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SMART GRID: SOLUTIONS FOR FUTURE DEVELOPMENT

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- **SPECIAL FEATURE:** The Startup Revolution
- **SPECIAL REPORTS:** Tehri PSP – India's First Variable Speed PSP; Diu – India's First Fully Solar-Powered District
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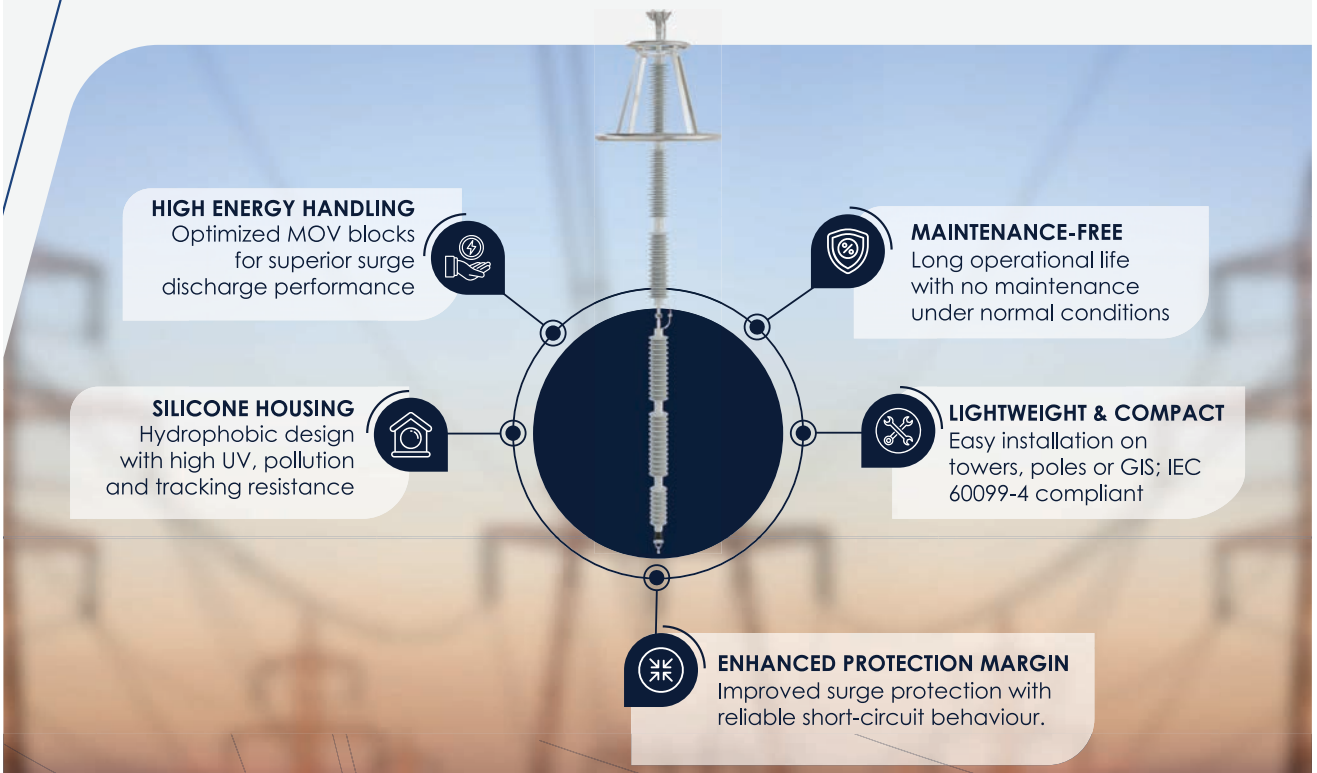

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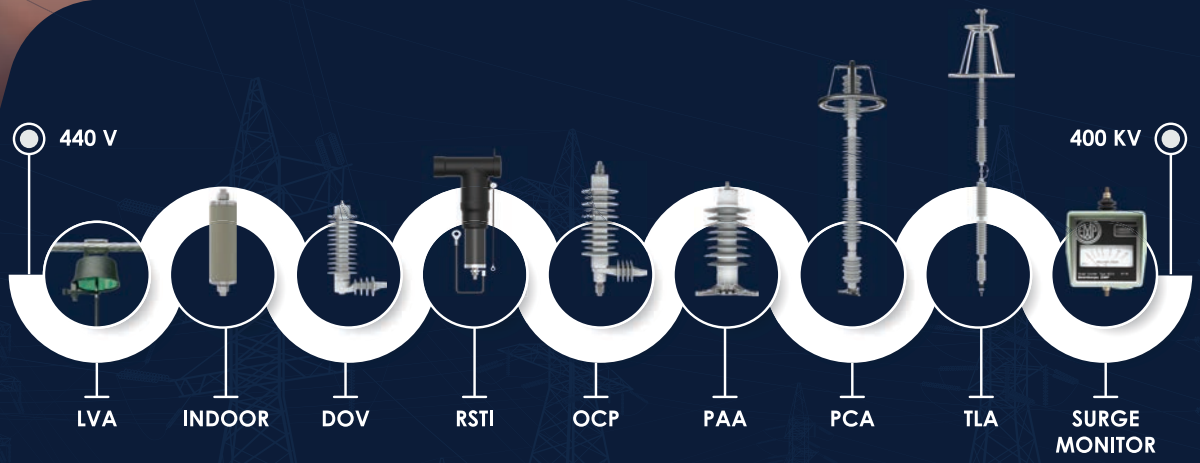

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COVER STORY

India's grid is one of the largest synchronous grids in the world. As India moves towards high renewable penetration and greater electrification, emerging smart grid technologies will play a crucial role in making the system reliable, resilient, and flexible. **IEEMA JOURNAL** explores these critical technological advancements that can help future grid development; India's journey in implementing smart grid solutions across the value chain; and how collaboration among stakeholders is key to achieving India's Smart Grid Vision.

THINK TANK

SPECIAL FEATURE

India's entrepreneurial landscape is redefining innovation and creating new opportunities across sectors, with start-ups seizing the opportunity to energise India's development story and become a cornerstone in the global energy transition.

FOCUS

By harnessing the power of data and technology, smart grids pave the way for a more interconnected, efficient, and sustainable energy future. **Swetha Ravi Kumar, Executive Director, FSR Global,** highlights key takeaways to enable India's interoperable digital grid while exploring the focus of the Smart Grid Observatory from 2025-2029.

INSIGHTS

The technical convener of **IEEMA Meter Technical Division, Vipin Kumar Mishra, Vice President Technology, Capital Power Systems Ltd,** details the importance of the role of smart meters by touching upon aspects of automation, addresses cyber security in digital grids, enlists future trends to conclude with a vision about building smart meters for real-world use.

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Date: 10th-12th December, 2025
Time : 10AM to 6PM
Venue: Yashabhoomi IICC, Dwarka
New Delhi, India

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EDITORIAL BOARD

Regd Office – Mumbai
501, Kakad Chambers, 132, Dr A Besant Road,
Worli, Mumbai 400 018.
Phone: +91(0) 22 24930532 / 6528
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Corporate Office - New Delhi
Rishyamook Building, First floor,
85 A, Panchkuian Road, New Delhi 110001.
Phone: +91 (0) 11-23363013, 14, 16
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Branch Office – Bengaluru
K Seetharaman, *Assistant Director*
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Mobile: +91 99800 04982
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Branch Office – Kolkata
Sanjoy Mukherjee, *Regional Representative-Eastern Region*
Mobile: +91 98308 50757
Email: sanjoy.mukherjee@ieema.org

Website: www.ieema.org

STATE HEADS

Rajesh Parab
Senior Executive Officer & State Head-Maharashtra
Mobile: +91 97022 69598
Email: rajesh.parab@ieema.org

Anuj Kumar Chaturvedi
State Head-UP, Uttarakhand & MP
Mobile: +91 98396 03195 / 95191 38844
Email: anuj.chaturvedi@ieema.org

Ashish Vikram
State Head-UP
Mobile: +91 98733 05589
Email: ashish.vikram@ieema.org

Omkar Pradhan
State Head-Gujarat
Mobile: +91 98199 06433
Email: omkar.pradhan@ieema.org

Mohammad Irfan Parray
State Head-Jammu & Kashmir
Mobile: +91 98584 55509
Email: Irfan.parray@ieema.org

Nilankha Chaliha
State Head-North East
Mobile: +91 97063 89965
Email: nilankha.chaliha@ieema.org

Rajnish Kaushik
State Head-Haryana, Punjab, Himachal Pradesh & Chandigarh
Mobile: +91 99911 10246
Email: rajnish.kaushik@ieema.org

Sairam Rayepeddi
State Head-Hyderabad
Mobile: 9642345691
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FROM THE PRESIDENT'S DESK

Dear Readers,

It gives me immense pride to share some recent milestones that reflect IEEMA's unwavering commitment to innovation, collaboration, and leadership in India's energy sector.

We recently launched a six-month certificate course on Reliability Engineering in collaboration with IIT Kharagpur. This initiative aims to build a strong foundation in reliability principles among professionals and young engineers, which is vital as our systems evolve to meet the needs of an all-electric and interconnected future. The enthusiastic response from industry participants reaffirms our belief in the need for focused knowledge development in quality and reliability.

IEEMA also hosted the MEP Consultants Meet in Kochi, a vibrant and insightful gathering that brought together consultants, manufacturers, system integrators, and policymakers. The discussions highlighted the strategic role MEP consultants play in shaping future-ready infrastructure — not just in terms of energy efficiency but also in enabling faster adoption of clean technologies. As the industry shifts toward net-zero and electrification goals, MEP consultants are becoming the key enablers of sustainable design, optimised implementation, and future-proof system integration.

IEEMA is committed to strengthening this partnership. We envision a collaborative framework where MEP consultants and electrical equipment manufacturers work hand-in-hand, co-developing specifications, digital tools, and training programmes. Together, we can expedite India's energy transition in a way that is both scalable and inclusive.

In this spirit of innovation and ecosystem collaboration, we warmly welcome the formation of the Task Force for the India Energy Stack under the mentorship of Nandan Nilekani. This initiative holds immense promise for integrating India's energy systems with a unified digital framework – enabling real-time data exchange, seamless market access, and smarter planning across generation, transmission, distribution, and consumption. IEEMA sees this as a game-changer, akin to what UPI did for fintech. It will empower stakeholders, reduce inefficiencies, and foster innovation on a national scale.

India's grid is one of the largest synchronous grids in the world and the nation's goal is to achieve 500 GW of renewable energy capacity by 2030. With this comes the need for modernising DISCOM operations by improving their financial viability and effectively managing the grid by integrating large-scale renewable energy into the power system. IEEMA, as an industry association, has been advocating for modern grid technologies, encouraging collaboration between stakeholders, and promoting industry best practices. Its efforts aim to ensure that renewable energy growth is matched with grid resilience and operational flexibility.

As we move forward, let us continue to build strong bridges between policy, technology, and people – and ensure that India's energy future is not only secure and reliable but also smart, connected, and sustainable.

SUNIL SINGHVI

SAMVAAD

Dear Readers,

On June 9, India successfully met peak power demand of 241 GW, with zero peak shortage reported. This achievement underscores the nation's robust power infrastructure, as we are striving to become a power surplus country.

In a push for energy security and renewable integration, the Ministry of Power has also approved a VGF scheme for 30 GWh of battery energy storage systems at an investment of Rs33,000 crore. The ministry has also announced a waiver extension of ISTS charges for storage projects until June 30, 2028 – a crucial step for meeting India's growing storage needs and optimally using its transmission lines.

Furthermore, nine 1,100 kV lines and 10 substations are to be developed by 2034 at an investment of Rs53,000 crore, with testing facilities being developed by CPRI. The Central Government has also increased compensation for land used in laying transmission lines to ease right of way issues.

At IEEMA, we are focused to advocating policy reforms that benefit the industry. We recently met with **Hon'ble Minister of Power, Shri Manohar Lal,** and are grateful to him for giving IEEMA the opportunity to present the growth and investments by the transformer industry. We highlighted the opportunities and challenges that need to be addressed to drive growth. IEEMA is committed to the guidance provided by the HMoP to prioritise 'Make in India' and quality while serving the nation's energy needs.

IEEMA welcomes the Union Cabinet's approval of a Rs1 lakh crore Research, Development and Innovation (RDI) scheme, chaired by **Prime Minister Narendra Modi.** The focus on strategic and "sunrise" sectors such as clean energy, Artificial Intelligence (AI), and deep technology, are critical for the electrical and electronics manufacturing ecosystem; and this move is a critical step towards achieving indigenous innovation and enhancing India's global competitiveness in advanced technological domains.

Strengthening our focus on quality and reliability, IEEMA has collaborated with IIT Kharagpur's Subir Chowdhury School of Quality and Reliability to launch a certification course in 'Reliability Engineering for Electrical Industry Professionals'. Twenty-five participants from different functions and nine member organisations are being trained under this course, which has both academic input and project work for implementing the learnings in their respective organisations.

As a first-ever event of its kind in the region, IEEMA hosted the North-East Power Conclave 2025 in Guwahati in June. The conclave witnessed the presence of two state power ministers and three state power secretaries, senior government officials, utilities, and industry leaders from all eight North-Eastern states. We were honoured to host **F Rodingliana, Hon'ble Minister, Power & Electricity Department, Government of Mizoram** and **KG Kenye, Hon'ble Minister, Department of Power, Government of Nagaland,** and state power secretaries – Jadav Saikia, IAS, Secretary, Power Department, Government of Assam, K Lalrinzuali, IAS, Secretary, Power & Electricity Department, Government of Mizoram, and Abhishek Singh, IAS, Secretary, Department of Power, Government of Tripura.

Our MEP Consultants Meet in Kochi facilitated dynamic engagement among MEP professionals, developers, government officials, and industry experts. In June, we also organised the Electrical Fire Safety Conclave in Bengaluru, after successful editions in Mumbai in April and Delhi in May.

As part of our commitment to building a resilient, innovative, and sustainable MSME ecosystem within the electrical and electronics industry, IEEMA also hosted a high-impact webinar on 'Accelerate Your MSME: Unlock Finance, Tech & Energy Solutions' – a first in a series of activities planned by IEEMA SME division.

In July, we will be hosting the much-awaited T&D Conclave in Delhi and the Kolkata chapter of the Electrical Fire Safety Conclave. Watch out for updates on our future state conclaves and more in the coming months...

CHARU MATHUR

Diu: India's First Fully Solar-Powered District

Diu is reportedly now the first district in India to meet its entire power demand with solar energy, with an 11.88 MW capacity.

Diu is a shining national example of renewable energy adoption in India, with its entire daytime electricity demand being met through solar energy, said **Union Minister for New and Renewable Energy Shri Pralhad Joshi.**

The minister recently visited Diu to review its remarkable progress in solar energy adoption and assess the implementation of the PM-Surya Ghar: Muft Bijli Yojana. He congratulated Diu's exceptional milestone as the first district in India to meet its entire power demand with solar energy, achieving 11.88 MW (9 MW ground-mounted + 2.88 MW rooftop) capacity.

Shri Pralhad Joshi undertook a field visit to key solar energy facilities in Diu, including the 9-MW solar park located in Fudam. The solar park stands as a symbol of Diu's sustainable transition and plays a vital role in meeting the region's clean energy requirements.

Notably, the Fudam solar park has significantly contributed to reducing transmission and distribution (T&D) losses and enabled the revision of electricity tariffs, making them more affordable for consumers. The minister praised the leadership of the Union Territory Administrator Shri Praful Patel, stating that his proactive approach and vision have been instrumental in realising this clean energy transformation.

Speaking on the long-term impact, Shri Pralhad Joshi remarked that the capital investments made over the past decade in renewable energy infrastructure in Diu have already been recovered through the supply and sale of solar power. He called for even faster and more effective implementation of the PM-Surya Ghar Yojana to maximise its benefits for the residents of the Union Territory and achieve total household saturation.

The minister chaired a high-level meeting at Diu with senior officials of the UT administration to review the status of solar energy generation, its current supply framework, and future expansion prospects. During the meeting, Shri T Arun, Energy Secretary of the Union Territory of Dadra and Nagar Haveli and Daman and Diu, made a detailed presentation on existing solar energy plants, their production capacities, and household-level benefits. He informed the minister that a large number of families in the UT are now availing the benefits of solar energy. The meeting was also attended by Diu Collector Dr. Vivek Kumar, Deputy Collector Shri Shivam Mishra, Executive Engineer Shri Yogesh Tripathi, Shri Paresh Patel, and other senior officials.

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SMART GRID: Solutions for Future Development

India's grid is one of the largest synchronous grids in the world. As India moves towards high renewable penetration and greater electrification, emerging smart grid technologies will play a crucial role in making the system reliable, resilient, and flexible. **IEEMA JOURNAL** explores these critical technological advancements that can help future grid development; India's journey in implementing smart grid solutions across the value chain; and how collaboration among stakeholders is key to achieving India's Smart Grid Vision.

"*Transform the Indian power sector into a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active participation of stakeholders*" – this is the Smart Grid Vision for India! So, what can be done to fast-track the implementation of smart grid solutions across the value chain?

First, let's define a smart grid: An electrical grid with automation, communication and information technology (IT) systems that can monitor power flows from points of generation to points of consumption and control the power flow or curtail the load to match generation in real-time.

Smart grid solutions help monitor, measure, and control power flows in real-time that can

help identify losses, allowing for appropriate technical and managerial actions to be taken to arrest losses.

Benefits of Smart Grid Deployments

Smart grid implementation provides multiple benefits to utilities, customers, and regulators. Reduction of transmission and distribution (T&D) losses; peak load management, improved quality of service and reliability; reduction in power purchase cost; better asset management; increased grid visibility and self-healing grids; renewable integration and accessibility to electricity; increased options such as time-of-use (ToU) tariff, DR programmes, net metering; satisfied customers and financially sound utilities are some of the benefits.

Ashish Tandon

Additionally, **Ashish Tandon, Executive Vice President, Genus Power Infrastructures Ltd,** lists down direct benefits consumers receive:

- **Smart metering:** Accurate billing, no manual errors, real-time tracking of usage.
- **ToU pricing:** Lower bills if consumption is shifted to off-peak hours.
- **Energy insights:** Apps and dashboards to monitor, compare, and optimise energy usage.
- **Integration of rooftop solar:** Sell excess power to the grid (net metering/prosumer benefits).
- **Remote connection/disconnection:** Faster service requests, no need for field visits.
- **Load management and alerts:** Notifications about over-usage, high bills, or grid constraints.

Real Examples from India

Sunil Kumar Singh

Sunil Kumar Singh, Head of Business (India & APAC Region) & Global Project Engineering, L&T Digital Energy Solutions, shares examples of smart meter rollout, wherein over 10 million smart meters have been deployed (as of 2025), with Uttar Pradesh, Bihar, and Rajasthan among the largest beneficiaries *(in the graph on the next page)*.

Puducherry – India's first city to fully pilot a smart grid: Showed 30 percent improvement in billing efficiency.

Mysuru smart grid project – Demonstrated reduction in aggregate technical and commercial (AT&C) losses and enabled remote fault monitoring.

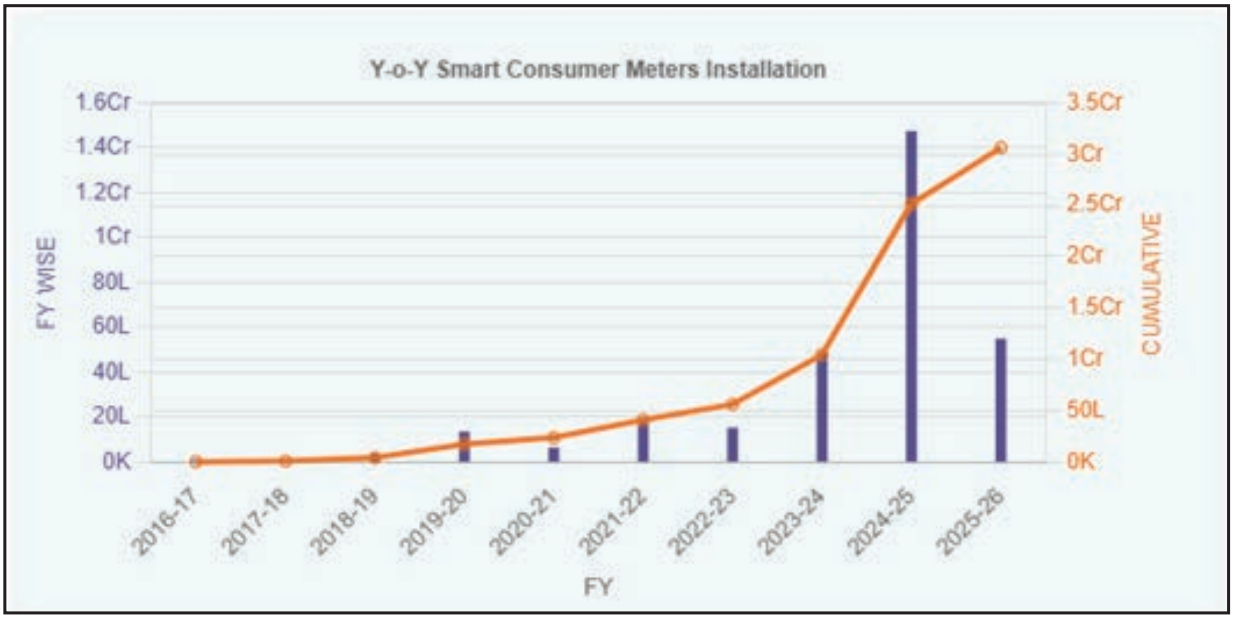
"In India, the smart grid is more than a technology upgrade – it is a tool for equitable, efficient, and

Key Features of a Smart Grid

While the core features of a smart grid are universal, their benefits in the Indian context take on a distinct flavour. **Sunil Kumar Singh, Head of Business (India & APAC Region) & Global Project Engineering, L&T Digital Energy Solutions,** describes key features of a smart grid in India's context:

Feature	Description (India-Specific Examples)
Advanced metering infrastructure (AMI)	Smart meters being rolled out under the Revamped Distribution Sector Scheme (RDSS). Enables real-time billing and remote meter reading.
Distribution automation (DA)	Helps identify and isolate faults automatically – piloted in cities like Chandigarh, Panipat, and Mysuru.
Renewable energy (RE) integration	Facilitates grid integration of rooftop solar, especially in Gujarat, Delhi, and Rajasthan.
Two-way power and data flow	Supports prosumers (eg, solar rooftop users) and better load forecasting.
Peak load management and demand response (DR)	Used during high summer load conditions to reduce stress on the grid. Trials in Andhra Pradesh and Maharashtra.
Energy storage and electric vehicle (EV) charging integration	EV charging infrastructure development linked with DISCOM planning (especially in Delhi and Karnataka).
Supervisory control and data acquisition (SCADA) and geographical information systems (GIS) integration	Many urban utilities now operate SCADA-enabled control centres and GIS mapping for asset tracking.
Cybersecurity and grid monitoring	National guidelines on cybersecurity for power sector released by CEA. Phasor measurement units (PMUs) and wide area monitoring systems (WAMS) are improving real-time grid visibility.

Smart Meters Deployed *(as of 2025)*



Source: www.nsgm.gov.in

sustainable energy access," avers Singh. "For consumers, this means fewer outages, lower bills, better control over energy use, and a cleaner power mix."

Smart meters and advanced grid management systems have allowed Tata Power Delhi Distribution Limited (Tata Power-DDL) to enhance real-time monitoring and streamline power distribution. "Smart meters have played a crucial role in enhancing both, efficiency and revenue collection at Tata Power-DDL," says **Gajanan S Kale, former CEO, Tata Power-DDL and currently CEO-TPNODL, Chief-Odisha Distribution Business.** "One of the key benefits has been the faster detection of outages and quicker restoration of services, minimising downtime for customers. Smart meters provide real-time alerts to consumers, giving them more control over energy use. Customers can take immediate corrective actions if their usage violates threshold values for factors such as power factor, load, or ToU." This ultimately leads to lower energy bills.

Gajanan S Kale

RE Integration through Enhanced Monitoring

India is targetting 500 GW of non-fossil capacity by 2030, but renewables like solar and wind are intermittent and location dependent. Smart grids are critical for effectively integrating these RE sources. They leverage technologies like artificial intelligence (AI)-based forecasting, SCADA, and smart metering for real-time monitoring to anticipate and respond to fluctuations in renewable generation.

Furthermore, observes Kale, "deployment of battery energy storage systems (BESS) has enhanced the ability to smoothen peaks, provide frequency regulation, and store excess RE for later use. Moreover, initiatives such as rooftop solar net metering, DR, and urban

Anil Kadam

Smart Technologies for Future Grid Development

India's grid is indeed one of the largest synchronous grids in the world, interconnected from Kashmir to Kanyakumari and Kutch to Kohima, covering five regional grids. As India moves toward high renewable penetration and greater electrification, emerging smart grid technologies will play a crucial role in making the system reliable, resilient, and flexible.

IEEMA JOURNAL talks to leading industry experts, delving into functionalities and technological advancements in these critical emerging technologies that can help future grid development:

Advanced Metering Infrastructure (AMI)

AMI = Smart meters + communication network + data management system.

AMI facilitates monitoring and measurement of consumer information through smart meters installed at customer premises.

Role in India's grid and how it helps:

- Enables real-time consumption data and remote billing.
- Beter load profile, better demand side orchestration (automated billing, DR, ToU, DER flexibility gateway and management.
- Reduces manual errors, theft, and AT&C losses – a chronic DISCOM issue.
- Facilitates ToD tariffs, DR, and pre-paid billing.
- Enables consumer engagement and distributed energy integration (eg, solar net metering).

Peak load management

Peak load management (PLM) = Techniques and tools to manage electricity demand during peak hours.

Peak management refers to controlling the demand and matching it to the available supply at the instant of peak.

Role in India's grid and how it helps:

- Can be used to accommodate intermittent distributed renewable energies.
- Identifies and shifts peak loads using DR programmes and smart tariffs.
- PLM via DR, smart appliances, and industrial

participation lowers grid stress, BESS.
- Works in tandem with AMI to send peak-hour alerts and incentives to consumers.
- Reduces strain during summer or festival season peaks when demand skyrockets.
- Helps avoid load shedding and reduce costly short-term power purchases.
- Reduces the need for expensive peaking power plants and avoids grid congestion.

Power quality management

Power quality management = Ensuring voltage, frequency, and waveform quality within specified limits.

Power quality management address events like voltage flickering (sags or swells), unbalanced phases voltages and harmonic distorted or contaminated supply, among others.

Role in India's grid and how it helps:
- Detects and mitigates issues like voltage sags, frequency deviations, harmonics, and flickers using smart sensors and advanced relays, power factor corrections.
- Essential for sensitive industries (eg, IT, pharma) and urban clusters.
- High penetration of solar PV and inverter-based devices introduces harmonics and voltage instability.
- Smart inverters, real-time voltage monitoring, and FACTS devices help maintain power quality.
- Ensures stable operation of sensitive industrial and digital infrastructure.
- Helps protect consumer equipment and reduce technical losses.

Outage management system (OMS)

OMS = Software tools integrated with SCADA, GIS, and AMI to manage faults and outages.

OMS manages unscheduled and scheduled outages of distribution infrastructure like distribution transformers (DTs), HT/LT feeders, etc.

Role in India's grid and how it helps:
- Employs OMS integrated with SCADA and GIS to identify, localise, and restore faults quickly.
- Detects faults faster through real-time feeder and transformer monitoring.
- Better SAIDI/SAIFI, CADI/CAFI – resulting in better customer satisfaction and reducing energy not supplied with enhanced reliability/ revenue protection for DISCOMs.
- Sends alerts to field crews and consumers; improves mean time to restore (MTTR).
- Combines with self-healing networks (via automated switches) for automatic fault isolation.
- Enables proactive communication with consumers on restoration timelines.

Microgrids

Microgrids = Localised grids that can operate independently or with the main grid.

A Microgrid is an integrated energy and communication system consisting of interconnected loads and DER, which mainly operate in standalone mode or in parallel with the grid (macro grid) in case of emergency.

Role in India's grid and how it helps:
- Act as self-sustaining localised grids that can operate independently (islanded mode) during main grid disturbances.
- Intelligent power management on demand side, better integrating DER behind the meters, higher grid flexibility and improved system resiliency.
- Ideal for rural and remote areas, especially those with unreliable grid supply.
- Supports community-scale renewables (solar, biomass) with battery storage.
- Acts as a resilience solution during grid outages or natural disasters.
- Pilots in Ladakh, Chhattisgarh, and Sundarbans demonstrate success.

Distributed generation

Distributed generation = Small-scale, decentralised power generation close to consumption points (eg, rooftop solar, biomass).

Development and implementation of new and innovative technologies for distributed generation including technology, products, vendors and solutions, evaluation and design of suitable solution for managing renewable integration.

Role in India's grid and how it helps:
- Reduces transmission losses and infrastructure dependency.
- Integrated with smart inverters and digital monitoring for safe grid interconnection.
- Better harnessing distributed RE potential, more green and sustainable.
- Encourages decentralised energy production from solar rooftops, wind, bioenergy, etc, empowering consumers to become prosumers.
- Can feed surplus back to the grid via net metering or support local loads in microgrids.
- Requires smart grid infrastructure to balance, control, and forecast variable input.

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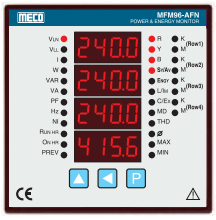

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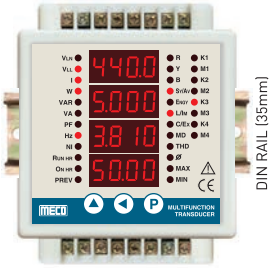

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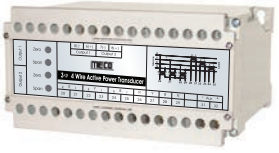

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microgrids are examples of how smart infrastructure can integrate distributed renewable resources seamlessly."

Anil Kadam, Director-Solution Architect Innovation, Power System, Schneider Electric, further explains how smart grid development can facilitate the integration of large-scale renewable generation through enhanced monitoring of the power system:

Enhanced monitoring and control for renewables: Smart grids use real-time data acquisition and advanced analytics to:

- Monitor variable renewable generation (like solar and wind) across the grid.
- Forecast generation and demand more accurately using AI and machine learning (ML).
- Balance supply and demand dynamically, reducing curtailment of renewables.
- Enable grid flexibility through automated switching and voltage control.
- This ensures that intermittent sources can be integrated without compromising grid stability.

Support for distributed energy resources (DERs): Smart grids facilitate:

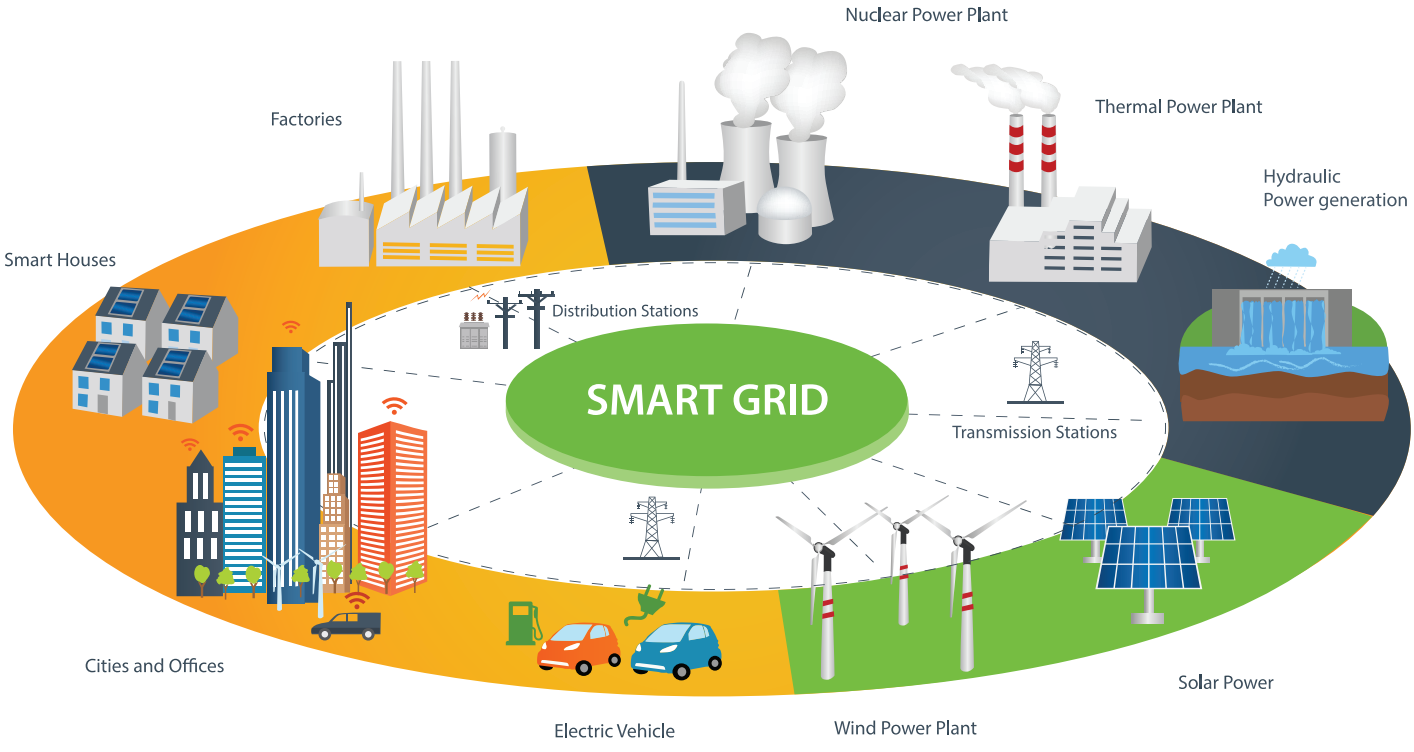
- Two-way power flows, allowing consumers to become prosumers (producers + consumers).
- Integration of rooftop solar, battery storage, and EVs at the distribution level.
- Virtual power plants (VPPs) that aggregate small-scale renewables into dispatchable units.
- This decentralisation reduces the load on central infrastructure and enhances energy resilience.

Optimising Grid Operations

Smart grid development improves grid flexibility, consumer engagement, and financial sustainability – all vital for India's transition to a clean, reliable, and economically viable energy future. Singh notes that "flexible grid operations enable DR and load shifting, helping absorb renewable surges during peak generation. Time of day (ToD) pricing also motivates consumers to align usage with renewable availability."

With optimised grid management, Tandon points to real-time data and control capabilities allowing for dynamic adjustments to power flows, balancing supply and demand.

"The future grid ought to be equipped with advanced grid automation systems to enable real-time monitoring, control, and optimisation of energy flows," Kale confirms. "Smart technologies such as AMI, SCADA, and DR systems will be essential in improving operational efficiency, reducing outages, and ensuring better demand-supply management. As we accelerate the adoption of RE sources, particularly solar and wind, energy storage solutions will be crucial in balancing supply



Advances in Power Devices for Developing a Communicating Smart Grid

Industry experts share examples of how integrated communication, computational and advances in power devices can be harnessed to develop a smart grid that communicates with its users and managers…

Gajanan S Kale, former CEO, Tata Power-DDL and currently CEO-TPNODL, Chief-Odisha Distribution Business: "At Tata Power-DDL, we are leveraging advanced innovations, a recent one being the Universal Network Interface Card (NIC) with Bluetooth-enabled communication. Developed through a first-of-its-kind collaboration in the power sector with Probus Smart Things Private Limited, this solution will redefine smart metering connectivity and elevate grid performance, even in challenging network environments. The Universal NIC enables reliable multi-point connectivity, where a robust network availability-checking algorithm supports seamless communication through neighbouring meters. It integrates seamlessly with mobile applications and meter reading systems, and will create a direct communication loop between the utility, its infrastructure, and end-users. On the backend, data from these meters is processed by a meter data management system (MDMS) and integrated with billing, load forecasting, and outage management tools. This level of integration exemplifies how communication technologies, computational analytics, and smart devices can work in harmony to create a truly interactive, efficient, and intelligent grid."

Anil Kadam, Director-Solution Architect Innovation, Power System, Schneider Electric: "Let's take an example of feeder terminal units (FRTUs) of medium-voltage power equipment or low-voltage network monitoring devices in low-voltage distribution devices. The communication capabilities of these devices are reaching next level, making it possible for real-time distributed intelligence, optimisation, and efficiency improvements. Computational advances have enabled edge computing to next-level increased response times of these uses for the evolving new energy landscape."

Sunil Kumar Singh, Head of Business (India & APAC Region) & Global Project Engineering, L&T Digital Energy Solutions, presents a case study, demonstrating how real-time communication, AI-based computation, and advanced grid devices work together to enable an interactive, efficient smart grid.

Smart Grid in a Mid-Sized Indian City – 'Smart Power Zone' Model

Components involved

1. **Integrated communication**
   - Smart meters at every consumer premise send usage data every 15 minutes via RF mesh or NB-IoT to the utility's data centre.
   - SCADA system collects real-time operational data from substations.
   - GIS and mobile apps connect consumers with real-time outage and billing updates.
2. **Computational technologies**
   - A cloud-based AI engine analyses: Load patterns and forecasting; solar power output prediction; theft detection and billing anomalies.
   - DR algorithms send automated alerts to shift or reduce load during peak hours.
3. **Advanced power devices**
   - Automated reclosers and load-break switches isolate faults and reroute power in seconds.
   - Smart inverters from rooftop solar systems interact with the grid to manage voltage and reactive power.
   - BESS smoothens power supply during renewable variability or grid stress.

How it all works together!

1. **Real-time monitoring and forecasting**
   - At 1 PM, the system predicts a surge in electricity demand due to rising temperatures.
   - Rooftop solar is expected to peak around 1:30 PM, while grid congestion is likely.
2. **Automated control and alerts**
   The grid control centre receives a forecast alert and automatically:
   - Sends a DR signal to residential and commercial users to reduce air-conditioning usage.

- Engages BESS to discharge power in high-demand feeders.
- Adjusts solar inverters to optimise power factor and voltage.

3. **Consumer communication**
   - Consumers receive app notifications offering rebates for reducing usage for the next 30 minutes.
   - Smart appliances (eg, air-conditioners or water heaters) auto-adjust if enrolled in DR.
4. **Outage and self-healing**
   - A branch falls on a local line. Automated switches detect the fault, isolate the section, and reroute power within seconds.
   - Affected consumers receive an SMS/app update with ETA for service restoration.

This integrated model showcases a truly smart grid – where communication systems, computational intelligence, and advanced devices work in harmony to: Optimise operations, engage consumers, maximise renewables, and improve reliability and efficiency. "This is not just conceptual; elements of this model are being implemented in cities like Panipat, Chandigarh, Delhi, and Bengaluru under India's National Smart Grid Mission (NSGM)," shares Singh.

and demand. Storage systems will allow us to capture excess RE during periods of low demand and dispatch it during peak hours, stabilising the grid and reducing dependency on fossil fuels."

AI and ML will play a critical role in optimising grid operations, predictive maintenance, and asset management. These technologies can analyse vast amounts of real-time data from sensors and other grid infrastructure to predict failures, detect anomalies, and improve decision-making. They can also help forecast energy demand patterns, facilitating better grid planning and resource allocation.

Addressing Key DISCOM Challenges

DISCOMs in India, as elsewhere, face persistent issues like high AT&C losses, inefficient billing, cashflow stress, and poor consumer service.

Here, Singh shares structural solutions that smart grids provide:

- **Reduced technical losses via grid automation:** SCADA and DA identify overloads, losses, and faults in real-time; allow better asset utilisation and reduction of technical losses.
- **Data-driven decision-making:** Smart grids give DISCOMs granular data on demand patterns, asset health, and load flows, enabling better load forecasting and planning.
- **Peak load management:** Demand-side management helps lower peak power purchase costs, which are a major financial burden on DISCOMs; helps avoid load shedding and unscheduled outages.

Additionally, Kadam notes that smart grids help by:

- **Improving revenue collection:** Prepaid and time-of-use billing models improve cashflow; remote disconnection/reconnection reduces operational costs.
- **Enhancing consumer engagement:** DISCOMs can offer customised tariffs and demand response programmes.
- **Operational efficiency:** Predictive maintenance reduces equipment failure; load forecasting helps in better procurement and scheduling of power.

Vision for India

The goal of modern India's power system can be achieved by deploying smart grids for improved efficiency.

"India's implementation of smart grid technologies is a work in progress with significant strides made in some areas, but notable gaps remain," notes Singh. He provides his structured evaluation below.

Generation

Status: Moderate progress

Strengths: India is a global leader in RE capacity additions (especially solar and wind). Real-time monitoring and forecasting systems for renewables (like RE forecasting by POSOCO) are increasingly used.

Challenges: Lack of widespread energy storage integration. Intermittent renewable sources are straining the grid due to insufficient flexibility and DR mechanisms.

Transmission

Status: Moderate to strong

Strengths: POWERGRID has adopted several smart transmission systems, including WAMS and PMUs. URTDSM is one of the projects highlighting the same. SCADA and energy management systems (EMS) are in place across many regions. NTAMC and ULDC projects are shining examples here.

Challenges: Cybersecurity and data privacy concerns. Upgradation to support higher renewable

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penetration and real-time optimisation is ongoing but incomplete.

L&T Digital Energy Solutions is executing the NTAMC upgrade and SRLDC projects, and is integrating multiple subsystems such as remote accessibility system, automated fault analysis system and visual monitoring system, thus helping POWERGRID manage its numerous assets in the switchyard across India.

Distribution

Status: Mixed progress

Strengths: Several pilot smart grid projects have been completed under the National Smart Grid Mission (NSGM) in cities like Puducherry, Chandigarh, and Jaipur. AMI rollouts are underway, especially under RDSS. Distribution automation, SCADA/ADMS are implemented in Tier-1 urban zones.

Challenges: Many utilities have not implemented the required automation, so technical and commercial losses are still on the higher side. AMI penetration remains low relative to total customer base (despite targets for 250 million smart meters). Financial health of DISCOMs impedes faster rollouts.

L&T Digital Energy Solutions is executing the BEST Mumbai, MGVCL RDSS, and WBSEDCL ADMS projects. It is at the forefront of this journey, providing solutions like field force automation for outage management along with integration of SCADA/ADMS with GIS data.

According to Kadam, India has matured solutions under the smart grid domains in conventional generation and transmission. "For two decades, we have been implementing smart grid solutions such as SCADA, DMS, and outage management system (OMS) in the distribution segment to enhance efficiency on the medium-voltage side of the distribution grid. We have now also done pilots on AMI and smart metering and are now embarking on larger rollouts of AMI and 250 million smart meter implementation to unlock higher possibilities in the smart grid landscape. With an increase in distributed energy, especially renewables and EVs, we must start building technologies to better integrate new energies. Also, the renewable mix is expected to increase substantially in our overall energy portfolio, so we will need efficient technologies to better integrate these (such as DR, demand side management, energy storage technologies, dynamic energy and EV Load management systems). As these new energies will interact with low-voltage grids, we need new technologies for effective low-voltage network management," Kadam observes.

Tandon notes that India has made notable progress in implementing smart grid technologies across the power value chain – generation,

Photo courtesy: Tata Power-DDL

transmission, distribution, and consumption – "but the pace and scale vary widely across segments and states," he observes. For instance, he points:

- **Integration of renewables:** High renewable capacity (~125 GW solar + wind) demands grid balancing; however, flexibility in conventional plants is still evolving.
- **Smart generation initiatives:** Some utilities have started integrating digital tools like internet of things (IoT), predictive maintenance, and real-time data analytics.
- **Smart metering (AMI):** Over 2 crore smart meters installed under RDSS and earlier schemes (as of May 2025), with a target of 25 crore by 2027.
- **DA:** SCADA/DMS deployed in many urban areas.
- **Loss reduction:** Smart meters and feeder monitoring helping curb AT&C losses.
- **ToU tariffs:** Only a few DISCOMs have implemented ToU or net metering for prosumers.
- **Consumer engagement tools:** Apps and dashboards are emerging but limited to Tier-I cities.
- **Policy frameworks:** Standards (BIS, CEA), cybersecurity guidelines (CERT-IN, MoP), and draft regulations support smart grid development.

A smart grid is not just a technical upgrade, but a system-wide transformation – and such a transformation requires strong, aligned action from multiple stakeholders.

For his part, Kale says that Tata Power-DDL is one of the first Indian utilities to adopt smart grid technologies, starting with the rollout of AMI, SCADA, GIS, and distribution management systems (DMS). Its efforts have created a replicable model of smart distribution that includes not only automated metering but also peak load management, integration of distributed RE, and OMS. The DISCOM has deployed over 5.75 lakh (as of March 2025) smart meters and has executed pioneering projects such as South Asia's first grid-connected 10 MW BESS at Rohini. The project was done in collaboration with AES and Mitsubishi Corporation to stabilise the grid, manage peak load demands better, add system flexibility, and enhance the reliability of power supply in the region. "India stands at a promising midpoint where successful utility-led initiatives demonstrate the technical and operational feasibility of smart grids, though broader implementation will require sustained investment, policy alignment, and stakeholder engagement," adds Kale.

Collaboration among Stakeholders: Key to achieving India's Smart Grid Vision

A smart grid is not just a technical upgrade, but a system-wide transformation – and such a transformation requires strong, aligned action from multiple stakeholders.

Let's take a look at key stakeholders in the smart grid ecosystem:

Stakeholder	Role in Smart Grid Development
Central Government (eg, MoP, MNRE)	Policy direction, funding schemes (eg, NSGM, RDSS)
State governments	State-level regulation, support for DISCOMs and local programmes
DISCOMs	Grid modernisation, AMI rollouts, consumer engagement
Regulators (CERC/SERCs)	Tariff design, net metering rules, demand response policies
Technology providers	Supply smart meters, automation systems, analytics platforms
Consumers (residential and industrial)	Participate in demand response, adopt solar, monitor usage
R&D/Academia	Innovation, pilots, skill development
Financial institutions	Fund smart grid infra, support PPP models

Source: L&T Digital Energy Solutions.

Our experts elaborate on why collaboration is critical to India's Smart Grid Vision:

Aligning vision with implementation

- Central policies like the National Smart Grid Mission (NSGM) need to be translated into state-level actions by DISCOMs.
- Without coordination, pilots remain isolated and fail to scale.

Coordinated policy and regulatory support

- DISCOMs require clear regulatory frameworks to justify investments in AMI, DR, and grid automation.

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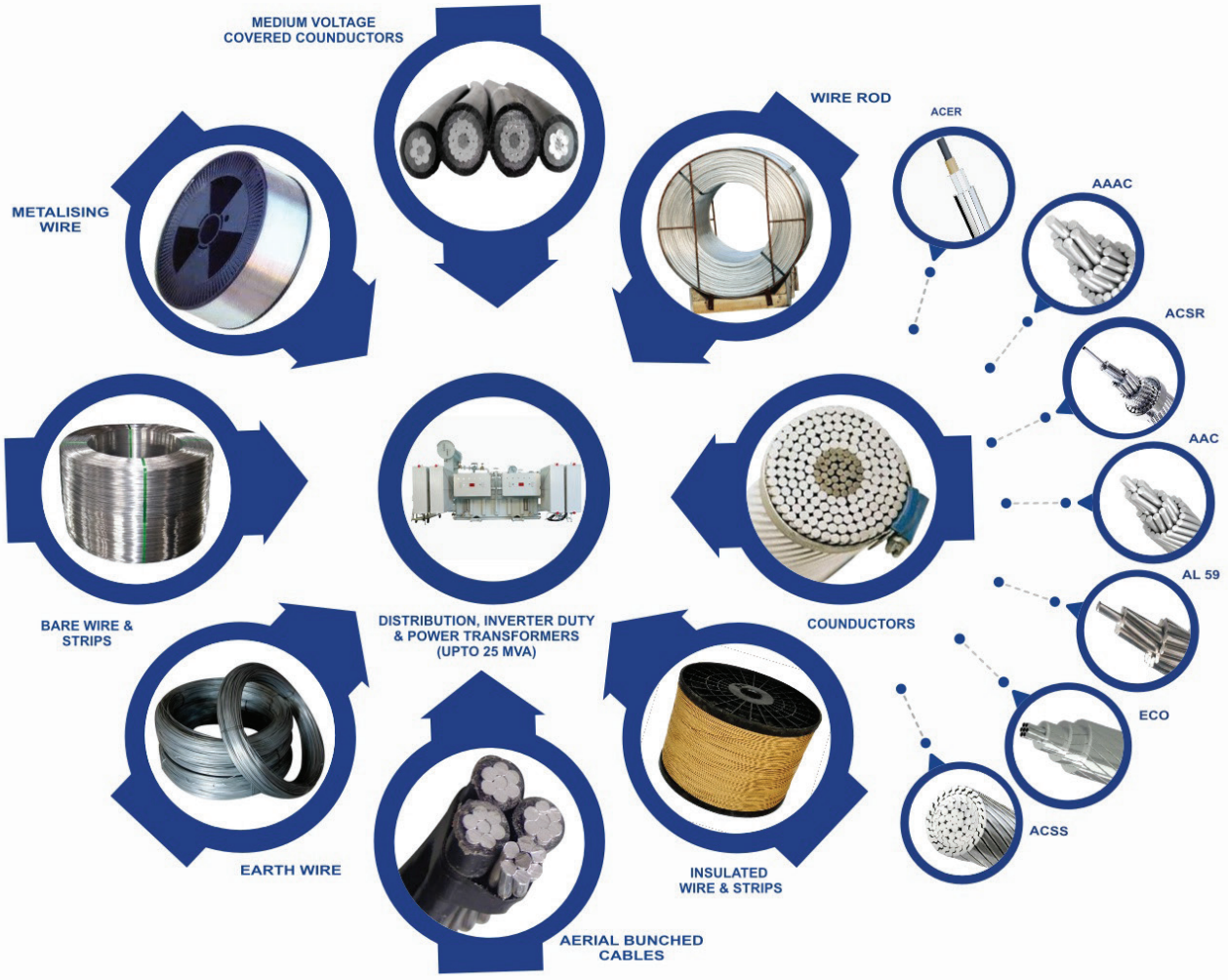

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- Regulators must coordinate with MoP, MNRE, and state governments to implement ToD tariffs, net metering, and DR.
- Standardisation bodies like BIS and CEA must ensure compatibility and interoperability.

Standardisation and interoperability

- Uniform tech standards, protocols, and cybersecurity norms require cooperation between vendors, utilities, and regulators.

Integration of technologies and systems

- Technological providers (meter manufacturers, software firms, grid automation companies) must ensure seamless interoperability and data integration.
- Cybersecurity protocols and data-sharing mechanisms must be jointly developed by utilities, CERT-In, and NCIIPC.

Financing the transformation

- DISCOMs alone cannot afford smart grid investments. Public-private partnerships (PPPs) and blended finance require collaborative structuring.

Consumer participation

- For DR and distributed generation to work, consumers must be: 1) educated about benefits like energy savings, net metering returns, and prepaid flexibility and 2) engaged – which requires collaboration between DISCOMs, civil society, and government.
- Partnerships between DISCOMs and consumer groups or NGOs can facilitate smoother rollout and trust.

Capacity building

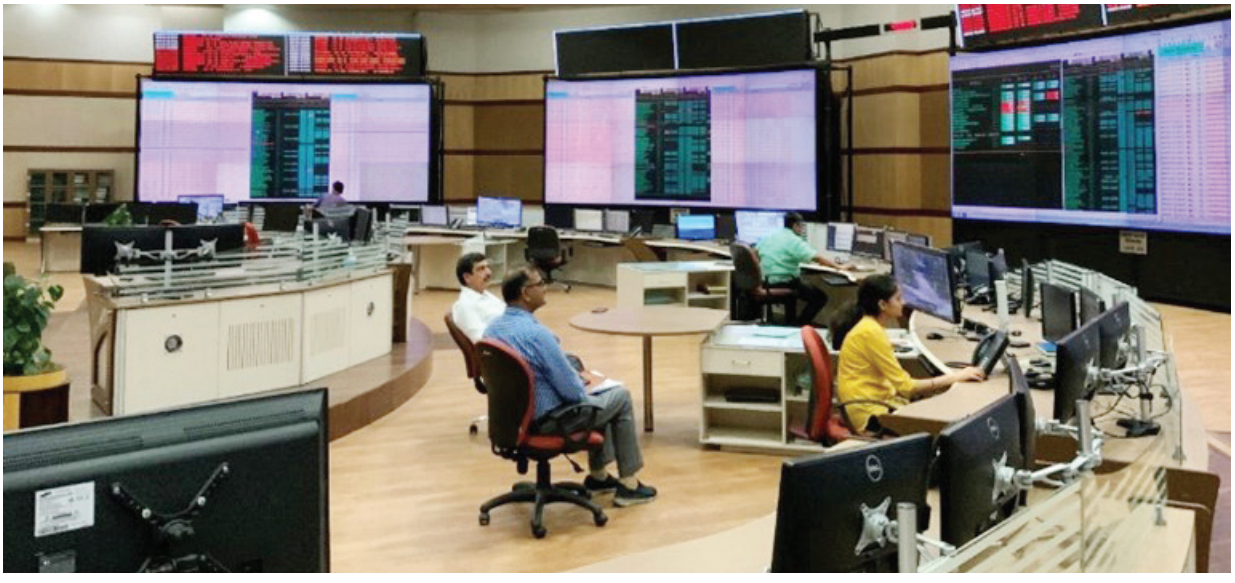
- Large-scale deployment requires trained manpower across utilities, service providers, and regulators – possible only through coordinated training and skilling programmes.

What Can be Done to Fast-Track Collaboration

Achieving the ambitious Smart Grid Vision for India requires a highly collaborative approach involving utilities, government bodies, technology providers, consumers, and regulators. "At Tata Power-DDL," says Kale, "we have actively fostered such collaborations by partnering with global and domestic firms for pilot projects in smart metering, energy storage, blockchain-based energy trading, and AI-based forecasting. We have also played a pivotal role in capacity building by offering training and consultancy to other Indian and international utilities through our Centre of Excellence and Learning Centre."

Achieving the ambitious Smart Grid Vision for India requires a highly collaborative approach involving utilities, government bodies, technology providers, consumers, and regulators.

Kale believes regulatory support to be crucial for standardising frameworks around DR, ToD tariffs, net metering, and DER participation. "At Tata Power-DDL, we engage consumers through awareness campaigns and incentivise them to adopt rooftop solar, participate in DSM programmes, and use energy-efficient devices." On the policy front, he adds, "we advocate for faster rollout of nationwide AMI schemes, funding support for BESS and microgrids, and streamlined procedures for DER integration."



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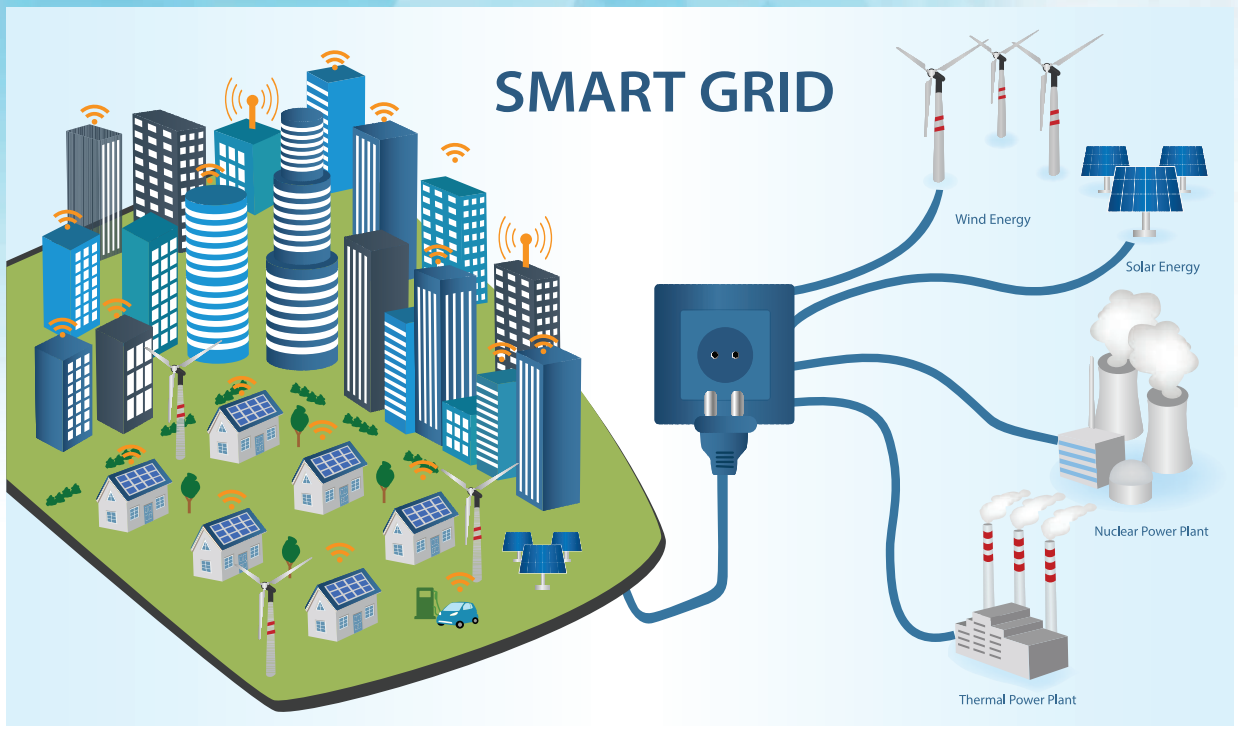

Regulations should enable energy efficiency, notes Kadam. "There must be policies and incentivisation for attracting investments in smart grid technologies, especially on the low-voltage side of distribution, and importantly, on the demand side interventions. It is also important to bring in competition on the supply side to increase value-added services powered by smart grid technologies."

In conclusion, industry experts share steps needed to accelerate progress in this direction:

Empower DISCOMs with resources and incentives

- Conditional funding tied to performance (eg, smart meter rollout linked to AT&C loss reduction).
- Provide technical support units (TSUs) at state level for implementation.

Create a central coordinating authority or task force

- A National Smart Grid Mission Authority (eg, under MoP or NITI Aayog) to monitor progress, set inter-ministerial targets, resolve bottlenecks, standardise implementation templates for DISCOMs.

Create joint working groups

- State-level working groups involving DISCOMs, regulators, tech providers, and consumers for customised smart grid roadmaps.

Strengthen regulatory push

- SERCs must mandate ToD tariffs, DR programmes, and smart grid KPIs.
- Central guidelines need faster adoption by states.

Enforce mandates with financial backing

- Link disbursements under RDSS or future schemes with clear smart grid milestones (AMI coverage, feeder automation, DR programmes).
- Viability gap funding for early adopters in high-loss areas or small DISCOMs.

Encourage PPPs

- Model PPP contracts for smart metering, EV infra, and DER systems.
- Ensure risk sharing and long-term clarity for investors.

Consumer awareness drives

- Use DISCOM portals, mobile apps, and smart meter interfaces to educate users.
- Launch campaigns like 'Ujala' (LED) or 'Saubhagya' for smart energy use.

Develop shared platforms and open standards

- Mandate open, interoperable standards for: MDM, HES, and SCADA systems; smart meter communication protocols; integration of DERs and EV infrastructure.

Promote open data and interoperability

- Create a national smart grid data exchange platform.
- Ensure all tech systems are vendor-neutral and interoperable.

India's smart grid transition is not just an engineering challenge, but a collaborative governance mission. Ultimately, synergy between technology, policy, consumer involvement, and investment will determine the pace at which India transitions to a digitally empowered and sustainable energy future. And with the right collaborative frameworks, India can leapfrog towards a smarter, cleaner, and more inclusive energy future.

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- **Vibha Gupta,** Chairperson, IEEMA Smart Grid Division

Comment on the current state of the power sector in India with reference to grids, T&D, smart meters and utilities at large. What is the need for the adoption and integration of smart grids?

The power sector in India as of 2025 is undergoing a complex transformation, marked by both significant progress and pressing challenges. On the one hand, India's installed capacity continues to grow rapidly, with total capacity projected to hit ~550GW in 2025 and 1TW by 2030 with a strong renewables push. But with peak demand surges growing as well, (it is expected to hit 270GW in 2025, as compared to 250GW in 2024), NLDC warns of 15-20GW power shortages during non-solar hours in May-June, 2025.

That's where smart grids come in. Think of them as the ***"brains"*** of the power system. They help us manage electricity more efficiently, reduce power cuts, detect faults quickly, and even allow people to generate their own power (like rooftop solar) and feed it back into the grid. They help with demand-side management by enabling dynamic pricing and demand response programmes to flatten the load curve and reduce stress on the grid.

With rising demand, more renewable energy, and the need to reduce losses, smart grids are no longer optional—***they're essential.***

Example: In Bihar, smart meter installations under the RDSS helped reduce billing losses and improved revenue collection. This shows how smart grids can help utilities become more efficient and financially stable.

Comment on the role of T&D issues and other factors affecting the performance of grids with real-life examples from all four regions of India (North, East, West & South).

While at a national level, it is important to address T&D losses, improve billing accuracy and lower operational costs for utilities, if we dive deep into regions, every region has its own set of challenges vis-à-vis grid performance.

North: Grid congestion and peak Demand Stress: For example, this year, there has been peak demand stress in Uttar Pradesh and New Delhi with peak loads exceeding 25GW in May 2025. This has led to frequent load shedding as transmission corridors from neighbouring states were congested due to limited interstate transmission capacity.

West: Industrial load and renewable integration: For example, Maharashtra and Gujarat faced grid balancing issues during midday solar peaks and evening demand spikes.

East: Infrastructure and Rural Electrification: For instance, Bihar and Jharkhand experience voltage fluctuations and frequent outages due to weak last-mile distribution networks.

South: Renewable Surge and Grid Modernisation: For instance, Tamil Nadu and Karnataka, who are leaders in wind and solar experienced grid frequency deviations due to intermittent generation and limited forecasting.

The future is bright—and smart. By 2047, India could have over 2,500 GW of power capacity, mostly from renewables. Our grid will be digital, automated, and capable of handling everything from rooftop solar to electric vehicles.

List challenges in grid operation with potential solutions.

Running the grid today is like juggling many balls at once, here are some big challenges:

CHALLENGE	DESCRIPTION	POTENTIAL SOLUTIONS
1. Load Forecasting Errors	Inaccurate demand prediction leads to over/ under generation.	- Use AI/ML-based forecasting models
		- Integrate weather and consumption data
2. Renewable Energy Variability	Solar and wind are intermittent and unpredictable.	- Deploy energy storage systems
		- Use hybrid generation (solar + wind + thermal)
		- Improve forecasting tools
3. Grid Congestion	Overloaded transmission lines during peak hours.	- Expand transmission capacity
		- Implement real-time congestion management systems
4. Frequency and Voltage Instability	Caused by sudden load/ generation changes.	- Use automatic generation control (AGC)
		- Install voltage regulators and FACTS devices
5. High T&D Losses	Technical and commercial losses reduce efficiency.	- Upgrade infrastructure
		- Deploy smart meters and automated meter reading (AMR)
6. Cybersecurity Threats	Increasing digitalization exposes grids to cyberattacks.	- Implement robust cybersecurity protocols
		- Regular audits and penetration testing
7. Ageing Infrastructure	Old equipment leads to frequent failures and inefficiencies.	- Prioritize asset replacement
		- Use predictive maintenance technologies
8. Limited Consumer Participation	Consumers lack tools to manage their energy use.	- Promote smart home technologies
		- Introduce time-of-use tariffs
9. Skilled Workforce	Lack of skilled workers	- Trainings and upskilling of people to manage the advanced systems

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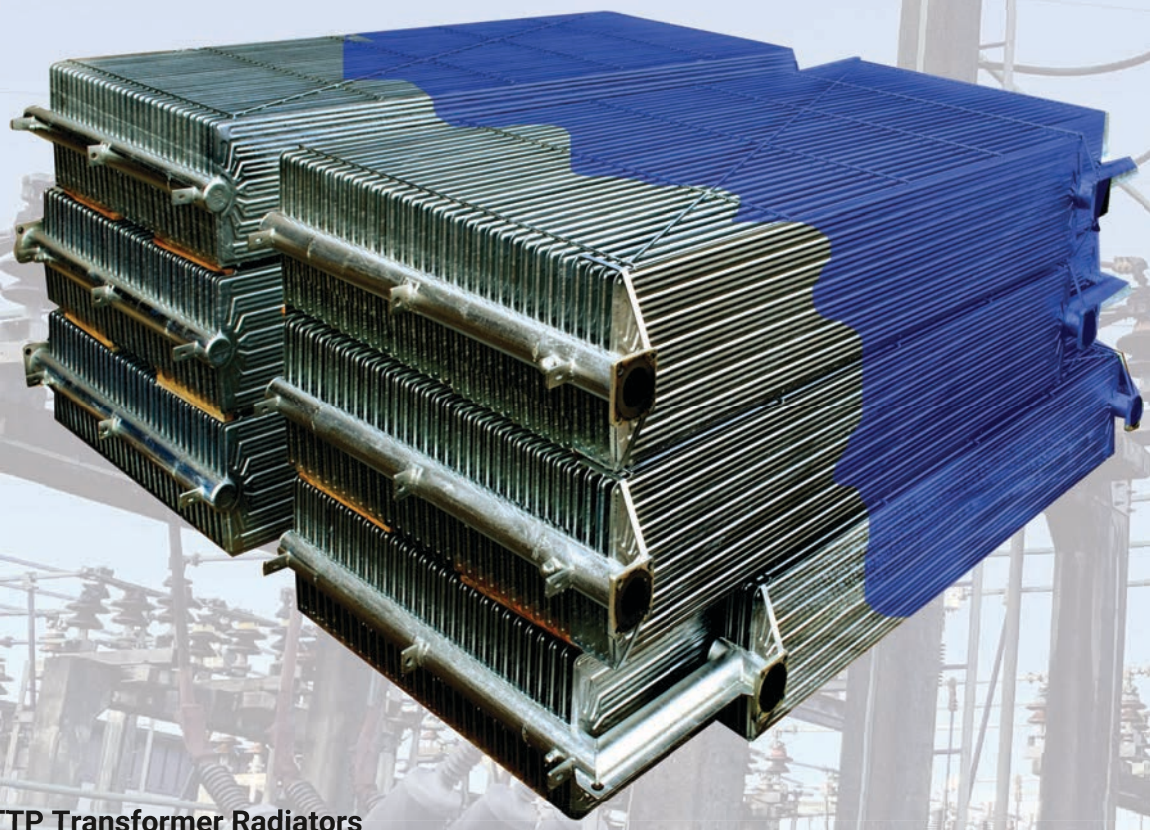

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What is the significance of cyber security in this sector?

Imagine if someone could hack into the grid and shut down electricity in the city! This is not science fiction but has already happened in some places!

The word 'smart' also indicates that we are changing from a conventional approach to a digitised one. Digitalisation brings connectivity to networks but also exposes the grids to cyber-attacks.

Some common attacks on smart grids include:

> **Malware and ransomware** targeting control systems;
> **Denial-of-Service (DoS)** attacks disrupting communication and in turn availability;
> **Data breaches** compromising consumer privacy.

> "With the right mix of innovation, policy, and training, India can lead the world in building a modern, resilient power grid."

That is where cybersecurity plays a vital role to ensure threats are mitigated, maintaining the integrity and availability of the grid.

Three major aspects concerning cybersecurity in smart grids are as follows:

1. Smart grids rely on real-time data and automated control. A cyberattack could cause **blackouts or brownouts, lead to equipment damage, disrupt load balancing and demand response.**

Robust cybersecurity ensures continuous and stable power delivery.

2. Smart grids collect vast amounts of data from smart meters, IoT sensors and distributed energy resources.

Cybersecurity ensures that this data is:

- **Accurate** (no tampering)
- **Confidential** (protected from unauthorised access).

3. Consumers are more likely to adopt smart grid technologies (like smart meters or home energy management systems) if they trust that their data is secure, their privacy is respected, and the system is resilient to attack.

How important is the integration of renewable sources in the grid? What are the challenges towards achieving the same?

India's ambitious renewable capacity targets include more than doubling our current capacity of 220GW by 2030 (15% CAGR). And in the past few years, we have seen India perform spectacularly in making renewable energy commercially viable. Take solar energy for example: from over INR 100 per kwh in 2010s, it is now under INR 6 per kwh now with the lowest tariffs being under INR 3. This means that from a technological and production viewpoint, we are ready for tremendous scale. And given our limited resources for nuclear power, renewable energy is being viewed as a critical lever for growth in the coming decades.

However, by nature, renewable energy is intermittent and not as reliable as conventional power. What happens when the sun doesn't shine or the wind doesn't blow!?

That's the challenge. We need to make our grid flexible enough to handle these ups and downs. This means better forecasting, energy storage (like big batteries), and smarter systems that can quickly adjust supply and demand. It's a big task, but it's necessary for a cleaner, greener future.

Example: In Karnataka, solar fluctuations cause daily frequency swings of up to 0.8 Hz. To manage this, hydropower reserves are used as a buffer.

Example: Rajasthan's solar farms face curtailment due to lack of transmission lines. This shows the need for better planning and faster project execution.

Mention any technical innovations currently present in the market or the need for research to enhance operation.

Some key technological innovations that are already enabling our grid operations include:

a. **High Voltage Direct Current (HVDC) Systems –** India operates ±800 kV HVDC lines for interregional power transfer.
b. **Green Energy Corridors –** Dedicated transmission lines for evacuating renewable energy from high-generation zones (e.g., Rajasthan, Gujarat, Tamil Nadu) to demand centers.
c. **Wide Area Monitoring Systems (WAMS) –** Uses Phasor Measurement Units (PMUs) for real-time grid visibility and faster fault detection.
d. **Battery Energy Storage Systems (BESS) –** Though still limited (219 MWh as of 2024), BESS is being scaled up to 41.65 GW by 2030.
e. **Smart Grid Technologies –** Integration of smart meters, automated substations, and demand response systems which enables two-way communication and real-time control.
f. **AI and Predictive Analytics –** Used for load forecasting, asset health monitoring, and outage prediction.
g. **Digital Twin Technology –** Virtual replicas of grid infrastructure for simulation, planning, and diagnostics.

h. **Digital Substations** using Process Bus technology thereby minimising copper usage.

*We still need to work more on battery storage systems, cyber security, and making our systems more climate resilient.

Comment on the government's support in terms of projects and policies and suggest further.

We have seen a lot of focus from the government on renewables' expansion and improving grid performance. In the Union Budget, 2025, apart from incentives for domestic production of solar PV cells, wind turbines, EV batteries and high-voltage transmission equipment, there were tax benefits and financial aids announced for smart grid technologies and battery storage. Moreover, the PPP model for grid infrastructure was also discussed to boost private investment in transmission and distribution. We see these as positives for our division, given that our technologies and expertise are poised well to fuel the nation's ambition.

> "We must learn from past mistakes—like blackouts caused by poor planning or lack of coordination."

Some of the areas that we would like to see more focus on in the coming years are grid-scale energy storage technologies, DER integration and a national cybersecurity centre for energy infrastructure.

What is your outlook on the future of grids in India and are there any learnings?

The future is bright—and smart. By 2047, India could have over 2,500 GW of power capacity, mostly from renewables. Our grid will be digital, automated, and capable of handling everything from rooftop solar to electric vehicles.

The Integration of **AI, IoT, and digital twins** will enhance predictive maintenance and operational efficiency. This will be coupled with decentralised and consumer-centric consumption; peer-to-peer energy trading and virtual power plants will become mainstream. Needless to say, grids will be designed to withstand cyber threats and extreme weather events, with robust disaster recovery protocols.

But we must learn from past mistakes—like blackouts caused by poor planning or lack of coordination. We also need to invest in people, not just technology. With the right mix of innovation, policy, and training, India can lead the world in building a modern, resilient power grid.

Example: NTAMC (National Transmission Asset Management Centre) already remotely operates 281 substations. This is a glimpse of the future—where grids are self-healing and AI-managed.

Learning: The Texas blackout of 2021 showed what happens when grids are not weather-ready. India must invest in climate-resilient infrastructure.

Globally what is the grid scenario, how different is it from India?

Globally, we find instances of countries being more advanced than India in terms of renewables integration. Countries in the EU boast of highly flexible grids, which need a regulatory and technological upgrade in the Indian market. In terms of smart grids, adoption is much higher in the EU and the US, whereas in India, it is unevenly spread across states. This entails that India needs policy harmony-i.e. align central and state-level policies.

India is catching up fast. We are installing smart meters at record speed and building massive renewable projects.

Our challenge is scale—we have to serve over a billion people. But that also gives us a chance to leapfrog older technologies and build a grid that is smarter, greener, and more inclusive from the ground up.

Example: Europe has 47% smart meter coverage; India is at 5% but growing fast.

Example: Japan has 3% T&D losses; India averages 15.37%.

Example: California mandates battery storage with solar projects. India is now planning 4.2 GW of storage by 2030.

India's strength is in scaling fast and leapfrogging—like using 800 kV HVDC links in Rajasthan to evacuate solar power.

Please conclude with a vision for your division.

At IEEMA, we see the Smart Grid division as a key driver of India's energy future. Our goal is to bring together industry, government, and academia to:

- Promote local innovation and manufacturing.
- Set strong standards for safety and interoperability.
- Train the next generation of power professionals.
- Support policies that make our grid smarter and more secure.

We believe that smart grids are not just about technology—they're about empowering people, protecting the planet, and preparing India for the future.

Vision: To be the bridge between government, industry, and academia—supporting local manufacturing, setting standards, and training the next generation of grid professionals.

Example: IEEMA is working with the Ministry of Power to align smart grid policies with India's Atmanirbhar Bharat goals.

Tehri PSP: First Variable Speed PSP in the Country

THDC India has commenced the COD process of Unit-I (250 MW) of the 1,000-MW Tehri PSP, marking a historic milestone in India's renewable energy journey as the country's first variable speed PSP.

THDC India Limited (THDCIL) has successfully commenced the commercial operation date (COD) process of the first unit (250 MW) of the 1,000-MW variable speed pumped storage plant (PSP) at Tehri, Uttarakhand.

This landmark achievement marks a historic milestone in India's renewable energy journey, establishing the Tehri PSP as the largest pumped storage plant by any central public sector enterprise (CPSE) and the first variable speed PSP in the country.

The commencement was virtually graced by Shri Manohar Lal, Union Minister of Power, Housing and Urban Affairs, Government of India.

Eminent dignitaries of the power sector including Shri Pankaj Agarwal (IAS), Secretary, Ministry of Power, Government of India; Shri Akash Tripathi (IAS), Addl Secretary, Ministry of Power, Government of India; Shri Gurdeep Singh, Chairman & Managing Director, NTPC; Shri RK Vishnoi, Chairman & Managing Director, THDCIL; Shri Shallinder Singh, Director (Personnel), THDCIL; Shri Bhupender Gupta, Director (Technical), THDCIL; and Shri Sipan Kumar Garg, Director (Finance), THDCIL, were also present on the occasion.

Shri Manohar Lal, Hon'ble Union Minister of Power, Housing and Urban Affairs, Government of India, while addressing the gathering stated that

the successful operation of the first unit of India's first variable speed pumped storage plant at Tehri is not just a technological achievement by THDCIL, but a bold stride towards India's energy self-reliance. "The project will significantly strengthen our grid stability and support the integration of renewable energy. Variable speed technology allows us to manage power flow with precision, making our energy ecosystem smarter and more flexible," said the minister in a PIB release.

The Union Minister congratulated the entire THDCIL team, implementing partners, and every individual who contributed directly or indirectly to this historic success.

Shri Pankaj Agarwal, Secretary, Ministry of Power, lauded the commissioning milestone, stating that the variable speed pumped storage plant at Tehri is a path-breaking development that significantly strengthens our grid flexibility. "It plays a pivotal role in our mission to integrate increasing amounts of renewable energy and transition towards a cleaner, more reliable energy ecosystem."

Shri Gurdeep Singh, Chairman & Managing Director, NTPC, extended his congratulations, saying that this milestone reflects the high-end engineering capabilities of Indian PSUs in the hydropower sector. "It sets a powerful precedent for future PSP developments across the nation."

Shri RK Vishnoi, Chairman & Managing Director, THDCIL, conveyed his heartfelt congratulations on this significant achievement and stated that once fully operational, this project will elevate the Tehri Hydro Power Complex's capacity to 2,400 MW, making it India's largest hydropower complex. "This project will be instrumental in converting off-peak surplus energy into peaking power, enhancing grid resilience and supporting round-the-clock power availability."

Designed to provide flexible peaking power and critical grid balancing support, the Tehri variable speed PSP represents a significant leap forward in India's ability to manage intermittent renewable energy. This commissioning milestone reaffirms THDCIL's leadership in state-of-the-art hydropower solutions and bolsters India's clean energy credentials on the global stage. The power electronics and controls, along with the 250-MW variable-speed pumped storage hydropower unit, have been supplied by GE Vernova. GE Vernova is a global energy company that produces advanced technologies to harness hydropower and deliver reliable energy solutions.

Also present at the occasion were Shri LP Joshi, Executive Director (Tehri Complex), THDCIL, along with senior officials from THDCIL and representatives from the project consortium comprising GE Vernova, HCC, and other key stakeholders from the power sector.

THE STARTUP REVOLUTION

India's entrepreneurial landscape is redefining innovation and creating new opportunities across sectors, with start-ups seizing the opportunity to energise India's development story and become a cornerstone in the global energy transition.

India has established itself as the third-largest startup ecosystem in the world, with lakhs of certificates issued by the Department for Promotion of Industry and Internal Trade (DPIIT) for recognition of startups. With an aim to increase capital mobilisation for startups, the DPIIT – under the Ministry of Commerce and Industry – has also notified the expansion of the Credit Guarantee Scheme for Startups (CGSS), increasing the ceiling on guarantee cover per borrower under the scheme from Rs10 crore to Rs20 crore. The broad objective of CGSS is to finance eligible startups, by enabling collateral-free debt funding to startups through avenues such as working capital, term loans, and venture debt.

Moreover, in a significant boost to the country's startup ecosystem, Union Budget 2025-26 witnessed the government extending the eligibility window for startups to claim benefits under Section 80-IAC of the Income Tax Act. In May this year, the DPIIT approved 187 startups for income tax exemption under the revamped Section 80-IAC. As reported, the tax benefit allows eligible startups a 100 percent income tax deduction on profits for any three consecutive years within a 10-year window from the date of incorporation. The scheme is designed to support emerging businesses in their formative years, encouraging innovation, job creation, and wealth generation. A PIB release states that more than 3,700 startups have been granted exemptions since the scheme's inception.

Hon'ble Minister Shri Piyush Goyal, Union Minister of Commerce & Industry, Government of India, at a recent event, also mentioned that Indian startups are poised for a promising future on the global scale, with several countries wanting to

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adopt India's development model. The call for start-ups is for deeper, more substantial innovation, particularly in sectors like semiconductors and advanced technology, among others. The Union Minister, at Startup Mahakumbh 2025, also announced the launch of a dedicated 'Startup India Desk' – a helpline number for emerging entrepreneurs in India.

The country's entrepreneurial landscape is already redefining innovation and creating new opportunities across sectors. Major hubs like Bengaluru, Hyderabad, Mumbai, and Delhi-NCR have been at the forefront of this transformation, while smaller cities are increasingly contributing to the momentum with over 51 percent of the startups emerging from Tier-II and Tier-III cities.

Hon'ble Minister Shri Piyush Goyal

Through initiatives like Startup India, the government has played a pivotal role in nurturing this growth and empowering the next generation of entrepreneurs.

KEY SCHEMES AND INITIATIVES FOR STARTUPS

Startup India

Launched on January 16, 2016, Startup India is a flagship initiative by the Government of India to foster innovation and create a thriving startup ecosystem. Its goal is to drive economic growth and generate large-scale employment opportunities. By supporting startups in their growth journey, the initiative encourages innovation and design. Through various schemes, it aims to empower startups to scale and succeed.

Progress and impact: The number of DPIIT-recognised startups has risen from about 502 in 2016 to 157,706 as of December 31, 2024. Startups have created over 17.28 lakh direct jobs as of December 31, 2024, with the IT services sector leading at 2.10 lakh jobs, followed by healthcare and lifesciences (1.51 lakh) and professional and commercial services (96,474), as per a PIB release.

Startup India Seed Fund Scheme (SISFS)

Launched in 2021 with a corpus of Rs945 crore, the SISFS supports startups at various stages, including proof of concept, prototype development, product trials, market entry, and commercialisation. The scheme, operational since April 1, 2021, is overseen by the Experts Advisory Committee (EAC), which evaluates and selects incubators for fund allocation.

Progress and impact: 213 incubators have been approved under the scheme as of December 2024. A PIB release notes that a total of 2,622 startups have benefited from Rs467.75 crore in funding as of December 2024.

Fund of Funds for Startups (FFS) Scheme

Launched in June 2016 with a corpus of Rs10,000 crore, the FFS aims to boost access to domestic capital for startups. Managed by SIDBI, it funds SEBI- registered alternative investment funds (AIFs), which then invest in startups through equity and equity-linked instruments.

Progress and impact: By 2024, Rs6,886 crore have been committed by DPIIT to SIDBI and Rs11,687 crore was committed by SIDBI to AIFs under the FFS scheme as of December 2024. This commitment reportedly catalysed investments of Rs21,276 crore in 1,173 startups.

Credit Guarantee Scheme for Startups (CGSS)

The CGSS provides credit guarantees for loans to DPIIT-recognised startups from scheduled commercial banks, non-banking financial companies (NBFCs), and venture debt funds. Implemented by the National Credit Guarantee Trustee Company Limited (NCGTC), it aims to offer credit guarantees up to a specified limit, easing access to funding for startups.

Progress and impact: As of January 3, 2025, the scheme has guaranteed 260 loans worth Rs604.16 crore to 209 startups. Among these, Rs27.04 crore has been allocated to 17 women-led startups, notes PIB.

Atal Innovation Mission (AIM)

Launched in 2016 by NITI Aayog, the AIM aims to promote innovation and entrepreneurship across India. It includes initiatives like Atal Tinkering Labs at the school level to foster creativity, Atal Incubation Centres (AICs) build a robust startup ecosystem, and Atal Community Innovation Centres to serve unserved and underserved regions.

Progress and impact: About 10,000 Atal Tinkering Labs have been established in schools across India under AIM. As of December 18, 2024, a total of 3,556 startups have been incubated in 72 AICs, creating 41,965 jobs.

MeitY Startup Hub (MSH)

India is home to one of the most vibrant startup ecosystems with close to 30,000+ tech startups, making it the third largest startup ecosystem in the world. The MSH aims at fostering a vibrant innovation and startup ecosystem by uniting technology innovation stakeholders and promoting economic growth through innovation and technological advancement. MSH facilitates the sharing of resources, best practices, and ideas across the entire innovation and startup ecosystem.

Progress and impact: 5,310+ startups, 495+ incubators, and 328+ labs are part of the MeitY Startup Hub (MSH) scheme.

India's startup ecosystem is continuing to experience tremendous growth. With initiatives and sector-specific schemes, the dynamic collaboration among stakeholders has strengthened the ecosystem, driving economic growth and empowering next-generation innovators.

STARTUPS REVOLUTIONISING ENERGY TRANSITION

At IEEMA, **Electraverse Sparks** is our very own flagship platform to acknowledge startups revolutionising energy transition in India. At ELECRAMA 2025, IEEMA hosted the highly anticipated **3rd edition of Electraverse Sparks.** The platform brought together early-stage and late-stage startups to showcase their breakthrough innovations in energy, electronics, artificial intelligence (AI), automation and sustainability solutions. The event served as a competitive stage for 51 of the most promising startups, each presenting cutting-edge solutions with the potential to transform the industry.

Electraverse Sparks showcased groundbreaking startup innovations across key industry themes, from scalable in-house prototype development to AI-powered automation. Startups presented cutting-edge solutions in sensor technology, autonomous systems and smart energy management, with a strong focus on sustainability and reducing import dependence. The event highlighted AI-driven analytics and vision-based automation, demonstrating their impact across sectors. With pioneering advancements in autonomous navigation and precision monitoring, the competition reinforced India's position as a global leader in emerging technologies.

The Electraverse Sparks Showcase and Awards at ELECRAMA 2025 saw 232 applications, a four-fold increase in the number of startups that applied. A total of 51 innovative startups across early-stage and late-stage categories showcased groundbreaking solutions in energy, automation, AI and sustainability. From these, 14 startups won cash rewards for a total of Rs40,00,000 solely funded by IEEMA, along with an opportunity to interact with potential investors *(see winners list)*.

Here's a domain-wise distribution of startups that pitched their innovations at the Electraverse Sparks Showcase and Awards at ELECRAMA 2025:

- Decarbonisation, energy efficiency, and stationary storage – 17
- Clean transportation, e-mobility, charging infrastructure, and storage – 12
- AI, data analytics, internet of things (IoT), automation, and ICT – 9
- Power and renewable equipment, power quality, industrial electronics, and semiconductors – 7
- New innovations like carbon markets, renewable forecasting, cyber security, among others – 6

Committee members included industry veterans **Atul Arya, IEEMA Electraverse Sparks Startup Committee Chairman; Mustafa Wajid, Managing Director & CEO, Meher Group; Poyni Bhatt, Member of Investment Committee of the Maharashtra Innovation and Technological Development Fund; Abhishek Mohla, President & CMO, Copper Business, Hindalco; Nishit Mehta, Chief Business Officer, Serentica Renewables;** and **Shantanu Chaturvedi, Partner, Transition Venture Capital.**

What Committee Members Think!

"The Electraverse Sparks Showcase & Awards is more than just a showcase and awards ceremony; it serves as a catalyst for connecting these entrepreneurs with mentors, investors, and industry leaders, providing them with the support and visibility they need to scale their innovations," says **Abhishek Mohla, President & CMO, Copper Business, Hindalco.** "By fostering an environment of collaboration, it embodies the spirit of *Make in India* and encourages a forward-thinking mindset of *Make for the World*. These innovations are developed not only to address India's energy challenges but also to seize the numerous opportunities for growth and improvement, with the potential to scale and make a significant impact on

Abhishek Mohla

the global stage," he adds *(See more on his message to young entrepreneurs in the box).*

The Electraverse Sparks Showcase & Awards at ELECRAMA 2025 has become a key platform for nurturing and promoting innovation within the energy sector. This year, the programme saw 232 startups apply, with 51 selected to showcase their solutions – more than doubling the participation from the previous edition. "This growth reflects the increasing momentum and interest among young entrepreneurs eager to drive change in areas like e-mobility, smart energy solutions, and sustainable infrastructure," avers Mohla.

Poyni Bhatt, Member of Investment Committee of the Maharashtra Innovation and Technological Development Fund, adds that startup-industry engagement is crucial for B2B startups, specially for understanding industry pain-points, getting product validation, opportunities for customer

Poyni Bhatt

Create for Scale, Design for Impact, Lead with Purpose

Abhishek Mohla, President & CMO, Copper Business, Hindalco, through IEEMA JOURNAL, sends out a message to young entrepreneurs about the industry's expectations to drive next-generation R&D that's visionary, scalable, and inclusive in the emerging energy sector, and more…

In terms of innovation and R&D, what are the industry's expectations from young entrepreneurs?

The global energy sector is at a pivotal moment, with sustainability, efficiency, and resilience emerging as the new cornerstones of growth. India's electricity demand is projected to grow rapidly. By 2040, India is expected to become the largest global contributor to the increase in electricity demand, accounting for a significant share of global demand growth. India is increasingly focusing on integrating renewable energy sources like solar, wind, and hydropower into its energy mix. By 2030, the country aims to have 50 percent of its energy generation capacity from non-fossil fuel sources, including a strong push for electric vehicles (EVs) and battery storage solutions. The industry now looks to young entrepreneurs to drive next-generation R&D that's visionary, scalable, and inclusive in the emerging energy sector.

In India, the expectations are even more profound. As we march toward the goal of a *Viksit Bharat,* the role of innovation in energy, infrastructure, and industrialisation becomes central. We look to young minds to reimagine:

- Next-generation energy storage systems for renewables
- Smart grid technologies for efficient integration of renewable energy
- Sustainable materials for clean energy and electric vehicle components
- Advanced IoT, AI, and digital twin technologies for smart energy solutions
- Scalable and eco-friendly manufacturing solutions for electric vehicles and green technologies

The bar is high – not because the challenges are overwhelming, but because the opportunities are limitless. The world is watching India's innovation ecosystem with growing admiration. Our entrepreneurs are leading the way, demonstrating how homegrown innovation can address challenges on a global scale.

Any message that you would like to send out to start-ups in the domain?

To the changemakers, the risk-takers, the builders of tomorrow – this is your moment. The journey to *Viksit Bharat* will not be shaped in boardrooms alone; it will be shaped in your labs, your studios, your prototypes, and your pitches.

As you build, carry forward the spirit of *Make in India* – rooted in self-reliance, innovation, and quality. But let your ambition not stop at national borders. Think globally. Let your solutions embody the vision of *Make for the World*. Create for scale, design for impact, and lead with purpose.

In this transformative decade, your work can electrify more than just homes and industries – you have the power to energise India's development story and become a cornerstone in the global energy transition.

Keep dreaming, keep building, and never forget: You are the architects of a developed India – *Viksit Bharat 2047*. The future is not something we wait for; it's something we create – together.

Winners of the Electraverse Sparks Showcase & Awards

EARLY STAGE
Winner: Hydrogen Innovation Private Limited
1st Runner Up: Vimano EWA Pvt Ltd
2nd Runner Up: Universally Green Technology Private Limited
Special Mentions: Xenreality Technologies Private Limited; ARKLE Energy Solutions Pvt Ltd; Xalten Systems Private Limited; EarthSync Technologies Private Limited

LATE STAGE
Winner: C Electric Automotive Drives Pvt Ltd
1st Runner Up: Fitsol Supply Chain Solutions Private Limited
2nd Runner Up: Multi Nano Sense Technologies Private Limited
Special Mentions: Orxagrid Solutions Pvt Ltd; Xeeed IO Private Limited; Faclon Labs Private Limited; Suzhiyam Industrial Machines Pvt Ltd

Early Stage I Winner: Hydrogen Innovations Pvt Ltd

Early Stage I 1st Runner-up: Vimano Inc

Early Stage I 2nd Runner-up: Universally Green Technology Pvt Ltd

Late Stage I Winner: C Electric Automotive Drives Pvt Ltd

Late Stage I 1st Runner-up: Fitsol Supply Chain Solutions Pvt Ltd

Late Stage I 2nd Runner-up: Multi Nano Sense Technologies Pvt Ltd

pilots over and above getting access to industry professionals for mentoring. "IEEMA is actually scaling these efforts by providing engagement opportunities to startups and industry on an ongoing basis," says Bhatt. "The Electraverse Sparks Startup Challenge provides a unique opportunity to startups to amplify their visibility in the large industry network of members of IEEMA," she adds.

What Winners Say!

Says **Sanjaiy Narayanan, Chief of Staff-Strategy and Planning, Hydrogen Innovation Pvt Ltd,** "ELECRAMA 2025 was a transformative experience for HYDGEN. The exposure at the Startup Pavilion brought us face-to-face with leading EPCs, industrial clients, and global investors. The showcase support was seamless and helped us demonstrate our 25-kW stack to a highly technical audience. We had meaningful conversations with strategic partners in system integration, utility deployment, and component manufacturing, many of whom we are now engaging for upcoming pilots in India and Southeast Asia. The visibility, credibility, and networking opportunities at ELECRAMA have helped

Winners Speak

IEEMA JOURNAL speaks to winners of the **Electraverse Sparks Showcase & Awards** to understand their pitches at the Electraverse Sparks Pitch session at ELECRAMA 2025, the key factor in terms of innovation in product, USP, etc, that led them to winning the award, and more...

Tell us about your pitch at the Electraverse Sparks Pitch session at ELECRAMA 2025?

Sanjaiy Narayanan, Chief of Staff-Strategy and Planning, Hydrogen Innovation Pvt Ltd: At ELECRAMA 2025, we pitched Hydrogen Innovation Pvt Ltd (HYDGEN) – a deep-tech startup building India's first Anion Exchange Membrane (AEM) electrolyser stacks for cost-effective and decentralised green hydrogen production. Our pitch focused on how our AEM technology bridges the efficiency of PEM with the affordability of alkaline systems, while avoiding rare earth materials like iridium and titanium. We showcased our journey from lab innovation to the launch of India's first 25 kW single-stack AEM electrolyser, positioning us as a scalable green hydrogen solution for the industry. The pitch highlighted our impact potential in decarbonising sectors such as chemicals, energy, and mobility.

Dinesh Kumar V, Head-R&D, Vimano EWA Pvt Ltd: It was a great opportunity to pitch about our startup to industrial stakeholders. Electraverse Sparks provided a platform to showcase our technology and how we can work with ecosystem players. Also engaging with fellow start-ups was useful as we could share common insights and experiences among us.

Gaurav Dwivedi, Director, Universally Green Technology Private Limited: We talked about OCOFix, our carbon capture device, and how it is a gamechanger for industries like power, oil and gas, steel, cement, and other hard-to-abate sectors. What made the pitch different was that it was not just an idea; we have showcased our successful pilot with Oil India Limited, so we were able to show real results – not just theory. We focused on why this kind of technology is important right now, especially for countries like India where industrial emissions are still growing and need sustainable solutions to achieve India's net-zero targets. We got to hear feedback from people who'd been in the clean energy and electrical industry for decades.

Shashank Kumar, CEO, Co-Founder & Director, Multi Nano Sense Technologies Private Limited: The Electraverse Sparks Pitch session at ELECRAMA 2025 was a great platform to showcase our patented gas sensing innovations tailored for the power sector – covering transformer health, SF leak detection, hot spot monitoring, hydrogen safety, and lithium-ion battery applications. The jury's insightful questions helped highlight the depth of our solutions, sparking strong interest and collaboration enquiries from the audience. It was a rewarding experience.

What, according to you, was a key factor in winning the award – in terms of innovation in product, USP, etc...?

Sanjaiy Narayanan: Our key differentiator was the technological innovation and localisation of AEM electrolyser stacks – something not previously done at a commercial scale in India. Unlike PEM systems that rely on imported, expensive, and scarce materials, HYDGEN's stack is 90 percent locally sourced, enabling massive cost reductions. The jury also appreciated our modular approach, real-world pilot deployments, and the fact that we are not just prototyping but building an ecosystem-ready solution for India's hydrogen ambitions.

Dinesh Kumar V: Our products are critical components in different types of electrochemical devices such as fuel cells, electrolysers, and flow batteries. The reason we won the award was the component level performance innovation, which dramatically reduces the cost of building such devices. Another reason is that we have been able to build these components using sustainable materials which are non-toxic.

Gaurav Dwivedi: We were not just pitching an idea; we were pitching something that's already out and working. This made it attractive for industrial leaders and investors.

We were clear about the problem: CO_2 emissions from heavy industries aren't going anywhere. And not enough companies are tackling this, in India especially.

Shashank Kumar: We won because we combined deep-tech innovation with strong IP, clear product differentiation, and a proven track record – over 100 paying customers, including 40+ global ones. Gas sensors are a unique space with wide cross-sector applications, and our clean business model with healthy unit economics stood out.

accelerate our go-to-market plans and build long-term collaborations."

Shares **Dinesh Kumar V, Head-R&D, Vimano EWA Pvt Ltd,** "We could connect with startups, industrial players, and other business connections where our products could potentially fit in with their system. We could get more leads for our products for various types of applications and connected with people across the ecosystem. We also received good ground support from stall arrangement organisers, enabling us to showcase our products to various visitors."

Adds **Gaurav Dwivedi, Director, Universally Green Technology Private Limited,** "We knew ELECRAMA was a huge event, but we didn't expect the kind of energy and exposure we got here. The Startup Pavilion was buzzing. We were surrounded by other incredible startups, and the kind of people walking in – from PSUs to investors to engineers – was amazing. This event provides great exposure in the power sector – people from thermal power plants, EPC companies, and clean energy firms stopped by our stall. Some of them weren't even fully aware that carbon capture was now becoming modular and scalable, especially from a young Indian startup, so it was amazing introducing OCOFix to them. ELECRAMA was more than just a showcasing platform, it was a place where we repositioned ourselves – from a startup working in carbon capture for oil and gas to a company with the potential to support India's larger decarbonisation journey across multiple core sectors, including power."

Avers **Shashank Kumar, CEO, Co-Founder & Director, Multi Nano Sense Technologies Private Limited,** "ELECRAMA 2025 was the largest and most dynamic exhibition we've participated in – it truly felt like a goldmine of opportunities. We forged meaningful connections with potential customers, discovered innovative vendors who can enhance our offerings, and initiated exciting collaboration talks with both startups and major PSUs. It is an incredible platform and provided invaluable exposure. We are now actively following up on these leads and look forward to converting this momentum into long-term partnerships and growth."

Looking ahead, India's startup landscape is set to reach even greater milestones, all asset to revolutionise the energy transition in India!

Developing India's Interoperable Smart Grid

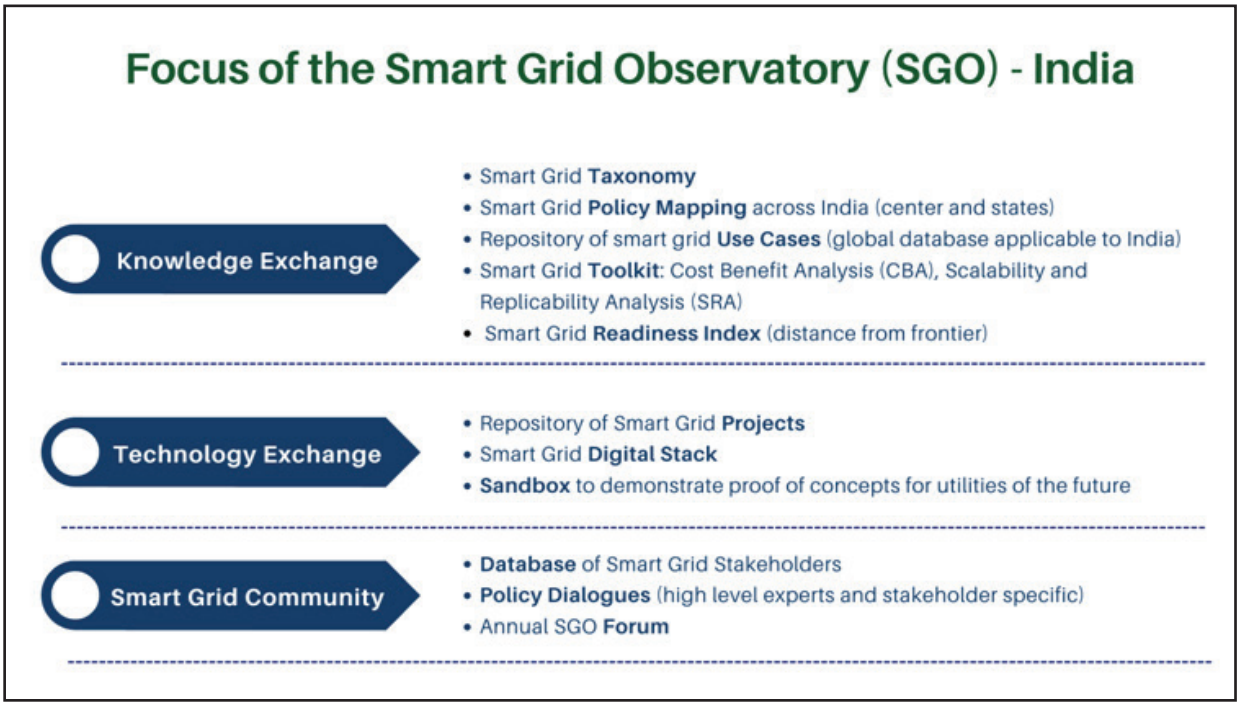
By harnessing the power of data and technology, smart grids pave the way for a more interconnected, efficient, and sustainable energy future. In this article, **SWETHA RAVI KUMAR, Executive Director, FSR Global,** highlights key takeaways to enable India's interoperable digital grid while exploring the focus of the Smart Grid Observatory from 2025-2029.

INTRODUCING THE SMART GRID OBSERVATORY (SGO) – AN ECOSYSTEM APPROACH TO INNOVATION

Digitalisation is revolutionising the energy and power sector by leveraging digital technologies – both operational technologies and information technologies – to optimise and improve the performance of energy systems. As a variety of new and emerging technologies are being deployed globally, it is prudent to assess and map the ongoing developments and advantages these technologies provide. To facilitate this process, a new initiative called the 'Smart Grid Observatory (SGO)' has been established in India under the EU-India Clean Energy Climate Partnership (CECP), in collaboration with the EU Delegation to India and the Ministry of Power - National Smart Grid Mission (NSGM), with FSR Global acting as the Chair and Secretariat.

The SGO will function as an open digital platform that unites all stakeholders within the smart grid ecosystem, aiming to transform the power grid through the development of digital stacks, showcasing cutting-edge technologies, facilitating knowledge transfer, and creating demonstrative sandboxes (SGO, 2024).

Figure 1: Focus of the Smart Grid Observatory (SGO) – India



Source: Author's own

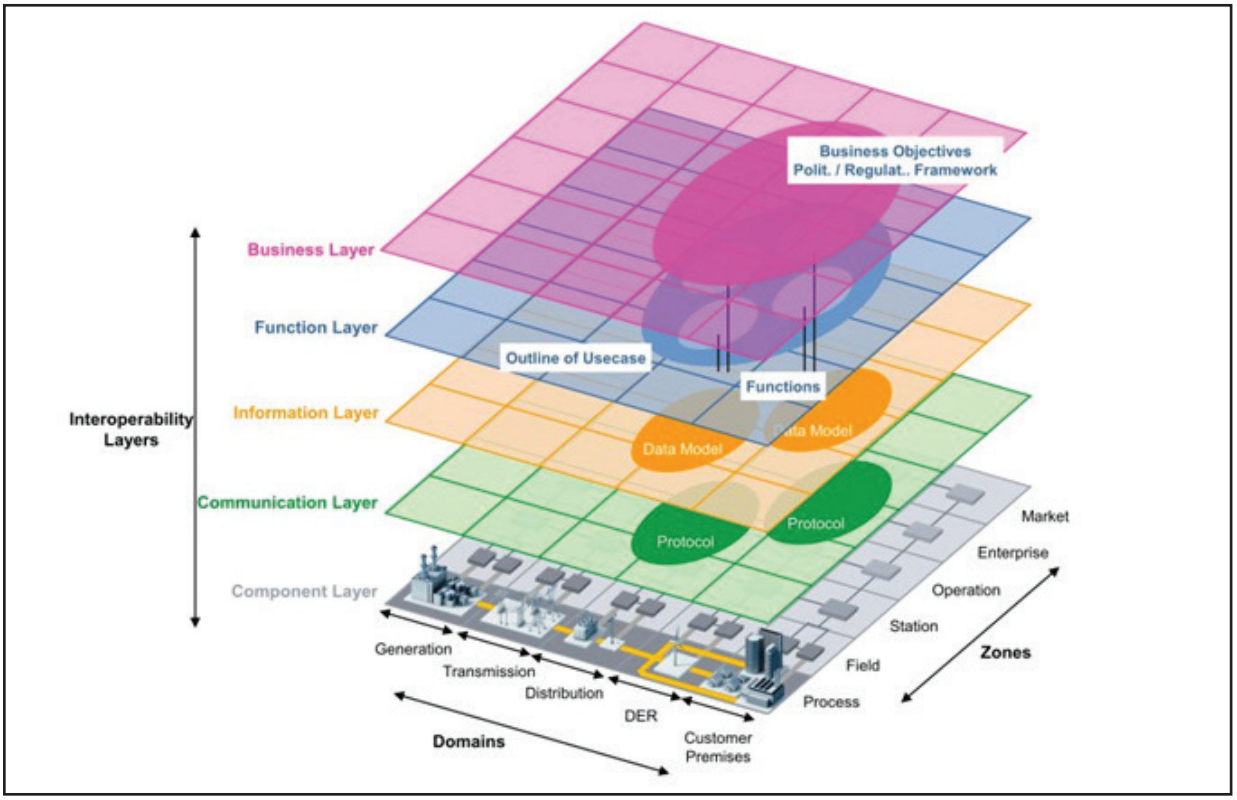
SGO Stakeholders

Smart Grids for The Future

Smart grids are playing a pivotal role in India's ongoing digital and green transformation within the power sector. These advanced grids combine innovative digital technologies with traditional power infrastructure, facilitating efficient monitoring, management, and optimisation of electricity distribution and consumption. At their essence, smart grids utilise state-of-the-art sensors, meters, and communication networks to collect real-time data on electricity usage, generation, and grid conditions (Choudhury, 2024). This wealth of data empowers both utilities and consumers to make informed decisions about energy consumption patterns, resulting in more effective resource allocation and reduced waste. The International Energy Agency (IEA) describes a smart grid as "an electricity network that uses digital and other advanced technologies to monitor and manage the transport of electricity from all generation sources to meet the varying electricity demands of end users" (IEA, 2023).

Smart grids establish a two-way flow of electricity and data, which can be effectively visualised through the three-dimensional smart grid architectural model (SGAM) framework (illustrated in Figure 2). SGAM serves as "a reference model to analyse and visualise smart grid use cases in a technology-neutral manner" (CEN-CENELEC-ETSI, 2012). This framework highlights the importance of interoperability, which is seen as a crucial enabler for smart grids. The GridWise Alliance defines interoperability as the "capability of two or more networks, systems, devices, applications, or components to exchange information between them and to utilise the information exchanged" (GWAC, 2008). While the concept of interoperability is not new, the rapid growth of digital markets and services has intensified the need for appropriate regulations to govern interoperability effectively.

Figure 2: Focus of Research within Smart Grid Architecture Model (SGAM)



Source: Author adapted

Interoperability can be classified into two categories (Ravi Kumar, 2024),

- Narrow interoperability: Focuses on the level of devices and is used to describe technical systems. It typically covers interoperability among information and communication technology (ICT) systems.
- Broad interoperability: Focuses on the level of organisations. It considers that political, legal, regulatory, organisational, and social factors influence technical systems and their performance.

Moreover, interoperability among ICT systems is viewed as an enabler for the interoperability of organisations, meaning it enhances the ability of organisations to collaborate more efficiently and effectively.

Figure 2 is structured to show how different components and systems need to work together (interoperate) for a digitalised power sector to function efficiently. It distinguishes between broad interoperability (across different functions and stakeholders) and narrow interoperability (within specific technical domains). In essence, the image represents a framework for understanding how digitalisation impacts the power sector, emphasising the need for seamless communication, data exchange, and coordination among various stakeholders and systems. The various layers that enable narrow and broad interoperability are explained below:

Business (Roles and Responsibilities)

Details the responsibilities of each stakeholder category. For example, transmission companies (TRANSCOs) and state load dispatch centres (SLDCs) are responsible for cyber security policy, data management, and grid operation. System operators and distribution companies (DISCOMs) handle real-time information systems and automated operations. Regulators focus on policies like energy efficiency and demand response.

Function (Monitoring/Flexibility)

Describes the functions performed within the power system, such as monitoring asset conditions, controlling grid operations, managing blackouts, and ensuring grid stability. It also highlights the importance of demand and generation flexibility, as well as load forecasting.

Information

Specifies the data types and models used for communication and information exchange (CIM, IEC, COSEM).

Communication

Outlines the communication networks used at different levels, including field area networks (FAN) for real-time monitoring and wide area networks (WAN) for real-time markets and operations.

Component (System of Systems)

Lists the physical components and systems involved, from generation management systems and DER storage to EMS, SCADA, substation automation, and distribution automation systems. It also includes components at the consumer premise, like smart devices and demand response management systems.

KEY TAKEAWAYS TO ENABLE INDIA'S INTEROPERABLE DIGITAL GRID

By harnessing the power of data and technology, smart grids pave the way for a more interconnected, efficient, and sustainable energy future. To achieve a high state of digitalisation with different elements of the electricity value chain interacting with each other in a meaningful and data-driven manner, multiple processes and stakeholders must work in tandem in a cross-sectorial and a holistic manner.

A series of expert group discussions were conducted in 2024, which included key experts from Europe and India from across stakeholders. Some of the key observations that were derived from these discussions are mapped to the SGAM interoperability framework.

Need for Updated Standards

Standards must evolve alongside technological advancements to remain relevant and effective. As new technologies emerge, it is essential that standards reflect these changes to ensure they support the latest innovations and practices. This alignment not only facilitates the adoption of new technologies but also enhances the overall efficiency and functionality of systems relying on these standards.

Establishing minimum data and format requirements is crucial for achieving interoperability among various systems and platforms. When standards are consistently applied, they create a common framework that allows different technologies to communicate and work together seamlessly. This interoperability is vital in today's interconnected world, where disparate systems must collaborate to deliver optimal performance and user experience.

Inclusive Standard Setting Process

An inclusive standard-setting process is essential, as it must consider the needs of all stakeholders, both public and private. Engaging a diverse array of voices ensures that the standards developed are comprehensive and address the various challenges faced by different sectors. By fostering collaboration among stakeholders, the standards can better reflect the realities of the market and the needs of users.

Regular updates based on stakeholder feedback are crucial to maintaining the relevance of standards. The landscape of technology and user requirements is constantly shifting, and standards must adapt to these changes. By incorporating feedback, standard-setting bodies can ensure that their guidelines remain effective and meet the evolving demands of the industry.

India's participation in international standardisation is vital for compatibility and influence. As a rapidly developing nation with a growing technological landscape, India must engage in global standard-setting initiatives. This involvement not only helps ensure that Indian technologies are compatible with international standards but also allows India to have a voice in shaping those standards, enhancing its influence on the global stage.

Balancing Standards and Innovation

While standards are necessary for consistency, they should not hinder technological advancements. Striking the right balance between maintaining robust standards and promoting innovation is key. Overly rigid standards can stifle creativity and slow down the adoption of new technologies, which can be detrimental in a fast-paced technological environment.

Flexibility in standards is essential for fostering future innovations. By allowing for adaptability within established frameworks, organisations can explore new ideas and approaches without being constrained by outdated regulations. This flexibility ultimately encourages technological growth and supports the development of groundbreaking solutions.

Financial Support for Technological Advancement

Targeted financial support is necessary for utilities to invest in new technologies. Without adequate funding, organisations may struggle to adopt latest innovations, hindering their operational efficiency and competitiveness. Financial assistance can help utilities integrate new technologies that improve service delivery and enhance overall performance.

Additionally, financial incentives should encourage innovation and infrastructure upgrades. By providing support for the adoption of cutting-edge technologies, governments and organisations can stimulate growth within the sector. These incentives can lead to more robust infrastructure and a more dynamic technological landscape.

Addressing Vendor Diversity

The presence of multiple vendors can create compatibility issues that complicate system integration. When different vendors use varying standards, it can result in inefficiencies and increased costs for organisations trying to implement these technologies. Addressing these compatibility concerns is crucial for ensuring seamless operations across platforms.

Establishing clear hardware standards from the start is critical for interoperability. By setting definitive guidelines early in the development process, organisations can reduce the risk of compatibility issues later on. This proactive approach helps facilitate smoother integration and fosters a more cohesive technological ecosystem.

Inconsistency of Data Formats

The variability in data formats among operators, original equipment manufacturers (OEMs), and vendors poses a significant challenge in the smart grid landscape. This inconsistency hinders efficient data collection and analysis, making it difficult to derive actionable insights. To address this issue, it is essential to establish harmonised templates along with broad country-level guidelines on data resolution. By implementing these solutions, we can enhance the accuracy of analytics and support the scaling of smart grid technologies through improved data comparability.

Enhancing Communication Between Devices and Control Centres

There is a pressing need to improve communication efficiency between devices and control centres. The European Union has set a precedent by implementing regulations that facilitate seamless communication across the power sector. The overarching goal of these initiatives is to optimise the operational efficiency of smart grids, leading to better management of energy resources.

Approaches to Effective Communication Networks

A mixed strategy that combines both open-source and proprietary solutions is recommended for creating effective communication networks. The success of Spain, with its single platform for

nationwide utility information, serves as a model. In India's context, it is vital to emphasise top-down and open-source methods to reduce dependency on specific vendors. Ensuring flexibility and scalability within the communication system is essential, along with the establishment of regulations that foster a sustainable and efficient smart grid ecosystem.

Cross-Sectoral Coordination

Cross-sectoral coordination is crucial for the successful implementation of smart grid technologies. An example could be collaborative efforts between the power and telecommunications sectors. Such coordination will result in improved integration and robustness of infrastructure, enabling it to meet the demands of modern energy systems effectively.

Standardise Data Need and Collection

The information layer is crucial for advancing effective smart grid implementation through robust data collection standardisation measures. It is essential to define the methods of data collection, the types of data required, and the formats for data presentation. This standardisation serves as a foundation for consistent and accurate analytics across the power sector. Additionally, ongoing capacity-building efforts are necessary to equip all stakeholders with the skills and knowledge needed to manage and utilise data effectively.

Data Privacy and Trust

Prioritising data privacy and trust is vital from the beginning as part of policy and regulation. Building trust among stakeholders – including consumers, DISCOMs, and vendors – is essential for successful collaboration. Balancing the demands of consumers with the operational needs of DISCOMs and vendors presents a complex challenge. Hence, developing a clear and transparent regulatory framework that addresses the diverse interests of these groups is critical for progress.

Integration of New Technologies

Integrating new technologies with existing legacy systems, such as the Common Information Model (CIM), poses a significant challenge worldwide. While standardising protocols among stakeholders is necessary, exploring the option of building new systems rather than retrofitting legacy ones may be beneficial, particularly in countries like India. However, this approach may encounter obstacles, such as the monopolistic influence of existing vendors, which can hinder innovation and flexibility in the energy sector.

Cybersecurity Measures

Robust cybersecurity measures are essential to protect grid infrastructure from potential threats and to ensure the safety and integrity of data. Additionally, open API formats are necessary to facilitate interoperability and seamless communication between different systems and platforms.

Active Market Involvement

Active market involvement is crucial for the widespread adoption and scaling of smart grid technologies. It is important to provide clear and favourable signals from the outset to encourage investment and participation from both private and public sectors. By fostering an environment conducive to innovation and competition, countries can accelerate the development and deployment of smart grid solutions.

Real-time Insights

The foundation for effective data collection, management, storage, and analysis is crucial for developing digital models that can unlock the future potential of digital twins and comprehensive digital energy systems. These advanced models offer real-time simulations and insights, significantly enhancing decision-making and optimising energy management. As the industry progresses toward these sophisticated technologies, it is vital to establish foundational steps that facilitate future advancements.

Creating Basic Data Lakes

While awaiting ideal solutions, it is practical to start developing basic data lakes. These data lakes act as centralised repositories, providing a single source of truth for data analytics. By consolidating data from various sources, they enable stakeholders to conduct accurate and consistent analyses, which are essential for informed decision-making in energy management and policy development.

Standardisation of Data Management

Implementing protocols for standardised data collection and storage is essential for ensuring data consistency and interoperability. Standardised methods will promote seamless integration and information sharing across different systems and stakeholders. This standardisation will also support the scaling of digital energy solutions and foster innovation within the sector.

Infrastructure Upgrades and Workforce Development

Significant infrastructure upgrades are necessary to support this transition, including

technological advancements and human resource development. IT infrastructure must be enhanced to manage the increasing volume and complexity of data while implementing robust cybersecurity measures to protect sensitive information. Concurrently, workforce capacity building through training and education is vital for equipping personnel with the skills required to effectively manage and leverage digital technologies.

Building Trust Among Stakeholders

Trust building among stakeholders is a fundamental aspect of this transformation. Establishing trust involves transparency, clear communication, and the implementation of reliable measures to safeguard data privacy. By creating an environment of collaboration and mutual understanding, stakeholders can work collectively to address challenges and drive the successful adoption of digital energy systems.

In the realm of digital transformation, the data value chain plays a pivotal role in unlocking the full potential of data within the energy sector. This value chain includes critical components such as data collection, management, and exchange – all of which are essential for optimising decision-making and enhancing operational efficiency. By establishing a robust framework for the data value chain, organisations can ensure that their data is accurate, accessible, and actionable, ultimately enabling them to leverage insights for improved outcomes.

Data Governance: Establishing Trust and Integrity

At the heart of the data value chain framework lies the concept of data governance. This involves creating rules that address key elements like data trust and sovereignty. Effective data governance is crucial for responsible data handling, ensuring that there are clear policies in place to protect privacy and maintain data integrity. By implementing these governance rules, organisations can foster confidence among stakeholders, making certain that data is used ethically and in compliance with applicable regulations.

Defining Roles and Responsibilities

Clearly defining the roles and responsibilities of stakeholders within the data ecosystem is essential for promoting accountability and coordination. Each participant, from data providers to end-users, has a specific function that contributes to the data value chain's overall efficiency and effectiveness. By delineating these responsibilities, organisations can encourage collaboration and ensure that all parties are aligned in working toward common objectives.

Fostering Open Communication

Open channels of dialogue between stakeholders are vital for addressing challenges and capitalising on opportunities within the data ecosystem. Regular communication and information sharing enable stakeholders to align their efforts, identify best practices, and collaboratively tackle problems. This openness is essential for building trust and nurturing a culture of innovation and continuous improvement.

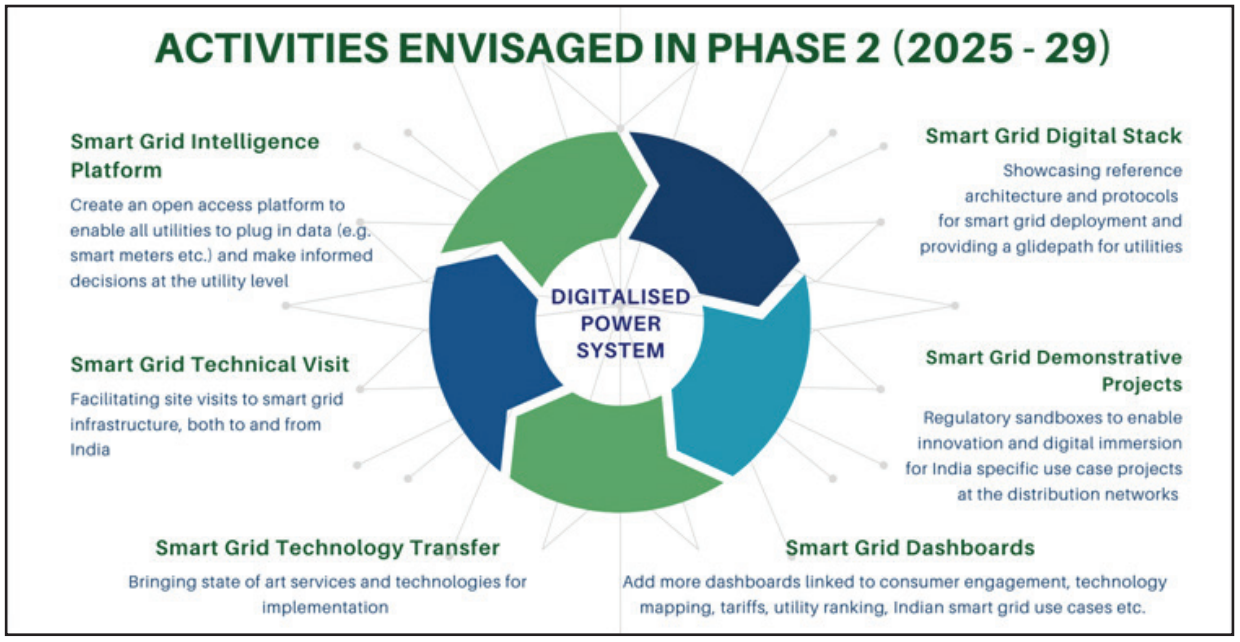
Collaborative Approaches – Forming Task Forces

To enhance coordination and integration across various sectors, cross-institutional task forces can be established, adopting a 'whole of government' and 'whole of society' approach. These task forces bring together representatives from both governmental and non-governmental organisations to collaboratively address complex issues that span multiple domains. By leveraging diverse expertise and resources, these task forces can develop comprehensive solutions to tackle the multifaceted challenges associated with data management and governance.

TAKING THEORY TO PRACTICE – FOCUS OF SGO FROM 2025-2029

Adopting a systems approach is essential for creating a comprehensive digital framework for India's smart grid ecosystem. This involves incorporating the principle of digital public infrastructure to establish the India Energy Stack (IES). The IES is envisioned as a nationally shared digital public asset that offers a standardised, modular, and secure framework for managing, monitoring, and innovating within the energy sector. It integrates advanced data exchange protocols, real-time analytics, and open APIs, empowering utilities, renewable energy producers, consumers, and innovators alike. By facilitating seamless interoperability and ensuring strong privacy and security, apart from providing a modular architecture, the IES is set to propel India's transition towards a sustainable, resilient, and intelligent energy future.

In the next phase, the Smart Grid Observatory (SGO) will focus on designing and developing the IES, beginning with a use case aimed at creating a utilities intelligence platform. Additionally, the SGO will develop dashboards that concentrate on consumer insights, technology mapping, and smart grid indexing. Alongside these knowledge and information dashboards, a significant aspect will



be capacity building to help all stakeholders grasp the latest developments and their relevance to India. Finally, as a community-driven ecosystem, the SGO will enable ideas to evolve into demonstrative projects based on the use cases identified within the SGO framework.

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ABOUT THE AUTHOR

Swetha Ravi Kumar, Executive Director, FSR Global, is responsible for the development of research, training and policy dialogue activities. She also holds the position of Vice President Communications at the International Association for Energy Economics and the Indian Association for Energy Economics and is also the Chair of 'The Energy Network', a women platform for energy professionals. Kumar has a Master's degree in Sustainable Energy Engineering from KTH Royal Institute of Technology (Erasmus Scholar), Sweden; an Advanced Management Program from the Indian Institute of Management Bangalore (IIM B), India; and holds a Bachelor's degree in Electrical Engineering from Jawaharlal Nehru Technological University, India.

SMART METERS:
Enabling Grid Reliability Through Advanced Manufacturing, Responsive Field Operation, and Consumer Empowerment

India is inching towards a smarter power grid armed with high quality manufacturing and upgraded, reliable services. Smart meters make the power grid smarter and smart metering enables the grid's reliability. The technical convener of IEEMA Meter Technical Division, Vipin Kumar Mishra details the importance of the role of smart meters by touching upon aspects of automation, addresses cyber security in digital grids, enlists future trends to conclude with a vision about building smart meters for real-world use.

India's smart meter mission under RDSS is a game-changer for the power sector. With 25 crore meters rolling out, the project's success rides on solid manufacturing, smooth performance, and fast problem solving. These smart meters aren't just for billing; they're the brains of a smarter, digital power grid. And it all starts with getting things right at the manufacturing unit.

Precision Manufacturing: Building Reliability into Every Meter

Smart meters perform well over time only if they're built right from the beginning. This starts with smart manufacturing that focuses on quality and reliability at every step. Usage of precise calibration tools, stable components like current transformers and shunts, and accurate converters ensures that the data these meters provide is true and trustworthy. If the foundation is strong, the entire digital power system runs better.

Smart Production Lines for Consistency and Accuracy

Smart meter manufacturers are turning to automation to make production faster, more accurate, and more reliable. Robots now handle tasks like soldering circuit boards, calibrating meters, and checking for defects using advanced camera systems. This helps keep quality consistent and reduces mistakes, even when making meters in large numbers. At the final stage, automated tests simulate real-life conditions to ensure each meter meets strict standards like IEC 62053, IS:16444 and IS:15959, etc. With automation, every meter is built to perform and built to last.

Latching Relays: Defending the Meter Against Tampering

Meet the latching relay: the smart meter's muscle and brain. For Demand Side Management (DSM), it lets the DISCOM dial consumer power up or down on demand, shaving peak loads and saving energy costs. And when someone tries lapping on a magnet, bypassing wires, or fiddling with the neutral line, this relay may lock out instantly. It has been battle-tested for thousands of on/off cycles, withstands heat like a champ, and reacts in milliseconds to any tamper trigger.

Rigorous Testing and Field Reliability Compliance

Smart meters and their internal components, especially relays, are built to ensure peak performance and long service life. Relays are precisely assembled using advanced machines that align each component for optimal operation. Their

electrical connections are tested for smooth power flow, and they undergo thousands of on/off cycles to verify endurance and prevent wear over time.

Beyond relay-specific checks, smart meters are subjected to a series of rigorous tests to validate overall reliability under field conditions. Highly Accelerated Life Testing (HALT) is performed for extended durations at 85°C temperature and 85% relative humidity to assess durability and component strength. Communication efficiency is evaluated through TRP (Total Radiated Power) and TRI (Total Radiated Isotropy) tests, ensuring reliable data transmission. Meters also undergo life cycle assessments and timing accuracy tests to confirm their consistent performance under voltage fluctuations, tampering, and network-related issues.

Automation Features and Secure Firmware: Preloaded for Field Performance

Smart meters help make the power grid smarter. They come with features like turning power on or off remotely, controlling how much power a consumer uses, and changing prices based on the time of day.

These features are set up and tested at the factory to make sure they work well. They also have strong security to stop hacking and tampering, keeping the meter safe and reliable.

Cybersecurity: Protecting the Digital Grid

As smart meters connect to the internet, keeping them safe from hackers is very important. India's smart meter rules follow strong standards like IS 15959 and CEA guidelines. They require meters to use AES-128 or AES-256 encryption to protect data, update software safely, and control who can access the system. Meters connect through secure networks and check devices with IDs to make sure only trusted meters are on the grid. This helps keep the energy system safe from cyber-attacks.

Strengthening Issue Resolution Through SLA-Driven Accountability

India's adoption of the AMISP (Advanced Metering Infrastructure Service Provider) model places full deployment and maintenance responsibility on competitively selected vendors. Service Level Agreements (SLAs) define strict performance standards under communication uptime, installation schedules, tamper response, and grievance redressal as per AMISP specification requirements. Meters must support automated fault diagnostics, and vendors are accountable for resolving issues within defined timeframes. This structure links accountability directly with performance.

Consumer Trust and Local Manufacturing Synergy

Digital interfaces like mobile apps and Bluetooth-enabled meters empower consumers to monitor usage, receive alerts, and raise service requests even in areas with limited connectivity. BLE features allow technicians and consumers to access meters locally, improving uptime and service delivery.

Make in India: Enabling Domestic Innovation and Supply Chains

Compliance with Minimum Local Content (MLC) norms ensures that meters are largely manufactured in India. Indian manufacturers lead with over 60% localisation, producing key components like enclosures, relays, mechanical structures, moulded and metallic parts, embedded software, and operating full-scale local production lines. This domestic focus strengthens India's supply chains and supports faster, end-to-end issue resolution. For more local content, the ministries and industries are making efforts to ensure the availability of IC, polycarbonate, and batteries locally.

Future Trends

Interoperability at Network and Common Pluggable Communication Module (CPCM) Level

Modern smart meters use different technologies like RF or cellular to stay connected. To make upgrades easy, working group experts under BIS created a plug-and-play module (CPCM) so meters can swap communication parts without replacing the whole meter. They also built the technical specification for a Unified HES, a common system that helps all meters, whether RF or cellular, work together smoothly on the network.

CPCM (Common Pluggable Communication Module) Integration

From a manufacturing standpoint, ensuring tight mechanical tolerances, firmware compatibility, and RF shielding during CPCM integration is critical. Each module undergoes factory acceptance testing (FAT) in simulated network environments to ensure signal strength, packet integrity, and data throughput. This plug-and-play design simplifies large-scale deployment and future-proofs smart meters against evolving communication technologies. TEC and BIS are working on the field replacement protocols and guidelines for CPCM.

Conclusion: Building Smart Meters for Real-World Use

In today's growing power sector, smart meters are no longer just tools for reading electricity; they are active parts of the power grid. Their performance in the field depends on good manufacturing, smart design, and strong testing. Features like tamper-proof relays, easy-to-replace communication modules (CPCM), support for both RF and cellular, strong cybersecurity, and service-level agreements are not just useful; they are essential.

At the same time, adding too many extra features that do not give real value to the consumers and DISCOMs should be avoided. More hardware and software can reduce the meter's reliability index.

As India moves toward a smarter power grid, the focus must stay on quality manufacturing and reliable service. When done right, smart meters will do much more than measure electricity; they will support India's digital energy future and help build smarter, connected homes.

ABOUT THE AUTHOR

Vipin Kumar Mishra, Vice President-Technology Capital Power Systems Ltd. is an electrical engineering graduate with over three decades of experience in the metering industry. Member of IMTEF, OC of MI-22, MI-24, Mr Mishra is the Convener of the Technical Committee of IEEMA Energy Meters division.

Application & Role of Surge Protection Devices in Solar Smart Grid Stations

The author considers various types of damage possible to the solar grid and presents a paper on the integration of surge protection devices in solar smart grid stations as critical for the protection of both DC and AC components, as well as sensitive monitoring and control systems.

A smart grid is an all-encompassing term in today's power distribution industry. The threat of its equipment disruption and damage from transient surges is very real and can have dire consequences upon the delivery of electricity to residential, commercial and industrial users.

Solar photovoltaic (PV) plants are susceptible to electrical surges, which can cause costly damage to equipment and result in temporary power supply outages. Surge Protection Devices (SPDs) are essential components in solar smart grid stations, ensuring system reliability and safeguarding electronic equipment from transient over-voltages caused by lightning strikes, switching operations, or faults. Their application enhances both the safety and operational efficiency of smart grid-connected solar systems.

Possible Sources of Lightning Damages as per IS 62305

Sources of damage (S1 to S4): the largest voltage peaks in the low-voltage network are caused by lightning discharges. The high energy content of lightning surges, when a direct strike hits the external lightning protection system or a low-voltage overhead line or high masts, usually causes total outages of the connected consumers and damage to the insulation. Yet induced voltage peaks on energy or data supply cables can also reach many times the nominal operating voltage. Switching surges, too, which in fact do not cause such high voltage peaks as lightning discharges but occur much more frequently, can result in immediate system failure. As a rule, switching surges amount to two to three times the operating voltage; lightning surges, on the other hand, can sometimes reach 20 times the nominal voltage value and transport high energy content. Often, failures occur only after a time delay, as the aging process of electronic components in the affected devices triggered by smaller transients causes insidious damage. A number of different protection measures are required as described.

Minor Cause, Major Effect: Damage Caused by Surges

Our dependency on electrical and electronic equipment continues to increase in both our professional and private lives. Critical equipment

like inverters and data networks in solar PV units are vital for the real-time transfer of information that has long since been indispensable. It is not only lightning strikes that pose a latent threat to these systems. More and more frequently, today's electronic aids are damaged by surges caused by remote lightning discharges or switching operations in larger electrical systems. During thunderstorms, too, high volumes of energy are instantaneously released. These voltage peaks can penetrate a building through all manner of conductive connections and cause enormous damage. The failure of such equipment certainly incurs great expense.

Current statistics and estimates of property insurers reveal damage levels caused by surges¾excluding consequential or outage costs¾long since reached drastic levels due to the growing dependency on electronic "aids". It's no surprise, then, that property insurers are checking more and more claims and stipulating the use of devices to protect against surges.

Direct Lightning Strikes a Building

If a lightning strike hits the external lightning protection system or earthed roof structures capable of carrying lightning current (e.g., roof antenna), the lightning energy can be safely diverted in advance to the ground potential. However, this has not yet been done with a lightning protection system alone: due to its impedance, the building's entire earthing system is raised to a high potential. This potential increase causes the lightning current to be split over the building's earthing system and also over the power supply systems and data cables to the adjacent earthing systems (adjacent building, low-voltage transformer). Threat value: up to 200 kA (10/350).

Switching Surges in the Low-Voltage System

Switching surges are caused by switch-on and switch-off operations, by switching inductive and capacitive loads and by interrupting short-circuit currents. Particularly when production plants, lighting systems or transformers are switched off, electrical equipment located in close proximity can be damaged. Threat value: several kA (8/20).

Direct Lightning Strike into a Low-Voltage Over-Head Line

A direct lightning strike into a low-voltage overhead line or data cable can couple high partial lightning currents in an adjacent building. Electrical equipment in buildings at the end of the low-voltage overhead line are at particular risk of damage caused by surges. Threat value: upto 100 kA(10/350).

Coupling of Surges Through Local or Remote Lightning Strike

Even if lightning protection and surge protection equipment are installed, a local lightning strike creates additional high magnetic fields, which in turn induce high voltage peaks in line systems. Inductive or galvanic coupling can cause damage within a radius of up to 2 km around the lightning impact point. Threat value: several kA (8/20).

What Impulse Forms Exist?

High lightning currents can flow to the ground during a storm. If a building with external lightning protection receives a direct hit, a voltage drop occurs on the earthing resistor of the lightning protection equipotential bonding system, which represents an overvoltage against the distant environment. This potential increase poses a threat for the electrical systems (e.g., voltage supply, telephone systems, cable TV, control cables, etc.) that are routed into the building. Suitable test currents for testing different lightning and surge protectors have been defined in national and international standards.

Lightning currents that can occur during a direct lightning strike can be imitated with the surge current of waveform 10/350 µs (Fig. 1: impulse 1). The lightning test current imitates both the fast rise and the high energy content of natural lightning. Lightning current arresters Type 1 (previously Class B) and external lightning protection components are tested using this current.

The surges created by remote lightning strikes and switching operations are imitated with test impulse 8/20 µs (Fig. 1: impulse 2). The energy content of this impulse is significantly lower than the lightning test current of surge current wave 10/350 µs. Surge arresters Class II and Class III (previously Classes C and D) are impacted by this test impulse.

Typical Application in Solar Farms

Electrical surges can be caused by external factors such as lightning strikes, internal malfunctions, or fluctuations in the electrical grid. The large surface areas and exposed placements, such as on rooftops or on the ground in open spaces, make solar panels prone to lightning strikes that can shorten their lifespan. Lightning poses significant risks of complete or partial destruction to solar farms, either immediately from a direct strike or results in degenerative damage from an indirect strike.

Over-voltages can impact a solar panel system installation in different ways from:

- Direct strikes to the external lightning protection system located in the plant, near it, and even to the PV installation itself
- Lightning-induced currents distributed into the electrical network
- Over-voltages transmitted from the electrical network of atmospheric origin (lightning) and/or due to operations
- The grid, if lightning hits medium or low voltage conductors
- The earth, if lightning hits close to the PV's inverter
- The DC side, if lightning hits the PV modules

Solar power systems, particularly those installed in open or elevated areas, are highly susceptible to lightning-related surges. Additionally, switching surges within the grid can lead to transient overvoltages. Surge protection devices (SPDs) are designed to divert these surges safely to the ground, thereby protecting inverters, monitoring systems, and other sensitive electronic devices from damage.

Photovoltaic (PV) Array (DC Side Protection)

- SPDs can be placed between the PV strings and the inverter to protect the inverter input from DC side surges. Selection of Type 1, 2 or 1+2 SPDs can be decided based on risk assessment outcome.

Inverter (DC Input and AC Output Protection)

- On the DC input side, SPDs guard against surges from the PV array.
- On the AC output side, SPDs shield the inverter from grid-originating disturbances.

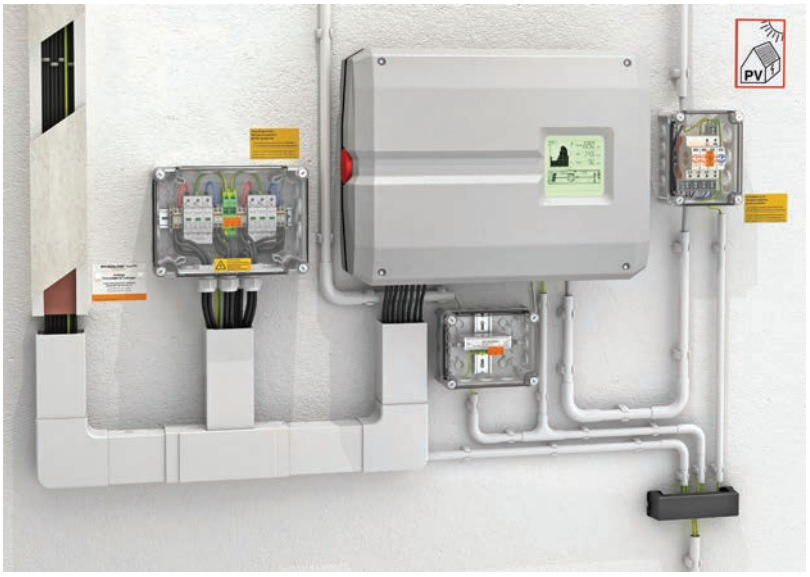
Communication and Monitoring Systems

- Communication lines (e.g., Ethernet, RS-485/ Modbus) are vulnerable to surges.

4. Integration with Smart Grid Features

Benefits of SPDs in Modern Solar Smart Grid Systems:

- Protecting Remote Monitoring components & IoT devices
- Minimizes downtime and equipment damage.
- Enhances overall system reliability and safety.
- Reduces maintenance costs and service interruptions.
- Ensures data integrity in communication networks such as real-time surveillance of SPD performance and failure alerts.



Failure Modes and Analysis of Surge Arresters

Common failures include thermal degradation due to repeated surge exposure, electrical overstress from high-energy transients, and aging of metal oxide varistors (MOVs). Environmental factors such as moisture ingress, dust, or chemical pollution can cause insulation breakdown and surface tracking, particularly in outdoor or industrial settings. The most common cause is cumulative damage from repeated surges, which gradually degrades components like metal oxide varistors (MOVs) until the device can no longer provide effective protection. A single, extreme surge—such as from a nearby lightning strike—can also overwhelm and destroy the SPD instantly. Temporary overvoltages (TOVs) caused by utility faults or wiring issues can similarly lead to thermal stress and failure. Improper installation, such as poor grounding, long lead lengths, or using an incorrectly rated SPD, increases the risk of failure. Additionally, physical damage, overheating due to poor ventilation, or simple aging and environmental exposure can degrade the SPD over time. Signs of failure include extinguished or red indicator lights, physical damage like burn marks, or a noticeable lack of protection. Mechanical issues like vibration or poor installation may also lead to internal disconnections. To analyse these failures, techniques such as insulation resistance testing, leakage current monitoring, and clamping voltage verification are commonly employed.

Hybrid Surge Protection Systems

Hybrid surge protection systems combine traditional surge arresters with coordinated protective devices to offer enhanced and layered defence against transient over-voltages in electrical networks. These systems integrate components like metal oxide varistors (MOVs), gas discharge tubes (GDTs), spark gaps, and thermal disconnects, allowing them to handle a wide range of surge energies and durations. The principle of coordination lies in matching the response time, clamping voltage, and energy-handling capacity of each device, ensuring that surges are progressively managed from coarse to fine protection stages. For example, in a hybrid setup, a fast-acting spark gap may first suppress a high-energy surge, allowing a slower but more precise MOV or GDT to absorb the remaining transient. Thermal protection elements and fuses are included to disconnect the device safely during prolonged overvoltage or overheating conditions, preventing fire hazards and equipment damage and complying with international surge protection standards (IS/IEC 62305, IEC 61643).

Conclusion

The integration of SPDs in solar smart grid stations is critical for the protection of both DC and AC components, as well as sensitive monitoring and control systems. By effectively mitigating the impact of electrical surges, SPDs contribute significantly to the longevity, safety, and efficiency of modern solar energy systems.

ABOUT THE AUTHOR

Dr K Janakiraman is the Head - Market Development at OBO Bettermann India Pvt Ltd.
and member of TC 81 - IEC Technical Committee,
ETD 20 (BIS), ETD 44 (BIS) and CED 46 (BIS).

NEW WORLD RECORD:
ABB Motor achieves 99.13% Energy Efficiency

This large synchronous electric motor is created for a steel plant in India, which is projected to have estimated electricity cost savings of ~US$ 6 million through improved energy efficiency over the motor's 25-year lifespan.

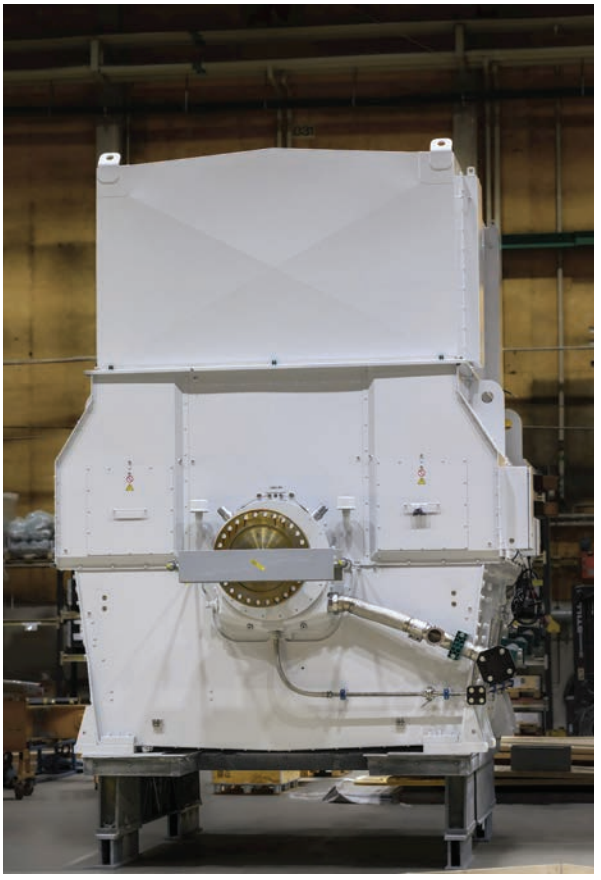
ABB has broken its own world record for energy efficiency in large synchronous electric motors with a new motor designed in line with its Top Industrial Efficiency (TIE) initiative, which delivers equipment that exceeds standard performance benchmarks. ABB's TIE motors and generators are engineered to surpass current efficiency benchmarks, helping customers reduce electricity usage, operating costs, and total cost of ownership (TCO) without compromising performance or adding complexity.

This large synchronous electric motor, created for a steel plant in India, is the most efficient ever made, thanks to top industrial efficiency design. Notably, it has achieved an efficiency rating of 99.13 percent during testing, a substantial improvement over ABB's previous world record of 99.05 percent set in 2017. The efficiency rating is the ratio between the energy a motor draws and the amount it turns into motion. The theoretical limit is 100 percent efficiency. Getting closer to this target becomes increasingly challenging in terms of the motor design and manufacture. This is why the previous world record stood for eight years.

Electricity cost savings of ~US$ 6 million over 25-year lifespan

Opting for a TIE-optimised motor, rather than the standard design with 98.64 percent efficiency level, will enable the customer to save around 61 GWh of energy and US$ 5.9 million in electricity costs over a 25-year lifespan – equivalent to four days of peak output from the world's largest offshore wind farm. The investment in energy efficiency will have a projected payback period of just over three months.

The motor will also support avoiding 45,000 tonne of CO emissions, comparable to removing 10,000 cars from the road for a year. The scope for savings and avoided emissions is even greater in other countries where electricity is more expensive.



A 56-megawatt (MW) synchronous motor utilised for an air separation unit (ASU).

The motor will drive an air separation unit (ASU) that will liquify atmospheric air so that the oxygen and nitrogen can be separated out to provide pure gases for the steelmaking process.

The motor, destined for a steel plant in India, has achieved an efficiency rating of 99.13 percent.

Says **Brandon Spencer, President, ABB Motion,** "ABB is on a mission to help industries outrun – leaner and cleaner – and this project shows how our products go beyond standards with our Top Industrial Efficiency (TIE) initiative, which delivers large motors and generators with the highest possible energy efficiency. He adds, "This initiative helps our customers boost profitability since electricity costs are, by far, the largest component in the total cost of ownership (TCO) of this type of motor, at the same time they are also cutting their carbon emissions."

ABB's TIE initiative addresses a major gap in energy efficiency standards for large motors (3 MW+), which, despite being a small part of the global motor base, convert about 25 percent of all motion-related energy.

Setting the new world record on efficiency reflects ABB's ongoing commitment to further optimising the motor's electrical and mechanical construction, drawing on extensive application knowledge and over a century of experience in manufacturing electric motors. This achievement is particularly significant given that the average efficiency for this type of synchronous motor typically ranges between 98.2 percent and 98.5 percent.

NORTH-EAST POWER CONCLAVE

Driving Regional Energy Transformation in Eight NE States

IEEMA hosted the North-East Power Conclave 2025 in Guwahati as the first-ever event of its kind in the region, attracting over 500 delegates in the presence of two state power ministers and three state power secretaries, senior government officials, utilities, and industry leaders from all eight North-Eastern states.

In a major step toward accelerating energy development in India's Eastern frontier, IEEMA hosted the North-East Power Conclave 2025 on June 17-18, 2025, in Guwahati.

As the first-ever event of its kind in the region, the conclave hosted **F Rodingliana, Hon'ble Minister, Power & Electricity Department and KG Kenye, Hon'ble Minister, Department of Power, Government of Nagaland and State Power Secretaries from Assam, Mizoram, and Tripura.** The event attracted more than 500 delegates and featured the presence of senior government officials, utilities, and industry leaders from all eight North-Eastern states to chart the future of sustainable, connected energy systems.

The two-day conclave aimed at fostering regional collaboration, accelerating infrastructure investments, and addressing unique opportunities and challenges faced by the North-East in its energy journey. From sustainable generation to smart transmission and last-mile connectivity, the agenda reflected a holistic approach to regional transformation. The conclave set the tone for strategic dialogue, with a strong focus on green energy, modern transmission systems, and cross-state cooperation.

Inaugural Session

The first-ever North-East Power Conclave commenced on a radiant note, setting the tone for two days of dialogue, discovery, and direction. With policymakers, innovators, and experts under one roof, the conclave will enable strategic discussions, regional opportunity mapping, and a collective vision for the future of power in the North-East.

Address by Guest of Honour KG Kenye, Honble Minister, Department of Power, Government of Nagaland

Address by Guest of Honour F Rodingliana, Hon'ble Minister, Power & Electricity Department, Government of Mizoram

Address by Special Guest Jadav Saikia, IAS, Secretary, Power (E) Department, Government of Assam

Welcome Remarks by Utkarsh Bansal, Chairman, IEEMA ER

The inaugural session of the North-East Power Conclave featured keynote addresses from IEEMA leadership and eminent dignitaries. The session also included the facilitation of the Guests of Honour – KG Kenye, Hon'ble Minister for Power, Government of Nagaland, and F Rodingliana, Hon'ble Minister for Power & Electricity, Government of Mizoram.

During his address at the inaugural session of the North-East Power Conclave, Guest of Honour **KG Kenye, Hon'ble Minister, Department of Power, Government of Nagaland,** emphasised the growing opportunities in the region. He acknowledged IEEMA's valuable role in the power sector and invited the industry to actively explore Nagaland for private investment and strategic partnerships and called for increased industry attention to the region: "I just learnt how IEEMA has been a partner to this country. You may have concentrated on the mainland for far too long and this could be your first big visit to this region. With all your expertise, experience, and infrastructure, the Vision of 2047 for a Viksit Bharat is actually meant for my state – Nagaland – a state with a huge energy deficit and growing demand. We have faced a resource crunch due to political situations, and private players and big industrialists have stayed away because of the dynamics surrounding the state. But things are changing. The environment is now conducive, and private partnerships are beginning to come in."

From Mizoram, Guest of Honour **F Rodingliana, Hon'ble Minister, Power & Electricity Department, Government of Mizoram,** appreciated IEEMA's efforts in bringing the industry together and spotlighted Mizoram's untapped hydropower potential. He also urged the revival of key schemes to help states like Mizoram harness their true energy capacity. "We are thankful to IEEMA. In my state, it is a remote area. One thing about Mizoram these days is that there is a lot of potential, especially in hydropower. We have a river capacity of 3,600 MW, but the rivers are not conducive to power generation. We are generating below 100 MW, while our peak demand is about 60-100 MW. So, we have a lot of work to do. Now, we are targeting three rivers. There is one scheme by MNRE for small hydro-projects that has stopped over the past five years. This scheme is important for our

Address by Special Guest K Lalrinzuali, IAS, Secretary, Power & Electricity Department, Government of Mizoram

Vote of Thanks by Arjun Deb, Vice Chairman, IEEMA ER

state, but the budget for power is low. I have asked the Centre to revive the scheme."

Speaking at the conclave, Special Guest **Jadav Saikia, IAS, Secretary, Power (E) Department, Government of Assam,** reaffirmed the state's ambitious clean energy goals and welcomed greater industry participation. He appreciated IEEMA's deep understanding of the region's unique challenges and emphasised the importance of collaborative action to turn vision into reality. "I appreciate IEEMA's comprehensive understanding of the region's challenges, and I believe this conclave will help bridge the gap between vision and execution through meaningful state-industry collaboration. The North-East holds immense promise as a future power exporter to our neighbours. Assam alone targets 3,000 MW of solar by 2030 and 5,000 MW of pumped storage by 2035. We are in Seismic Zone-V, yes, but with the right technology, even that challenge can be met. We have received over 20 private investment proposals, and I assure you, the government is fully committed to supporting each one."

NEPC FACTS

- Presence of two state power ministers from Nagaland, and Mizoram
- Three state power secretaries from Assam, Mizoram, and Tripura
- 500+ delegates
- 150+ buyer seller meetings
- Seven state utilities and four PSUs

Delivering the keynote address, **Sunil Singhvi, President, IEEMA,** highlighted the region's critical role in the national renewable energy roadmap: "Actually, the North-East is the gateway for energy transition – it is not only the gateway to South-East Asia. The region has huge potential, with approximately 58,000 MW of hydro capacity, which is critical for meeting our renewable energy targets. I believe the North-East holds an investment potential of about Rs60,000-70,000 crore over the next 10 years, be it in hydro generation or grid expansion. Despite its geographical challenges, the industry can deploy modern technologies here. Local industries can be trained, and we can work together with regulators, the government, and local manpower to skill them and transition the entire system onto a new technology platform."

Siddharth Bhutoria, Vice President, IEEMA, reflected on the larger vision behind the conclave: "This conclave is about more than power, it is about empowerment. The North-East is ready to take its place in the national energy narrative, and we at IEEMA are committed to enabling this journey through policy dialogue, industrial collaboration, and capacity building. IEEMA's presence here is not ceremonial, it is intentional. We are here to partner with the region in driving investment, enhancing transmission capability, and unlocking the immense energy potential that can power not only the North-East, but also support national growth."

The event continued with technical sessions featuring representatives from PowerGrid, REC, PFC, CEA, and NEEPCO, among others, who discussed opportunities in grid integration, next-gen transmission, and financing models for upcoming regional projects.

The conclave also featured a buyer-seller meet on the sidelines, giving participating companies an opportunity to forge profitable business partnership to drive growth.

Session 1: Overall Opportunities in North-East India

The first session of the North-East Power Conclave, chaired by Rajiv Agarwal, NEC Member, IEEMA, brought together industry experts to explore emerging opportunities in the region. Key themes included infrastructure development, renewable integration, grid expansion, investment facilitation, and more, laying a strong foundation for the sessions to follow.

Session Chair: Rajiv Agarwal, NEC Member, IEEMA

Panellists:

- Ajay Kumar Gupta, HoD & Sr. Chief Program Manager & Aurabind Pal, Manager-Technical, REC Limited, Guwahati.
- Dr. Veepin Kumar, Dy Director, Energy Storage & System Division, Central Electricity Authority (CEA)
- Shwetabh Verma, Senior General Manager, Power Finance Corporation Ltd
- Rajesh Gupta, Executive Director, Guwahati, Power Grid Corporation of India Ltd
- Nava Jyoti Medhi, GM (Tech), North-Eastern Electric Power Corporation Limited (NEEPCO)
- Gurpreet Oberoi, Chief Business Officer, Kimbal Pvt Ltd.

Session 2: Next-Gen Transmission for North-East India

Chaired by Siddharth Bhutoria, Vice President, IEEMA, Session 2 spotlighted the future of transmission systems in the region. From innovation to system reliability, the discussion highlighted how future-ready infrastructure is essential to unlock the North-East's energy potential.

Session Chair: Siddharth Bhutoria, Vice President, IEEMA

Panellists:

- Bharat Sehgal, Vice President & Head Design & Engg Dept, Polycab India Ltd
- Jashobant Singh Ray, Vice President, KEI Industries Ltd
- Amit Bajaj, President, Lumino Industries Limited

Session 1: Overall Opportunities in North-East India

Session 2: Next-Gen Transmission for North-East India

- Harish Agarwal, President – Business Development, Laser Power & Infra Pvt Ltd
- Sushma Sharma, Head CSR, Anvil Energy Pvt Ltd.

Session 3: Special Plenary Session

Session 3 brought together senior leaders for a Special Plenary Session, moderated by Mr. Harish Agarwal, Past President, IEEMA. The keynote was delivered by **Abhishek Singh, IAS, Secretary, Department of Power, Government of Tripura.** The session offered strategic perspectives on strengthening North-East India's power ecosystem through policy support, infrastructure planning, and coordinated action.

During his keynote, **Abhishek Singh, IAS, Secretary, Department of Power, Government of Tripura,** said, "The future of India's energy transformation runs through the North-East. Once overlooked, this region is now a key driver of national goals, from enabling 500 GW of renewable energy capacity to enabling cross-border power trade and building smarter, greener grids. With innovations like underground cabling in Agartala, drone surveillance and AI-led power management, the North-East stands ready. Tripura, recognised as a clean city and a catalyst for region, welcomes the industry to collaborate and co-create solutions."

Moderator: Harish Agarwal, Past President, IEEMA

Panellists:

- Abhishek Singh, IAS, Secretary, Department of Power, Govt of Tripura
- AI Syngkon, General Manager, Power Grid Corporation of India Ltd
- Utkarsh Bansal, Chairman, IEEMA ER.

Fire Side Chat on Modern Warfare

Day 1 of the conclave concluded with a Fire Side Chat with **Lieutenant General Rana Pratap Kalita (Retd.),** PVSM, UYSM, AVSM, SM, VSM on Modern Warfare in conversation with **Utkarsh Bansal, Chairman, IEEMA ER and Charu Mathur, Director General, IEEMA.**

Session 4: Upcoming Projects and Developments in North-East

Day 2 of the North-East Power Conclave began with an insightful Session 4 on 'Upcoming Projects and Developments in the North-East'. The session

Session 3: Special Plenary Session with Abhishek Singh, IAS, Secretary, Department of Power, Government of Tripura

Fire Side Chat on Modern Warfare

Session 4: Upcoming Projects and Developments in North-East

Session 5: Tech-Driven Transformation in Power Sector of North-East

brought together industry experts to discuss ongoing and planned infrastructure initiatives aimed at strengthening the region's power ecosystem. From generation to distribution, the dialogue emphasized the importance of strategic investment, collaborative execution, and technology adoption to unlock the full potential of the North-East's energy landscape.

Session Chair: Utkarsh Bansal, Chairman, IEEMA ER

Panellists:

- Aklantika Saikia, GM, Assam Power Generation Corporation Limited (APGCL)
- Nirupam Guha, AGM, Transmission & Ms. Sujata Sarkar, DGM (C & T), Tripura State Electricity Corporation Ltd (TSECL)
- Dr. Sarangthem Sanajaoba Singh, DGM, Manipur State Power Corporation Ltd (MSPCL)
- Charmene Karie B Sangma, Superintending Engg, Meghalaya Power Distribution Corp. Ltd (MePDCL)
- Moa Meren, Superintending Engineer (Tech), Department of Power, Nagaland.

Session 5: Tech-Driven Transformation in Power Sector of North-East

The final session of the North-East Power Conclave, 'Tech-Driven Transformation in the Power Sector of North-East', brought the two-day event to a forward-looking close. The session explored the transformative potential of digital tools, automation, and advanced systems in the North-East. It highlighted how technology can drive efficiency, transparency, and resilience across the power value chain. from generation to last-mile delivery.

Session Chair: Amit Bajaj, President, Lumino Industries Limited

Panellists:

- Mukesh Wadhwa, Director Sales, India Region, Electrification Software Business, GE Vernova
- Lt Col (Retd.) Amitabh Bhardwaj, Project Consultant, IITM Pravartak Technologies Foundation
- Sagar Samaddar, Lead Electrical Project & Utilities, Tata Electronics.

3rd MEP Consultants Meet

IEEMA's 3rd MEP Consultants Meet – held from June 12-14, 2025, in Kochi – brought together over 250 delegates, facilitating dynamic engagement among MEP professionals, developers, government officials, and industry experts.

IEEMA successfully hosted its 3rd edition of the MEP Consultants Meet from June 12-14, 2025, at Grand Hyatt Bolgatty, Kochi. The flagship event brought together over 250 delegates, including more than 95 leading mechanical, electrical, and plumbing (MEP) consultants from across India.

This exclusive platform facilitated dynamic engagement among MEP professionals, developers, government officials, and industry experts. The discussions centred around safety, sustainability, reliability, and innovation in building services and infrastructure design.

Inaugural Session & Key Highlights

The event was inaugurated on June 13, 2025, in the presence of IEEMA leadership and senior government dignitaries.

Key speakers included:

- Welcome Address: Shashi Amin, Chairman, MEP Consultants Meet
- Context Setting: Vipul Ray, Past President, IEEMA
- Presidential Address: Sunil Singhvi, President, IEEMA


Shashi Amin


Vipul Ray


Sunil Singhvi


Kamal Goliya


Shashin Shah

- Address: Kamal Goliya and Shashin Shah, OC Members.
- Chief Guest: Vivek Srivastava, IPS, Director General, Fire Services, Civil Defence & Home Guards, Ministry of Home Affairs, Government of India.


Vivek Srivastava

In his keynote address, **Vivek Srivastava, IPS, Director General, Fire Services, Civil Defence & Home Guards, Ministry of Home Affairs, Government of India,** emphasised the urgent need to integrate fire-safe design principles within MEP systems. He stressed that fire safety must not remain siloed but be treated as a core element of holistic MEP design.

He advocated for the harmonisation of standards across disciplines – electrical, mechanical, plumbing, and fire safety – to enable cohesive and compliant implementation. Highlighting the role of technology, he spoke on artificial intelligence (AI)-driven monitoring, internet of things (IoT)-based sensors, real-time electrical diagnostics, and fire simulation modelling as transformative tools in modern building design.

He concluded by urging the industry to invest in innovation, stating that India's global leadership in the built-environment sector depends on adopting a safety-centric, forward-looking, and tech-enabled approach.

IEEMA MEP Division Roadmap Presentation

The IEEMA MEP Division Roadmap aims to raise compliance of design standards by promoting certified, safety-compliant MEP practices. This will create greater demand for high-quality electrical products, directly benefitting IEEMA members. IEEMA aims to pursue faster implementation of the Professional Engineers (PE) Bill prepared by the Government of India.

Through training programmes, regulatory engagement and global outreach, IEEMA members will gain new business opportunities, improved compliance clarity, and increased visibility in smart and sustainable infrastructure projects.

At the event, **Narendra Duvedi, Mentor at SAS Powertech Pvt Ltd,** presented the IEEMA MEP Division Roadmap, outlining a vision to raise national design standards through certified, safety-compliant practices. He shared how this initiative would benefit IEEMA members by creating: new business opportunities, greater regulatory clarity, and enhanced visibility in smart and sustainable infrastructure.


Narendra Duvedi

This presentation received an encouraging response from attending consultants and manufacturers alike, laying the groundwork for stronger engagement through the MEP Division.

Conference Themes & Sessions

- Effective Use of Standards, Codes & Regulations
- Gaps in Achieving Safety, Sustainability & Reliability
- Future-Proofing MEP Design for Smart Buildings
- Electrical Safety Best Practices and Certification

Technical Sessions

- Fireside Chats with representatives from CEA, BIS, and NBC
- Three Thematic Panel Discussions
- Curated Presentations by Industry Experts
- Interactive Dialogues between Consultants, Regulators, and Manufacturers

Key Case Study Presentations made by Industry Experts

- 'How to Be a Proactive MEP Consultant' – NK Jain, Director, N K Jain Consulting Engineer
- 'Design Implementation of India's Largest Tier IV Data Centre' – Shikha Jain, Datacentre Design Specialist, N K Jain Consulting Engineer


NK Jain


Shikha Jain


Pankaj Dharkar


Mustafa Wajid

Panel 1: Effective Use of Standards

Panel 2: Addressing Gaps in Safety, Sustainability & Reliability

Panel 3: Future-Proofing MEP Design

Panel 4: Electrical Safety & PE Certification

- 'Safety, Sustainability, Reliability & Innovation for Hospitality & Warehouses Projects' – Pankaj Dharkar, Director, PDA Consultants
- 'Buildings – The Net Zero Opportunity' – Mustafa Wajid, Managing Director & CEO, MHM Holdings Pvt Ltd.

Panel Discussion Highlights

Panel 1: Effective Use of Standards

- Urged simplification of codes for sector-specific applications.
- Emphasised public-private partnerships (PPPs) for awareness.
- Proposed mandatory certification and online training for engineers.

Panel 2: Addressing Gaps in Safety, Sustainability & Reliability

- Identified lack of safety investment by project owners.
- Stressed greater code awareness among architects and designers.
- Recommended government-recognised, certified MEP professionals.

Panel 3: Future-Proofing MEP Design

- Advocated for energy-efficient and safe building materials.
- Recommended integrated system testing (IST) as a mandatory BOQ item.
- Encouraged integration of AI, solar, and smart grid technologies.

Panel 4: Electrical Safety & PE Certification

- Called for urgent passage of the Professional Engineers Bill.
- Suggested capacity-building programmes by IEEMA.
- Promoted PE-led implementation of standards and compliance mechanisms.

Participation & Engagement

- Total delegates: 250+
- MEP consultants: 95+
- Government officials: BIS, CEA, NBC, and Ministry of Home Affairs

The event also witnessed an enthusiastic response to the launch of the IEEMA MEP Division. Many consultants registered onsite, with several expressing keen interest in playing an active role in the division's future initiatives.

Sembian Balasubramanian

Imteyaz Siddiqui

Conclusion and Way forward

The success of the 3rd MEP Consultants Meet lays a strong foundation for the next phase of development:

- Expanding the IEEMA MEP Division.
- Strengthening industry-academia-government collaborations.

IEEMA remains committed to enabling technical excellence, regulatory compliance, and innovation within the MEP consultant ecosystem.

Electrical Fire Safety Conclave, Bengaluru

IEEMA organised the Electrical Fire Safety Conclave in Bengaluru on June 6, 2025, with an aim to create mass awareness on preventing fires and mitigating their adverse effects while formulating a perspective that will serve as a guideline for all stakeholders, civic officials, and industry experts.

Today, electricity has become the backbone of development. It is one of the essentials required to sustain modern society life. Electricity, though a good servant, may prove to be hazardous if due care is not exercised in its use. Accident statistics show that nearly 60 percent of fire accidents in buildings are due to electrical reasons, which have resulted in fatalities, indicating its potential of severity. Although utmost quality and safety is observed during manufacturing of electrical equipment, errors in installation, improper maintenance, and ignorance of safety precautions during their use may lead to accidents. With an increase in reported injuries and deaths associated with the use of electricity, electrical safety is becoming a more prominent health and safety concern for the society at large.

IEEMA's Electrical safety campaign is an effort to promote safe and reliable practices in electrical installations and usage according to the latest National Regulations 'measures relating to safety and electric supply regulations 2023' and the 'National Electrical Code of India 2023'. It aims to increase awareness among the general public, businesses, and organisations about the importance of electrical safety, the consequences of ignoring it, and the recommendations in the new regulation and code of practice.

The Conclave at Bengaluru!

IEEMA organised the Electrical Fire Safety Conclave in Bengaluru on June 6, 2025, at Radission Blu Atria. The conclave's primary objective was to create mass awareness on preventing fires and mitigating their adverse effects.

The conclave had a mix of domestic experts from varied segments speaking on electrical fire safety issues. It focused on formulating a perspective that will serve as a guideline for all stakeholders, civic officials, and industry experts.

Key Takeaways

Key takeaways from the conclave were:

- Understanding the importance of electrical safety.
- To know statutory requirements under relevant laws.
- Ability to identify electrical hazards.
- Knowledge of control measures, regulatory frameworks, and standards.
- Knowledge of best practices and technologies.
- Understand safety procedures in installation of electrical equipment and during maintenance work.

Inauguration

- Gaurav Gupta, Additional Chief Secretary to Government, Energy Department, Karnataka
- Theethira N Appachu, Chief Electrical Inspector to Government of Karnataka
- Shashi Amin, NEC Member & Chairman IEEMA MEP Consultant Meet
- R Prakash, NEC Member, IEEMA
- Aarya Satyanarayana, NEC Member, IEEMA
- Aruna Janardhana, NEC Member, IEEMA.

Session I: Regulatory Framework: Provisions, Challenges and Opportunities

Moderator: Dayananda Cheluva, Head Design Electrical, Qpro Design Consultants Pvt Ltd

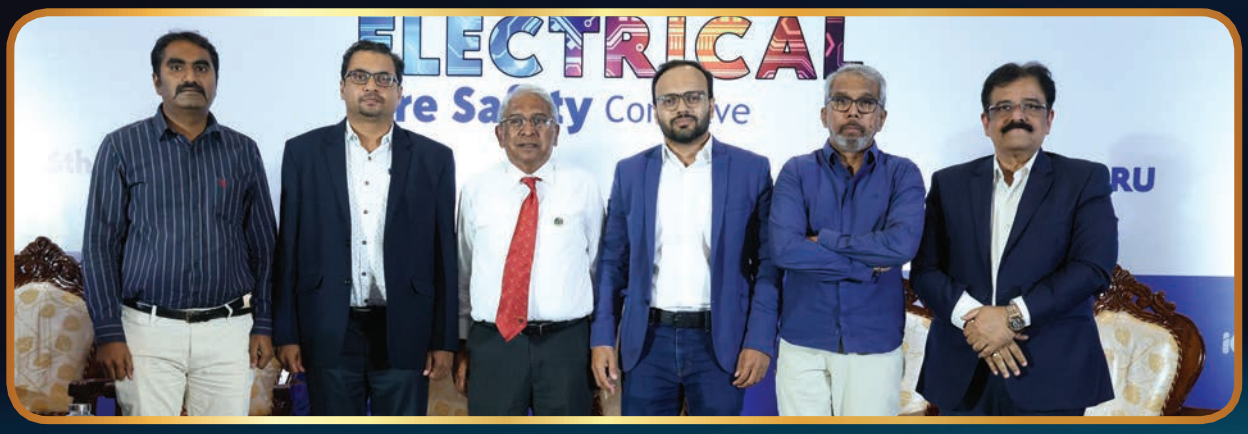
Panellists:

- Ramaprakash S, Director & Technical Advisor, Akash Electro Consultants Pvt Ltd
- Shashiraj KB, Rtd Additional Chief Electrical Inspector, Karnataka
- Meena KP, Additional Director, Group Head, (MED & CED) & HoD-CDD, CPRI
- Vinodini Kishore, Scientist-E and Director, BIS.

Session II: Electrical Fire Safety in Today's Buildings & Construction

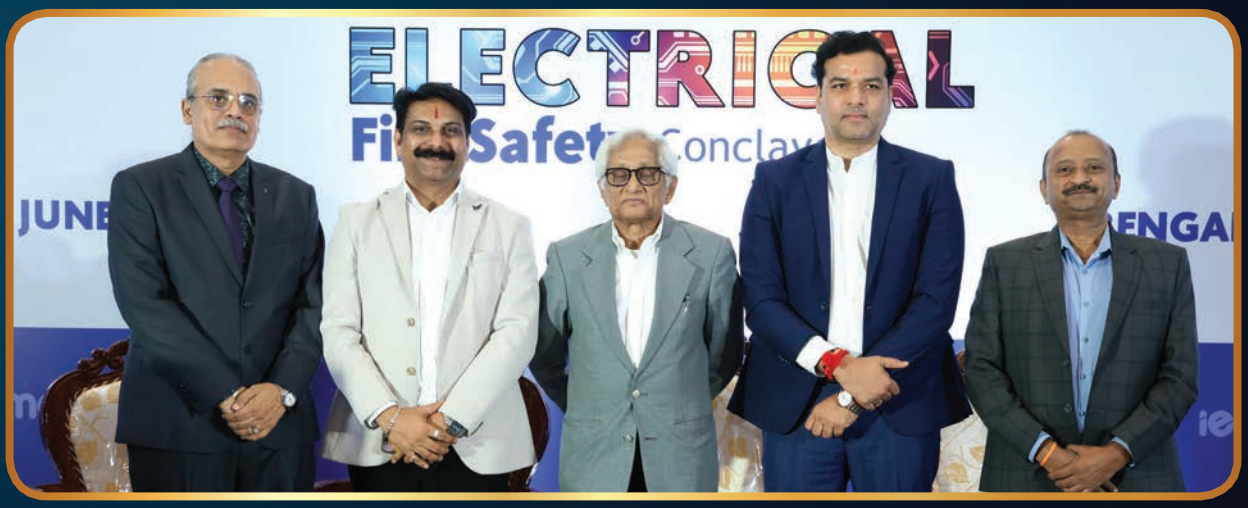
Moderator: Mani Samuel, Procon Consultants, CMD & President-ELCA (Expert in Real Estate and Commercial Buildings)

Session I: Regulatory Framework: Provisions, Challenges and Opportunities



Session II: Electrical Fire Safety in Today's Buildings & Construction

Session III: Electrical Fire Safety in IT Parks and Data Centres



Session IV: Best Practices and Technologies of Electrical Fire Safety

Panellists:

- Ramesha G, Chairman & Managing Director, Ralys Consultants (IT & Hospital Buildings)
- Jayesh Painy, Associate Director-Building Services, Colliers
- Bhadresh S, General Manager & Head-MEP, Sattva Group
- Chandrashekar GN, Leader-Infrastructure Management Function (MEP), Azim Premji Foundation
- Shashi Amin, CEO-Cable Solutions, Apar Industries Limited.

Session III: Electrical Fire Safety in IT Parks and Data Centres

Moderator: Vinay Singh, Director, Ralys Consultants

Panellists:

- Vijay Kumar, Managing Director, EPG Consultants Pvt Ltd (Specialist in Data Centres)
- Siddanagoud Patil S, Deputy Director & Head, MEP & Sust Initiatives-Project Management, CapitaLand India
- Shankar KM, Senior Director-Data Center Operations, ST Telemedia Global Data Centres
- Janakiraman, Head-Projects, CRESCON.

Session IV: Best Practices and Technologies of Electrical Fire Safety

Moderator: BRV Murthy, Co-Founder, Potential (Expert in Real Estate and IT Buildings) and Founder Member, ELCA

Panellists:

- Niileish Patil, Senior Vice President & Head Projects (Commercial, Hospitality, Retail), PrimeCo Realty Pvt Ltd
- Devaraja TH, Executive Vice President & HOD-M&E (Electrical & HVAC), Sobha Limited
- R Rajesh Shetty, Chairman & Managing Director, Shankar Electricals Services (I) Pvt Ltd
- Deepak Tikle, Executive Director, V-Marc India Ltd.

Certification Course in 'Reliability Engineering for Electrical Industry Professionals'

IIT Kharagpur is the largest technical institution in India. It is ranked among the top five Indian universities by ranking agencies. The Subir Chowdhury School of Quality and Reliability was formerly known as Reliability Engineering Centre (REC). REC came into existence in 1983. It offers MTech, MS, and PhD degree programmes in Quality and Reliability Engineering. The school is actively engaged in research and consultancy projects for the government and private organisations and also offers certificate courses to industry participants.

About the Course

- The certificate programme is exclusively designed in collaboration with IEEMA and offered to industry participants only.
- The course will help participants understand reliability engineering concepts and enable them to apply these concepts for better product life-cycle management.
- The schedule is stretched over six months and the course is a good blend of theoretical knowledge, practice sessions, and practical applications.

At the inauguration held at the IIT Kharagpur campus on June 16, 2025, **Prof. Neeraj Kumar Goyal, Course Coordinator,** gave a welcome address, followed by opening remarks by **Prof. Sanjay Kumar Chaturvedi, Chairperson (Officiating), SCSQR, IIT Kharagpur** and an address by **Suresh Bhardwaj, Consultant (Quality), IEEMA.** This was followed by an online address by **Siddharth Bhutoria, Vice President, IEEMA;** and messages from **Charu Mathur, Director General, IEEMA,** and **Sunil Singhvi, President, IEEMA.**

Chief Guest Prof. Haimanti Banerji, Associate Dean (Outreach), IIT Kharagpur, then addressed the participants, followed by an introduction of the participants and mentors.

Twenty-five participants from different functions and member organisations will be trained under this course that has both, academic input and project work, for implementing the learnings in their respective organisations.

This initiative of IEEMA will usher in the culture of reliability in the industry.

Meeting with Hon'ble Minister of Power

IEEMA is grateful to the **Hon'ble Minister of Power, Shri Manohar Lal,** for giving IEEMA the opportunity to present the growth, investment by the transformer industry as well as some challenges to be streamlined.

IEEMA is fully committed to the guidance provided by the HMoP to prioritise 'Make in India' and quality while serving the nation's energy needs.

Webinar on 'Accelerate Your MSME: Unlock Finance, Tech & Energy Solutions'

IEEMA SME Division successfully hosted a high-impact webinar titled **'Accelerate Your MSME: Unlock Finance, Tech & Energy Solutions'** on June 20, 2025. The session was part of IEEMA's commitment to building a resilient, innovative, and sustainable MSME ecosystem within the electrical and electronics industry. This webinar is first in a series of activities planned by IEEMA SME division. More than 75 MSME entrepreneurs, industry professionals, and stakeholders participated in the knowledge-rich session.

The session began with **Charu Mathur, Director General, IEEMA,** welcoming participants and emphasising on the need to equip MSMEs with actionable insights on financing, technology adoption, and sustainable practices.

Dr. Kamal Goliya, Chairman, IEEMA SME Division, framed the session around three key pillars critical to MSME growth: 1) Access to finance 2) Technology adoption (Industry 4.0) and 3) Clean and efficient energy solutions. He emphasised on the need for MSMEs to adapt to a changing industrial landscape and leverage government incentives, digital tools, and sustainability-focused strategies to scale up.

The webinar also featured a presentation by **Praful Umare, IEDS, Assistant Director-I, MSME-DFO, Mumbai.** He elaborated on critical MSME financial schemes including, PMEGP, CGTMSE, SRI Fund, TReDS, ZED, and Lean/GIFT initiatives. He emphasised on access to credit, grievance redressal, and green finance.

Kartik Lath, Manager-Customer Success, Indi4 Pvt Ltd, made a presentation on digital transformation with Industry 4.0. He showcased how MSMEs can improve productivity, quality control, and supply chain efficiency using, IoT, AI/ML, smart dashboards, and predictive maintenance. He used cases from national digital factory pilots for MSMEs.

Manya Ranjan, Co-founder, Two Point O Capital, in his presentation on Energy Efficiency & Clean Energy Financing, introduced innovative lease-based clean energy financing models for rooftop solar, heat pumps, water treatment projects that enable savings of 25-40% with zero upfront investments, and shared success stories across pharma and auto sectors.

Participants actively engaged in the Q&A session on finance, tech adoption, and sustainability. **Ashok Saigal, Member, IEEMA SME Division,** expressed gratitude to the speakers, participants, and the IEEMA Secretariat team for the webinar's seamless execution. He urged MSMEs to stay connected with IEEMA and continue leveraging the division's support network.

The webinar delivered clear takeaways to help MSMEs become digitally empowered, financially supported, and sustainability driven. IEEMA SME Division will continue to lead efforts to enable MSMEs to scale and thrive in a competitive landscape.

India successfully met peak power demand of 241 GW on June 9, 2025, with zero peak shortage: Shri Manohar Lal

Union Minister Shri Manohar Lal recently highlighted 11 years of transformative growth in India's power sector in a recent press conference in New Delhi. The minister said, "It is our goal to make power accessible to everyone and at all times, and the government is aiming for 100 percent electrification of households across the country." Shri Manohar Lal declared that India has become power sufficient, meeting all its power demands, and is well on the path of power surplus country.

1. India meets peak demand with zero shortage: Union Minister Shri Manohar Lal informed that demonstrating remarkable growth and resilience, India successfully met peak power demand of 241 GW on June 9, 2025. This achievement underscores the nation's robust power infrastructure, with zero peak shortage reported.
2. Big push to battery energy storage – VGF scheme for 30 GWh battery storage: Shri Manohar Lal announced that in a massive push for energy security and renewable integration, the Ministry of Power has approved a viability gap funding (VGF) scheme for 30 GWh of battery energy storage systems (BESS), in addition to the 13.2 GWh already underway. This Rs5,400 crore scheme aims to attract Rs33,000 crore in investment, meeting the country's BESS requirement by 2028.
3. Boost for storage: ISTS waiver extended for storage projects: Union Minister Shri Manohar Lal in the press conference stated that the waiver of inter-state transmission system (ISTS) charges for storage projects has been extended until June 30, 2028, benefitting pumped storage projects awarded and BESS commissioned before this date. This extension is crucial for meeting India's growing storage needs and optimising the utilisation of transmission lines.
4. Ultra-high voltage alternating current (UHV AC) transmission system to reshape India's grid by 2034: Shri Manohar Lal said that India is set to revolutionise its power transmission with the rollout of an UHV AC transmission system. Nine 1,100 kV lines and 10 substations have been identified for development by 2034, with testing facilities under development by the Central Power Research Institute. Investment would be Rs53,000 crore.
5. Compensation for power transmission lines increased: Shri Manohar Lal said that in a landmark move, the Central Government has increased the compensation for land used in laying transmission lines to ease the right of way (RoW) issues. Compensation for the tower area has jumped from 85 percent to 200 percent of the land value, and for the RoW corridor from 15 percent to 30 percent, directly linking land value to market rates. Haryana and Delhi have already adopted the new guidelines issued on March 21, 2025.
6. More private investments in state transmission grids: In a move set to attract more private investment and ensure financial discipline, the late payment surcharge (LPS) rules have been expanded to include intra-state transmission systems. This crucial reform, previously applied only to inter-state transmission systems, aims to expand the intra-state transmission networks to absorb renewable electricity.
7. India adds historic 34 GW generation capacity in FY25, led by renewables: Shri Manohar Lal also stated that in an unprecedented feat, India added its highest-ever generation capacity of 34 GW during 2024-25, with renewable energy accounting for 29.5 GW. The nation's total installed capacity now stands at 472.5 GW, up from 249 GW in 2014.
8. 250 MW Tehri Pumped Storage Project (PSP) commissioned: Adding flexibility to the grid, 250 MW first unit of the Tehri Pumped Storage Project (PSP) in Uttarakhand has been commissioned. This project will help in managing peak demand and integrating renewable energy.
9. Energy shortages plummet to record low of 0.1 percent nationally: A testament to significant additions in generation and transmission capacities, India's national energy shortage has drastically reduced to a mere 0.1 percent as of April 2025. This marks a monumental improvement from the 4.2 percent shortage experienced in 2013-14, ensuring greater power availability for all.

MNRE participates in World Hydrogen Summit 2025, highlights India's vision and capabilities in renewable energy and green hydrogen

Secretary, Ministry of New & Renewable Energy, Government of India, Shri Santosh Kumar Sarangi recently addressed the World Hydrogen Summit 2025 in Rotterdam, highlighting India's strategic vision and capabilities in the domain of renewable energy and green hydrogen production.

The secretary underscored India's transformative potential of green hydrogen to become a global leader in this space. This ambition largely relies on India's strength in the renewable energy domain.

The secretary highlighted that India has already installed over 223 GW of renewable energy – including 108 GW from solar and 51 GW from wind – placing India among the fastest-growing renewable energy markets globally. He reiterated India's vision to achieve energy independence by 2047 and reach net-zero emissions by 2070.

To drive this transition, the National Green Hydrogen Mission was launched by the Government in 2023, with an initial allocation of US$ 2.4 billion. It lays out a comprehensive roadmap to:

- Identify and create demand in potential sectors.
- Provide production incentives for setting up domestic capacity.
- Achieve 5 million metric tonne of green hydrogen production by 2030.
- Averting nearly 50 MMT of CO2 emissions annually.
- Attract investments of about US$ 100 billion.
- Generate over 600,000 jobs.

The secretary further mentioned that India has made remarkable strides in green hydrogen development. The country has allocated 862,000 TPA production capacity annually to 19 companies and awarded 3,000 MW annual electrolyser manufacturing capacity to 15 firms, and we have launched pilot projects in steel, mobility, and shipping sectors.

The Green Hydrogen Certification Scheme of India has been launched recently. The mission is working on a whole-of-government approach and major policy provisions have been made to support the nascent but fast growing domestic green hydrogen industry. Green hydrogen and green ammonia plants have been exempted from environmental clearance by the Ministry of Environment, Forest and Climate Change. To push this forward, three major ports – Kandla, Paradip and Tuticorin ports – have been identified by Ministry of Ports, Shipping and Waterways (MoPSW) to be developed as green hydrogen hubs. Furthermore, 15 states have announced policies to support green hydrogen. These effective actions firmly establish India to be a global leader in green hydrogen sphere, but challenges ahead such as high production costs, lack of standardised frameworks, and infrastructure limitations pose hindrance to scaling up hydrogen economy.

The secretary invited delegates attending the Green Hydrogen Summit 2025 to visit India's Pavilion during the next two days and interact with Indian industries to explore partnerships.

The secretary's keynote address showcased that India's vision is not only to meet its domestic demand but also become a major global exporter of green hydrogen by 2030 – contributing meaningfully to decarbonisation action.

IREDA successfully raises Rs2,005.90 crore via QIP to boost green financing

The Indian Renewable Energy Development Agency Ltd (IREDA) has successfully raised Rs2,005.90 crore through a qualified institutions placement (QIP). The capital was mobilised by issuing 12.15 crore equity shares at a price of Rs165.14 per share, including a premium of Rs155.14 per share over the face value of Rs10.

The issue price of Rs165.14 reflects a discount of 5.00 percent to the floor price of Rs173.83 per equity share. Launched on June 5, 2025, the QIP issue closed on June 10, 2025, receiving an encouraging response from a diverse set of both domestic and foreign qualified institutional buyers (QIBs), including insurance companies, scheduled commercial banks, and foreign portfolio investors. The board has approved allotment of equity shares to eligible qualified institutional buyers in its meeting held on June 11, 2025.

The QIP was oversubscribed with bids amounting to Rs2,005.90 crore against the base issue size of Rs1,500 crore, achieving a subscription of 1.34 times. The capital raised through this

successful issue will further strengthen IREDA's Tier-I capital and overall capital adequacy ratio (CAR), enhancing the company's capacity to support the expanding renewable energy sector in India.

Reflecting on this achievement, **Shri Pradip Kumar Das, Chairman & Managing Director, IREDA,** said: "The successful completion of this QIP in a short span after our IPO in November 2023 is a testament to the trust and confidence the investor community and the Ministry of New & Renewable Energy have reposed in IREDA. This capital infusion will empower us to scale up our financing activities, enabling greater investments in renewable energy projects and accelerating India's transition towards a greener and sustainable energy future."

IREDA has reaffirmed its commitment to leading the country's clean energy financing initiatives.

Wind Energy is at the centre of India's strategy for the renewable energy sector: Union Minister Shri Pralhad Joshi

On Global Wind Day 2025, celebrated on June 15, **Union Minister of New and Renewable Energy Shri Pralhad Joshi** addressed a conference of stakeholders in Bengaluru, stating that wind energy is at the centre of India's strategy for the renewable energy sector.

To become a global manufacturing hub, India needs energy – be it solar, wind, or any other form of energy, said Shri Pralhad Joshi, as stated in a PIB release. "Our national goals are ambitious and clear: 50 percent of our power capacity from non-fossil fuel sources by 2030, and a net-zero India by 2070. Wind energy is central to achieving these goals. Wind energy is not a component of our renewable energy strategy, but it is at the heart of it and at the centre of *Atmanirbhar Bharat*," said the minister.

India has huge potential in the renewable energy sector as it globally has the fourth largest wind power installed capacity and it is the third largest renewable energy producer. "No one had thought that India would become the third largest manufacturer of renewable energy in 10 years, but today it is a reality," said the minister, stated the PIB release.

Furthermore, the minister underlined three key issues for the wind energy sector, saying: "First, we must combine wind with solar and storage (BESS) to deliver round-the-clock power and grid stability. Second, tariffs must be competitive. A rate of Rs3.90 per unit is too high; we must work together to reduce costs. Third, domestic manufacturing must become more efficient, not just to meet our own targets, but to boost exports."

Underlining the dedicated efforts from GoI to unleash the potential of renewable energy sector, Shri Joshi said, "The Government is backing this sector with full seriousness. This year's renewable energy budget has gone up by 53 percent, to Rs26,549 crore, with a large share directed to wind."

"The transition to renewables is inevitable. States must lead this transition. Land availability and transmission delays must be overcome. This is not the time for hesitation, it is the time for execution," the minister added.

Shri Joshi added, "I am happy to note that India is manufacturing wind turbines ranging from 225 kW to 5.2 MW, with 33 models being produced by 14 companies. These turbines meet our domestic needs and are also cost-competitive globally."

The minister further added that to fully unlock national wind potential, a coordinated national push is needed. Thus, the focus on five priorities:

i. Expanding into new states like Madhya Pradesh, Telangana, and Odisha.
ii. Launching the offshore sector with 4 GW of leasing areas identified in Gujarat and Tamil Nadu and tenders being readied.
iii. Integrating wind into round-the-clock and firm green power strategies, through storage-linked business models.
iv. Modernising the grid, investing in AI-based forecasting to manage variable renewable energy.
v. Boosting local manufacturing across the entire wind value chain.

Union Minister Shri Manohar Lal reviews power and urban development sector for J&K

Union Minister of Power and Housing & Urban Affairs Shri Manohar Lal recently reviewed the urban development and power sector scenario for the Union Territory of Jammu & Kashmir at Srinagar.

Shri Omar Abdullah, Hon'ble Chief Minister, J&K, and Shri Nasir Aslam Wani, Advisor to Hon'ble CM,

J&K, were also present in the meeting. The meeting was also attended by Chief Secretary of the UT of J&K, senior officials from the Government of India (GoI), UT Administration, representatives of state power utilities and CPSEs.

During the meeting, power sector issues in the UT of J&K were deliberated. The UT also highlighted concerns and major achievements related to urban and power sector and the possible solutions so as to meet future demand.

The UT highlighted the role that Revamped Distribution Sector Scheme (RDSS) of the Central Government has played in bringing improvement in the power distribution sector and in strengthening electricity distribution infrastructure for the remote areas of the UT. The UT also thanked Union Minister for approving the revised cost for RDSS works.

Chief Minister, J&K, in his address, thanked the Union Minister for his visit to Srinagar for review of UT of J&K for issues related to the urban and power sector and also highlighted major concerns for the UT. The UT requested for support from GoI for upgradation of the power distribution and transmission sector. It was remarked that the UT would make all out efforts for improvement in the sector.

In his address, Shri Manohar Lal, Union Minister of Power and Housing & Urban Affairs, welcomed all the dignitaries to the meeting. He mentioned that his visit to the UT would help in resolution of issues and in identification of new initiatives that may be taken up to further improve services to the citizens of the UT.

He asked the UT administration to plan for capacity augmentation as per the Resource Adequacy plan. He congratulated the UT for making concerted efforts for reducing power purchase costs and reducing the gap between power purchase costs and revenue realised, which will help improve finances of the power utilities and also facilitate reliable power supply in the UT.

The minister advised the UT to expeditiously implement the works sanctioned under RDSS. He advised the UT to take up prepaid smart metering works in a time bound manner, starting with government establishments and subsequently for commercial and industrial consumers. Based on experience and demonstration of benefits, the smart meters may be rolled out to other category of consumers. He mentioned that the UT should expedite payment of pending government department dues and saturate prepaid meters for all government establishments and government colonies by August 2025.

He also emphasised that the UT has a huge hydro-power potential, which should be effectively utilised. He mentioned that the UT should work in coordination with the Central Govt for skill development and capacity building of local workforce for hydro projects. He also asked the UT to resolve pending issues in the ongoing projects of NHPC to have their early completion. He also requested the UT to consider waiving-off of water cess levied on hydro projects, which will help reduce power supply costs and ultimately tariffs for consumers.

During the visit, Union Minister Shri Manohar Lal inaugurated various projects, including:

1. Augmentation of 132/33 kV grid station Awantipora from 145 MVA to 175 MVA.
2. Augmentation of grid station Wanpoh by way of replacement of age old 20 MVA, 132/33 kV power transformer by 50 MVA, 132/33 kV power transformer to be spared after augmentation of grid station Kulgam along with construction of boundary wall for the grid.
3. Augmentation of grid substation Amargarh from 135 MVA to 195 MVA.
4. Augmentation of grid substation Magam from 100 MVA to 130 MVA.
5. Replacement of 50 MVA transformer bank at Kulgam grid station by 80 MVA/100 MVA for load catering with allied works like as bus strengthening, equipment replacement, upgradation, etc.

Government notifies guidelines for scheme to promote manufacturing of electric passenger cars in India

The government has approved a forward-looking scheme to promote the domestic manufacture of passenger cars, with a special focus on electric vehicles (EVs). The initiative is aligned with India's national goals of achieving net-zero by 2070, fostering sustainable mobility, driving economic growth, and reducing environmental impact. It is designed to firmly establish India as a premier global destination for automotive manufacturing and innovation.

The Ministry of Heavy Industries (MHI) has issued a notification regarding detailed guidelines for the 'Scheme to Promote Manufacturing of Electric Passenger Cars in India' (SPMEPCI / the Scheme). MHI had issued the scheme notification on March 15, 2024. The Department of Revenue, Ministry of Finance, had also issued the notification on March 15, 2024, for reduced import duties in line with the provisions of the scheme. The Notice for inviting applications under the Scheme is proposed to be notified shortly, whereby the prospective applicants would be able to submit online applications.

The scheme will help attract investments from global EV manufacturers and promote India as a manufacturing destination for e-vehicles. The scheme will also help put India on the global map for manufacturing of EVs, generate employment, and achieve the goal of 'Make in India'.

To encourage global manufacturers to invest under the scheme, the approved applicants will be allowed to import completely built-in units (CBUs) of e-4W with a minimum CIF value of US$ 35,000 at reduced customs duty of 15 percent for five years from the application approval date.

Approved applicants would be required to make a minimum investment of Rs4,150 crore in line with the provisions of the scheme.

Custom duty benefits:

- The approved applicants will be allowed to import CBUs of e-4W manufactured by global group companies with a minimum CIF value of US$ 35,000 at reduced customs duty of 15 percent for five years from the application approval date.
- The maximum number of e-4W allowed to be imported at the aforesaid reduced duty rate will be capped at 8,000 numbers per year. The carryover of unutilised annual import limits would be permitted.
- The maximum number of EVs to be imported under this scheme will be such that the total duty foregone will be limited to the lower of the following:

i. The maximum duty foregone per applicant (limited to Rs6,484 crore), or

ii. Committed investment of the applicant (minimum Rs4150 crore).

- Total duty to be foregone will be limited to lower of Rs6,484 crore or the investment made under this scheme.

NATIONAL

Centre to float 4 GW offshore wind tenders in Tamil Nadu and Gujarat

The Government of India will reportedly float offshore wind energy tenders totalling 4 GW in Tamil Nadu and Gujarat. Reports suggest that the centre is focusing on five key areas to unlock India's wind energy potential – expansion into new states such as Madhya Pradesh, Telangana and Odisha; leasing 4 GW of offshore wind zones; hybrid integration with solar and storage and investments in artificial intelligence (AI)-based forecasting and grid upgrades; and domestic manufacturing support.

CERC notifies draft CERC (Power Market) (First Amendment) Regulations, 2025

The Central Electricity Regulatory Commission (CERC) has released the draft Power Market (First Amendment) Regulations, 2025, with an aim of modernising the country's electricity market. These proposed amendments aim at deepening market liquidity, improving operational flexibility, and enabling more efficient power trading. Key changes include the formal recognition of virtual PPAs, which offer a financial contracting mechanism for renewable energy. The regulations also expand the over-the-counter market to include new instruments like battery energy storage system (BESS) contracts and power banking.

MoP issues draft amendments on ESS usage and ownership

The Ministry of Power has issued the draft Electricity (Amendment) Rules, 2025, to amend the Electricity Rules, 2005, introducing provisions on the utilisation, ownership, and legal treatment of energy storage systems (ESS). As per the draft, ESS may be utilised either as an independent storage system or as an integrated component of generation, transmission, or distribution infrastructure. The ESS can be developed, owned, leased, or operated by generating companies, transmission or distribution licensees, consumers, system operators, or independent energy storage service providers.

MNRE issues revised norms for wind turbine prototypes

The Ministry of New and Renewable Energy (MNRE) has issued revised guidelines for installing and testing of prototype wind turbines to improve safety, certification, and technical compliance. The norms require manufacturers to obtain type certification from internationally accredited agencies before deploying prototypes. They also prohibit the use of second-hand components, ban serial production without revised list of models and manufacturers listing, and mandate full ownership retention by the manufacturer. The National Institute of Wind Energy will serve as the nodal agency, with limits set on the number of prototype installations and a cap of 18 months for grid synchronisation.

Centre approves Rs54 billion VGF for 30 GWh BESS

The Centre has approved a viability gap funding (VGF) scheme of Rs54 billion to support the development of 30 GWh of battery energy storage systems (BESS). This is in addition to the 13.2 GWh of BESS already under implementation. The initiative is reportedly expected to attract investments worth Rs330 billion, enabling India to meet its energy storage requirements by 2028.

Powergrid acquires MPTL under TBCB route

The Power Grid Corporation of India Limited (Powergrid) has acquired MEL Power Transmission Limited (MPTL), a project-specific SPV established for evacuating power from the Mahan Energen Limited generating station in Madhya Pradesh. MPTL has been acquired for approximately Rs 85.3 million under tariff-based competitive bidding. The project entails the establishment of a 400 kV direct current transmission line and associated bays at the Rewa PS (PG) substation in Madhya Pradesh, on a build, own, operate, transfer basis.

Unit-I of Ghatampur thermal power project in Uttar Pradesh launched

The Prime Minister has launched Unit-I (660 MW) of the 1,980-MW Ghatampur thermal power project

in Kanpur Nagar, Uttar Pradesh. The project is being developed by Neyveli Uttar Pradesh Power Limited, a joint venture between NLC India Limited and Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited (UPRVUNL) at an estimated Rs 217.81 billion. The other two units of 660 MW each are expected to be commissioned by 2025-26.

MNRE revises guidelines for small hydro power projects

The Ministry of New and Renewable Energy (MNRE) has issued revised guidelines for small hydro power schemes. The revised guidelines aim to address ongoing sectoral challenges faced by stakeholders. For release of the balance central financial assistance (CFA), projects now need to achieve at least 80 percent of the projected generation for any one corresponding month as per the detailed project report (DPR). If not, the second installment of CFA will be proportionally reduced.

Foundation stone laid for NTPC's Rs299.48-billion thermal power project in Bihar

Prime Minister Narendra Modi recently laid the foundation stone for the Nabinagar super thermal power project stage-II (3 x 800 MW) in Aurangabad, Bihar. The project is being developed by NTPC Limited at an estimated Rs 299.48 billion and is based on ultra-supercritical technology. The plant is expected to enhance electricity supply to Bihar and other beneficiary states including Rajasthan, Uttar Pradesh, Odisha, West Bengal, and Punjab.

RECPDCL incorporates SPV for transmission project in Madhya Pradesh

REC Power Development and Consultancy Limited (RECPDCL), a wholly owned subsidiary of REC Limited, has incorporated a SPV – Rajgarh Neemuch Power Transmission Limited – for two transmission projects in Madhya Pradesh. The SPV has been set up for evacuating power from renewable energy projects in Rajgarh (1,500 MW) under Madhya Pradesh Phase-III and from renewable energy projects in Neemuch (1,000 MW) special economic zones under Madhya Pradesh Phase-II. The Ministry of Power has appointed RECPDCL as the bid process coordinator for selecting a transmission service provider under the tariff-based competitive bidding route.

Gujarat to invest Rs290 billion to develop GEC-III

The Gujarat Government will invest Rs290 billion for developing the third phase of the green energy corridor (GEC-III) to facilitate the transmission of 16,500 MW of renewable energy across key regions in the state. GEC-III will reportedly connect renewable energy zones in Kutch, Jamnagar-Bet Dwarka, Banaskantha-Patan, and central Gujarat. The project involves the construction of 3,430 circuit km of transmission lines linked to six 765-kV substations and 860 circuit km connected to four 400-kV substations. Additionally, four static synchronous compensators will be installed to ensure stable power quality.

PFCCL incorporates two SPVs for transmission projects in AP and Maharashtra

PFC Consulting Limited (PFCCL) – a wholly owned subsidiary of Power Finance Corporation Limited (PFC) – has incorporated two new SPVs for developing interstate transmission systems in Andhra Pradesh and Maharashtra. Kurnool IV REZ Power Transmission Limited has been incorporated for implementing the transmission system for

Kurnool-IV REZ – Phase-II (3 GW) in Andhra Pradesh while Waghdari Transmission Limited will be responsible for developing a 400/220-kV substation at Waghdari in Solapur district, Maharashtra. Both SPVs have been set up to carry out preparatory activities such as project profiling, land acquisition, forest clearance, surveys, and report preparation. Once the bidding process is concluded, the SPVs will be transferred to the successful bidders, who will be responsible for project execution.

Odisha approves Rs38.78 billion investments across 17 projects

The Odisha Government has reportedly approved 17 investment proposals worth Rs38.79 billion at the state level single window clearance authority (SLSWCA). In the energy sector specifically, Iron Triangle Limited aims at investing Rs3.10 billion to set up a 200 MWh battery energy storage system in Bolangir district.

UPSIDA launches solar energy initiative to power industrial zones in Uttar Pradesh

The Uttar Pradesh State Industrial Development Authority (UPSIDA) has launched a solar energy initiative aimed at powering industrial zones across the state. UPSIDA has identified 13 sites for installation of solar power plants, including Surajpur site-5, export promotion industrial park in Gautam Budh Nagar, trans Delhi signature city in Ghaziabad, SEZ in Moradabad, along with sites in Baghpat, Agra, Mathura, Jhansi, Prayagraj, and Shahjahanpur. These zones have been selected for their industrial significance and will be developed as solar-enabled hubs.

INTERNATIONAL

India plans Rs900 billion undersea transmission links to the UAE and Saudi Arabia

The Government of India is reportedly planning an investment of about Rs900 billion to establish undersea power transmission lines for exporting electricity to the UAE and Saudi Arabia. As reported, the joint venture agreements have been signed with both countries. The UAE link – spanning 1,600 km – is estimated at Rs430 billion, while the Saudi Arabia link – with a cable length of 1,400 km – is estimated at Rs470 billion. Each transmission corridor will have the capacity to carry 2 GW of electricity.

Nepal commissions 40 MW power export to Bangladesh via Indian transmission line

Nepal has reportedly commenced exporting 40 MW of electricity to Bangladesh through the Indian transmission network. The move follows the trilateral agreement signed between Nepal, India, and Bangladesh on October 3, 2024, to enable cross-border electricity trade. As per the agreement, Nepal will supply 40 MW of electricity to Bangladesh from June 15 to November 15, 2025, using India's 400 kV Muzaffarpur-Baharampur-Bheramara transmission line. The power flow to Bangladesh reportedly began at midnight on June 15.

CORPORATE

Crompton Greaves secures Rs1.01 billion order for solar pump project in Maharshtra

Crompton Greaves Consumer Electricals Limited has secured a Rs1.01 billion order from the Maharashtra Energy Development Agency (MEDA) for supplying and installing 4,500 off-grid solar photovoltaic water pumping systems. The project – implemented under Component-B of the Pradhan Mantri Kisan Urja Suraksha evam Utthaan Mahabhiyan scheme – will be executed on a turnkey basis. It includes design, manufacturing, supply, installation, testing, and commissioning of the systems, along with a five-year comprehensive maintenance contract.

Rayzon Solar to file draft papers for Rs15 billion IPO with SEBI

Rayzon Solar Limited is set to file draft papers with the Securities and Exchange Board of India (SEBI) for an initial public offering (IPO) worth around Rs15 billion, as reported. The company has appointed leading investment banks to manage the issue, which is expected to comprise a fresh issuance of equity shares. Proceeds from the IPO will reportedly be utilised to fund expansion plans.

Global Scenario

HVDC Global

The adoption of HVDC has grown substantially in recent decades. An impressive 375 GW of HVDC capacity is operational today. With numerous plans and proposed projects, this capacity is set to surge, nearly doubling within the next two decades.

Figure 1: Installed HVDC Capacity (GW)

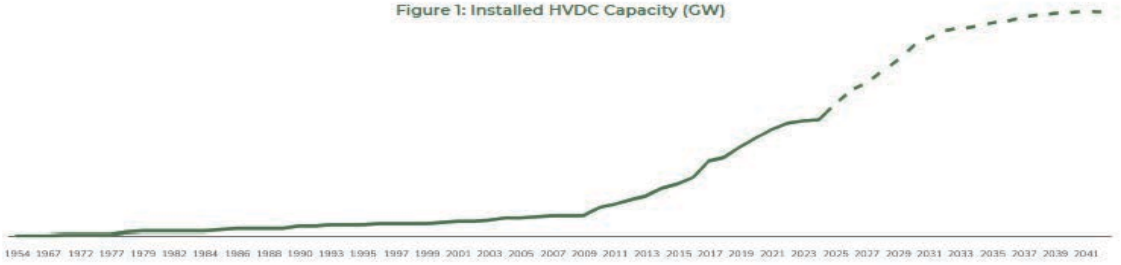
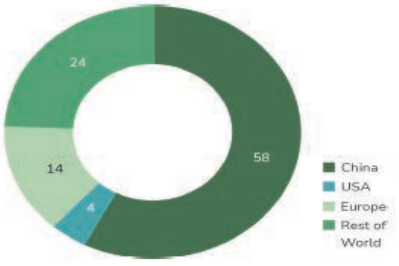


Figure 2: 2024 HVDC Installed Capacity by Region/Country (%)



Source: Global Transmission Report

Figure 3: Growth in HVDC Capacity by Region/Country (GW)

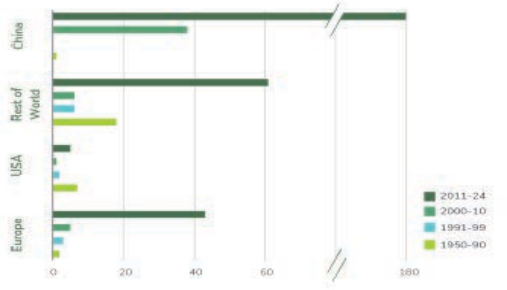


Figure 6: Long Distance HVDC Application Showcase

	Jinping-Sunan UHVDC Project, China	Northeast-Agra UHVDC Link, India	Changji-Guquan UHVDC Project, China	TransWest Express Project, USA
Developer	State Grid Corporation of China	Powergrid Corporation of India	State Grid Corporation of China	TransWest Express LLC
Capacity	7.2 GW	8 GW	12 GW	3 GW
Voltage	±800 kV	±800 kV	±1,100 kV	±600 kV
Line length	2,090 km	1,728 km	3,000 km	1,175 km
Commissioning year	2013	2017	2019	Expected in 2027
Objective	Connects hydroelectric plants in central-west to the eastern region	World's first ±800 kV multiterminal project transporting power from northeast to central-north India	World's first ±1,100 kV project, integrating remote generation	Will transmit wind energy from Wyoming to Colorado, Utah and Nevada

Figure 8: Urban HVDC Project Showcase

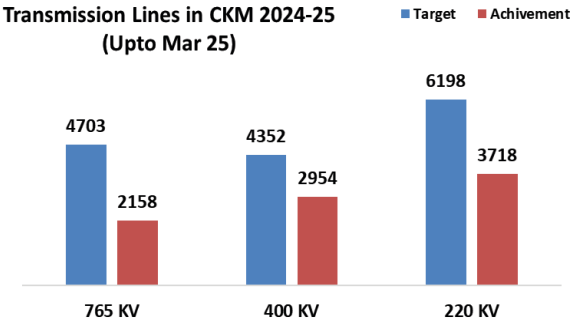
	Trans Bay Cable Project, USA	New York City Hudson Transmission Project, USA	Mumbai Green HVDC Link, India
Developer	Trans Bay Cable LLC, owned by NextEra Energy	PowerBridge	Adani Energy
Capacity	400 MW	660 MW	1 GW
Voltage	±200 kV, VSC	Back-to-back AC-DC-AC converter	±320 kV, VSC
Line length	85 km of underwater and underground cables	12 km	80 km overhead and underground link
Commissioning year	2010 2018 (upgrade of the control system)	2013	2025
Objective	Delivers additional power to San Francisco, helping to reduce congestion	Back-to-back converter station in New Jersey, to deliver power to customers in New York City	Based on VSC-MMC technology, will greatly enhance electricity supply to the metropolitan city of Mumbai

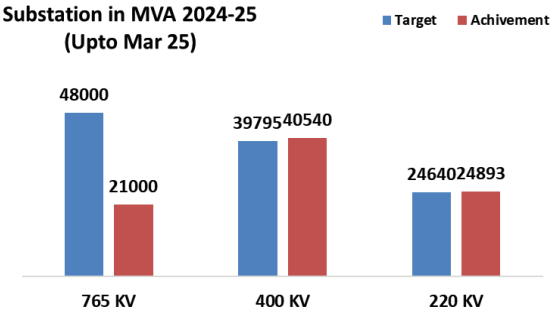
Source: Global Transmission Report

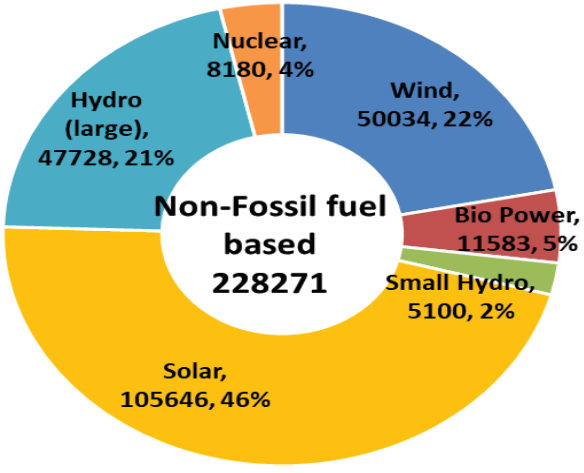
Indian Scenario

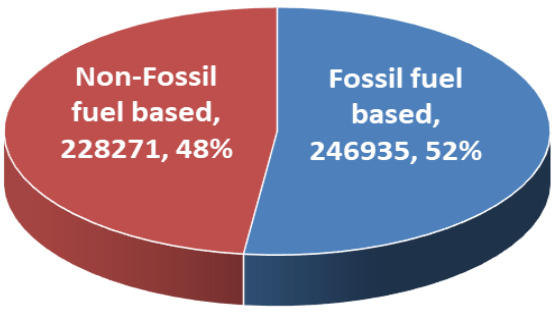
Indian Electrical Industry

As on 31.03.2025	Target for FY 2025-26
Installed Power Generation Capacity: Fossil fuel based: 2,46,935MW Non-Fossil fuel based: 2,28,271MW	Installed Power Generation Capacity: Conventional: 12,860MW
AC Transmission Lines: 4,94,374ckm HVDC : 19,375 ckm 765 KV : 56,955ckm 400 KV : 2,06,792ckm 220 KV : 2,11,252ckm	AC Transmission Lines: 24,400ckm HVDC : NIL 765 KV : 12,865ckm 400 KV : 5,933ckm 220 KV : 5,602ckm
AC Substation Transformation Capacity: 12,47,488 MVA HVDC: 32,500 MW 765 KV : 2,99,819 MVA 400 KV : 4,72,376 MVA 220 KV : 4,75,293MVA	AC Substation Transformation Capacity: 1,97,617MVA HVDC : NIL 765 KV : 1,03,000MVA 400 KV : 62,150MVA 220 KV : 32,467MVA





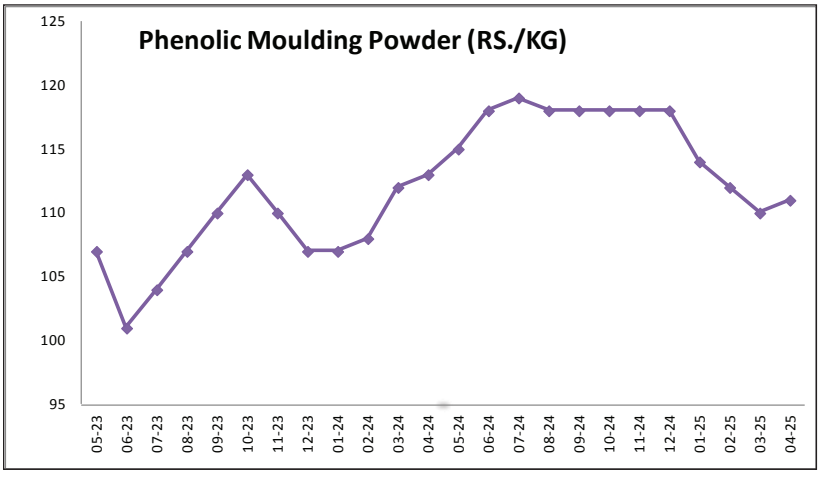




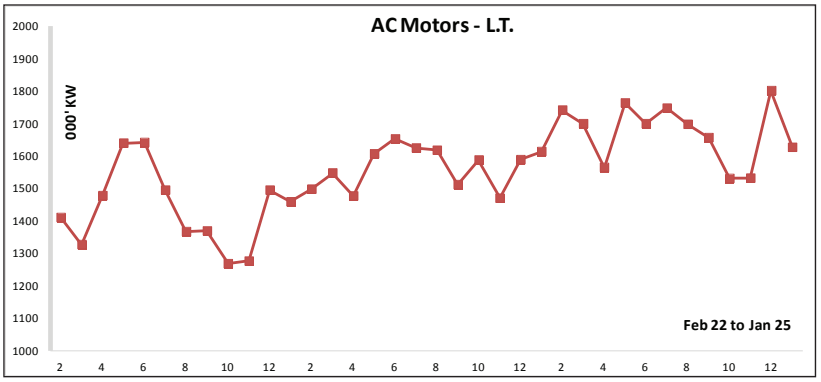
Source: CEA

Basic Prices and Indices

	as on April 1, 2025
IRON, STEEL & STEEL PRODUCTS	
BLOOMS (SBLR) 150mmX150mm	44385.00
BILLETS (SBIR) 100MM	48129.00
CRNGO Electrical Steel Sheets M-45,C-6 (Ex-Rsp)	115.55
CRGO Electrical Steel Lamination	667484.00
NON-FERROUS METALS	
Electrolytic High Grade Zinc	293400.00
Lead (99.97%)	207300.00
Copper Wire Bars	833420.00
Copper Wire Rods	853722.00
Aluminium Ingots - EC Grade (IS 4026-1987)	254017.00
Aluminuium Properzi Rods - EC Grade (IS5484 1978)	259767.00
Aluminium Busbar (IS 5082 1998)	358000.00
OTHER RAW MATERIALS	
Epoxy Resin CT - 5900	766.00
Phenolic Moulding Powder	111.00
PVC Compound - Grade CW- 22	156325.00
PVC Compound Grade HR - 11	157325.00
Transformer Oil Base Stock (TOBS)	95340.00
OTHER IEEMA INDEX NUMBERS	
IN-BUSDUCTS (BASE August 2000=100) FOR THE MONTH February 2025	384.28
IN - WT (BASE JUNE 2000=100)	403.43
Wholesale price index number for 'Insulators' (Base 2011-12 = 100) for the month February 2025	130.60
Wholesale price index number for 'Manufacture of Basic Metals (Base 2011-12 = 100) for the month February 2025	137.90
Wholesale price index number for' Fuel & Power (Base 2011-12 = 100) for the month February 2025	153.40
ALL INDIA AVERAGE CONSUMER PRICE INDEX NUMBER FOR INDUSTRIAL WORKERS (BASE 2016=100) February 2025	142.80
# Estimated, NA: Not available	



Production Statistics



Name of Product	ACC Unit	Production		Highest Annual Production
		For the Month January-25	From Feb 24 to January 25	
Electric Motors				
AC Motors - LT	000' KW	1,627.00	20,087.00	19,195.00
AC Motors - HT	000' KW	490.00	5,206.00	5,273.00
DC Motors	000' KW	31.00	429.00	618.00
Switchgears *				
Contactors	000' Nos.	1,513.00	18,414.00	16,503.00
Motor Starters	000' Nos.	227.00	2,594.00	2,427.00
SDF	000' Nos.	55.00	674.00	752.00
Circuit Breakers DIN Rail Mounted	000' Poles	21,467.00	242,613.00	221,179.00
Circuit Breakers - LT	Nos.	605,408.00	6,599,278.00	5,703,052.00
Circuit Breakers - HT	Nos.	8,258.00	95,229.00	119,282.00
Custom Built Product	Rs. Lakhs	23,827.00	329,062.00	452,536.00
HRC Fuses & Overload Relays	000' Nos.	1,835.00	21,917.00	17,246.00
Power Cables *	KM	116,656.00	1,122,126.00	1,052,205.00
Power Capacitors - LT & HT	000' KVAR	5,974.00	63,550.00	65,385.00
Transformers *				
Distribution Transformers	000' KVA	4,679.00	58,213.00	58,341.00
Power Transformers	000' KVA	20,999.00	247,306.00	234,922.00
Instrument Transformers				
Current Transformers	000' Nos.	1,015.00	5,994.00	1,390.00
Voltage Transformers	Nos.	17,505.00	211,074.00	217,752.00
Energy Meters	000' Nos.	2,938.00	32,559.00	28,579.00
Transmission Line Towers *	000' MT	103.00	1,145.00	1,250.00

**** Weighted Production***

Export and Import

Import Export data - Apr 24 - Mar 25

ITC Codes	Product Groups	Apr - Mar FY 2024-25		Apr - Mar FY 2023-24		April - Mar FY 25 Vs FY 24	
		Import	Export	Import	Export	Import	Export
		Value in Rs. Crores		Value in Rs. Crores		% Variation	
8501 excl. 850110 & 20	Motors & AC Generators	9013	6015	7787	4899	16	23
850423	Power TRF	444	1260	71	1090	525	16
850421-22, 850433-34	Distribution TRF	1101	4130	968	3998	14	3
853210	Capacitors	303	493	557	431	-46	14
8535, 853720	HV SWGR incl. Panels	3308	3926	1851	3053	79	29
8536, 853710	LT Switchgears incl Panels	21914	17150	18738	13925	17	23
854442/49/60	Cables - LV & HV	2446	9236	2158	8005	13	15
902830	Energy Meters	82	611	59	375	39	63
73082011/19	Tr. Line Towers	20	3679	33	3690	-39	0
7604 & 7614	Conductors	1076	4473	945	5881	14	-24

Top Ten countries - IMPORT Rs. Crores				
Country	Apr - Mar 25		Country	Apr - Mar 24
CHINA P RP	69095		CHINA P RP	55387
GERMANY	10369		GERMANY	8191
SINGAPORE	8258		KOREA RP	7822
KOREA RP	7625		SINGAPORE	7256
Hong Kong	7165		Hong Kong	7175
JAPAN	7129		JAPAN	5993
U S A	7018		U S A	5821
RUSSIA	5237		RUSSIA	4255
FRANCE	2739		VIETNAM SOC REP	2816
U K	2494		ITALY	2007

Top Ten countries - EXPORT Rs. Crores				
Country	Apr - Mar 25		Country	Apr - Mar 24
U S A	29363		U S A	24447
GERMANY	9111		GERMANY	6363
U ARAB EMTS	6505		U ARAB EMTS	5458
U K	4678		U K	5287
FRANCE	3888		AUSTRALIA	3564
SAUDI ARAB	3210		FINLAND	2808
CHINA P RP	2825		BANGLADESH PR	2600
ITALY	2708		CHINA P RP	2589
SOUTH AFRICA	2691		FRANCE	2577
AUSTRALIA	2645		NETHERLAND	2411

Source: DGCIS

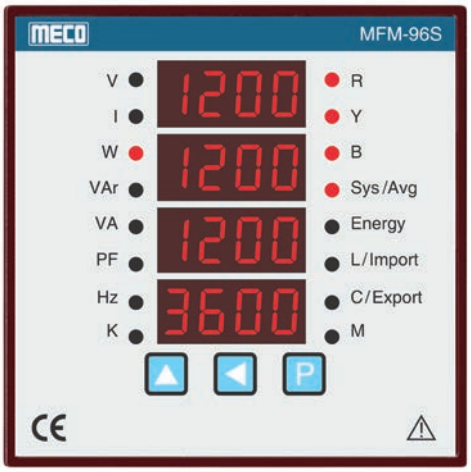
Export and Import

Top Ten products - IMPORT Rs. Crores						
HS Code	Description	Apr - Mar 25		HS Code	Description	Apr - Mar 24
85076000	LITHIUM-ION	25462		85076000	LITHIUM-ION	24346
85044090	OTHERS	10878		85044090	OTHERS	10253
85369090	OTHER	8639		85369090	OTHER	7683
85371090	OTHER	8262		98010013	POWER PROJCTS	5350
98010013	POWER PROJCTS	7222		90328990	OTHR ATMTC RGLTNG/CNTRLNG INSTRMNTSANDAPPRTS	5241
85049090	PRTS OF OTHR ELECTRIC PWR MCHNRY OF HD8504POWER MACHINERY OF HDG 8504	6762		85322990	OTHER FIXED CAPACITORS	5076
85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	5062		85049090	PRTS OF OTHR ELECTRIC PWR MCHNRY OF HD8504POWER MACHINERY OF HDG 8504	4861
90328990	OTHR ATMTC RGLTNG/CNTRLNG INSTRMNTSANDAPPRTS	4739		85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	3762
85322990	OTHER FIXED CAPACITORS	4624		85365090	OTHR SWITCHES	3017
85365090	OTHR SWITCHES	3290		85444999	OTHR ELCTRC CNDCTRS FOR A VOLTAGE <=80 V NOT FITTED WITH CONNECTORS	2515

Top Ten products - IMPORT Rs. Crores						
HS Code	Description	Apr - Mar 25		HS Code	Description	Apr - Mar 24
85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	9566		85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	8726
85044090	OTHERS	7713		85044090	OTHERS	6071
85371090	OTHER	4512		85044010	ELECTRIC INVERTERS	4157
85369090	OTHER	4212		73082011	T0WERS FOR TRANSMISSI0N LINE W/N ASSEMBLED	3300
85044010	ELECTRIC INVERTERS	4007		85444920	PAPER INSULATED CNDCTRS FR VLTGE <= 80 V NOT FITTED WITH CONNECTORS	3251
85444920	PAPER INSULATED CNDCTRS FR VLTGE <= 80 V NOT FITTED WITH CONNECTORS	3683		85369090	OTHER	3174
85072000	ELECTRIC ACCUMULATORS, INCLUDING SEPARATORS THEREFORE, WHETHER OR NOT RECTANGULAR (INCLUDING SQUARE) OTHER LEAD-ACID ACCUMULATORS	3414		85072000	ELECTRIC ACCUMULATORS, INCLUDING SEPARATORS THEREFORE, WHETHER OR NOT RECTANGULAR (INCLUDING SQUARE) OTHER LEAD-ACID ACCUMULATORS	3001
73082011	T0WERS FOR TRANSMISSI0N LINE W/N ASSEMBLED	3300		76149000	OTHR STRNDED WIRE,CBLS PLAITD BNDS ETC	2670
85443000	IGNTN WIRING SETS AND OTHR WIRING SETS OF A KIND USED IN VEHICLES AIRCRAFT/SHIPS	2958		76141000	STRANDED WIRE,CBLS ETC WTH STEEL CORE	2638
85049010	PARTS OF TRANSFORMERS	2851		85443000	IGNTN WIRING SETS AND OTHR WIRING SETS OF A KIND USED IN VEHICLES AIRCRAFT/SHIPS	2610

Source: DGCIS

Multifunction Power and Energy Monitor



MECO's multifunction power and energy monitor – model **MFM-96S** – is a microcontroller based with MODBUS RTU protocol, indigenously designed, tooled, and manufactured by the company's R&D department.

Its 96 x 96 sq mm size eliminates the usage of conventional panels with 10 different meters. It helps save more than 50 percent of panel cost with its reduced panel size, with a single MFM-96S having 10 parameters and little wiring. The power and energy monitor is built with four rows and super bright red LED displays with four digits and eight digits resolutions (energy import-export – four quadrant operations). Furthermore, it has inbuilt memory to store CT ratio, PT ratio, instrument addresses, with a password and energy reset facility. It also has an option of the RS485 Port with MODBUS protocol and power master software to store parameters on the PC.

MFM-96S has simultaneous display of 10 parameters, 48 values on 16 pages for voltage, current, active power, reactive power, apparent power, frequency, power factor, active energy, reactive energy and apparent energy (import-export – four quadrant operations).

TRMS measurement, 3-phase-3-wire and 3-phase-4-wire (user selectable), CTR, PTR, instruments address, password protected, energy reset, and auto/manual scroll display (programmable) are key features of MFM-96S. Sturdiness and moulded derlin with suitable hardware for mounting are additional features.

MFM-96S is competitively priced and is ideal for monitoring and acquiring power data from the generator, remote monitoring, building management system, PLCs/SCADA application, energy audit, QC testing, and power management, among others.

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SHOCKS and SPARKS

FAMOUS FEASTS

BY: **R. G. Keswani**

Sometime ago I received a call from a colleague. He was about to give a student a zero for his answer to a physics question, while the student claimed a perfect score. The instructor and the student agreed to an impartial arbiter, and I was selected.

I read the examination question: "Show how it is possible to determine the height of a tall building with the aid of barometer."

The student had answered, "Take the barometer to the top of the building, attach a long rope to it, lower it to the street, and then bring it up, measuring the length of the rope. The length of the rope is the height of the rope is the height of the building." The student really had a strong case for full credit, since he had really answered the question completely and correctly! On the other hand, if full credit were given, it could well contribute to a high grade in his physics course and to certify competence in physics, but the answer did not confirm this.

I suggested that the student have another try. I gave the student six minutes to answer the question with the warning that the answer should show some knowledge of physics. At the end of five minutes, he had not written anything. I asked if he wished to give up, but he said he had many answers to this problem, he was just thinking of the best one. I excused myself for interrupting him and asked him to please go on. In the next minute he dashed off his answer, which read: Take the barometer to the top of the building and lean over the edge of the roof. Drop the barometer, timing its fall with a stopwatch. Then using the formula, $x=0.5\ at^2$, calculate the height of the building." At this point, I asked my colleague if he would give up. He conceded and gave the student almost full credit. While leaving my colleague I recalled that the student had said that he had other answers to the problem, so I asked him what they were.

"Well," said the student, "there are many ways of getting the height of a tall building with the aid of a barometer. For example, you could take the barometer out on a sunny day and measure the height of the barometer, the length of its shadow, and the length of the shadow of the building, and by the use of simple proportion, determine the height of the building."

"Fine," I said, "and others?" "Yes," said the student, "there is a very basic measurement method you will like. In this method you take the barometer and begin to walk up the stairs. As you walk up the stairs, you mark off the length of the barometer along the wall. You then count the number of marks, and this will give you the height of the building in barometer units."

"A very direct method." "Of course. If you want a more sophisticated method, you an tie the barometer to the end of a string, swing it as a pendulum, and determine the value of 'g' at the street level and at the top of the building. From the difference between the two values of 'g,' the height of the building, in principle can be calculated." "On this same tact, you could take the barometer to the top of the building, attach a long rope to it, lower it to just above the street, and then swing it as a pendulum. You could then calculate the height of the building by the period of the precession."

"Finally," he concluded, "there are many other ways of solving the problem. Probably the best," he said, "is to take the barometer to the basement and knock on the superintendent's door. When he answers, you speak to him as follows: Sir, here is a fine barometer. If you tell me the height of the building, I will give you this barometer."

At this point, I asked the student if he did not know the conventional answer to this question. He admitted that he did but said that he was fed up with high school and college instructors trying to teach him how to think. The student was Neils Bohr and the arbiter, Rutherford.

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