kumar H.B., Assistant Manager, Power Grid Corporation of India Limited

Time: 15:30 – 17:30

Energy Storage and Circularity

- Priya Shrivastava, Research Manager, Wood Mackenzie
- Priyansh Mohan, Co-Founder and CEO, Meine Electric Private Limited
- Suhas Bhagwat, VP, India Operations, Themes LLC
- Eshita Gupta, Technical Director, KPMG in India
- Nilotpal Banerjee, Senior Manager, NTPC Limited
- Dr Sourav Das, Assistant Professor, Institute of Engineering and Management, Kolkata
- Rupali Brahmachary, Project Associate, National Institute of Technology, Durgapur