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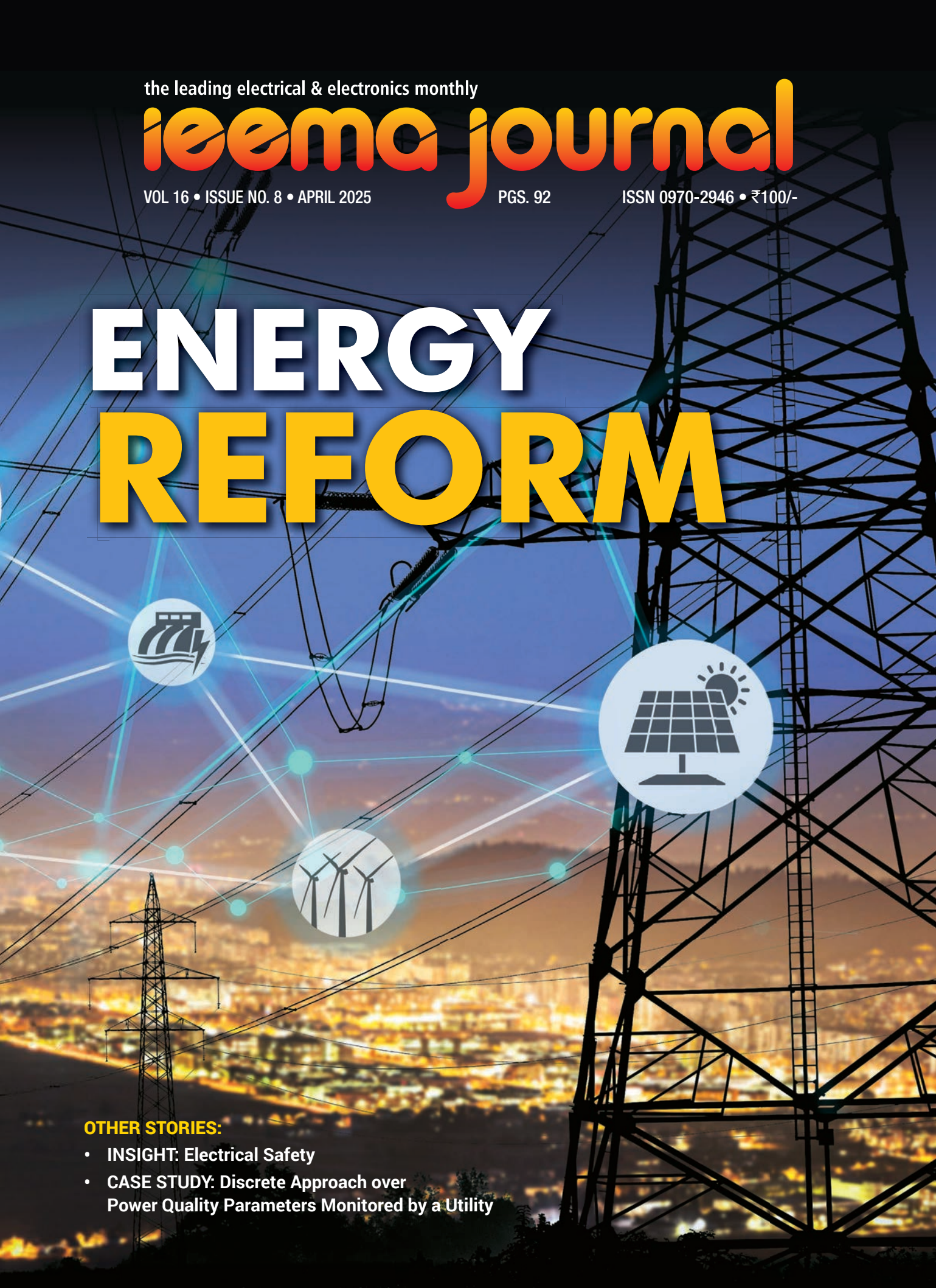
ENERGY REFORM



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COVER STORY

With the increasing adoption of renewable energy and smartening of the grid, India is on the path for a resilient, efficient, and sustainable energy future. In the centre of this transition stands the world's largest show – ELECRAMA. In this edition, we present insights from the power-packed conferences at ELECRAMA 2025 – the **World Utility Summit** and **eTECHnxt,** with the themes **'Empowering Utilities: Transforming Energy Challenges into Resilient Future'** and **'Clean Energy (R)Evolution – Carbon Markets, Storage & Generation'**, respectively. *Read on...*

Vikram Gandotra, Chairman, ELECRAMA 2025

CASE STUDY

As India continues its journey towards a cleaner energy future, addressing power quality challenges will be crucial to ensure efficient and reliable operations of its electrical systems. By implementing appropriate mitigation strategies and maintaining power quality parameters within IEEE standards, utilities can enhance system performance, reduce losses, and protect equipment, writes **Dr Manish Wath, Chief Engineer (Testing), Maharashtra State Electricity Distribution Company Limited.**

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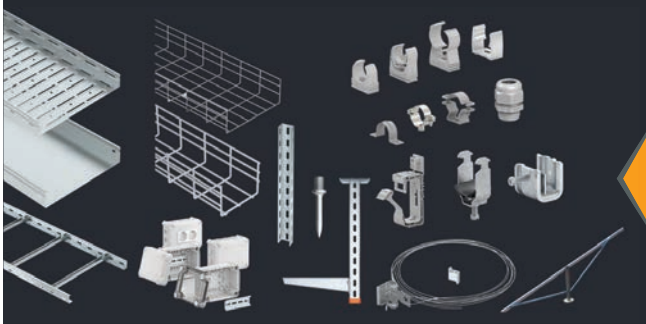

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FROM THE PRESIDENT'S DESK

Dear Readers,

In today's rapidly evolving energy landscape, energy efficiency and demand-side management are economic imperatives. As the world transitions towards a sustainable and resilient energy future, these strategies hold the potential to transform our electricity ecosystem by reducing consumer energy bills, optimising infrastructure investments, and minimising carbon emissions. For consumers, energy efficiency measures, such as advanced metering, smart appliances, and industrial process optimisations, translate into direct cost savings.

Among the biggest challenges in the power sector is balancing supply and demand while ensuring reliability. Demand-side management is crucial for reducing peak loads, allowing utilities to defer or even eliminate the need for new power generation and transmission infrastructure. With cost savings, this also enhances grid stability, allowing for better integration of renewable energy sources like solar and wind.

By improving energy efficiency and managing demand effectively, we can significantly cut down on the consumption of fossil fuel, aligning with India's commitment to net-zero emissions.

The shift towards energy efficiency and demand-side management opens massive opportunities for energy service companies (ESCOs). From implementing retrofit projects in industries and commercial buildings to deploying smart energy management solutions, ESCOs can drive innovation and unlock new business models.

As the voice of India's electrical and electronics industry, IEEMA is committed to driving policy advocacy, industry collaboration, and technology adoption to accelerate energy efficiency and demand-side management programmes. By working with policymakers, utilities, and industry stakeholders, we aim to foster an ecosystem that enables large-scale implementation of energy-saving solutions.

Testament to this was the recently concluded ELECRAMA 2025 – the world's largest electrical show. IEEMA and its members took a pledge of committing to the vision of Viksit Bharat and becoming the manufacturing hub of electrical equipment for the world. Keeping up to this commitment, the industry is scaling up manufacturing and playing a lead role in its energy transition journey – particularly in integrating renewable power generation, energy storage, green hydrogen, and electric mobility. We now hold the baton of *Panchamrit*, tasked with driving our country towards its ambitious 500 GW renewable energy target.

ELECRAMA's influence and global appeal were powerfully demonstrated by the co-located events – World Utility Summit (WUS) and eTECHnxt. The prestigious 5th WUS featured regulators, tech firms, consultants, government, and utilities discussing upcoming energy challenges and opportunities. Themed 'Empowering Utilities: Transforming Energy Challenges into a Resilient Future', it delved into advanced solutions for utility resilience and sustainability. eTECHnxt, themed 'The Green Energy (R)Evolution', focused on key green energy technologies and business opportunities. Its 4th edition featured three tracks to drive innovation and accelerate the transition to sustainable energy.

It is time to recognise that energy saved is energy generated. As we work towards a decarbonised grid and a sustainable future, IEEMA is proud to lead the way through industry collaboration and knowledge sharing. Let us work together to power progress efficiently.

SUNIL SINGHVI

SAMVAAD

Dear Readers,

India is progressing towards establishing itself as the third largest global energy hub by 2030. By adopting renewable energy solutions, green energy solutions, artificial intelligence, machine learning and various technologies aimed at decarbonising the energy grid, the nation is set to enhance efficiency, sustainability, and innovation. The industry has the capability to shape a promising future, creating a smarter and electrified India that can serve as a model for the world.

The Indian electrical sector has undergone substantial transformation, aiming for an ambitious target of 500 GW capacity by 2030, guided by the leadership of Shri Manohar Lal, the Hon'ble Union Minister for Power. "Actions speak louder than words," said the Hon'ble Minister Shri Manohar Lal at the inaugural of the world's largest electrical show – ELECRAMA 2025 – that was recently concluded. The Ministry of Power has great expectations from our industry and has promised to create industry-friendly policies that drive innovation, efficiency, and sustainable growth for a brighter future.

Over the past decade, our industry has already achieved 200 GW – an impressive 2.81x growth. We have major transmission expansions underway, targeting 500 GW capacity with advanced distribution systems. Achieving our energy goals, upgrading the grid, and enhancing our workforce offer significant business opportunities.

We are in the midst of an 'Energy Revolution' and we are perfectly placed to leverage all these opportunities. To deepen our focus on this further, we leveraged our conference platforms at ELECRAMA on these themes. The World Utility Summit (WUS) and eTECHnxt focused on potential opportunities and shared challenges to drive the next phase of growth.

IEEMA is gearing up to grow its thought leadership focus on key topics this year. I am excited to share that we will be hosting the series of Electrical Fire Safety Conclaves in Mumbai, Delhi and Bengaluru, starting this month. To further strengthen our regional focus, we will be adding new location to our state conclaves, the details of this will be shared with you closer to the day.

I am excited for the opportunities that the future holds for our industry and hope you are enjoying reading about all about these developments in IEEMA Journal. Stay connected with me for more exciting information in the coming days!

CHARU MATHUR

ENERGY REFORM!

With the increasing adoption of renewable energy and smartening of the grid, India is on the path for a resilient, efficient, and sustainable energy future.

The energy landscape is globally undergoing an essential transformation. Sustainability and security are driving the need for clean energy. Amid this transition comes the need for increasingly adopting renewable energy (RE) and smartening the grid.

India is taking no backseat. It is the third-largest producer and consumer of electricity worldwide. The country's total installed power generation capacity stands at 462,002 MW as on December 31, 2024. In fact, 2024 marked a landmark year for India's power sector, with the sector seeing historic advancements in energy generation, transmission and distribution. From meeting a record power demand of 250 GW to reducing energy shortages at the national level to a mere 0.1 percent in FY2024-25 – the sector demonstrated resilience and commitment to sustainable growth.

Significant strides in energy conservation, consumer empowerment and infrastructure development underscore the government's efforts to ensure reliable, affordable and clean energy for all. With groundbreaking initiatives such as universal electrification, enhanced rural power availability and the adoption of cutting-edge technologies, India is firmly on the path to becoming a global energy leader.

New Energies

India's RE capacity has reached 214.67 GW, with solar (47.78 percent) and wind (22.63 percent) leading the energy mix. New domestic content norms for solar PV cells and policies promoting co-located energy storage aim to enhance grid stability. States such as Madhya Pradesh, Assam, and Haryana have introduced policies to attract investment and expand the adoption of clean energy.

The Indian Government's strategic investments in domestic battery manufacturing, exemplified by the public-linked incentive (PLI) scheme and the Reliance ACC allocation, are poised to dramatically improve RE storage infrastructure, ensuring a more stable power grid and enabling a larger share of solar and wind energy.

The green hydrogen sector in India is growing too, driven by the National Green Hydrogen Mission and increasing pilot projects in transportation. The sector attracts private investment in production and technology, with state support and collaborations to expand applications. Collaborations are also on the rise, with ongoing efforts to produce sustainable aviation fuel and explore diverse applications of hydrogen, showcasing the versatility of this clean energy source. India's development in the green hydrogen segment is being recognised globally as well, paving the way for international funding and cooperation.

India is also witnessing significant investments in electric vehicle (EV) and charging infrastructure to meet the PM E-DRIVE Scheme's mandate for localised EV component production by May 2025. State governments, including Madhya Pradesh and Rajasthan, are offering subsidies, while financial institutions like SBI are backing private sector expansion in this burgeoning market.

Transformative Reforms

The Union Budget 2025-26 announced earlier this year aimed at initiating transformative reforms across six domains over five years, with power among one of these domains.

Initiatives aimed at improving the financial and operational stability of electricity distribution companies (discoms) along with incentives for enhancing intra-state transmission capacity are expected to increase efficiency in the power sector.

The Budget also announced the full exemption of scrap of lithium-ion battery, Lead, Zinc and 12 more critical minerals from basic customs duty – a welcome move that will help secure their availability for battery manufacturing in India. The proposal to add 35 more capital goods in the exempted list for EV battery manufacturing for EVs was also announced. Additionally, the vision to develop at least 100 GW of nuclear power by 2047 underscores India's ambitious transition towards clean energy. Furthermore, the target of operationalising at least five indigenously developed SMRs by 2033 will further strengthen India's energy security and solidify its leadership in advanced nuclear technology.

Such reforms are expected to set the stage for a resilient, efficient, and sustainable energy future.

US$ 130 billion Industry by 2030

The electrical and electronics industry in India is poised to become a US$ 130-billion industry by 2030. As a rising powerhouse, India is opening up vast opportunities for international collaboration and growth since the last decade.

In the centre of this transition stands the world's largest show – ELECRAMA, whose Vision for 2047 and Mission for 2030 includes:

- Focus on energy transition, digitalisation and supply chain security.
- Focus on buildings, transportation and industry to enhance electricity penetration.
- Leading the way in storage technology and green hydrogen value chain.
- Upskilling, retaining, and promoting talent.

IEEMA organised the 16th edition of **ELECRAMA 2025** from February 22-26 at the India Expo Mart, Greater Noida. With the theme **'Reimagining Energy for a Sustainable Future',** this edition was an unparalleled showcase of innovation, collaboration and opportunity in the electrical industry, and was only bigger, better, and bolder!

Focus areas for this edition included: 1) Sustainability 2) Innovation 3) Safety, Quality & Reliability 4) Automation.

With a dedicated showcase on 'New Energies', 'Digital Energy' and seven international pavilions, ELECRAMA 2025 also hosted several focussed co-located events like 'World Utility Summit', 'eTECHnxt', 'Reverse Buyer Seller Meet', 'Domestic Buyer Seller Meet'', ELECTRAVERSE SPARKS' and 'Women in Power'.

In this edition, we present insights from the power-packed conferences – the **World Utility Summit** and **eTECHnxt,** with the themes **'Empowering Utilities: Transforming Energy Challenges into Resilient Future'** and **'Clean Energy (R)Evolution – Carbon Markets, Storage & Generation',** respectively. *Read on...*

World Utility Summit

Empowering Utilities: Transforming Energy Challenges into Resilient Future

ELECRAMA 2025 hosted the 5th edition of the **World Utility Summit (WUS)** from February 23-25, 2025, with the theme **'Empowering Utilities: Transforming Energy Challenges into Resilient Future'**, jointly organised by IEEMA, IEEE and IEEE PES.

Since its inception in 2016, WUS has evolved as a thought leadership forum for utilities across the globe, setting the agenda for future utilities, with a vision to create a global forum where world utility leaders continually engage in dialogue and exchange information.

Here are key highlights of the 5th edition of the summit:

- Six technical sessions and three high-level panel discussions.
- Total unique participation of 538, including international delegates from 37 countries.
- Delegates from utilities and government – 118; from industry, academia, testing labs and others – 361.
- Release of six knowledge papers by Knowledge Partners – CDRI, DNV, Deloitte, FSR Global, KPMG, and EY.
- Presence of 59 speakers.

Inaugural

SR Narasimhan, Chairman, WUS, in his opening address at the 5th edition of WUS, emphasised critical challenges that global energy systems are facing, such as climate change, urbanisation, and technological advancements. He stressed the importance of transformation in the energy sector, not just through technology, but also by rethinking business models, policies, and consumer engagement. Drawing attention to India's efforts in integrating renewables, modernising grids, and adopting AI-driven automation, he highlighted the role of the country's leadership in these changes. The Chairman urged participants to engage actively, challenge assumptions, and collaborate to drive a decarbonised and digitalised power ecosystem, making the summit a launchpad for tangible actions.

SR Narasimhan

Ghanshyam Prasad, Chairperson, Central Electricity Authority (CEA) and **Chief Guest of the Summit**, acknowledged the significance of the summit, highlighting the high level of attention from attendees. He also pointed out on the role of WUS in promoting collaboration among utilities, manufacturers, academia, and policymakers.

Ghanshyam Prasad

The CEA Chairperson discussed India's rapid development in the last decade, particularly in energy generation, where the country has managed to increase its capacity significantly, even overcoming resource shortages. He highlighted the shift toward renewable energy (RE), particularly solar power, due to India's limited natural gas resources. He explained the country's ambitious targets for RE integration, including achieving a net-zero emission goal by 2070. Despite challenges, India has built a strong transmission infrastructure, providing connectivity to RE developers within a much shorter timeframe than the global world.

The Chief Guest also emphasised the importance of manufacturing domestically, citing India's push for 'Make in India' and the need to avoid supply chain disruptions, particularly in light of geopolitical events. Regarding grid challenges, he mentioned how the variability of RE generation – especially in places like Rajasthan and Gujarat – requires innovations such as battery storage systems and hydro pumped storage to balance supply and demand. He further discussed the growing role of smart metres and data utilisation, which can empower consumers to become "prosumers" (producers and consumers of energy), with the potential for backflow of energy from residential solar systems. This shift, combined with prepayment metres, could improve cashflow and reduce costs for utilities. He stressed the need for continued synergy among all stakeholders – utilities, academia, research and development (R&D) centres, manufacturers, and policymakers – to advance innovation and address challenges in the energy sector.

Finally, the CEA Chairperson expressed optimism for the future of India's energy sector, highlighting the importance of collaborative efforts to drive further progress and wished the summit success in developing actionable recommendations.

Vikram Gandotra, President-Elect, IEEMA and **Chairman, ELECRAMA 2025,** shared his deep personal connection to the event, having been


Vikram Gandotra

involved in leading three of the five editions. He expressed pride in the summit's progress, recognising the esteemed experts present and the event's smooth execution. Reflecting on India's power sector, he highlighted the remarkable growth, noting the widespread adoption of solar panels and wind turbines across the country. He also emphasised the progress of electrification of rural areas, showing the real impact of India's energy transition.

The ELECRAMA Chairman stressed that RE and the shift to clean energy are no longer just buzzwords but are actively transforming the country. He expressed confidence in the success of the summit and encouraged participants to seize the opportunity for networking and building lasting relationships.


Sunil Singhvi

Sunil Singhvi, President, IEEMA, stressed on the critical challenges faced by the global utility sector. With energy demand continuing to rise and the urgent need for an energy transition, he highlighted that India – with an interconnected grid of over 460 gigawatts (GW), including more than 200 GW of RE – serves as a global model. India anticipates a 7-8 percent load growth over the next five years, alongside the complex task of managing energy transition and grid resilience while ensuring affordable power. He emphasised that utilities must evolve from simply power providers to service enablers and innovators, adopting emerging technologies like AI, IoT, smart grids, and energy storage.

He advocated for the creation of R&D departments within utilities to address future technological and sociological challenges. Recognising the importance of regulatory frameworks, he called for a balanced approach to protect both customers and suppliers, as well as addressing financial sustainability, citing global examples like the energy crisis in Europe. He also highlighted the importance of cybersecurity in large-scale digitisation and system integration. He urged stakeholders to collaborate – governments, technology providers, utilities, and consumers – to unlock new possibilities and ensure a secure, sustainable energy future. With India's rapid urbanisation and digital infrastructure advancements, he stressed the need for innovation to meet the country's ambitious clean energy goals. He concluded by urging the timely implementation of policies discussed at the summit to ensure energy remains affordable and sustainable for all.


Raj Beasla

Guest of Honour Raj Beasla, Sr. Director, PG & E, reflected on the significant changes in electric power systems since his graduation in 1983. He emphasised the importance of WUS as a platform for global leaders to collaborate and work towards building a more resilient and affordable energy system. He highlighted the growing energy demand in California, with energy usage projected to double in 10 years. He emphasised that currently, California's peak demand is 52,000 megawatts (MW) and is expected to surpass 100,000 MW in the next decade. He also discussed the increasing challenges posed by extreme weather events such as the California fire, which further complicates grid management.

He stressed on the need for collaboration to design and build a sustainable energy future, with IEEE PES playing a crucial role in innovation. He called on attendees to be energised by the opportunity to engage in this mission, ensuring a more resilient and sustainable energy system for future generations.


Luc Remont

Guest of Honour Luc Remont, Chairman & CEO, EDF, highlighted India's critical role in the global energy transition, acknowledging the nation's rapid development and high energy demand. He praised India's ambitious goal of achieving zero carbon emissions by 2070, noting that if India succeeds, it will set an example for the world. EDF, with its long-standing experience in low-carbon electricity, delivers 520 terawatt hours globally, 95 percent of which is low-carbon. Remont emphasised the importance of RE, grid resilience, and balance of power for India's future, while supporting the integration of nuclear energy into the country's energy mix.


Manish Pant

He expressed EDF's commitment to providing tailored-made solutions for India's unique energy challenges, focusing on collaboration, and shared goals for a sustainable future.

Guest of Honour Manish Pant, EVP, Schneider Electric, discussed India's crucial role in the global energy transition

and its progress towards sustainable energy and decarbonisation. He emphasised the need for public-private partnerships (PPP) to help India meet its growing energy demands. He pointed out that India is set to double its RE capacity in five years, highlighting the country's massive energy needs, driven by its growing population and economic development.

Pant also highlighted Schneider Electric's contribution through technologies that improve energy supply and demand-side management, focusing on electrification and energy efficiency. On the supply side, India's renewable capacity expansion aligns with Schneider's work to advance sustainable energy technologies, such as nuclear power and digitised grids. For instance, Schneider Electric's EcoStruxure grid infrastructure in South Bihar has led to 90 percent grid uptime and significant savings, improving energy access and reliability. Additionally, he mentioned Airset technology, which eliminates SF6 and saves 25,000 kg of CO2 per kg of SF6 avoided. Pant concluded by stressing the importance of digitisation and the role of artificial intelligence (AI) in optimising grid management, calling for collective action to fast-track decarbonisation using available technologies.


Vera Silva

Guest of Honour Vera Silva, CTO, GE Vernova, discussed the evolving energy landscape and the challenges and opportunities in transforming global energy grids. She highlighted the significant growth in energy demand, driven by electrification and the expansion of data centres, particularly in India. She emphasised the need for having a technology roadmap to address these challenges and enable a low-carbon future. She stressed that energy must be low carbon, affordable, and reliable for long-term security. Silva outlined GE Vernova's focus on grid solutions, power conversion, and storage technologies to address bottlenecks and manage the integration of renewables and other low-carbon generation sources. She highlighted the growing importance of power electronics and digitisation, including the use of AI for grid optimisation.

Silva highlighted key initiatives of GE Vernova, including: High voltage DC to improve electricity transmission over long distances; integration of power electronics and grid-forming capabilities for better stability and efficiency; digitisation of grids with orchestration software and software-defined automation for greater reliability and efficiency; commitment to sustainable grid infrastructure through eco-design and SF6 replacement.

Silva concluded by emphasising the need for collaboration between utilities, original equipment manufacturers (OEMs), and the government to overcome challenges and accelerate the energy transition, especially in India, where the pace of change is particularly vibrant and promising.


Dr. Ashish Kumar Goel

Guest of Honour Dr. Ashish Kumar Goel, Chairman, UPPCL, addressed key issues related to utilities and the electrical industry. He highlighted the formation of the All India Discoms Association (IDA), which aims to bring together utilities across India to engage with equipment manufacturers and ELECRAMA to ensure uniform specifications for electrical equipment. This will streamline procurement processes, reduce costs, and improve competitiveness. Dr. Goel also emphasised the importance of smart metres, noting their significant role in transforming utilities, although acknowledging the industry's uncertainty about how to fully leverage them. He suggested the opportunity for the IT sector, startups, and the electrical industry to collaborate in developing smart equipment that can communicate with smart metres and improve operational and commercial efficiencies.

Furthermore, Dr. Goel stressed the need for better quality parameters in the electrical industry, proposing a certification or accreditation system for manufacturers and equipment. This would enable differentiation in both quality and pricing, benefiting the industry overall. He concluded by expressing his commitment to addressing these challenges and further engaging with stakeholders to find solutions.

Guest of Honour Guilherme Mendonca, CEO, Siemens Energy India & Chairman, Siemens Gamesa India, highlighted India's growing economic prominence and its ambitious energy goals. He underscored the nation's strategy to expand its energy infrastructure while decarbonising the economy, aiming for 500 GW of RE by 2030. He commended India for turning its ambitious plans into tangible progress on ground.


Guilherme Mendonca

Mendonca emphasised the critical role of power transmission in supporting the RE transition, noting the need for substantial expansion and modernisation of the grid, including the addition of 1,000 GVA of transformation over the next decade. He acknowledged global supply chain challenges impacting the power transmission sector, including

Launch of Whitepapers at the WUS Inaugural.

longer lead times for transformers and power transmission equipment, but emphasised on India's 'Make in India' initiative as a key strategy to build resilience in the supply chain.

He highlighted the importance of innovative technologies like high-voltage direct current (HVDC), AI, and digitalisation to improve grid efficiency and reliability, seeing this as a significant opportunity for India to become a global manufacturing hub for power transmission equipment.

Mendonca concluded by stressing the importance of collaboration, long-term vision, and bold decisions to achieve India's Viksit Bharat ambition, inviting all stakeholders to work together to drive forward the country's energy future.

Plenary Session 1: The Utility Renaissance: Shaping Tomorrow's Power Infrastructure

Session moderator: Hamza Arsiwala, CMD, Stelmec India

Panellists: Deepak Sharma, MD & CEO, Schneider Electric; Robert HK Demann, EVP, Siemens Ltd; Sandeep Zanzaria, CEO & MD, GE Vernova; Yazeed Alzoom, Deputy CEO-Dar Massader, Saudi Arabia; KR Jyothilal, IAS, Government of Kerala

The discussions underscored the necessity for a transformative shift in energy systems, emphasising openness, integration, and digitalisation to meet the challenges of increasing RE penetration and grid modernisation.

Plenary Session 1 - The Utility Renaissance: Shaping Tomorrow's Power Infrastructure

Plenary Session 2 - Driving Innovation: Industry Perspectives on Future-Ready Utilities

KR Jyothilal advocated for a future of seamless energy conversion and utilisation, promoting a globally integrated energy grid and addressing the challenges of smart metre adoption and grid stability through decentralised storage and innovative billing strategies. Deepak Sharma emphasised the importance of a flexible discom system, integrating solar power, storage, and digital technologies like internet of things (IoT) and AI to create a unified ecosystem for prosumers. Robert HK Demann highlighted the critical need for robust cybersecurity measures alongside digitalisation and electrification, stressing the importance of both digital and physical training for grid infrastructure. Yazeed Alzoom shared insights from the Saudi-India partnership, focusing on challenges of grid expansion and the importance of data-driven asset management and storage solutions for grid stability. Sandeep Zanzaria addressed the unique challenges faced by different utilities across India, highlighting the need for a clear roadmap, standardisation, and long-term partnerships for facilitating the integration of green power and attracting skilled professionals.

Across these discussions, the common thread was the imperative for collaboration, technological innovation, and strategic planning to navigate the complexities of energy transition, ensuring a reliable, sustainable, and secure energy future.

Plenary Session 2: Driving Innovation: Industry Perspectives on Future-Ready Utilities

Session moderator: Krishna Kumar Ramanathan, MD & CEO, S&S Power

Panellists: Abhishek Ranjan, CEO, BRPL; Akilur Rahman, CTO, Hitachi Energy; Dr. Bruno Meyer, Secretary General, GO-15; Dr. Subir Sen, ED (Technology Development), Powergrid; Tripta Thakur, DG, NPTI

The discussions converged on the urgent need to modernise and adapt India's energy infrastructure to meet the ambitious goal of 500 GW of RE by 2030, while ensuring grid stability and resilience.

Akilur Rahman envisioned a future grid powered by non-fossil sources, supported by advanced technologies like HVDC and flexible AC transmission systems (FACTS), emphasising on grid resilience, cybersecurity, and the integration of AI for improved forecasting and asset management. Dr Bruno Meyer highlighted the importance of grid flexibility, demand-side management, and stakeholder collaboration to navigate the challenges of decreasing dispatchable generation and rising demand. Dr Subir Sen addressed infrastructure challenges, particularly in transmission line construction, advocating for increased power intensity and the adoption of technologies like 1,200 kV lines, HVDC, and SF6-free switchgear, while emphasising the PQRS approach for sustainable growth. Abhishek Ranjan focused on optimising existing grid assets through battery storage and AI-driven initiatives, including demand forecasting, predictive maintenance, and customer behaviour prediction, to create a flexible and decentralised grid. Tripta Thakur addressed critical skill gaps in the energy sector, outlining NPTI's efforts to provide industry-specific training and develop a workforce equipped with skills in data analytics, AI, and emerging technologies, crucial for the successful energy transition.

Across all discussions, the emphasis was on leveraging technological innovation, strategic planning, and collaborative efforts to build a sustainable, resilient, and efficient energy future for India.

Plenary Session 3 - Financing the Energy Transition and Reform

Plenary Session 3: Financing the Energy Transition and Reform

Session moderator: Mustafa Wajid, CEO & MD, Meher Group

Panellists: Saurav Kumar Shah (IPS), ED, PFC; Yashraj Khaitan, CEO, Polaris; Samrat Ray, Senior Energy Specialist, ADB

The discussions centred on the financial and regulatory aspects of India's energy transition, highlighting the challenges and opportunities in achieving a sustainable and efficient energy future.

Saurav Kumar Shah emphasised on the evolving energy landscape, focusing on RE integration, financing mechanisms, and regulatory reforms that have accelerated deployment, particularly in electric vehicle (EV) infrastructure and rooftop solar. He pointed out the importance of adapting the grid for smaller RE generators, implementing smart metres and time-of-day tariffs, and proactively planning capacity to meet rising energy demands from data centres and EV charging stations. Samrat Ray highlighted the significant financial and social costs of energy transition, estimating a substantial capital expenditure by 2047, and stressed the need for a mix of private and public sector financing, leveraging institutions like GCF and CDF for low-cost funding. He also emphasised the importance of regulatory reforms, green procurement, and the active participation of large industries in the transition, supported by initiatives like the Green Steel Taxonomy and outcome-based programmes. Yashraj Khaitan shared his entrepreneurial experience, illustrating how regulatory changes have transformed the financing landscape for smart metering projects, enabling the company to raise significant non-collateralised funds. He underscored India's leadership in cost-effective smart metering deployment and the importance of demand response systems, extending the service-based metering model to gas distribution.

Collectively, these discussions underscored the critical role of strategic financing, regulatory innovation, and technological advancements in driving India's energy transition towards a sustainable and efficient future.

Technical Session 1 - Energy Storage: Enabling Firm and Dispatchable Renewable Energy

This session was jointly held with the eTECHnxt conference at ELECRAMA 2025. *See pages to follow for key takeaways from this session on energy storage and more…*

Technical Session 2 - Energising a Greener Grid: Decarbonisation meets Distributed Solutions

Knowledge partner: DNV

Session moderator: Dr. Surekha Deshmukh, Domain Consultant, Tata Consultancy Services

Technical Session 2: Energising a Greener Grid: Decarbonisation meets Distributed Solutions

Panellists: Gopal Nariya, Head CES & Automation, BSES; Raj Baesla, Sr. Director, PG & E; Dr. Bruno Meyer, Secretary General, GO-15; Dr. Saifur Rahman, Past President, IEEE; Wilfried Breuer, MD, Maschinenfabrik Reinhausen GmbH

The panel featured global representation from India, the US, Germany and France, with professional organisations including TCS, PG&E, MR GmbH, GO -15, BSES Rajdhani Ltd and IEEE. One of the key takeaways was the need for a strong ecosystem that involves utilities, governments, regulatory boards, customers, and financing agencies to accelerate the achievement of RE targets. The panel also highlighted opportunities for decarbonisation on both sides – supply and demand, with significant customer participation through prosumers, EVs, and virtual grid (V-G) support. Additionally, there was a detailed discussion on the impact of RE on system parameters like voltage and a cascaded action plan to address these challenges. The panellists also emphasised on the role of technology, including data orchestration, AI, machine learning (ML), IoT, and digital engineering capabilities. Case studies demonstrated how technology is enhancing grid resilience and adaptation to adverse climate events such as wildfires and extreme load variations. Another important aspect discussed was capacity building, skill development, and cross-skilling, which were identified as crucial for success. The moderator also mentioned that IEEE, as the world's largest technical professional organisation, was recognised for its role in educating professionals on technological trends and industry priorities. It also offers standards and codes in areas like RE, DER, and sustainability, which are essential for industry leaders.

Technical Session 3 - Bytes & Breakers: Navigating the Digital Revolution in Utilities

Knowledge partner: FSR Global

Session moderator: Swetha Ravi Kumar, Executive Director, FSR Global

Panellists: Shaikh Sahid Hossain, Chief Revenue Officer, ETAP; Dr. Matthew Rowe, Director, Powergrids-Asia pacific, DNV; Beryl Lopez, Head of Grid Software, Siemens; Dr. G Ganesh Das, Chief-Strategy, Collaborations, Innovation and R&D and CEO, TPDDL; Praveen Kumar Agarwal, Former Director (Market Operation) and CISO Grid-India; Atul Bali, Director, National Smart Grid Mission (NSGM)

The discussions underscored the imperative for India's energy sector to undergo a comprehensive digital transformation, driven by escalating power demands, the imperative to integrate RE sources, and the necessity to enhance overall efficiency. This transformation necessitates a multi-faceted approach, encompassing technological advancements, strategic policy adjustments, robust human resource development, and stringent cybersecurity measures. Participants emphasised

Technical Session 3: Bytes & Breakers: Navigating the Digital Revolution in Utilities

on the critical role of digitalisation, particularly through smart metering, AI, and bigdata, in modernising the grid and empowering consumers as prosumers. Effective data management, utilising advanced technologies like VAMS and digital twins, is crucial for handling the vast amounts of real-time data generated by SCADA systems, while AI-driven load forecasting and grid analytics can optimise energy efficiency and asset management. Policy frameworks must foster collaboration, standardise data conventions, and facilitate regulatory sandboxing to test innovative solutions. Addressing cybersecurity threats, especially within operational technology, requires a distinct and proactive approach. Simultaneously, investing in human capital, particularly in nuclear energy and cybersecurity, is vital to ensure a skilled workforce capable of managing the evolving energy landscape. The increasing power demands of data centres and AI necessitate a careful evaluation of their energy consumption and a focus on integrating green energy solutions.

In conclusion, a strategic implementation approach, starting with pilot projects and scaling successful models, is crucial for realising the full potential of digital transformation in India's energy sector.

Keynote Address by Guest of Honour Vijay Mittal (IOFS), Joint Secretary, Ministry of Heavy Industries

Guest of Honour Vijay Mittal (IOFS), Joint Secretary, Ministry of Heavy Industries, in his keynote address, expressed his gratitude to IEEMA and WUS for the opportunity to speak. Being from the

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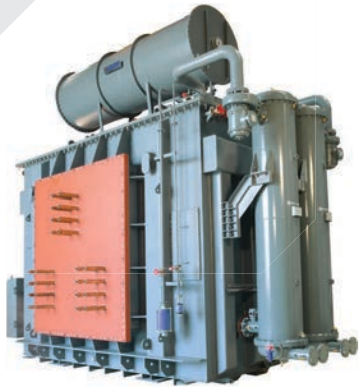

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electrical fraternity, he highlighted the pride he feels in contributions of the electric power and utilities sector, and also on IEEMA's role in contributing to 50 percent of the capital goods sector's revenue.

He emphasised on India's growing energy demand and the ministry's support for this growth, citing initiatives like the public-linked incentive (PLI) scheme for advanced chemistry cells and the successful implementation of the Quality Control Order (QCO) for low-voltage switchgear, which has boosted indigenous manufacturing.

He also discussed the ongoing revision of the Capital Goods Policy, encouraging IEEMA's input to help enhance the heavy electrical sector's contribution to GDP. He noted the ministry's continued focus on supporting R&D to foster innovation, reduce imports, and strengthen domestic manufacturing in the sector. In conclusion, he emphasised the importance of collaboration for India's energy future.

Technical Session 4 - Harmonising Grid Horizons: Evolving Regulatory & Policy Landscape

Knowledge partner: KPMG

Session moderator: Vikas Gaba, Partner, KPMG India

Panellists: Gajanan S. Kale, CEO, TPDDL; Ajay Talegaonkar, Member (E&C), CEA; Alpana Jain, Senior Operations Officer, IFC; Atul Bali, Director, NSGM; Nadzifah Hayati binti Ariffin, Chief Engineer, Tenaga Nasional; Cheten Tshering, Chief Manager, Bhutan Power Corporation Ltd

The discussion painted a cohesive vision of the future grid: a cleaner, smarter, flexible, and resilient system driven by RE integration and advanced technologies.

Ajay Talegaonkar emphasised on the necessity of renewable and nuclear energy, coupled with AI-driven grid intelligence and forecasting, to achieve a sustainable future. Gajanan S. Kale highlighted the practical challenges of integrating India's ambitious 500 GW RE target, showcasing Tata Power Delhi's modernisation efforts through smart metres, battery storage, and demand response programmes. Alpana Jain from IFC underscored the critical role of utilities in this energy transition, emphasising the importance of financial support and knowledge sharing through platforms like future grids. Atul Bali envisioned consumer-centric grids with dynamic tariffs and AI-enhanced grid management, highlighting the shift towards a TOTEX model for utility financing. Nazifa Hayati Binti Arifin shared Tenaga Nasional Berhad's (TNB) strategic approach to grid modernisation, focusing on integrating 70 percent RE by 2050 through substantial investments in smart technologies and predictive maintenance. Chetan Tshering detailed about Bhutan Power

Technical Session 4: Harmonising Grid Horizons: Evolving Regulatory & Policy Landscape

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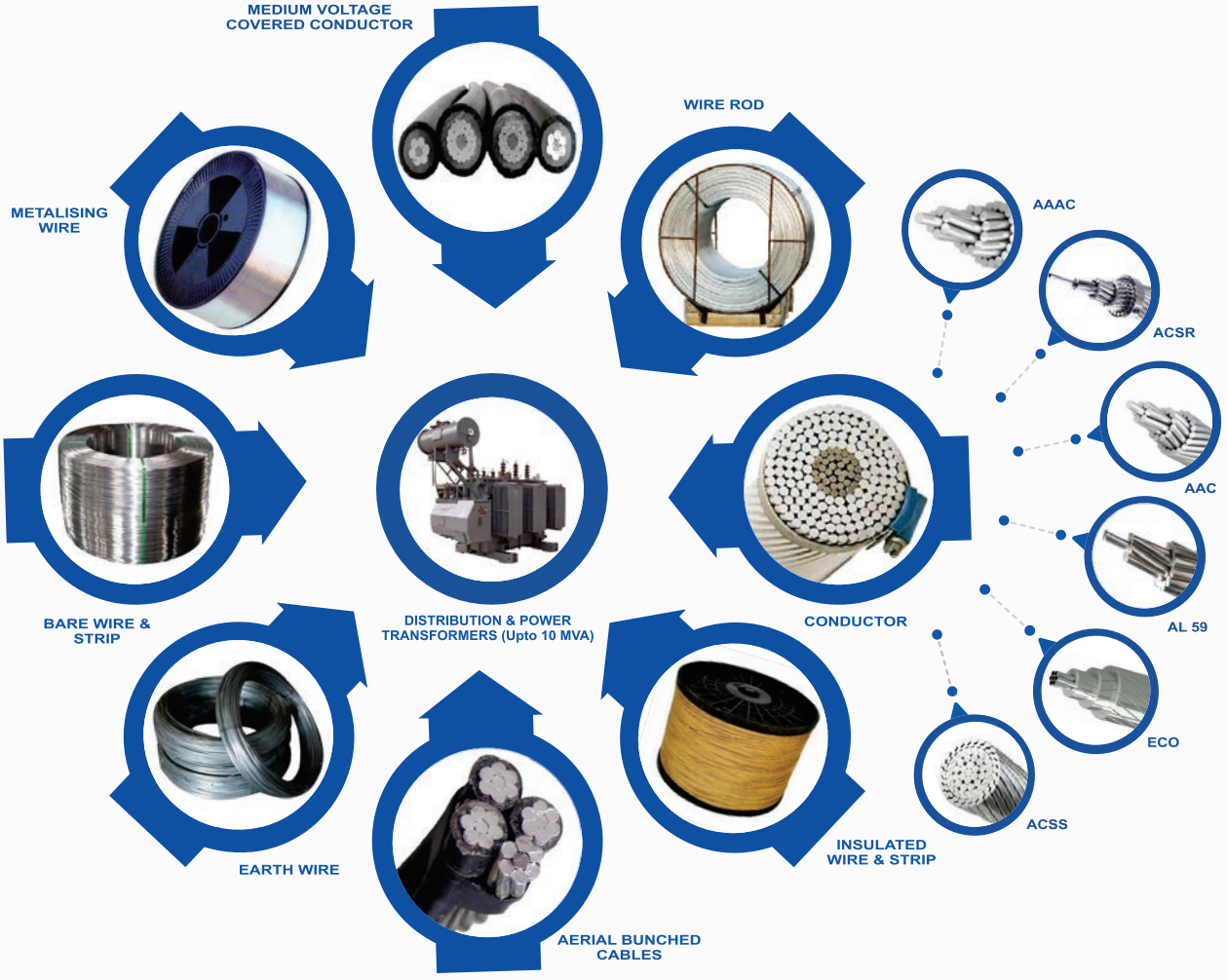

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Technical Session 5: MegaWatts to MegaBytes: Confluence of Utilities & Emerging Technologies

Corporation's (BPC) efforts to build a resilient grid in the challenging terrain, utilising ADMS, AMI, and SCADA to enhance reliability and fault detection.

Common themes across these discussions included the need for agile policies, regulatory sandboxing, and stakeholder collaboration to facilitate the adoption of new technologies and navigate the complexities of energy transition, all while ensuring grid stability and customer satisfaction.

Technical Session 5 - MegaWatts to MegaBytes: Confluence of Utilities & Emerging Technologies

Knowledge partner: Deloitte

Session moderator: Anujesh Dwivedi, Partner, Deloitte

Panellists: Nils Scheller, VP Energy Networks Digital & IT, E.ON SE (context setting); Anil Rawal, MD, Intellismart; Robert Denda, CEO, Gridspertise, Italy; Himanshu Singh, Co-Founder & CTO, Algo 8

The discussions highlighted the rapid digital transformation of energy grids, driven by the increasing integration of RE, rising demand, and the need for efficient grid management.

Nils Scheller from E.ON shared their extensive digital modernisation efforts, emphasising on the use of smart technologies like AI, automation, and satellite or drone maintenance to improve grid reliability and meet customer demands. Anil Rawal focused on India's significant progress in digitalising the electricity sector, particularly through the implementation of smart metres and the application of AI and data analytics to transform electricity into a service. He stressed the importance of robust commercial frameworks, cybersecurity, and skill development to fully leverage the data generated by smart metres. Robert Denda underscored the crucial role of advanced metering and AI in enhancing grid management, citing examples from Romania and Colombia where smart metres helped prevent grid instability. He emphasised on the necessity of automation, standardisation, and edge computing for real-time grid adjustments and enhanced cybersecurity, while also noting the organisational changes utilities must undergo to adapt to digital technologies. Himanshu Singh illustrated the growing complexity

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Technical Session 6: Investing in Future: Building Climate Resiliency in the Energy Ecosystem

of utility operations, highlighting the transformative potential of AI in areas like spare part management and consumer behaviour analysis. He also addressed the challenges utilities face, including data accessibility and AI reliability, and stressed the importance of continuous improvement and adaptation to the rapidly evolving technological landscape.

Across these discussions, the common themes were the critical role of AI, data analytics, and smart metering in modernising energy grids, improving efficiency, and ensuring reliability, while also acknowledging the need for robust cybersecurity, skill development, and organisational change.

Technical Session 6 - Investing in Future: Building Climate Resiliency in the Energy Ecosystem

Knowledge partner: CDRI

Session moderator: Nidish Nair, Partner, PwC

Panellists: Baldeo Purushartha, Dept of Economic Affairs, Ministry of Finance, DEA (context setting); PK Pattanaik, Director (Operations), OPTCL; Dr. Shivani Sharma, Principal Technical Consultant, Hitachi Energy; Raj Vikram Singh, Advisor, CDRI; Ravindra Desai, Program Manager-Standards, IEEE

The discussions converged on the critical need for climate-resilient energy infrastructure, highlighting both the challenges and solutions for India's evolving power sector.

PK Pattanaik showcased Odisha's successful adaptation to cyclones, emphasising the importance of preparedness, infrastructure development, and learning from past disasters, while advocating for RE integration. Dr. Shivani Sharma stressed the necessity of integrating 500 GW of RE sustainably, addressing intermittency with storage solutions, and managing the increasing power demands from digital transactions and EVs. Ravindra Desai emphasised on building a climate-resilient energy ecosystem by integrating climate data, utilising AI, and standardising successful practices, advocating for specific IEEE standards for DER interconnection. Raj Vikram Singh introduced CDRI, highlighting the significant infrastructure losses due to disasters and the need for coordinated efforts to integrate climate resilience into infrastructure planning, drawing on Odisha's resilience efforts as a model. SR Narasimhan focused on the challenges with field-level equipment, particularly in high-temperature regions, and the need for grid-forming inverters, stressing the importance of aligning technical standards with Indian conditions.

Across these discussions, the emphasis was on proactive planning, technological adaptation, standardisation, and collaborative efforts to ensure a reliable, sustainable, and climate-resilient energy future for India.

eTECHnxt

Clean Energy (R)Evolution – Carbon Markets, Storage & Generation

Release of Whitepapers at the eTECHnxt Conference.

ELECRAMA 2025 hosted the 4th edition of eTECHnxt from February 24-25, 2025, with the theme **'Clean Energy (R)Evolution – Carbon Markets, Storage & Generation'.**

The conference focused on driving sustainable energy transition within the electrical and allied electronics industry, aligning with India's Union Budget 2024-25's emphasis on sustainable energy, nuclear SMR, and carbon markets. Building upon previous editions that explored EVs, green hydrogen, energy storage, IoT and AI, this year's discussions centred on emerging decarbonisation technologies and strategies.

This year, the conference witnessed 40 speakers, 400+ participants, the release of three whitepapers by Knowledge Partners – EY, Capgemini and CMAI.

Track 1: Energy Storage – Enabling Firm & Dispatchable Renewable Energy

The Energy Storage session at the eTECHnxt conference focused on the pivotal role of energy storage in integrating renewable energy sources, ensuring grid reliability and resilience. The discussions highlighted the rapid advancements in battery storage technologies and their transformative impact on the energy sector by providing efficient, scalable, and cost-effective solutions.

Context setting: Rupam Raja, CCO, Fluence India

Keynote speaker: Abhishek Ranjan, CEO, BSES Rajdhani Power Limited

Session moderator: Ankit Piplani, Director-Power & Utility, EY

Panellists: Hitesh Kumar, CEO, Fluence India; Sunil Dayal, Senior Energy Finance Expert, World Bank; Upma Koul, Co-President, Long Duration Energy Storage (LDES) Council & Senior Vice President, Energy Storage Business, Sumitomo, SHI, FW; Bigyan Parija, COO-Solar & Storage, Serentica Renewables; Manoj Pande, MD, Statcon Energiaa; Dr. Shekhar Nath, Technical Sales Specialist, Hindalco Industries Ltd

Key discussion points:

- Rupam Raja initiated the discussion by outlining the current landscape of battery energy storage system (BESS) projects in India, highlighting the nation's burgeoning efforts to integrate RE sources. He then transitioned to exploring the significant opportunities that lie within the

Inaugural Session.

Indian BESS sector, emphasising on the potential for growth and innovation, driven by increasing energy demands and the push towards sustainable infrastructure.

- Abhishek Ranjan provided key insights into the role of energy storage in enabling firm and dispatchable RE. His presentation highlighted that the intermittent nature of RE sources like solar and wind requires balancing with BESS and demand response mechanisms to align with load demands. A portfolio approach that includes multi-location RE projects and virtual power plants (VPP) can help create a grid-friendly renewable energy product. Furthermore, bundling RE sources with BESS and market mechanisms can optimise energy generation and utilisation. BSES has been actively involved in deploying BESS solutions, including microgrids and larger scale projects, to enhance grid stability and manage peak loads. The presentation also noted

Session: Energy Storage – Enabling Firm & Dispatchable Renewable Energy

the declining costs of lithium-ion batteries and the increasing global deployment of BESS.

- **Integrating batteries with power electronics and achieving grid parity for BESS:** Hitesh Kumar spoke about the complex nature of integrating batteries with power electronics, safety protocols, communication systems, and the grid. He emphasised on strategies for seamless integration and the paramount importance of safety, capacity building, and the crucial role of the digital ecosystem. He also discussed alternate technologies, incentivisation support, and GW-scale implementation as key factors in accelerating the path to grid parity for BESS.
- **Financial sector expectations and BESS for ancillary services:** Sunil Dayal addressed the financial sector's expectations for evolving energy storage technologies to attract private and public investment for large-scale deployment. He also mentioned that BESS will gradually move towards providing ancillary services to enhance grid stability and reliability.
- **Emerging opportunities in Asia and the role of LDES:** Upma Koul shared global experiences and emphasised on the importance of long duration energy storage (LDES) and how global companies like Sumitomo can drive innovation and market adoption in Asia. She articulated the key benefits of LDES and its role in facilitating energy transition and meeting energy access requirements.
- **BESS project success factors and battery lifespan and degradation:** Bigyan Parija spoke about the quality of components used and life span and number of battery cycle used. Also, the success factor of the BESS project is a big concern.
- **Cybersecurity risks and technological advancements in BESS:** Manoj Pande raised concern about the security concern for energy storage and the inverter segment. He emphasised on the experience of C&I and rural consumers while discussing decentralised utilities of BESS.
- **Testing and safety standards and thermal runaway prevention:** Dr. Shekhar Nath emphasised on the need for comprehensive and consistent testing to ensure battery storage systems meet long-term operational requirements and industry safety standards. He also spoke about making systems safe by enabling action before thermal runaway is triggered.

The session provided valuable insights into the current state and future direction of energy storage, highlighting its critical role in enabling a sustainable energy future. Key takeaways included the importance of seamless technology integration, cost reduction strategies, the role of LDES, and the necessity of robust safety and testing standards.

Track 2: Power Generation NxT – New Frontiers

Special Plenary Session on Power Generation

Welcome address: Mustafa Wajid, Chairman, eTECHnxt

Context setting: Amit Kumar, Vice President & Head-MPS, Schneider Electric

Keynote speaker: Luc Remont, Chairman & CEO, EDF France

Vote of thanks: R Prakash, COO, EMR

The Power Generation Plenary Session at eTECHnxt highlighted the complexities of India's energy transition and the need for a balanced

Special Plenary Session on Power Generation

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strategy that combines various energy sources. Luc Remont provided valuable insights on the importance of nuclear energy, the continued development of renewables, and the necessity of energy storage solutions. The session underscored the significance of international partnerships and domestic industrial development in achieving India's energy goals and ensuring a sustainable and secure energy future.

Key pointers:

- **India's energy demand and future outlook:** Chairman Mustafa Wajid highlighted India's growing concern over energy management, noting that electricity consumption has doubled in the last 10 years and is expected to more than double in the next 10 due to increased demand from electric mobility, green hydrogen, and data centres. He emphasised the need for India to reduce its import dependency on energy, which currently amounts to approximately 6.5 percent of the GDP. Amit Kumar provided further context, stating that India's installed capacity is around 462 GW, with a goal to reach 777 GW by 2030. He also pointed out the disparity in per capita consumption, with India significantly lower than countries like China, indicating the potential for substantial growth in India's energy consumption.
- **Decarbonisation and diversified energy mix:** Mustafa Wajid stressed that decarbonisation is an essential element of new policies, driven by the environmental benefits and the potential to save foreign exchange. Both Wajid and Remont advocated for a diversified energy mix or 'energy bouquet' for India. Wajid acknowledged the continued role of coal in India's energy supply but expressed a desire to minimise its use. Remont highlighted the importance of storage and company storage as the fastest solutions to move towards a balanced electrical system. He emphasised that while renewables are crucial, they need to be balanced with dispatchable power sources to ensure grid stability and meet the growing energy demands.
- **Nuclear energy's strategic importance:** Wajid emphasised the importance of nuclear energy in India's energy mix and expressed the honour at having Luc Remont from EDF France, a pioneer in nuclear energy, on the panel. Remont stressed that nuclear energy has a significant role to play in India, providing the base load for industries and data centres and balancing the variability of RE sources. He welcomed the Indian Government's ambition to reach 100 GW of nuclear capacity. Remont highlighted EDF's commitment to partnering with India to develop its nuclear capabilities, focusing on technology transfer and building a self-sustainable local nuclear industry. He advised India to choose and replicate one or two types of reactors to achieve cost-effectiveness and efficiency, drawing on EDF's experience in France.
- **Renewables and storage:** Wajid discussed the importance of solar energy and the potential of solar thermal, with thermal energy storage as a solution for round-the-clock renewable energy. Remont acknowledged India's strong progress in renewables but emphasised on the need for dispatchable power sources to complement them. He pointed out that while storage is crucial for stability and reliability, it cannot currently provide the 24 x 7 reliability and capacity of nuclear energy.
- **Global trends and challenges:** Wajid mentioned the evolving carbon markets, the potential impact of initiatives like the carbon border adjustment mechanism (CBAM), and the uncertainties caused by global political changes, particularly in the US.

Session: Power Generation: Navigating New Frontiers in India's Energy Landscape

Special Address: Udai Singh, MD & CEO, Schneider Electric Infrastructure Ltd

Udai Singh's address provided a comprehensive overview of the transformative changes in India's power generation sector. He emphasised on the imperative for a paradigm shift towards sustainable, resilient, and digitally driven energy solutions to meet the nation's burgeoning energy demands.

Special Address: Udai Singh, MD & CEO, Schneider Electric Infrastructure Ltd

His presentation underscored Schneider Electric's commitment to facilitating this transition through innovative technologies and strategic partnerships.

Key themes and detailed analysis:

- **The evolution of India's power generation landscape:** He highlighted the transition from a historically conventional, fossil-fuel-centric power generation model to a more diversified and RE-driven approach. This evolution is propelled by: The escalating demand for electricity due to rapid industrialisation and urbanisation; the growing awareness of climate change and the imperative to adhere to global sustainability targets, particularly the 1.5-degree Celsius goal; the need for energy independence. Singh also emphasised on the growth of 'prosumers', which are consumers that also produce energy.
- **Key mega trends and their implications for India:** Global trends such as the pursuit of net-zero emissions, the adoption of dual sourcing strategies, and the impact of a youthful demographic are significantly influencing India's energy sector. The exponential growth of AI and data centres is driving a surge in electricity consumption, necessitating substantial investments in clean energy infrastructure. India's unique demographic dividend, with a large young population, presents both opportunities and challenges for energy development. The importance of localisation of technology was also stressed.
- **The future of India's power grid:** Singh articulated the critical need for a modernised and resilient power grid capable of accommodating bidirectional energy flow and integrating distributed energy resources. Key requirements for the future grid include: The deployment of microgrids and energy storage systems to enhance grid stability and reliability; the implementation of flexible and distributed energy resource management systems; the establishment of standardised grid codes to ensure interoperability and efficiency; the adoption of advanced analytics and cybersecurity measures to safeguard grid infrastructure; the importance of addressing aging infrastructure.
- **Strategic pillars for sustainable energy growth:** Singh outlined four fundamental pillars for achieving sustainable energy growth in India:
    1. **Sustainability:** Mitigating climate change through the adoption of renewable energy and energy-efficient technologies.
    2. **Electrical resiliency:** Strengthening the power grid to withstand disruptions and ensure reliable energy supply.
    3. **Localised innovation and upskilling:** Fostering indigenous technology development and investing in workforce training to enhance capabilities.
    4. **Prosumerisation:** Empowering consumers to participate in energy generation and management.

Udai Singh's address provided valuable insights into the complexities and opportunities within India's evolving power generation landscape. His emphasis on sustainability, grid modernisation, and localised innovation underscores the importance of a holistic and strategic approach to ensure a secure and sustainable energy future for the nation.

Session: Building a Robust and Resilient SMR Ecosystem for Sustainable Transition

Session moderator: Vinay Khanduri, Director-Nuclear, Capgemini

Panellists: Dr. A Rama Rao, Ex-Bhabha Atomic Research Centre (BARC); NK Jain, Principal Consultant, NK Jain consulting (Data Centre Veteran); Yatindra Mohan, GM-Nuclear Business Group, BHEL

This session explored the multifaceted challenges and opportunities associated with establishing a robust and resilient ecosystem for small modular reactors (SMRs) in India, aimed at facilitating a sustainable energy transition. The discussion encompassed technological, regulatory, industrial and economic considerations, while also addressing the growing energy demands of the data centre industry.

Key discussion points:

- **SMR's role in India's energy transition:** SMRs were recognised as crucial for decarbonising energy systems, providing clean, reliable baseload power, and complementing RE sources. The panel emphasised on the need to clarify the 'transition' aspect, be it from large reactors, renewables, or thermal power. Dr. A Rama Rao highlighted the suitability of SMRs for regions with smaller grids and lower power demands.
- **Data centres and SMRs:** The rapid growth of the data centre industry and its substantial energy consumption were identified as key drivers for increased nuclear power demand. The need for highly reliable, 24 x 7 power supply for data centres was stressed, making SMRs a potentially viable solution. It was clarified that data centres will remain reliant on the electrical grid for redundancy and reliability, even with SMR integration.
- **Ecosystem development:** Building a strong supply chain, including manufacturing capabilities and raw material availability, was deemed essential. A streamlined and predictable regulatory framework was considered crucial for timely

Session: Building a Robust and Resilient SMR Ecosystem for Sustainable Transition

SMR deployment. Challenges related to fuel supply and the need for government involvement in fuel management were discussed. The need for trained personnel, especially welders, was emphasised.

- **Economic considerations:** The economics of scale and the importance of modularity and series production to reduce SMR costs were highlighted. Minimising construction time was identified as a key factor in improving economic viability. The Indian Government has made a substantial financial commitment to SMR development.
- **Technology and safety:** The technical aspects of SMRs, including passive safety systems and fuel cycles, were discussed. Rigorous safety standards and regulatory oversight by the AERB were emphasised. The 220-MW pressurized small reactor (PSR) was presented as a potentially more viable domestic option. Thorium usage in SMRs was clarified as not being a current focus.
- **Regulatory and legal challenges:** The need to amend the Atomic Energy Act and the Civil Liability for Nuclear Damages (CLND) Act to facilitate private participation and international collaboration was identified. Creating a favourable regulatory environment for the SMR industry was deemed essential.
- **Manufacturing and capability:** Developing domestic manufacturing capabilities and addressing demand-related investment challenges were discussed.
- **Environmental impact:** The environmental impact of data centres, including heat generation and noise pollution, was acknowledged. The issue of nuclear waste management was raised as a significant concern.
- **Future expectations:** The panellists expressed optimism about government support for nuclear energy. The industry emphasised on the need for localisation of SMR technology and global partnerships that prioritise technology transfer.
- SMRs are looked at as a way to create grid stability alongside RE sources.

The session highlighted the potential of SMRs to play a significant role in India's sustainable energy transition, particularly in meeting the growing energy demands of the data centre industry. However, the panellists acknowledged the need to address various challenges, including regulatory hurdles, economic viability, manufacturing capabilities, and safety considerations. They emphasised on the importance of a collaborative approach involving the government, industry, and global partners to ensure the successful deployment of SMRs. The discussion also underscored the necessity of balancing energy demands with environmental concerns, particularly regarding nuclear waste management and the environmental impact of data centres. Overall, the session provided valuable insights into the complexities of building a robust and resilient SMR ecosystem in India.

Session: Achieving Technological and Cost Efficiencies for Large Scale Deployment of Solar Thermal

This technical session featured a detailed discussion on the techno-economics of solar thermal energy in India, with a comparative analysis

against solar photovoltaic (PV) systems and battery storage. The session explored the potential for large-scale deployment of solar thermal, addressing cost efficiencies, technological advancements, and policy implications.

Expert address: Jitender Singh, GM, Godavari Green Energy Pvt Ltd (Indigrid)

Session moderator: Mustafa Wajid, Chairman, eTECHnxt

Panellists: Rajan Varshney, DGM, NTPC; Dr. Arunendra Kumar Tiwari-Electricity & Renewable Division, TERI; Rajendran Vishwanathan, Vice President-Engineering Services and Global Sustainability

Key discussion points:

- **Techno-economics of solar thermal vs. solar PV and batteries:** The current cost of solar PV with limited storage (around two hours) is approximately Rs5 per unit. For extended storage durations (8-10 hours), concentrated solar power (CSP) costs range from Rs5-6 per unit. When combined with renewable power, the cost increases to about Rs8 per unit. India has witnessed a substantial reduction (70 percent) in CSP plus storage costs over the past decade, enhancing its competitiveness.
- **Advantages and applications of CSP:** CSP offers advantages like reliability, load shifting, energy arbitrage, and in certain instances, black start capability. Solar thermal, particularly CSP, is considered more suitable for industries that require continuous (24 x 7) heating. It can also be used for cooling through vapour absorption chillers.
- **Role of solar PV and batteries:** Solar PV systems, when integrated with battery energy storage, are effective in decreasing emissions, especially in buildings, which contribute significantly (26 percent) to global emissions. Battery storage solutions offer a return on investment (RoI) in approximately four and a half to five years through demand reduction, excess solar energy storage, and peak shifting. Solar PV and battery solutions are better suited for buildings, primarily focusing on cooling and daytime energy consumption.
- **Indigenisation potential:** Solar thermal has a higher potential for indigenisation within India compared to battery chemistry, which may still rely on imports.
- **Energy mix and policy support:** India requires a diverse energy mix that includes solar (both PV and thermal), wind, nuclear, and coal. To promote solar thermal, it is crucial to have clear policy guidelines, incentives, and targets, similar to those in place for solar PV and green hydrogen. Countries like China and Spain have successfully implemented supportive policies for solar thermal energy.
- **Affordability, reliability, and grid integration:** Industries are willing to pay a premium for reliable power. The intersection point where solar thermal becomes economically competitive with solar PV and storage is approaching. The cost of solar PV with storage does not always account for the costs associated with transmission infrastructure. Energy efficiency is essential for minimising transmission and distribution losses.
- **Co-existence and future of energy technologies:** A variety of energy technologies, including solar thermal, solar PV, batteries, nuclear, and even coal, will need to co-exist in India's energy scenario. While the goal is to move from coal to renewables and nuclear, dispensing with coal entirely in the near future is considered unrealistic.

The session provided a comprehensive overview of the potential of solar thermal energy in India,

Session: Achieving Technological and Cost Efficiencies for Large Scale Deployment of Solar Thermal

emphasising the need for a balanced approach that includes both solar thermal and solar PV. Solar thermal is increasingly competitive, particularly for industrial applications and long-duration energy storage solutions. Solar PV combined with battery storage is vital for reducing emissions in buildings. A mix of various energy technologies is crucial to meet India's diverse energy requirements. This necessitates a focus on policy support, cost reduction, indigenisation, and efficient energy utilisation to ensure a sustainable and reliable energy future for the country.

Track 3: Carbon Eco System & Markets

Session: The Evolving Carbon Markets: Insights, Regulations, and Growth

Moderator: Rohit Kumar, Secretary General, CMAI

Panellists: Manish Dabkara, CMD, EKI & President CMAI; Abhishek Gupta, Head of International, Strategy, Appliances, Rooftop Solar and PE & A, EESL; Amit Kumar, Vice President & Head-MPS, Schneider Electric

The session comprehensively covered the complexities and opportunities within the evolving carbon market. Experts highlighted the critical roles of regulation, technological innovation, and stakeholder collaboration in driving effective decarbonisation. The discussion emphasised the distinction between carbon neutrality and net-zero goals, the nuances of different carbon credit types, and the importance of addressing market integrity concerns. The session underscored India's significant potential in the global carbon market and provided actionable insights for industries seeking to navigate this dynamic landscape.

Key discussion points:

- **Introduction:** The Carbon Markets Track at the eTECHnxt conference provided an in-depth exploration of emerging trends, regulatory developments, and market mechanisms driving the carbon credit ecosystem. Industry experts shared insights on compliance and voluntary markets, the operationalisation of carbon credit trading schemes, and the evolving regulatory landscape, particularly in the context of India and global markets.
- **Key market trends and challenges:** This discussion revolved around the evolving carbon market due to regulations, corporate commitments, and net-zero goals. Rohit Kumar outlined four market layers: Article 6, national compliance, National & International Voluntary Carbon Markets. Concerns were raised about greenwashing and the definition of high-quality carbon credits and the impact of geopolitical events and differing global views on climate change on the carbon market. The importance of the VCMI and ICBCM in regulating the voluntary carbon market was also touched upon.
- **Opportunities and growth:** Discussions revolved around the potential for significant growth in both voluntary and compliance carbon markets;

Session: The Evolving Carbon Markets: Insights, Regulations, and Growth

the role of aggregation in making carbon credit monetisation viable, especially for MSMEs; the importance of energy efficiency and RE projects; the explanation of avoidance-based carbon credits vs. removal-based carbon credits; the explanation of how carbon credits are generated, and recognised by differing governing bodies.

- **Carbon credit mechanisms:** A detailed, multi-step process for carbon project registration and verification was explained, including feasibility assessment, PDD formation, validation, monitoring, and credit issuance. The roles of DOEs (Designated Operational Entities) and standardizing bodies (like VCM, VCS, GS) were clarified. The different stages of credit trading (primary, secondary) and retirement were discussed.
- **Carbon neutrality vs. net-zero:** The distinction between carbon neutrality (achieved through both avoidance and removal credits) and net-zero (requiring removal credits) was emphasised. The importance of removal-based credits for long-term climate impact and alignment with net-zero goals was highlighted.
- **Avoidance vs. removal-based credits:** The fundamental difference – avoidance credits prevent emissions, while removal credits actively remove CO2 from the atmosphere. Removal credits offer longer-lasting climate benefits and align with net-zero targets. Carbon removal technologies are gaining traction as a crucial component of long-term decarbonisation strategies. Manish Dabkara discussed innovative carbon removal methods such as biochar (hybrid solution), enhanced rock weathering, agroforestry, mangroves (Nature bases solutions) and direct air capture (engineered solution). He deliberated that engineered removal projects are costly in comparison to other solutions. He highlighted that removal-based carbon credits are essential for achieving net-zero targets, making them a high-growth investment sector. India, with its vast renewable energy potential, is well-positioned to become a leader in carbon removal credit generation.
- **Industry recommendations:** Panellists urged industries to adopt energy-efficient and clean technologies, emphasising the long-term financial benefits of carbon credits. The importance of companies taking early action in the carbon credit market was emphasised.

Through the discussions, Amit Kumar discussed company-wide net-zero goals and the reality of large companies making money from carbon trading. Abhishek Gupta expressed optimism for the Indian carbon market growth and the benefits that energy efficient technology will provide.

This session provided an in-depth exploration of the evolving carbon market, covering credit generation, market trends, regulatory challenges, and future opportunities. Panellists discussed the intricacies of carbon credit mechanisms and provided insights into achieving carbon neutrality and net-zero goals.

Session: Carbon Border Adjustment Mechanisms (CBAM) & Scope 1, 2 & 3: Preparing Indian Businesses for Global Trade & Climate Policy

Session moderator: Amit Kumar, Vice President & Head-MPS, Schneider Electric

Presentations: Atul Sharma, Co-Founder, Sarvada Legal and Anil Jauhri, Chairman, Carbon Registry-India

Key discussion points:

- **Carbon market dynamics and assurance:** Anil Jauhri emphasised on the growing significance of the carbon market, driven by the operationalisation of Article 6.4 of the Paris Agreement and India's development of its domestic carbon market. He clarified the distinction between compliance and voluntary carbon markets, highlighting the role of organisations like the Global Carbon Council and Gold Standard in the voluntary space. The importance of robust assurance mechanisms, including validation and verification by independent third-party bodies, was underscored. Jauhri explained the concept of accreditation, emphasising the need for competence, impartiality, and consistent operation in conformity assessment bodies. He detailed the role of international accreditation bodies like IAF and ILAC, and the relevance of ISO standards (particularly ISO 17029 and ISO 14065) in ensuring the integrity of carbon credit verification. Concerns regarding potential conflicts of interest within validation and verification bodies and the need for greater clarity on impartiality and independence were raised. The importance of regulatory oversight of the voluntary carbon market in India was stressed to maintain global credibility and ensure the quality of Indian carbon credits. Jauhri highlighted the need for programme owners to write clear requirements at all levels of the carbon credit generation process. The problematic issue of who pays for the validation and verification was raised along with the possible impartiality issues this causes.
- **Carbon Border Adjustment Mechanism (CBAM):** Atul Sharma explained CBAM as a regulatory 'stick' aimed at preventing carbon leakage and ensuring a level-playing field for industries

subject to carbon pricing. He detailed the scope of the EU's CBAM, focusing on the initial phase covering cement, iron and steel, aluminium, fertilisers, electricity, and hydrogen. The transitional reporting phase (2023-2025) and the potential for a delayed implementation of the actual tax were discussed. The mechanism for calculating CBAM obligations, including deductions for free allowances and existing carbon pricing mechanisms, was explained. The potential long-term impacts of CBAM, including the expansion of its scope to downstream products, the realignment of value chains, and the potential for widening emission gaps, were highlighted. The legal challenges to CBAM brought by Poland were mentioned. The need for MSMEs to be aware of the coming regulations was stressed, highlighting that they should begin collecting data from their raw material suppliers. The discussion showed that CBAM will lead to a super regulator, that will have worldwide emission level data for many products.

Session: Carbon Border Adjustment Mechanisms (CBAM) & Scope 1, 2 & 3: Preparing Indian Businesses for Global Trade & Climate Policy

- **Implications for Indian businesses:** The session highlighted the potential financial implications of CBAM for Indian exporters, particularly those in energy-intensive industries. The need for Indian businesses to proactively adopt sustainable practices, accurately measure their carbon footprint, and comply with CBAM reporting requirements was emphasised. The importance of understanding the complexities of Scope 1, 2, and 3 emissions was reiterated. The MSMEs must begin to prepare for the expansion of CBAM regulations to downstream products. Indian businesses must begin to track the carbon footprint of their raw material suppliers.
- **Recommendations:** Indian businesses should invest in robust carbon accounting and reporting systems to ensure compliance with CBAM and other emerging regulations. Industry associations and government agencies should provide guidance and support to help businesses navigate the complexities of carbon markets and CBAM. The Indian Government should consider implementing policies to support the transition to a low-carbon economy and enhance the competitiveness of Indian exporters. Indian businesses should proactively engage with their supply chains to ensure transparency and reduce emissions. The Indian Government should regulate the voluntary carbon market. Indian businesses should begin to diversify their export markets.

This session provided critical insights into the evolving landscape of carbon markets and the practical implications of CBAM for Indian businesses. The presentations by Anil Jauhri and Atul Sharma illuminated the complexities of carbon credit verification, the regulatory framework governing carbon markets, and the tangible impacts of EU's CBAM on global trade.

Conclusion:

The Carbon Markets Track at eTECHnxt reinforced that carbon trading is not just an environmental initiative—it is an economic opportunity. With growing international scrutiny and evolving policies, India must proactively position itself as a leader in the global carbon economy. The transition to a low-carbon future will require collaboration between industry, policymakers, and investors to create a robust and trustworthy carbon market.

This discussion at eTECHnxt serves as a catalyst for further action, ensuring that India's carbon market remains both credible and competitive in the evolving global landscape.

Vikram Gandotra, Chairman, ELECRAMA 2025 in conversation with IEEMA Journal

Vikram Gandotra,
Chairman, ELECRAMA 2025

IEEMA JOURNAL (IJ) Define broadly the vision of ELECRAMA 2025. Describe the sentiments of the growing number of exhibitors at the event.

VIKRAM GANDOTRA (VG): ELECRAMA 2025 was IEEMA's effort to seamlessly blend the global vision of a cleaner and energy-secure future, upholding renewable energy growth, especially in the solar, wind, EVs, and green hydrogen sectors to meet India's pledge to reach net zero emissions by 2070 and the global resolutions committed at COP29. India's economy is *enroute* to becoming the third largest in the world by 2027, and as the PM said, India's energy sector plays a pivotal role.

IEEMA's steadfast commitment to advancing the electrical and allied electronic industries through the world's largest electrical show, ELECRAMA 2025, successfully connected stakeholders, facilitated the exploration of emerging technologies, and enabled impactful policy dialogues. ELECRAMA 2025 proved to be a transformative platform that showcased cutting-edge innovations, fostered global collaboration, and accelerated the journey towards a sustainable energy

Chairman ELECRAMA 2025, Vikram Gandotra, (third from right), presents a memento to the Union Minister for Housing & Urban Affairs, GoI, Shri Manohar Lal Khattar, (third from left), along with the President of IEEMA, Sunil Singhvi, at the Inaugural of the event.

future. With 1000+ exhibitors, ELECRAMA 2025 empowered businesses of all sizes, from established global players to dynamic startups, creating opportunities for networking, knowledge exchange, and growth.

The visitors at ELECRAMA 2025 were exuberant and excited with the scale, variety of technology, richness of the co-located events and convenient facilities at the venue. The exhibitors were appreciative of the efforts made to attract a very large number of quality business visitors both from India and abroad to the event. The officials from our Focus Country, Germany, were impressed by the exhibition and all the co-located events and are looking forward to participating on a much larger scale as the Partner Country in the next edition of ELECRAMA 2027. Additionally, France as Associate Partner Country and 12 other countries who had pavilion level participation have also shown satisfaction with their participation. The new event BHARAT – THE VISHWAMITRA planned for our international visitors was a resounding success with engaging cultural activities and business discussions.

The event lived up to its tagline of 'Bigger, Better and Bolder'!

(IJ) What were the upgrades in terms of quality and services noticeable at ELECRAMA 2025?

(VG) - More convenient transport facilities to reach the venue from the airport and metro station,

- The ELECRAMA App and the Digital Kiosks couple with Show Guide and Site Map were very useful for the exhibitors and visitors to seek out each other,
- Access from the 3 gates spread across the venue helped avoid crowding or delays at any gate,
- Less waiting time at registration enabled faster entry into the exhibition,
- The focus on sustainability was clear, with "green electricity – generated through renewable sources" consumed at the venue; less use of plastic,
- More food courts, wider food choices made accessibility better and waiting time less,
- Free wifi zones made availability of the internet better than in the previous editions,
- A booth for booking cabs was provided at the venue, which was very useful to the visitors,
- The entertainment zone and the beer garden enabled exhibitors and visitors to unwind.

Overall, it was ease of access and ease of business with bountiful opportunities.

(IJ) How has ELECRAMA 2025 addressed emerging agendas like energy storage, renewable energy, etc.?

(VG) The co-located events like World Utility Summit and E-technxt provided platforms for the community to participate in engaging conversations on the emerging technologies with global technology experts and policymakers.

The exhibitors showcased cutting-edge solutions in the new technology areas such as the integration of renewable energy, storage, digital technologies, etc.

(IJ) In what way has the World Utility Summit created a lasting impression on the world's vision?

(VG) The World Utility Summit 2025 was planned to create a lasting impression on the global vision for utilities and played the role of a pivotal force in defining the future of the sector. The summit's comprehensive agenda, addressing critical themes, covered topics from sustainable power systems to the integration of AI and the building of resilient grids. The agenda of the discussions and collaborations accentuated innovative financing, strategic partnerships, and the evolution of regulatory landscapes to foster an environment of unprecedented levels of cooperation and knowledge exchange. The World Utility Summit 2025 impelled a global transition towards a future of sustainable, reliable, and interconnected energy systems.

(IJ) Comment on Reverse Buyer Seller Meet (RBSM) held at ELECRAMA 2025.

(VG) I am happy to inform you that we registered more than 2000 meetings in a short span of three days, perpetuating a business interest of over USD 4 BN stemming from 62 countries. We have also signed memorandums of understanding with Romania, Thailand, Malaysia and Belgium. Our exhibitors were overwhelmed by the interest from international buyers at their stalls at ELECRAMA 2025. Our maiden attempt to organise the international evening extravaganza was well received by our guests, who found it to be a great experience for all.

(IJ) Share your thoughts on the IEEMA initiative of Electraverse Sparks?

(VG) It is encouraging to note a four-fold increase in the number of participants in Electraverse Sparks (EVS). Out of the 232 startups that applied, 51 shortlisted EVS showcased innovations and solutions spanning stationary storage, moving storage, AI and data analytics in energy, power and renewable equipment, innovations in carbon markets, et al. The 'Startup Pitch Session & Awards' recognised 14 startups who won a total of INR 40 L in funding—an investment that signifies confidence in their potential to revolutionise the industry.

The future of a nation is always in the hands of the youth, and through EVS we are paving the way for the next generation of entrepreneurs to lead our industry's transformation. IEEMA has an unwavering commitment and a clear vision to mentor and provide exposure; facilitate access to funding and investment; create a synergistic platform where startups, corporates, and government bodies collaborate; and develop a knowledge repository that equips entrepreneurs with essential resources and insights.

(IJ) How is IEEMA faring with respect to extending the popularity of ELECRAMA?

(VG) Every edition of ELECRAMA is an improvement over the previous one, and this edition has grown to be the largest show of electricals and allied electronics in the world. This indicates the commitment of the IEEMA team—the organizing committee and the IEEMA Operations Team (IOT), who are genuinely committed to delivering the best value to the exhibitors and visitors who have called it a super success. The key to successfully organising such a large event requires starting early with proper plans and strong decentralised teams that operate in the most professional manner. The vast outreach build-up of the event with road shows in 30 cities in India and also across the globe ensured that the message of ELECRAMA 2025 was carried to our target audience. The new initiative to reach out to industries was a phenomenal success and attracted the interested buyers in large numbers. The success of ELECRAMA 2025 has reinforced the strong image of IEEMA amongst the global electrical community.

(IJ) How has ELECRAMA 2025 impacted the world economic scenario and direction of the global markets?

(VG) The industry is optimistic about the future demand of products, solutions and services required to meet the ambitious targets of energy transition. The increase in demand for finished products leads to challenges in the supply chain, which is also expanding its capacities. IEEMA's focus on quality, safety and reliability was mirrored by the exhibitors in their designs and products and showcases the ability of the Indian manufacturing industry to play a significant role in the global markets.

(IJ) How do you envision ELECRAMA 2027?

(VG) Even more "Bigger, Better & Bolder!!!"

Let's Work Together for an Electrical Safe India

Through this paper, **Dr. RAJESH KUMAR ARORA** provides insights of different causes of electrocution or fire hazards and provides recommendations and safety tips for an electrical safe India.

Nowadays, modern society is highly dependent on electrical power supply. To live and make our lives comfortable, we use a number of appliances or gadgets at our residences or offices. Almost daily we wake up to the news of electrocution or electrical fires in residential or commercial buildings, public locations, distribution transformers or substations. This forces us to ponder over the causes of such accidents that lead to loss of lives as well as loss of assets and properties. This paper provides insights of different causes of electrocution or fire hazards for all locations.

1.0 Introduction

The news of electric shock or electric fire killing people is painful and we all want to find a solution. But sadly, in a day or two, we again forget and wait for another accident to happen.

There are too many tales that different parts of the country have to tell each day (several cases are even not reported or recorded).

Electrocution, electrical fire and lightning kill 15,000 a year. Also 75,000 (approximate) suffer because of these deaths; there is loss of property and assets and dreams of many people associated with the deceased are shattered.

Around 1 lakh people died due to electrocution in the last decade, as per National Crime Records Bureau (NCRB) data *(refer to Table 1)*.

According to the NCRB, around 1 lakh people lost their lives because of electrocution in the last decade alone. The annual average of fatalities rose to 12,500 per year or 30 fatalities every day.

Calling the 30 electrocution deaths per day in India "accidents" is something not justified as it tends to insulate all stakeholder from accountabilities.

2.0 Causes of Electrocution and Electrical Fire Hazard

Electrocution and electrical fires in electrical installation may be broadly caused by:

- Over currents (overloads and short circuits)
- Harmonics
- Earth fault
- Electric arcs in cables and loose connections
- Failure of protection device or wrong selection of protection device
- Wrong selection of cables or wires
- Mismatch of illumination fittings rating and lamps used
- Use of extension cord for heaters or any other heavy loads
- Use of outlived (outdated) or damaged equipment
- Over voltages (lightning) and arcing ground
- Consumer has become prosumer
- Inadequate design for earthing or grounding
- Improper or no verification and testing (commissioning or periodical).

Table 1: NCRB Data of Deaths due to Lightning Electrocution and SC FIRE 2020-222

NCRB DEATH DATA (LIGHTNING, ELECTROCUTION & FIRE DUE TO SHORT CIRCUIT)						
DESCRIPTION	2020	2021	2022	% OF TOTAL (2020,21,22)		
TOTAL DEATH	374397	397530	430504	100	100	100
LIGHTNING	2862	2880	2887	0.76	0.72	0.67
ELECTROCUTION	13446	12529	12918	3.59	3.15	3.00
FIRE DUE TO ELECTRICAL SHORT CIRCUIT	1943	1808	1567	0.52	0.45	0.36

डायनामिक केबल्स लिमिटेड

वैश्विक स्तर पर
४२ से अधिक देशों
को निर्यात

गुणवत्ता और विश्वसनीयता का दूसरा नाम

निरंतर आपकी सेवा में उपलब्ध

हमारे उत्पाद

केबल
- 66 KV XLPE पावर केबल्स
- HT & LT एरियल बंच केबल्स
- LT PVC पावर और कंट्रोल केबल्स
- FR/FRLS/LSZH केबल्स
- HT & LT XLPE UG पावर केबल्स

कंडक्टर्स
- बेयर और इंसुलेटेड कॉपर कंडक्टर्स
- ACSR, AAA & AA कंडक्टर्स
- मीडियम वोल्टेज कवर्ड कंडक्टर्स (MVCC)

अन्य उत्पाद
- एयरडेक, कम्युनिकेशन और कन्सेन्ट्रिक केबल्स
- सोलर केबल्स
- रेलवे सिग्नलिंग, पावर और क्वाड केबल्स
- ईवी चार्जिंग केबल्स

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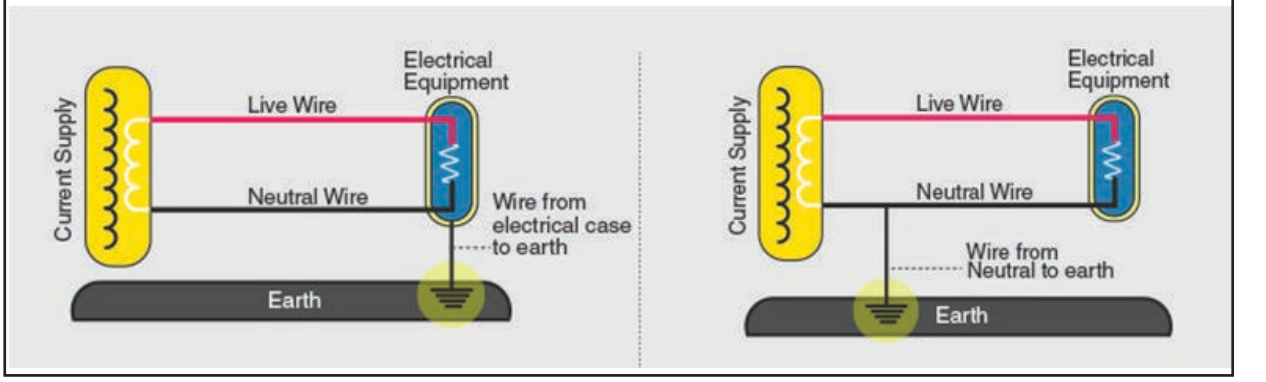
Fig 1: Equipment and Neutral Earthing



2.1 Role of Adequate Earthing/Grounding

Grounding or earthing means making a connection to the general mass of earth. The use of grounding is so widespread in an electric system that at practically every point in the system – from the generators to the consumers' equipment – earth connections are made.

There are two types of grounding *(refer to Fig 1)*:

1. Neutral grounding
2. General (equipment) grounding

The objectives of general grounding system include:

- To provide a low resistance return path for fault current, which further protects both working staff and equipment installed in the premises *(refer to Fig 2)*.
- To prevent dangerous GPR for remote ground during fault condition.
- To provide a low resistance path for power system transients such as lightning and over voltages in the system.
- To provide uniform potential bonding or zone of conductive objects within substation to the grounding system to avoid development of dangerous potential between objects (and earth).
- To prevent building up of electrostatic charge and discharge within the substation, which may result in sparks.
- To allow sufficient current to flow safely for satisfactory operations of protection system.

The main objective of grounding electrical systems is to provide a suitably low resistance path for the discharge of fault current, which ultimately provides safety to working personnel and costly installed equipment by providing sufficient current to safety devices.

2.2 Basic of Short Circuit in the Electrical System

Electrical fires very often take place in the residential sector. This is because most people do not take into account the rating of appliances while placing or connecting them. Being an individual, most of us are

Fig 2: Unearth System and Shock Hazard

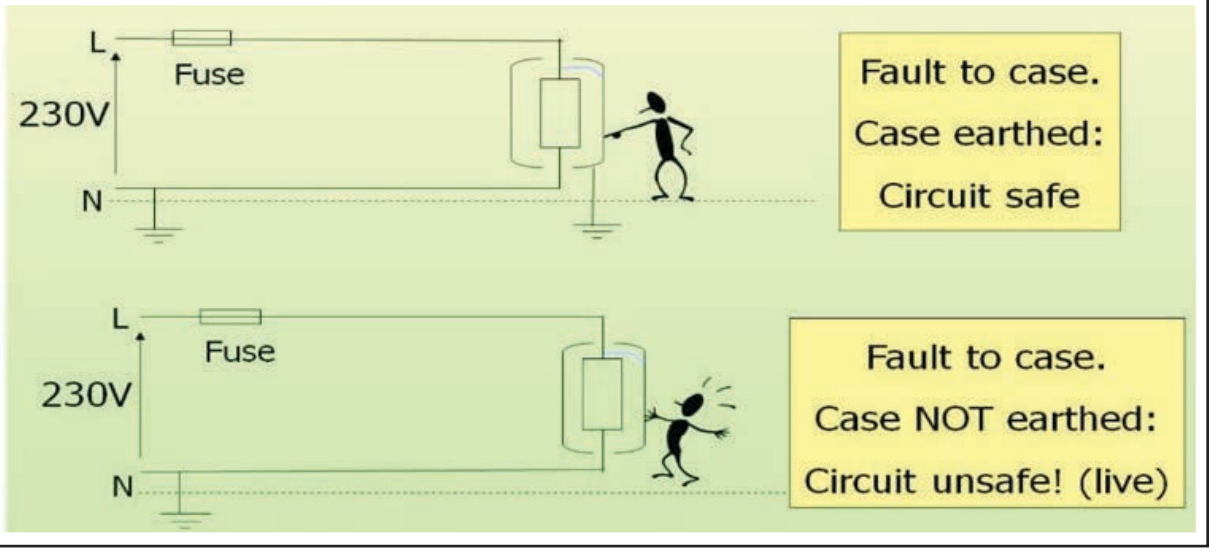
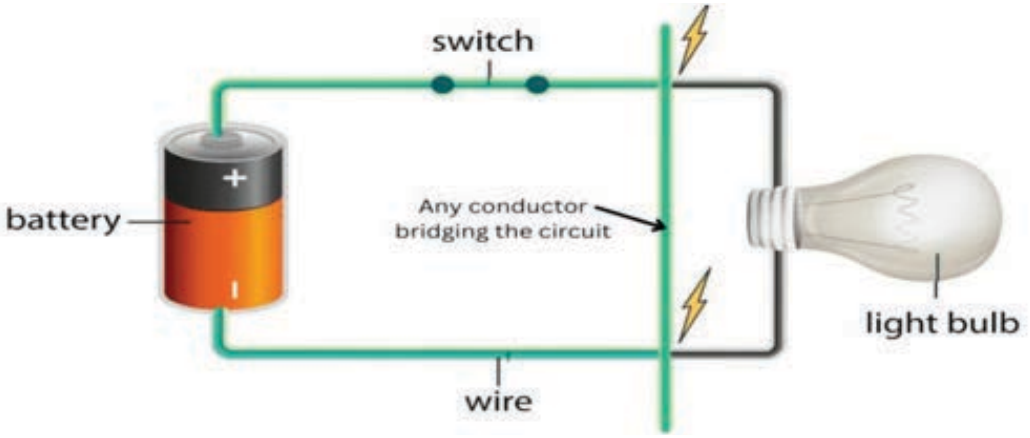


Fig 3: Concept of Short Circuit



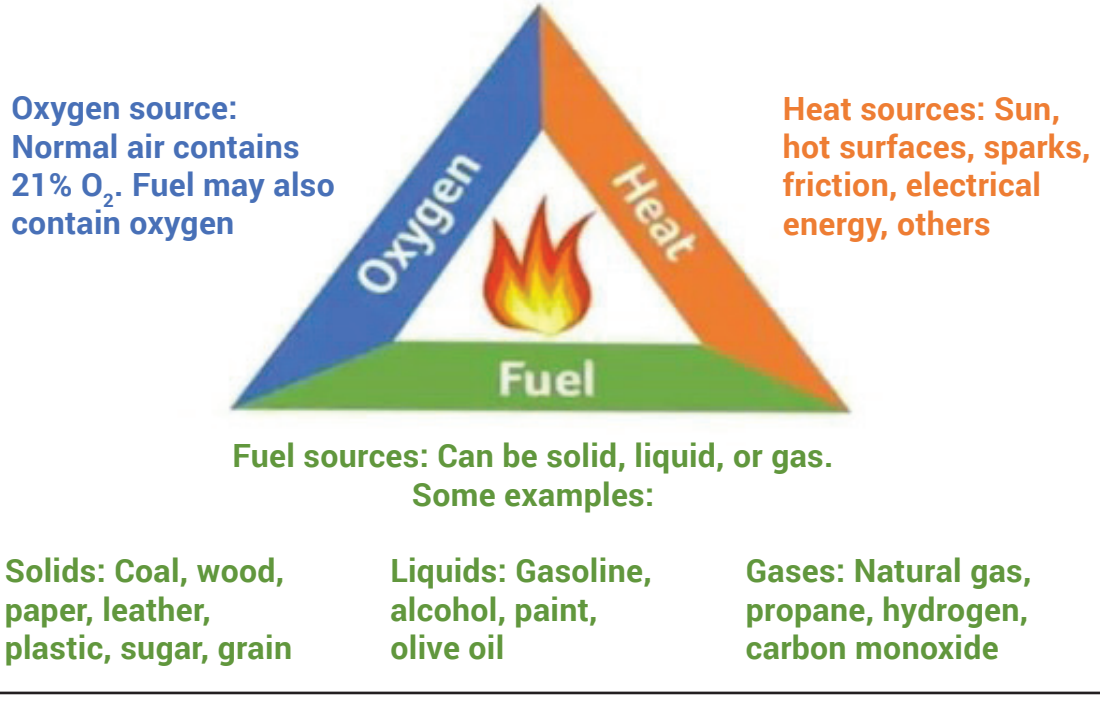
unaware of the parameters we should consider while purchasing a product. The only thing that people look for is cost-effectiveness, which in turn, leads to extreme situation, resulting in electrical fires. A major reason for electrical fire in LV system is short circuiting, ie, flowing of current through unintended path.

A short circuit is an abnormal connection between two nodes of an electric circuit intended to be at different voltages. This results in an electric current limited only by the equivalent resistance of the rest of the network, which can cause circuit damage, overheating, fire or explosion *(refer to Fig 3)*.

This high current generates high heat and the presence of fuel or any other flammable materials may result in fire hazards as governed by fire triangle in Fig 4.

Short circuits happen mainly due to degradation of insulation. As the wire gets old, the insulation gets degraded, due to which there is a chance of short circuiting *(refer to Fig 5)* and this may lead to fire.

Fig 4: Fire Triangle



Several factors contributing to the risk of electrocution and fire in residential as well as commercial places are given in Table 2 on the next page.

3.0 Electrical Safety at Public Places

Public places such as schools, hospitals, shopping malls and recreational facilities accommodate large numbers of people, making electrical safety paramount *(refer to Fig 6)*. Electrocution in public places is also evidence of power companies and governments cutting corners. Safety requires discoms to take all high-tension cables underground, but power companies resist this for the costs entailed and direct impact on electricity tariff.

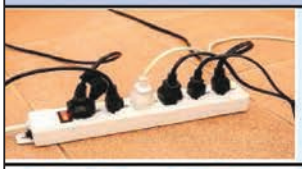
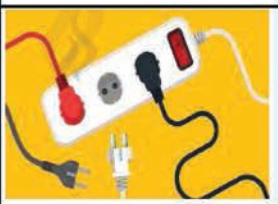
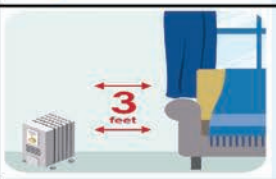
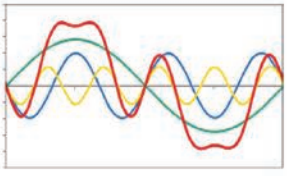
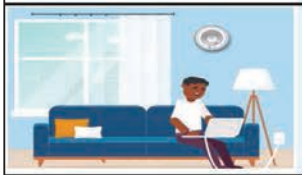
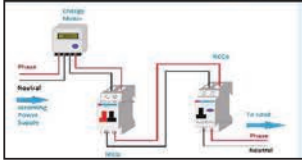
Causes of electrocution and fire in public places include *(apart from the above causes mentioned in Table 2)* are discussed below:

- **Aging infrastructure:** Older public buildings may have outdated electrical systems that are more prone to faults and failures, increasing the risk of electrical incidents.
- **Lack of maintenance:** Inadequate maintenance of electrical systems and equipment in public facilities can lead to deteriorating conditions and potential hazards.
- **Overcrowding:** Events or facilities that experience overcrowding may put strain on electrical systems, increasing the likelihood of overloads and electrical fires.
- **Improper installation:** Faulty installation of electrical systems or equipment in public places can create hazardous conditions that endanger occupants and visitors (refer to Fig 7).
- **Vandalism or sabotage:** Deliberate acts of vandalism or sabotage targeting electrical infrastructure in public places can result in electrocution hazards and fires.

Fig 5: Fire due to Insulaton Failure

Fig 6: Fire in High-rise Commercial Building

Table 2: Summary of Main Causes of Electrocution and Fire

Follow these safety tips to safeguard your home and commercial buildings from electrical hazards (electrical fires and accidents)			
	Avoid overloading of outlets or extension cords		Unplug appliances when not in use to save energy as well as minimise risk and shock and fire
	Loose connection must be avoided		Extension cords should only be used on a temporary basis
	Never plug space heater or any heavy loads into an extension cord or power strip		Never run cords under rugs or carpets, doors or windows
	Make sure extension cords do not become tripping hazards		Keep papers and other potential combustibles at least 3 ft away from space heaters and other heat sources
	Make sure you use proper rating illumination fitting for illumination lamps		Make sure your home has smoke (fire detection) alarm and replace the unit every 10 years
	Kindly ensure proper earthing or grounding design based on the site requirement		Proper selection of MCB, RCCB or any other protective device
	Harmonics: Use gadgets with less harmonics generation or use proper harmonic filters		Proper selection of cables and wires
	Use good quality gadgets. Also do not use outdated or outlived or damaged gadgets or appliances		Proper maintenance of equipment and gadgets; avoid use of outdated or damaged equipment
	Proper protection system coordination		Regularly inspect and test electrical cords, extension cords, electrical gadgets and electrical circuits for damage

Created By Igniting Power Engineers (IPE) - Dr. Rajesh Arora - for public awareness

Fig 7: Electrocution Hazard due to Poor Upkeeping

Fig 8: Electrocution and Fire due to Public Procession

4.0 Electrical Safety at Public Gathering and Processions

Public processions and gatherings hold significant cultural, religious and social importance in India, often involving large crowds congregating on streets. However, amid the fervor and celebration, safety concerns often take a backseat, leading to tragic incidents like electrocution and fire.

Causes of Electrocution

- **Improper wiring:** Inadequate or faulty wiring setups are common during public events due to hasty installations or lack of expertise. These setups may include temporary electrical connections that are not insulated properly, increasing the likelihood of electrocution if they come in contact with water or damp surfaces.
- **Overloaded circuits:** The demand for electricity surges during festivals and processions due to extensive lighting arrangements, sound systems and other electrical paraphernalia. Overloading circuits beyond their capacity raises the risk of short circuits and subsequent electrocution hazards.
- **Poor maintenance:** Existing electrical infrastructure often receives minimal maintenance, exacerbating risks during public gatherings. Aging cables, corroded connections and neglected equipment pose significant threats when subjected to the additional strain of large-scale events.
- **Unauthorised installations:** In the rush to set up for festivities, unauthorised installations by unqualified personnel are common. These

Fig 9: Electrocution and Fire due to Vehicles Contact with HT Wires

Fig 10: Fire in Generating Stations and EHV Substations

makeshift arrangements bypass safety protocols, heightening the probability of accidents such as electrocution.

- **High-tension wires:** High-tension wires, also known as high-voltage power lines, carry electricity over long distances at high voltages. These wires are typically installed on tall transmission towers or poles to ensure clearance from the ground and surrounding structures. However, during public processions, temporary structures such as stages, pandals (decorative tents) or banners may inadvertently come into contact with these wires, leading to catastrophic consequences *(refer to Fig 8)*.

4.1 Causes of Electrocution due to High-Tension Wires

- **Inadequate clearance:** Temporary structures erected for public processions often lack proper planning and supervision, resulting in insufficient clearance between the structures and overhead high-tension wires. Failure to maintain adequate distance increases the risk of accidental contact, especially when structures sway due to wind or crowd movement. (refer to Fig 10).
- **Ignorance and negligence:** Organisers and participants may lack awareness about the dangers posed by high-tension wires or fail to recognise the potential hazards associated with erecting structures near them. Ignorance, coupled with negligence in adhering to safety guidelines, exacerbates the risk of electrocution incidents.
- **Lack of coordination:** Coordination between event organisers, local authorities and power distribution companies is often inadequate, leading to haphazard planning and implementation of safety measures. Failure to

Table 3: Seven Golden Rules to Ensure Safety for Industrial Locations, Generating Stations and Substations

Sr. No.	Descriptions
1	Evaluate the work to be performed. Do an on-site hazard identification and risk assessment (HIRA).
2	Ensure that you clearly identify the work location and equipment where the maintenance work is to be carried out.
3	Always apply permit to work and discuss the work to be carried out in detail with the team to perform the work.
4	Always disconnect electrical sources and secure against reconnection in any condition (LOTO: Lockout-Tagout).
5	Verify the absence of operating voltages. Test before touching or starting any activity.
6	Ensure to carry out earthing of the part where the work is to be carried out by the team.
7	Protect adjacent live parts and take special precautions when working close to bare conductors.

NOTE: It is very important to use the required and recommended PPE before starting any maintenance activity.

coordinate activities such as route planning, structure placement and crowd management increases the likelihood of accidents involving high-tension wires.

- **Encroachment and unauthorised construction:** Encroachment on public spaces and unauthorised construction near high-tension wire corridors is a common phenomenon in many Indian cities and towns. Informal settlements, temporary shelters and makeshift structures often encroach upon the safety buffer zones around high-tension wires, heightening the risk of electrocution during public processions.

5.0. Electrical Safety at Industrial Locations, Generating Stations and Substations

Industries, generating stations and substations are critical components of electrical networks, but they also pose significant risks if safety measures are not strictly enforced (refer to Fig 9). Causes of electrocution and fire in substations include:

- **High voltage exposure:** Industries and substations contain high-voltage equipment that poses a severe risk of electrocution to untrained personnel or trespassers who come in contact with live components.
- **Equipment failure:** Malfunctions or breakdowns of transformers, circuit breakers and other substation equipment can result in electrical arcs, sparks and fires.
- **Lack of proper enclosure:** Unprotected or poorly enclosed panels or substations may expose electrical components to environmental factors such as moisture, debris and wildlife, increasing the risk of failures and fires.
- **Inadequate security measures:** Substations that lack sufficient security measures are vulnerable to unauthorised access, which can lead to tampering, theft or vandalism that compromises safety.
- **Insufficient training:** Workers at factories or substations must receive comprehensive training on electrical safety protocols and emergency procedures to mitigate risks effectively.

6.0 Conclusion (Recommendations and Safety Tips)

1. **Regular maintenance and condition monitoring testing** of all the equipment in the system must be done periodically to avoid any hazards. The list of tests to be conducted are summarised in Table 4 below.

Table 4: Tests to be Conducted as per IS 732

S. No.	Test (Description)	Test Execution Before or After Supply Connection
1	Continuity of Conductors	Tests before the Electrical Supply is connected or in OFF Conditions
2	Insulation Resistance of the Electrical Installation	
3	Protection by SELV, PELV or by Electrical Separation	
4	Floor & Wall Resistance / Impedance	
5	Automatic Disconnection of supply	
(i)	Earth Electrode Resistance	Tests before the Electrical Supply is connected or in OFF Conditions
(ii)	Earth Fault Loop Impedance (EFLI)	Tests with the Electrical Supply connected
6	Additional Protection	Tests with the Electrical Supply connected
7	Polarity Test (Continuity Measurement)	Tests before the Electrical Supply is connected or in OFF Conditions
	Polarity Test	Tests with the Electrical Supply connected
8	Test of the order of the Phase	Tests with the Electrical Supply connected
9	Functional & Operational Tests	
10	Voltage Drop Tests	

2. **Regular inspections:** Conduct routine inspections of electrical systems, wires, outlets and appliances to identify any signs of wear, damage, or overloading. Engage qualified electricians for these inspections.
3. **Proper wiring and installation:** Ensure all wiring and electrical installations comply with building codes and standards. Avoid calling unskilled persons electrical work and hire licensed professionals for installations and repairs.
4. **Overload protection:** Use circuit breakers, fuses and surge protectors to prevent overloading circuits. Distribute electrical loads evenly across circuits and avoid daisy-chaining power strips or extension cords.
5. **Fire extinguishers and smoke alarms:** Install smoke alarms in strategic locations and maintain them regularly. Additionally, equip buildings with appropriate fire extinguishers and ensure occupants are trained in their usage.
6. **Clearance and ventilation:** Keep electrical panels, equipment and outlets clear of obstructions. Adequate ventilation should be maintained around electrical appliances to prevent overheating.
7. **Education and awareness:** Educate residents, employees and the public about electrical safety practices, including avoiding water contact with electrical appliances, using appliances according to manufacturer instructions, and reporting any electrical issues promptly.
8. **Emergency preparedness:** Develop and communicate emergency procedures for dealing with electrical incidents, including evacuation plans and emergency contact information.
9. **Lightning protection:** All buildings and locations must be assessed for lightning strike and protection devices must be installed.
10. **During public processions,** prioritise safety by using insulated electrical equipment, securing cables to prevent tripping hazards, and avoiding water contact. Regularly inspect all electrical setups and provide adequate supervision. Instruct participants to steer clear of electrical installations and report any hazards immediately. Ensure emergency response plans are in place, including the availability of trained personnel and extinguishing equipment. Conduct thorough risk assessments before each event and communicate safety guidelines effectively to all involved.
11. **Extra precaution to be taken during rainy season or places with water logging** as these create lethal environment and pose potential threat to people in the vicinity.

By implementing these recommendations, individuals and organisations can significantly reduce the risk of electrocution and fire hazards in various locations.

Let us work together to make India electrical safe – let us give our contribution for this noble cause.

References

[1] Manual on," Grounding of A C Power Systems," Publication No 339, C.B.I.P. New Delhi.
[2] IS 3043-2018, Indian Standard Code of Practice for Grounding.
[3] CEA regulation 'Measures relating to Safety and Electric Supply' and 'Technical Standards for Construction of Electrical Plants and Electrical Lines.
[4] IS 732: Code of Practice for Electrical Wiring Installations
[5] IS/IEC 62305 – Protection Against Lightning
[6] National Building Code 2016
[7] National Electrical Code (NEC) 2023

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Dr. Rajesh Kumar Arora obtained the BTech and Master of Engineering (ME) degrees in Electrical Engineering from Delhi College of Engineering, University of Delhi, India, in 1999 and 2003, respectively. He completed his PhD in grounding system design from UPES, Dehradun. He is also a certified energy manager and auditor and has worked in 400 kV and 220 kV substations for more than 14 years at Delhi Transco Limited (DTL). He has also worked as Deputy Director (Transmission and Distribution) in Delhi Electricity Regulatory Commission (DERC) for three and a half years. He has also made his contribution in the OS department of DTL for more than two years and rendered his services in the SLDC of Delhi Transco Limited (DTL) as well. At present, he is working in the Design and Engineering (D&E) department of DTL. His research interests include high voltage technology, grounding system, protection system, computer application and power distribution automation.

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Discrete Approach over Power Quality Parameters Monitored by a Utility

As India continues its journey towards a cleaner energy future, addressing power quality challenges will be crucial to ensure efficient and reliable operations of its electrical systems. By implementing appropriate mitigation strategies and maintaining power quality parameters within IEEE standards, utilities can enhance system performance, reduce losses, and protect equipment, writes **Dr Manish Wath, Chief Engineer (Testing), Maharashtra State Electricity Distribution Company Limited.**

In this approach, various power quality features have been studied as in recent past and upcoming future power systems are gradually becoming electronically powered. Although power electronics technology brings a qualitative leap to renewable energy, microgrid technology, distributed power supplies, electric vehicles, etc, it also affects the power quality of the distribution network. This paper discusses the need for measures to address voltage fluctuations, harmonic distortion, and transient events. By implementing appropriate mitigation strategies and maintaining power quality parameters within the Institute of Electrical and Electronics Engineers (IEEE) standards, utilities can enhance system performance, reduce losses, and protect equipment. Collaboration between utilities and consumers is essential for effective power quality management.

1. Introduction

As the world's third-largest energy-consuming country, India plays a pivotal role in shaping the global energy scenario. While significant challenges remain, India is making remarkable strides in renewable energy. The country ranks fourth globally in both, renewable energy installed capacity and wind power capacity, and fifth in solar power capacity. This growth aligns with India's ambitious commitment to achieve 500 GW of non-fossil fuel-based energy by 2030, as outlined at COP26. This ambitious target is a key component of India's *'Panchamrit'* strategy for combating climate change.

India's power sector has undergone significant improvements, with increased access to grid electricity, reduced power deficiency, and substantial growth in renewable energy capacity. However, the evolving load profile, which now includes a mix of inductive and nonlinear components, presents new challenges for power quality management. High-quality power is essential for the optimal functioning of electrical and electronic equipment, reducing downtime, minimising faults, and improving overall efficiency and sustainability.

As India continues its journey towards a cleaner energy future, addressing power quality challenges will be crucial to ensure the efficient and reliable operations of its electrical systems.

2. Utility Perspectives Over Power Quality

India's vast electrical grid relies on approximately 13 million distribution transformers with a combined capacity of 6 lakh MVA. While some utilities have managed to significantly reduce the high failure rates (up to 20 percent) through strict quality standards, many still face challenges.

At the central level, the Central Electricity Authority (CEA) and the Central Electricity Regulatory Commission (CERC) oversee power quality regulations. State Electricity Regulatory Commissions (SERCs) enforce these regulations at the state level. Despite the existence of regulations, inconsistencies arise due to a lack of uniformity in their approach and implementation across different states.

Although basic guidelines for power quality metres are consistent, comprehensive monitoring mechanisms remain absent, hindering effective power quality management. Regulators monitor

distribution losses and AT&C losses, and reliability indices are also considered. However, insufficient penalties for non-compliance to utilities and high-tension (HT) consumers weaken the enforcement of regulations, leading to potential risks in maintaining power quality standards.

India faces challenges in ensuring consistent power quality standards across its distribution systems. However, ongoing efforts to improve the reliability and efficiency of these systems are essential for meeting the growing energy demands of the country.

3. Challenges

A. Grid Reliability with Renewable Energy Sources

Integrating renewable energy sources like solar and wind into the power grid poses significant challenges for maintaining grid reliability due to their inherent variability. Wind energy depends on fluctuating wind speeds, and solar power is affected by changing weather conditions and time of day. This unpredictability leads to difficulties in ensuring stable and high-quality power supply, which traditional grids are not designed to handle. For example, variations in power output can cause voltage fluctuations and frequency instability, leading to issues such as voltage sags, swells, or outages.

In India, the challenge is heightened by ambitious targets for renewable energy, aiming for 50 percent of electric power capacity from non-fossil sources by 2030. This requires expanding the transmission network significantly – 51,000 km of new lines and increased transformation capacity, costing around Rs244,000 crore. The distributed nature of renewable farms, often far from central monitoring stations, complicates real-time power quality management. Without effective oversight, the grid faces risks of interruptions and instability, particularly as the network adjusts to handle surplus power while managing power quality.

The power distribution system has been designed generally as a radial one. The centralised load dispatch centres manage the supply-demand by controlling large generating stations as per the system's demand. The installation of distributed solar generation under various schemes will provide another local source of electricity. However, after implementing these schemes at a massive scale, it will have a significant effect on the distribution system, mainly stability of grid, ie, voltage regulation, reactive power, etc. Solar power plants may not provide sufficient reactive power to maintain grid voltage stability, especially during the period when solar generation is high but demand is low.

B. Grid Reliability with Electric Vehicles

The rise of electric vehicles (EVs) is straining electrical grids due to increased charging demand. This irregular demand disrupts the grid's balanced load profile, posing challenges for electricity companies. EV charging stations further exacerbate the issue by introducing potential power quality problems, such as harmonics and altered power factor.

EVs themselves can also impact power quality. The power electronics used in EV chargers generate harmonics, distorted waveforms that can lead to various issues like voltage sags, swells, and phase imbalances. These disturbances can undermine grid stability and efficiency, affecting both equipment performance and overall reliability.

Addressing power quality challenges is crucial for ensuring the grid's sustainability and supporting the seamless integration of EVs. Identifying and mitigating these issues is key to maintaining a reliable power supply and a sustainable energy ecosystem.

C. Harmonic Generators

Harmonic generators, such as drives, LEDs, UPS systems, converters, and inverters, introduce electrical harmonics into the power network. These distortions can cause issues like overheating, reduced efficiency, and equipment malfunction. Industries like steel rolling mills, arc furnaces, textile factories, and data centres are significant contributors due to their reliance on such equipment.

Designated consumers connected at a supply voltage of 11 kV or higher of specific industries and sectors such as arc furnace, induction furnace, iron and steel, aluminium, textile, paper and pulp, chlor-alkali, petro-chemical, cement, pharmaceuticals, IT/ ITES, airports, malls, hotels, banking, railways and metros, or any other categories specified by regulatory authorities. The current harmonics they introduce into the power system must comply with the standards set forth in IEEE 519:2014, which may be updated periodically. Additionally, the voltage harmonics and total harmonic distortion (THD) for each individual supply voltage must adhere to IS 17036, as it is revised over time.

The growing demand for renewable energy and EVs, combined with continued industrialisation and technological advancements, puts further strain on the grid. To ensure reliable power delivery, substantial investments in upgrading outdated power grids are necessary. These older systems were not designed for modern industries' complex power needs, making infrastructure upgrades crucial to prevent disruptions and maintain efficiency.

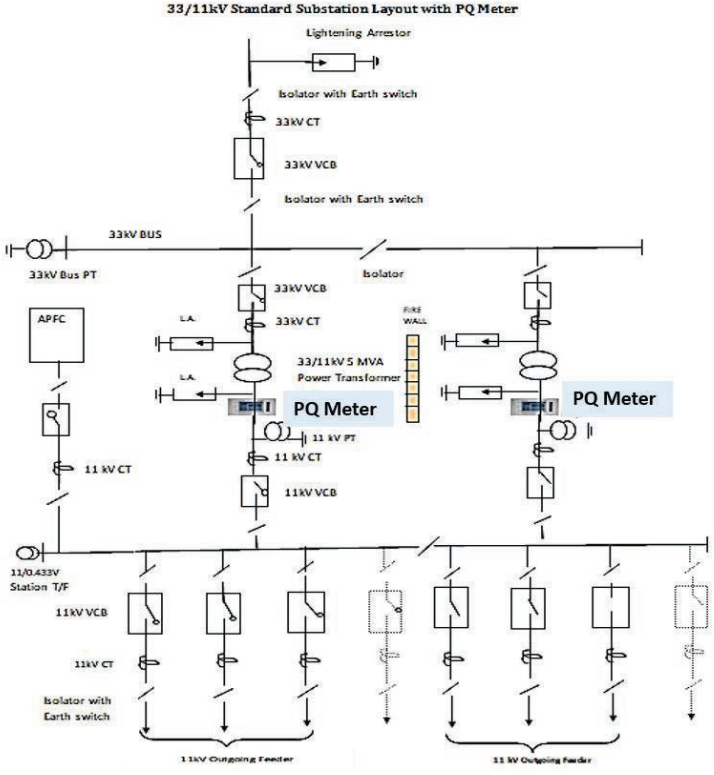
4. Need for Power Quality Monitoring, Analysing, and Reporting

Power quality monitoring is essential for various reasons:

- **Regulatory compliance:** Adhering to regulations like CEA and IEC 61000-4-30 ensures compliance with standards.
- **Grid stability:** Monitoring helps address challenges from renewable integration and non-linear loads, mitigating voltage variations and harmonics.
- **System performance:** Understanding system performance allows for better matching of supply and customer needs.
- **Problem identification:** Targeted monitoring can identify specific issues or load-related problems.
- **Enhanced power quality service:** Collaborative efforts between providers and customers can improve power quality through measures like installing power quality metres.
- **Predictive maintenance:** Monitoring enables timely equipment maintenance to prevent failures.

To ensure regulatory compliance and maintain power quality, MSEDCL has invested in total 6,791 power quality metres. These metres are installed at nearly every distribution sub-station to monitor the 11 kV (low voltage side) of power transformers.

Figure 1: Location of Power Quality Metre

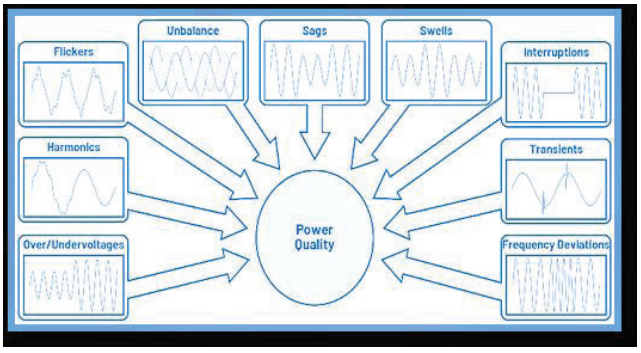


Overall, power quality monitoring is crucial for ensuring grid stability, meeting regulatory requirements, and providing reliable and efficient power supply.

5. Key Aspects of Power Quality

Power Quality (PQ) refers to maintaining the voltage, current, and frequency of the power system within acceptable limits. IEEE standards, particularly IEEE 519:2014, focus on defining acceptable limits for power quality to ensure efficient and safe operations of electrical systems.

Figure 2: Characteristics of Power Quality



6. Analysis of PQ Parameters

Power quality analysis is a critical area of research in electrical engineering, focusing on ensuring that electrical power systems operate efficiently without disturbances that could affect equipment performance. The IEEE has published numerous papers and standards on power quality analysis like IEEE Std 1159-2019, IEEE Std 519:2014, among others.

Techniques for Power Quality Analysis

Power quality analysis is crucial for ensuring reliable and efficient operations of electrical systems. Here are some common techniques used to assess power quality.

Waveform Analysis: Using tools like oscilloscopes to visualise voltage and current waveforms and identify distortions.

Harmonic Analysis: Measuring the harmonic content in the electrical system to identify and mitigate sources of distortion.

Transient Analysis: Capturing and analysing transient events to understand their causes and impacts.

Power Factor Correction: Implementing solutions like capacitor banks to improve the power factor and reduce energy losses.

Power Quality Parameters as per MERC SOP Regulations 2021, which are in line with IS 17036 and IEEE standard 519:2014

Table 1: PQ Parameters and its Limits

Sr.No	Parameter	Technical Explanation	Max/Min Limit	Standard	Rationale
1	Voltage Variation	The deviation of the RMS (Root Mean Square) value of voltage from its nominal value.	Un +10%/-15%	MERC SOP Reg 2021(reg. 22.5)	For 6351V the lower limit will be 5398 V per limit will be 6986.1V for 100% of time(Continuous)
2	Voltage Unbalance	root mean square (r.m.s.) values of the line-to-line voltages (fundamental component), or the phase angles between consecutive line voltages, are not all equal.	≤ 2%	MERC SOP Reg 2021(reg. 22.7)	The voltage unbalance is calculated by finding out Negative Sequence(V2) & Positive Sequence component (V1) by using Matrix method & then using the formulaV2/V1*100.
3	Voltage Dips/Swells	Short-duration reductions or increases in the RMS voltage.	**Dip:** 5%-90% **Swell:** >110% of nominal voltage Duration: 10ms up to and including 1 min	MERC SOP Reg 2021(reg. 22.8)	Dip:-If the residual voltage is between 90 to 80% say 85% of vtg 440v i.e.374V persists for 200ms then such 30 events per year are permitted & upto 500ms 40 events are permitted. Swell:- If voltage increases by 10% or more & lasts between 10 & 500ms is considered as a violation
4	Short Interruptions	Temporary loss of voltage.	Residual Voltage <5% of nominal voltage	MERC SOP Reg 2021(reg. 22.10)	If the residual voltage is below 5 % and interruption lasts between 10 to 200 ms, is a violation. 05 nos of events per yr during the above said time range is permitted.
5	Harmonic Distortion	The presence of harmonic currents or voltages in the power system.	≤ 5% (individual harmonic), ≤ 8% (THD-Total Harmonics Distortion)	IS-17036	95% of each period of one week-for individual harmonics upto 25th order & 100% of time for THD upto 40th harmonics order(Samples-1008(7d*24hrs*60s/10min)
6	Flicker (long term)	Visible variation in light intensity caused by voltage fluctuations.	≤ 1	MERC SOP Reg 2021(reg. 22.6)	Compliance limit is 95% of each period of week. Long term flickers are to be measured for 2hrs per day in a week (24hrs*7days/2= 84 nos samples)

Tools and Equipment

Power Quality Analysers: Specialised instruments that measure various power quality parameters, including voltage, current, harmonics, and transients.

Oscilloscopes: Used for detailed waveform analysis.

Software Tools: For modeling and simulation of power quality issues and their impact on electrical systems.

Applications

Industrial and Commercial Facilities: To ensure reliable operations of sensitive machinery and to improve energy efficiency.

Utilities: To maintain the stability and efficiency of the electrical grid.

7. Case Study

Case Study: Power Quality and Revenue Loss in MSEDCL

Introduction

This case study examines the challenges faced by MSEDCL, a major electricity distribution utility, in terms of power quality and revenue loss. A comprehensive analysis of 100 HT consumers reveals alarming trends, including excessive demand and harmonic distortion.

Table 2: Summary of Recorded Harmonics Data at Pune Region

Sr	Upstream Tx MVA	CD KVA	MD	KVAR	ISC/IL	Current distortion			VTHD %
						TDD %	TDD Comp %	Max THD %	
1	25	4000	3278	± 1200	49.81	23.12	8	55	4
2	100	3150	3008	-200 to +600	317	19.2	15	24	1.5
3	25	5500	5527	± 2000	29.81	8.78	8	27.5	7
4	50	2500	1403	± 500	324.3	4.15	15	80	2.5
5	100	3000	1500	-200	912.56	20.21	15	29	1.4
6	50	6207	6587	- 700 to + 1200	102.67	12.59	15	21	3.4
7	100	3301	1588	±300	576.18	2.25	15	35	2
8	50	5500	5307	600	73.01	7.02	12	10.5	1.2
9	25	10100	9986	- 4500 to + 4000	20.74	2.1	8	40	9
10	100	6340	6201	-600 to +1500	135	20.38	15	24	2
11	100	133	122	- 50 to + 10	9343.5	18.23	20	30	1
12	50	500	149	- 80	1553.9	11.04	20	25	1.1
13	25	4990	4917	- 1500 to +2000	11	8.75	5	18	1.2
14	25	3600	3697	- 4000 to + 2500	57.9	9.03	12	220	1.1
15	100	500	311	-70 to +50	2661.9	20	20	50	1.1
16	100	1900	1408	- 200 to + 300	598.19	6.47	15	22	1.5
17	50	3000	1571	130	413.62	12.06	15	16.5	1.1
18	50	2500	2097	170	255.2	4.91	15	16	0.7
19	10	1232	584	80	228.61	13.34	15	53	1.5
20	10	529	179	± 30	520.4	5.77	15	900	2.4
21	10	1665	387	-110 to +150	111.16	7.45	15	14	1
22	50	600	284	- 85	2935	12.44	20	17.9	2
23	50	3000	1411	- 200 to + 300	157.41	12.12	15	80	2.4
24	10	174	96	- 70 to + 80	528.74	21.37	15	600	5.5
25	10	400	132	± 50	491.85	13.52	15	65	2.1

Problem Identification

- **Excessive Demand:** 43 out of 100 consumers have maximum demand (MD) exceeding 1.0 MVA, and 36 have MD equal to or greater than their contracted demand (CD).
- **Harmonic Distortion:** 31 consumers have exceeded the total demand distortion (TDD) compliance limit, 10 are on the border, and four have crossed voltage THD compliance limits.

Reactive Power Compensation: The widespread use of fixed HT side capacitors and overcompensation of reactive power contribute to amplified harmonics.
Revenue Loss: This was resulting in indirect revenue losses to the utility.

Root Causes

- **Non-compliance with Demand Limits:** Consumers exceeding their contracted demand limits are contributing to network congestion and losses.
- **Harmonic Generation:** Excessive harmonics are being generated by consumers due to nonlinear loads and improper reactive power compensation.
- **Under/Overcompensation of Reactive Power:** Incorrect reactive power compensation can amplify harmonics and lead to increased losses.

Corrective Measures

- **Power Quality Monitoring:** Install power quality measuring metres to accurately monitor harmonic levels and identify problem areas.
- **Detuned Automatic Power Factor Control Panels:** Promote the use of these panels to mitigate harmonic distortion and optimise reactive power compensation.
- **Stricter Compliance Measures:** Enforce stricter compliance measures for new consumers to ensure they adhere to demand limits and harmonic standards.
- **Harmonic Control at PCC:** Encourage HT consumers to control harmonic currents at the point of common coupling (PCC) to reduce the overall harmonic burden on the network.

Conclusion

The case study highlights the critical issues of power quality and revenue loss faced by MSEDCL. By implementing the recommended corrective

Table 3: Summary of Recorded Harmonics Data at Ch. Sambhaji Nagar Region

Sr	Incoming Voltage KV	Upstream Tx MVA	CD KVA	MD	KVAR	ISC/IL	Current distortion			VTHD %
							TDD %	TDD Comp %	Max THD %	
	DHULE CIRCLE									
1	11	10	175	90	-15 to +5	1478	4.56	20	15	2.2
2	33	25	4999	3656	-150 to +750	71.8	15.31	12	23	3.8
3	33	25	2900	2845	-750 to +400	93.21	8.8	12	32	3.8
	AURANGABAD RURAL CIRCLE									
4	132	100	5500	4988	-100 to +600	138.3	5.3	7.5	7.3	2
5	33	50	10000	9888	-4000 to +3800	28.41	2.45	8	15	1.8
6	33	100	900	794	-450 to +320	1930	19.17	20	95	0.9
7	33	100	9000	5609	-1800 to +170	230.9	5.21	15	9.5	1.2
8	33	100	5000	2628	-300 to +270	425	5.96	15	14.5	1.1
9	33	50	1350	1156	-20 to +125	408.2	1.42	15	6	1.7
10	132	100	16900	18810	-12000 to +2400	88.65	3.37	6	18	0.8
11	33	100	5000	4207	+100 to +380	367.5	6.95	15	11	1.1
	AURANGABAD URBAN CIRCLE									
12	11	50	550	549	-40 to +160	1631	13.5	20	40	1.9
13	11	5	570	368	-160 to +40	190.8	3.77	15	55	1.9
14	33	100	1604	1502	-160 to +240	1890	15.07	20	21	1
15	11	50	2500	1430	-320 to +20	1496	4.04	20	33	1.6
16	33	100	8000	7763	-1700 to +300	292.2	6.88	15	16	1.2
17	11	10	500	374	-30 to +40	288.6	4.8	15	11	2.2
18	11	100	2264	2286	±750	1247	17.93	20	29	1.1
19	33	100	3900	3323	-100 to +500	200	8.9	15	12.5	0.8
20	11	50	299	167	0 to +60	3540	6.04	20	45	2.6
21	132	600	8000	7434	-2500 to +2700	1811	4.28	10	12	0.6
22	33	100	1200	874	±100	739	11.42	15	23	1
23	11	5	400	232	-20 to +50	158	2.2	15	40	3.3
24	11	50	1490	1140	±240	1255	16.5	20	48	2.3
25	33	100	995	625	-70 to +270	1048	10.66	20	37	1

Table 4: Summary of Recorded Harmonics Data at Nagpur Region

Sr	Incoming Voltage KV	Upstream Tx MVA	CD KVA	MD KVA	KVAR	ISC/IL	Current distortion			VTHD %
							TDD %	TDD Comp %	Max THD %	
	BHANDARA CIRCLE									
1	11	16	1900	1938	-90 to +280	107	15.52	15	23	5.7
2	11	10	5000	3138	-400 to +300	53.08	4.4	12	20	3.1
3	11	10	5000	3138	-120 to +120	219.1	7.47	15	500	2.3
4	33	10	1500	1233	-250 to +220	116.3	19.41	15	30	2.5
5	220	Fault level(3130 MVA)	46000	44260	-24000 to +13000	69.26	14.71	3.75	130	1.5
	NAGPUR URBAN CIRCLE									
6	33	50	5000	4357	-1300 to +600	113.3	8.04	15	16	1.2
7	33	50	2200	2200	-550	677	13.48	15	18	2.3
8	33	50	4300	3750	-270 to +370	105.3	4.9	15	7.5	2.7
9	11	10	375	100	-50 to +60	423.3	8.7	15	24	1.5
10	33	50	6500	7889	-3300 to +2000	62.6	4.42	12	20	2
11	33	50	6150	5617	-1600 to +100	75.16	5.24	12	18	2.3
	NAGPUR RURAL CIRCLE									
12	33	50	5300	5219	-3000 to +1700	79.75	9.29	12	37	3.5
13	33	50	1510	816	-150 to +20	783	6.33	15	110	3.3
14	132	200	9000	7572	-1700 to +3000	193.3	2.55	7.5	11	1.3
15	33	50	1650	1594	-400 to +350	327.1	19.16	15	32	1.7
16	33	50	1600	1094	-270 to +220	684.5	25.06	15	75	3.5
	VARDHA CIRCLE									
17	11	10	1140	630	-100 to +50	538.4	5	15	16	2.7
18	11	10	225	106	+20	1285	3.02	20	13	2.3
19	11	5	175	104	-15 to +30	780.5	3.65	15	19	2.6
20	11	10	250	99	-15 to +40	1525	7.18	20	95	2.1
21	11	10	655	901	-10 to +50	360.4	1.74	15	1000	2.1
22	33	50	9300	9178	+200 to +1050	46.4	8.35	8	9.5	2.4
23	132	100	16900	16048	-200 to +1200	59	3.3	6	4.2	1.8
24	33	50	1200	1142	-50 to +200	347	13.53	15	15.5	2.1
25	220	Fault level(728 MVA)	12000	13230	-1000 to +1600	157	3.27	3.75	75	1.3

Table 5: Summary of Recorded Harmonics Data at Konkan Region

Sr	Upstream Tx MVA	CD KVA	MD	KVAR	ISC/IL	Current distortion			VTHD %
						TDD %	TDD Comp %	Max THD %	
1	100	484	164	-40 to +40	4339	11.32	20	500	2.8
2	50	4430	4195	-1000 to -2500	92.56	33.41	12	250	14
		This consumer has HT Fixed capacitors. Major load is only in night.							
3	100	10100	9862	-4000 to +4000	50.14	3.83	12	12	5.5
		This consumer has HT Fixed capacitors. Continuous Load for 24 hours							
4	100	63	45	-25 to +30	15686	36.45	20	150	5.5
5	100	343	125	-25	18745	38.9	20	400	2.5
6	100	150	47	-15 to +20	12332	24.71	20	200	3
7	50	450	321	-50 to + 50	1450	24.56	20	40	1.6
8	50	250	216	-75	1383	19.2	20	45	1
9	50	160	99	-35	3309	27.21	20	48	2.6
10	50	800	542	-50	743	7.11	15	13.5	1.9
11	50	658	136	40	2039	6.4	20	85	1.5
12	50	315	158	0	3184	41	20	275	1.4
13	50	220	176	25	1557	3.7	20	18	1.9
14	50	6500	3250	500	144	15.41	15	23.5	1.2
15	50	3000	2600	600	171	7.17	15	16	2.6
16	50	500	535	150	516	18.52	15	50	1.8
17	100	250	110	7	6671	30.77	20	54	2.7
18	50	1101	976	-200 to + 200	159.6	3.87	15	250	6
19	100	900	503	-200 to + 200	895.66	68.28	15	180	1.1
20	100	267	134	-30 to + 30	7599.9	20.71	20	45	2.5
21	100	250	283	-50 to +20	5152.4	11.4	20	160	1.8
22	100	650	406	-30 to +50	2259.8	14.05	20	200	8
23	100	250	166	-40 to +80	3907.1	29.85	20	110	1.6
24	50	275	182	-70 to +50	1728.9	8.44	20	250	4.5
25	100	270	71	-15 to + 15	18378	14.41	20	250	3.7

measures, MSEDCL can improve power quality, reduce losses, and enhance the overall efficiency of its distribution network

Case Study 2: Impact of Harmonic Distortion and Revenue Loss to Utility

Introduction

This case study examines the root causes of transformer noise, vibration, and overheating at a 132/33 kV substation within MSEDCL. The substation was feeding power to three steel melting plants with induction furnaces.

Problem Identification

MSEDCL conducted measurements at the transformer and identified that voltage harmonics were significantly high, exceeding the prescribed limits outlined in IEEE 519:2014. These excessive harmonics were attributed to the three steel plants.

Data Collection and Analysis

Detailed measurements were carried out on the 33 kV feeder at the substation for approximately 26 hours. These measurements revealed that voltage harmonics were as high as 12 percent, leading to excessive energy losses in the transformer.

Figure 3: Voltage Harmonics in r/o Steel Industry

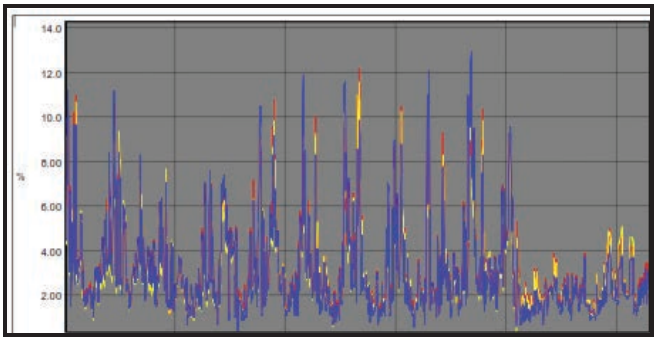
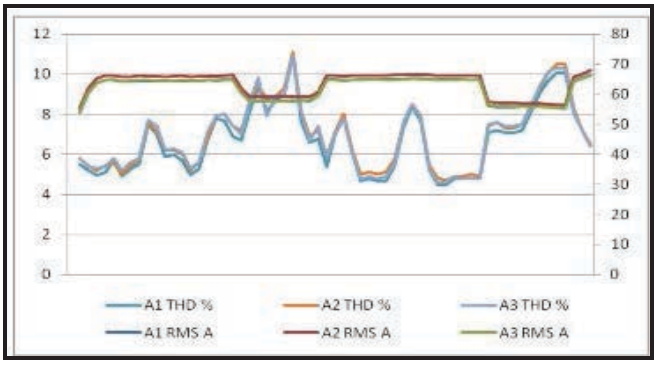


Figure 4: Current Harmonics in r/o Steel Industry



To isolate the individual contributions of each plant, MSEDCL requested that the plants be closed alternatively for one hour. However, only two steel industries conducted a harmonic study and submitted a report claiming compliance with IEEE 519:2014 standards.

Key Findings

- **Non-compliance with IEEE 519:2014:** One steel industry was found to be generating harmonics beyond the prescribed limits of IEEE 519:2014, including specific harmonic orders.
- **Insufficient Measurements:** Both industries had not conducted measurements for 24 hours under normal operating conditions as required by IEEE 519:2014.
- **Excessive Harmonics:** Other steel industry's higher order harmonics were causing excessive voltage harmonics in the system.
- **Revenue Loss:** The high levels of harmonics were leading to increased energy losses in the transformer, resulting in revenue loss for MSEDCL.

Recommendations

Based on the findings, the following recommendations were made:

- **Carry out 24-hour measurements at each plant:** To accurately assess harmonic levels and identify the root causes.
- **Reduce harmonics within IEEE 519:2014 limits:** If exceeding limits, industries should carefully select solutions to mitigate harmonics.
- **Avoid negative impact on the grid:** Industries should refrain from injecting excessive reactive energy, transients, or causing cross resonance.
- **Ensure harmonics are well below IEEE 519:2014 limits:** Adhere to the prescribed limits for both total harmonic distortion (TDD) and individual harmonic orders.

Conclusion

The case study demonstrates the significant impact of harmonic distortion on power quality and revenue loss in MSEDCL. By addressing the root causes and implementing the recommended measures, MSEDCL can improve the overall performance of its distribution network and reduce financial losses.

Case Study 3: Power Quality Comparison between Ag-Dominated and Industrial Substations

Introduction

This case study compares the power quality performance of two substations with different loading patterns: An agricultural (Ag) dominated substation and an industrial substation. The analysis focuses on key parameters such as voltage unbalance, sags, swells, interruptions, reverse voltage correction (RVC), frequency, and total harmonic distortion (THD).

Data Analysis

Tables 6 and 7 present the power quality data for both substations. A broad comparison reveals the following key observations:

- **Voltage Unbalance:** Both substations maintain voltage unbalance within acceptable limits, indicating good system performance.
- **Sag, Swell, and RVC:** The industrial substation experiences fewer sag, swell, and RVC events compared to the Ag-dominated substation. This is likely due to the more stable and less fluctuating nature of industrial loads.
- **Interruptions:** The Ag-dominated substation has a higher frequency of interruptions, leading to more sag, swell, and RVC events. This could be attributed to the sensitivity of agricultural loads to voltage fluctuations.
- **Frequency and THD:** The industrial substation faces challenges with frequency and THD. The non-linear and highly fluctuating nature of industrial loads, such as arc furnaces and plastic industries, can introduce harmonics and disrupt the frequency stability of the system.

Table 6: Events Recorded at 33/11kV Kanholibara, Nagpur Rural Area (AG dominated)

Week	Nos. of Voltage Unbalance	Sag	Swell	Short Interruptions	Flicker	(RVC)	Voltage Variation	THD	Frequency
02.09.2024 to 08.09.2024	Pass	80	43	2	Fail	103	Fail	Pass	Pass
09.09.2024 to 15.09.2024	Pass	65	58	1	Fail	78	Fail	Pass	Pass
16.09.2024 to 22.09.2024	Pass	54	43	2	Fail	76	Fail	Pass	Pass
23.09.2024 to 29.09.2024	Pass	75	46	9	Fail	101	Fail	Pass	Pass

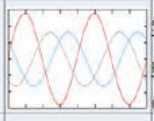
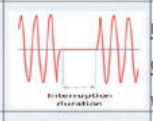
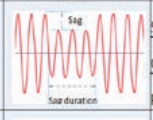
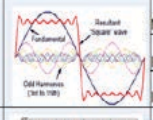
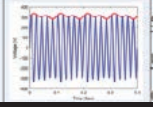
Table 7: Events Recorded at 33/11kV MIDC Butibori, Nagpur (Industrial Load).

Week	Nos. of Voltage Unbalance	Sag	Swell	Short Interruptions	Flicker	(RVC)	Voltage Variation	THD	Frequency
02.09.2024 to 08.09.2024	Pass	40	27	0	Fail	7	Pass	Fail	Fail
09.09.2024 to 15.09.2024	Pass	7	0	0	Pass	2	Pass	Fail	Fail
16.09.2024 to 22.09.2024	Pass	13	0	1	Pass	10	Pass	Fail	Fail
23.09.2024 to 29.09.2024	Pass	26	0	3	Pass	14	Pass	Fail	Fail

Table 8: Inference from Tables 6 and 7

PQ parameter	Events Status at Ag-Dominated S/Stn	Events Status at Industrial S/Stn
Voltage Unbalance	PASS	PASS
Sag/Swell	More	Less
Interruption	More	Less
RVC	More events	Less Events
Frequency	PASS	FAIL
THD	PASS	FAIL

Table 9: Causes & Remedial Actions for PQ Parameters

POWER QUALITY PARAMETERS	IMAGE	PROBABLE CAUSES	REMEDIAL ACTION
VOLTAGE UNBALANCE		Single-phase load imbalance	Uniform distribution of load on all phases
		Faulty conductors	Periodic maintenance / replacement of damaged conductors / cables
		Open neutrals	Proper grounding / Earthing.
VOLTAGE VARIATIONS		Fluctuations in load	Encouraging / educating consumer for PQ issues related to load fluctuation (DSM)
		Transmission line faults	Periodic maintenance.
		Poor power factor	Reactive power compensation / APFC at sub-station
VOLTAGE SHORT INTERRUPTIONS		Faults on the power system	Preventive maintenance.
		Overloading	Load control / Demand management
		Weather-related disturbances	Pre-monsoon maintenance.
VOLTAGE SAG/SWELLS		Switching off large loads	Encouraging / educating consumer
		Capacitor switching	APFC instead of manual / fixed compensation
		Power system disturbances	Preventive maintenance.
VOLTAGE HARMONICS DISTORTION		Non-linear loads (e.g., rectifiers, inverters)	Harmonic filters at consumer premises
		Resonant conditions in the power system	Plant audits for consumers for system healthiness
		Inadequate filtering	Penalty provisions as per MERC guidelines
VOLTAGE FLICKERS		Sudden Change in Loads(drives,Arc furnace)	Reactive Power control, Consumer awareness
		Uneven Load sharing	Load balancing, Voltage regulations
		Overloading of Transformers	Augmentation, Load diversion, line maintenance

Conclusion

The comparison of power quality data between the Ag-dominated and industrial substations highlights the distinct challenges associated with each type of load. While the industrial substation experiences fewer interruptions and voltage fluctuations, it faces issues with frequency and THD. The Ag-dominated substation, on the other hand, has more interruptions and related events.

To address these challenges, targeted measures can be implemented, such as improving system reliability, optimising load management, and installing harmonic measurement and mitigation equipment in industrial areas. By addressing these issues, MSEDCL can enhance the overall power quality and reliability of its distribution network.

Tables 6 and 7 shows power quality data of two sub stations with different loading patterns – Ag dominated and industrial load, respectively. As a broad comparison, it is observed that voltage unbalance is well maintained in system. Due to industrial non-linear and highly fluctuating load (eg, arc furnace and plastic industry), there is an effect on frequency and THD, however, there are less interruptions and less sag, swell and RVC. On the contrary, the Ag-dominated sub-station has more interruptions due to which sag, swell, RVC events are more.

From the above case study, the following generalised statement over causes, remedial actions and execution is tabulated:

7. Conclusions

The comprehensive power quality analysis conducted has provided valuable insights into the electrical supply system's stability and reliability. While the system generally maintains acceptable voltage levels, occasional dips and surges require attention through measures like transient fault mitigation and voltage regulation.

Harmonic distortion, a persistent issue, necessitates monitoring and mitigation strategies to protect equipment and prevent long-term problems. Additionally, the analysis identified transient events that can be addressed through surge protection measures.

By maintaining power quality parameters within IEEE standards, utilities can ensure reliable system operations, reduce losses, and safeguard equipment from damage. The growing emphasis on PQ measurement and analysis marks a significant step towards optimising energy infrastructure. As data collection expands, utilities will gain a deeper understanding of PQ issues, enabling informed decision-making and proactive measures to improve power quality.

Key considerations for both utilities and designated consumers include:

- **Installation of power quality metres:** Accurate measurement and analysis of PQ parameters are essential for identifying and addressing issues.
- **Collaboration between utilities and consumers:** Joint efforts can lead to more effective solutions and shared benefits.
- **Implementation of mitigation measures:** Targeted measures can address specific PQ problems, such as harmonic distortion or voltage fluctuations.

This comprehensive approach, encompassing data collection, analysis, and collaborative action, is crucial for meeting the demands of a technology-driven society and ensuring a reliable and efficient power supply.

8. References

[1] Zhao Min, Li Shunwei, Yue Yunli et al., "Performance and Influence Analysis of Power Electronics in Distribution Network[J]", China High-tech, vol. 1, pp. 149-150, 2017.

[2] Math H J Bollen and Sarah K Rönnberg, "Primary and secondary harmonics emission; harmonic interactiona set of definitions[C]", Intemational Conference on Harmonics & Quality of Power, pp. 703-708, 2016.

[3] YUAN Xiaoming, CHENG Shijie and HU Jiabing, "Dynamic Stability Problem of Multi-Scale Voltage Power Angle in Power Electronic Power System[J]", Proceedings of the CSEE, vol. 36, no. 19, pp. 5145-5154, 2016.

[4] Guo Shanghua, Huang Chun, Wang Lei et al., "Detection and Control Method of Voltage Fluctuation and Flicker[J]", Relay, vol. 32, no. 3, pp. 45-48, 2004.

[5] Hao Qi, Xiangsheng Wang, Shen Gao et al., "Research and Application of Power Quality Integrated Management System [J]", Electronic Design Engineering, vol. 25, no. 5, pp. 170-174, 2017.

[6] Aurora Gil-de-Castro, Sarah K Rönnberg and Math HJ Bollen, "A study about harmonic interaction between devices[C]", 2014 IEEE 16th International Conference on Harmonics and Quality of Power (ICHQP), pp. 728-732, 2014

[7] K Narendra, D Fedirchuk, R Midence et al., "New microprocessor based relay to monitor and protect power systems against sub-harmonics[C]", 2011 IEEE Electrical Power and Energy Conference (EPEC), pp. 438-443, 2011.

[8] Haixue Lin, "New Development of Harmonic Problems in Power Grid - On Superharmonics[J]", Supply and Electricity, vol. 1, pp. 35-38, 2016.

[9] A Larsson, "An overview of the origin and propagation of supraharmonics (2–150kHz) [J]", BrazilianJournal of Physics, vol. 32, no. 2b, pp. 483-494, 2014.

[10] Ana-Maria Blanco, Jan Meyer, Sarah Ronnberg and Math Bollen, "Survey of supraharmonic emission of household appliances [C]", International Conference on Electricity Distribution, 2017:1–5.

[11] Ana-Maria Blanco, Jan Meyer, Sarah Rönnberg and Math Bollen, "Survey of supraharmonic emission of household appliances [C]", International Conference on Electricity Distribution, 2017: 1–5.

Citation:
[1] H. Li, C. Lv and Y. Zhang, "Research on New Characteristics of Power Quality in Distribution Network," 2019 IEEE International Conference on Power, Intelligent Computing and Systems (ICPICS), Shenyang, China, 2019, pp. 6-10, doi: 10.1109/ICPICS47731.2019.8942538.

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IIT Kanpur hands over Substation Inspection Robot to POWERGRID

The Substation Inspection Robot (SIR) is an advanced autonomous mobile robot designed to enhance the safety and efficiency of substation inspections.

The Indian Institute of Technology Kanpur (IITK) has officially handed over the Substation Inspection Robot (SIR), developed at its SMSS Laboratory, to POWERGRID.

Developed by IIT Kanpur in collaboration with POWERGRID, SIR is an advanced autonomous mobile robot designed to enhance the safety and efficiency of substation inspections. It is equipped with AI-driven navigation, LiDAR, depth camera, IR and an array of motion sensors, enabling it to autonomously manoeuvre across substations, inspect critical components, and detect potential faults that could impact power transmission reliability. The robot was successfully field-tested on July 13, 2024, at POWERGRID Kanpur substation, demonstrating its capability for real-time condition monitoring and predictive maintenance.

Highlighting the significance of this technological advancement, **Prof. Manindra Agrawal, Director, IIT Kanpur,** stated, “India is on the path to becoming a

developed nation, and uninterrupted energy supply is crucial to achieving this goal. SIR, a testament to IIT Kanpur's commitment to innovation, utilises advanced vision processing and machine learning (ML) algorithms to perform repetitive and time-consuming inspection activities at substations on a regular basis. This is expected to enhance operational efficiency and worker safety by reducing human intervention in high-risk environments."

SIR is equipped with AI-driven navigation, LiDAR, depth camera, IR and an array of motion sensors, enabling it to autonomously manoeuvre across substations, inspect critical components, and detect potential faults that could impact power transmission reliability.

Prof. Bishakh Bhattacharya, HAG Professor, Department of Mechanical Engineering, IITK, who spearheaded the development, added, "SIR integrates AI-driven path planning and state-of-the-art thermal, visual, and ultrasonic sensors to detect anomalies such as overheating, leaks, and structural damage. The robot transmits real-time data to maintenance teams, enabling swift decision-making. With its remote-control functionality and wireless charging capabilities, SIR is built for continuous, autonomous operations in all-terrain and all-weather conditions."

A POWERGRID spokesperson noted that the adoption of robotics in operation and maintenance (O&M) marks a transformative shift from periodic inspections to continuous monitoring. SIR's ML-based condition monitoring algorithms will help identify, classify, and predict failures in substation components, extending asset lifespan and improving operational efficiency.

POWERGRID, which operates 170,224 ckm of transmission lines and 262 substations with a transformation capacity of 451,351 MVA, remains committed to leveraging cutting-edge technologies for enhanced network reliability. The integration of robotics in its infrastructure underscores its focus on efficiency, minimising downtime, and ensuring worker safety.

ERDA Inaugurates State-of-the-Art Solar Inverter Test Facility

The Electrical Research and Development Association (ERDA), on its 51st Foundation Day, inaugurated a state-of-the-art solar inverter test facility that can undertake research and evaluation of up to 250KVA class solar inverters.

Marking its 51st Foundation Day, Electrical Research and Development Association (ERDA) inaugurated a cutting-edge solar inverter test facility (grid tied/off grid) at its premises. The facility was inaugurated at the hands of AB Chaudhari, Chief Electrical Inspector, Gujarat state.

This advanced laboratory is designed to meet the rising demand for mandatory inverter testing, ensuring compliance with the Bureau of Indian Standards (BIS) Act and the Quality Control Order issued by the Ministry of New and Renewable Energy (MNRE), Government of India. The new state-of-the art solar inverter facility can undertake research and evaluation of up to 250KVA class solar inverters.

Facility Capabilities

Sr. No.	Name of Tests	Relevant IS/IEC
1	Islanding prevention (anti-islanding protection) test	IEC 62116/IS 16169
2	Measurement of MPPT (Dynamic & Static) and Conversion Efficiency	IEC 62891 / IS 17980 & EN 50530
3	Safety tests	IEC 62109/IS 16221 part 1 & 2
4	Grid connectivity / Utility Interface (LVRT, HVRT, FRT, and power quality)	IEC 61727, CEA and MNRE guidelines
5	Conversion efficiency	IS/IEC 61683

This new facility strengthens ERDA's commitment to advancing solar technology and grid integration, offering critical testing services to solar inverter and controller manufacturers, R&D institutes, small-scale industries, and distribution utilities.

Advanced Instrumentation

The facility is powered by state-of-the-art testing equipment, including a solar array simulator – which supports up to 12 mppt inputs, grid simulator, RLC load bank, measurement equipment (power analyser and digital oscilloscope), control and software systems for precise monitoring and analysis. This facility is equipped to test grid-tied (string and central inverters) and off-grid inverters up to 250 KVA.

This initiative aligns with India's commitment to ensuring high-quality solar power generation and grid integration, supporting the country's renewable energy goals.

PRODUCT LAUNCHES @ ELECRAMA 2025

HINDALCO INDUSTRIES LIMITED

PRODUCT 1

High-Strength Copper Silver Alloys

At ELECRAMA 2025, **Hindalco Industries Limited,** the metals flagship of the Aditya Birla Group, has launched **speciality copper alloys, copper silver up to 26 mm and other alloys** for manufacturing contact wires and other applications.

Product type and segment: Copper alloy rods for manufacturing contact wires and other applications

Industries it will cater to: High-speed rails, urban mass transit

USP: Cu-Ag alloys are known for their enhanced tensile strength, which can exceed 375 N per sq mm. This increased strength reduces wear, making Cu-Ag more durable, especially at high speeds or in areas with heavy usage. Copper silver alloys having higher thermal resistance prevents conductivity drop due to high temperatures. Studies have also demonstrated that copper alloy contact wires possess high strength, elevated softening temperatures and appropriate conductivity, making them well-suited for modern railway systems and other high-speed needs.

PRODUCT 2

Copper and Aluminium Foils for Li-Ion Barrier Cells

Hindalco Industries Limited has launched **copper and aluminium foils for Li-Ion barrier** cells at the upcoming ELECRAMA 2025.

Product type and segment: Foils for Li-Ion barrier cells

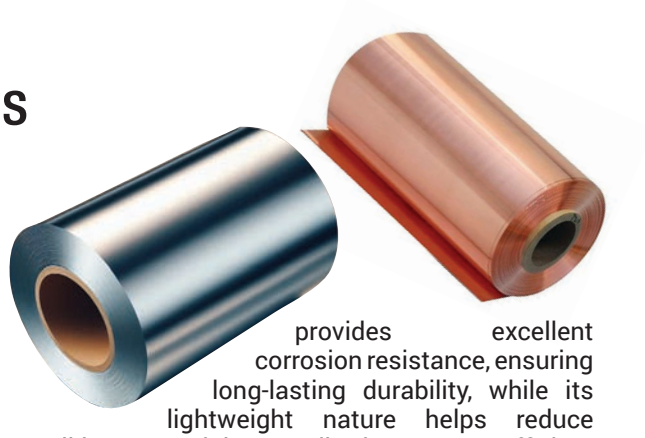
Industries it will cater to: EV and others

USP:

Copper foil: Copper foil is a highly sensitive product, with thicknesses as thin as 4.5 microns. It is essential for electrical conductivity and maintaining the structural integrity of the battery anode over multiple charge or discharge cycles, directly impacting battery performance, safety and longevity.

The copper foil produced is used in Li-ion batteries for electric vehicles (EVs) and energy storage systems. As a key component, it ensures battery efficiency, longevity, and performance, making it an essential material for India's green energy transition.

Aluminium foil: Aluminum foil in Li-ion batteries serves as the cathode current collector, offering an ideal balance of strength, weight and conductivity. It



provides excellent corrosion resistance, ensuring long-lasting durability, while its lightweight nature helps reduce overall battery weight, contributing to more efficient and portable energy solutions.

To ensure optimal performance, the foil must meet rigorous standards, including strength, elongation, conductivity, flatness, and surface cleanliness. While the typical thickness of the foil is between 10 to 15 microns, ongoing advancements in Li-ion technology demand even thinner foils, without compromising strength or elongation properties. Hindalco has developed a proprietary alloy that delivers a remarkable combination of high strength and elongation, enabling the production of thinner foils that maintain top-tier performance. This innovation helps drive the development of next-generation, high-performance, lightweight batteries for diverse applications.

SIEMENS

Innovative MV Gas-Insulated Switchgear

Step into the future of sustainable power distribution with the **8DJH 12 – blue GIS, Siemens'** groundbreaking **medium-voltage gas-insulated switchgear.** Designed with the planet in mind, it uses clean air insulation – a natural, eco-friendly alternative to SF_6 gas – making it a trailblazer in green technology. Compact, modular, and maintenance-free, the 8DJH 12 offers unparalleled reliability for even the most demanding applications. From utilities and data centres to renewables and transportation, this innovative switchgear seamlessly adapts to diverse industry needs. Equipped with IoT-ready features and advanced sensors, it integrates effortlessly into smart grids, ensuring real-time monitoring and smarter asset management. Compliant with international standards and built for longevity, it is the perfect blend of sustainability, safety and efficiency.

Product type and segment: Load-break switchgear for the secondary distribution level

Industries catered to: Utilities and discoms, infrastructure, data centre, solar, wind, smart cities and township

USP: The 8DJH 12 – blue GIS stands out as a pioneering, eco-friendly, and future-ready medium-voltage switchgear solution. It eliminates SF_6 gas. Its compact and modular design makes it ideal for space-constrained applications across diverse industries. The switchgear ensures high reliability with a hermetically sealed, maintenance-free system, enhanced safety features, and robust protection against environmental influences.

HENSEL ELECTRIC INDIA

PRODUCT 1

Compact and Efficient Cable Junction Box

Hensel Electric India has unveiled **DK 0100,** a compact and efficient **cable junction box**, ideal for installations in space-constrained areas, at ELECRAMA 2025. Smaller is sometimes big enough, as its advanced features require minimal installation tools while ensuring long-lasting performance.

Product type and segment: Electrical power branching solution for low-voltage applications.

Industries catered: Power plants, steel, cement, electronic manufacturing, data centres, and infrastructure.

USP: Suitable for floating terminals; for installation area with confined space; dust-free and watertight, hence long-lasting electrical connections; lid locking mechanism helps in faster installation; three mounting options offering compatibility at installation site.

PRODUCT 2

Electrical Power Branching Solution

The **KX range of junction boxes** for **ex-environments** by **Hensel Electric India** offers robust and maintenance-free performance for industrial power branching in potentially explosive atmosphere or hazardous area.

Product type and segment: Electrical power branching solution for low-voltage applications in ex-environment.

Industries catered: Oil and gas, food and beverage, pharmaceuticals, mining, petrochemicals and wood industries

USP: Anti-corrosive construction ensures durability in challenging environments; variable terminal positioning allows for quick and easy installation; provides dependable electrical connections even in hazardous conditions; lid-locking mechanism enhances efficiency during installations.

PRODUCT 3

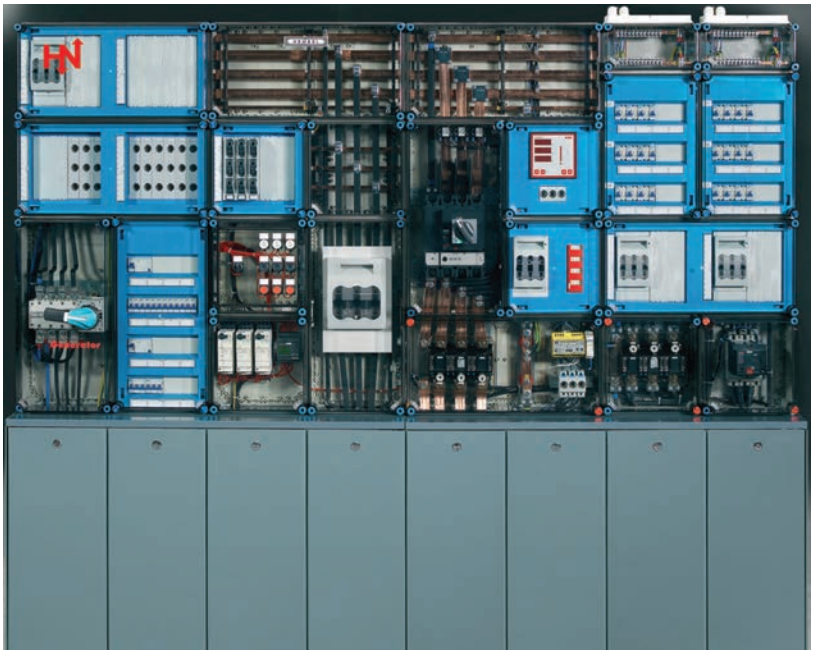
Modular Electrical Power Distribution Solution

The **Mi 1600 by Hensel Electric India,** a first-of-its-kind **innovative solution,** features a modular design and spacious enclosure, making it perfectly suited for electrical power distribution with higher ampere capacity in harsh industrial environments.

Product type and segment: Modular electrical power distribution solution up to 1600 A.

Industries catered: Steel, cement, engineering, manufacturing, data centres, water management, infrastructure, and transportation (airports, seaports, metro, and rail).

USP: Double-insulated modular enclosures ensure enhanced operational safety with higher ampere capacity; spacious design for better cable organisation and faster installations; multiple mounting options offer space efficiency, improved safety, cable management and flexibility; reliable performance across a wide temperature range, making it suitable for various industries.



RAYCHEM RPG PVT LIMITED

PRODUCT 1

Reliable DC Connectors

Raychem RPG Pvt Limited has launched **PV4-S connectors** that are extremely reliable (3 X IEC tested) and have power handling up to UL30A// IEC 45A at 85°C. They have a wire diameter range from 5.0 mm (IEC)//5.5 mm (UL) to 7.8 mm.

Product type and segment: 1,500V DC connectors

Industries catered to: Renewable energy, specifically solar

USP: Watertight IP 68 (1m/24 hrs); two versions – AWG 14 (2.5 sq mm) and AWG 12-10 (4-6 sq mm).

PRODUCT 2

Pioneering Self-Supporting HV Outdoor Termination

Raychem RPG Pvt Limited has launched the **145 kV Dry Type Self-Supporting Outdoor Termination (OHVT – 145 DS),** manufactured first time by a company in India, the company claims.

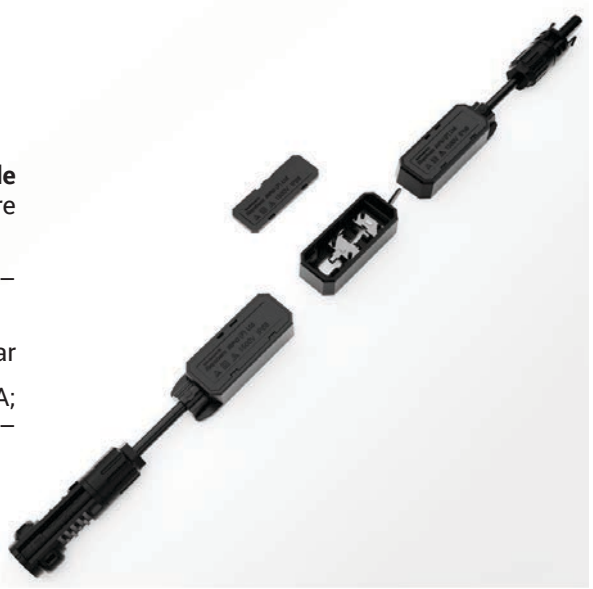
Product type and segment: High-voltage outdoor termination, high-voltage cable accessory

Industries catered to: Energy transmission

USP: Complete dry type (no usage of any special dielectric insulating oil, gel or gas), explosion-proof, easy to install.

PRODUCT 3

Solar Module Junction Box



Raychem RPG Pvt Limited has launched **solar module junction box** with extremely reliable diodes that are 3 X IEC tested.

Product type and segment: Split-type junction box – module level

Industries catered to: Renewable energy, specifically solar

USP: IP68 protection; rated current – 25A, 30A and 35A; temperature range – -40˚C to +85˚C; flammability class – UL-94 V0, 5VB.

MECO INSTRUMENTS PVT LTD

PRODUCT 1

Digital Clampmeter

MECO has launched **Model 3690P + AUTO,** 3-5/6 digit 6000 counts, auto ranging **digital clampmeter** with jaw opening for cable dia 35 mm, LCD display with backlight (white and orange), Hz/Duty and APO ranges. Measurement ranges are current 600A DC and AC, voltage 600V DC and AC, resistance 60MΩ, capacitance 60mF and frequency 9.999MHz. Additional features include duty cycle, diode test, low bat indication, audible continuity, diode test and low bat indication. Orange backlight for high voltage alert, NCV (buzzer and EF strength) are key features of MECO Model 3690P+ AUTO. The model is an integral part of several applications such as live current measurement of wire or cable, HVAC system maintenance, solar system, railways, elevators and escalators, and telecom, among others.

Industries catered to: Wires and cables, HVAC systems, solar systems, railways, elevators and escalators, telecom.

PRODUCT 2

Digital Multimeter

MECO has launched **model 45CF+ 4½** digit 20000 counts auto and manual ranging **digital multimeter** –TRMS having 4 digits 9999 counts digital display LCD with auto backlight, APO, resistance, capacitance, hFE, LoZ, frequency duty cycle, Infrared remote control check. Measurement ranges up to voltage 999V DC and 750V AC, current 9.999A DC and AC, resistance 99.99MΩ, capacitance 99.99mF and frequency 9.99MHz. It has special features like red and green light indication for input terminal selection, NCV, torchlight and bar graph with additional features like audible continuity, diode test and low bat indication. Model 45CF+ is an integral part of several applications such as electronic component testing, industrial maintenance, automotive battery testing, HVAC system maintenance, solar system, railways, elevators and escalators, and telecom, among others.

Industries catered to: Electronic component testing, industrial maintenance, automotive battery testing, HVAC system, solar system, railways, elevators and escalators, telecom.

PRODUCT 3

Made-in-India Digital Multimeter

MECO has launched **Made-in-India digital multimeter – model 101P+TRMS.** MECO Digital Multimeter Model 101P+TRMS, 3¾ digit 4000 counts pocket size auto ranging with LCD backlight display having ranges: voltage up to 1000V DC and 750V AC, current up to 10A DC/AC, resistance up to 40MΩ, capacitance up to 4.000mF and frequency up to 4.000MHz. It has special features like data hold, audible continuity, diode test, auto power off and low battery indication. Model 101P+ is an integral part of several applications such as electronic component testing, industrial maintenance, automotive battery testing, HVAC system maintenance, solar system, railways, elevators and escalators, telecom, among others.

Industries catered to: Electronic component testing, industrial maintenance, automotive battery testing, HVAC system maintenance, solar system, railways, elevators and escalators, telecom.

PROBUS SMART THINGS

Dual Communication NICs with added Bluetooth Module

Probus Smart Things has launched industry-first, **dual communication NICs – 4G with Bluetooth** capability that ensure 100 percent downlink for all scenarios and provide complete SLA compliance. This will help AMISPs and utilities achieve 100 percent SLAs in terms of re-connections; metre balance update; data communication even during certain network outages; critical metre data availability even during network outages; capturing metre data and enabling metre commands even when the metre is out of primary network utilising star connectivity.

Product type and segment: Communication cards/smart metering

Industries catered to: Electricity metering (electricity distribution)

USP: Metre-to-metre communication.

ELMEASURE INDIA

Smart IoT Module for Low Voltage Switchgear

Elmeasure India showcased **EL-Guard,** a revolutionary smart module that transforms traditional low voltage switchgear (ACB/MCCB) into a smart, connected, and future-ready system. Its key features include:

- Real-time insights: Energy usage and breaker status (ON, OFF, or TRIP) monitoring.
- Remote control capabilities: Manage breakers from anywhere, anytime.
- Comprehensive protection: Earth fault protection, energy metering, and breaker status monitoring.

- Integrated energy metering: Advanced phase-wise monitoring for energy optimisation.

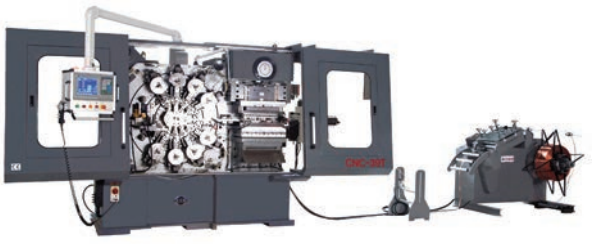
Product type and segment: Smart IoT module for low voltage switchgear; power management solutions/IoT-enabled smart devices for switchgear

Industries catered to: Power and energy sector; manufacturing and industrial units; commercial buildings; critical infrastructure (hospitals, data centres, airports).

YSM INDIA

Strip and Wire Forming Machine

YSM India has introduced **stamping and bending technology** – as a reliable low-cost manufacturing process – with the **YSM-36T model.** It helps identify the right process for production of high-volume precision parts. The product is tried, tested, engineered with fully tooled up production lines. It is a solution for production, integration, automation and assembly for the automotive, electrical, hardware, switchgear and appliance industry.



SHOBAPRAD MACHINERY LLP

‘5 in 1’ New Tension and Metering Sensor Technology

Shobaprad Machinery LLP has unveiled **CW/TMS Tension Metering Sensor.** TMS is a further innovative step made by **BTSR R&D Division** with reference to BTSR solutions developed for several sector applications. TMS Tension and Metering Sensor can simultaneously measure tension and speed values of the running wire. TMS comes with advanced design with minimisation of static contacts, bringing significant reduction of wire stress and breakages. It is equipped with rollers, reducing wire abrasion. Its main features include wire break monitoring; tension monitoring; metering detection; and speed detection. Advanced Monitoring Software aids perfect monitoring, thus acting as an advanced diagnostic tool too.

Industries catered to: Wire manufacturing, coil winding, wire winding, wire extrusion lines

USP: Four features in one sensor; high accuracy-low cost.

TDK INDIA PVT LTD

Power Quality Solutions

TDK India Pvt Ltd presented **PQSine Ultima,** an **active harmonic filter (AHF)** and **PQvar Ultima,** a **static VAR generator (SVG),** cutting-edge power quality solutions designed to improve power factor and mitigate harmonics. AHFs and SVGs are power quality solution products used in power systems to improve power quality, correct power factor, and mitigate harmonics. They are power factor correction (PFC) devices. They especially help reduce energy losses, improve the efficiency of power systems, and stabilise the grid voltage.

Product type and segment: Modular electrical power distribution solution up to 1600 A.

Industries catered: Data centres, renewables, building, heavy industry, oil and gas, automobile, metals and mines, healthcare, railway and metro, offices and commercial, airport, pharmaceuticals.

USP: SIC technology, 99 percent efficiency, true modular design, compact footprint, 3C3 conformal coatings.

BHAVYA MACHINE TOOLS LLP

3-in-1 Busbar Bending-Cutting-Punching Machine

Bhavya Machine Tools LLP has launched the **3-in-1 busbar bending-cutting-punching machine**. It is a 3-in-1 machine (cutting + bending + punching) for copper or aluminium busbars, widely used in panel industries. All three functions can be digitally controlled through one HMI and servo motor, increasing overall job accuracy.

Product type and segment: Machinery

Industries catered to: Electrical panel, switchgear

USP: Servo feature for all three stations

ASHIDA ELECTRONICS PVT LTD

Relays for T&D Segment

Ashida Electronics Pvt Ltd has launched line **differential protection relay, bus-bar protection relay, distance protection relay.** The company has a complete range of relays required for the transmission and distribution segment.

Product type and segment: Transmission and sub-transmission.

Industries catered to: Transmission utilities, industries.

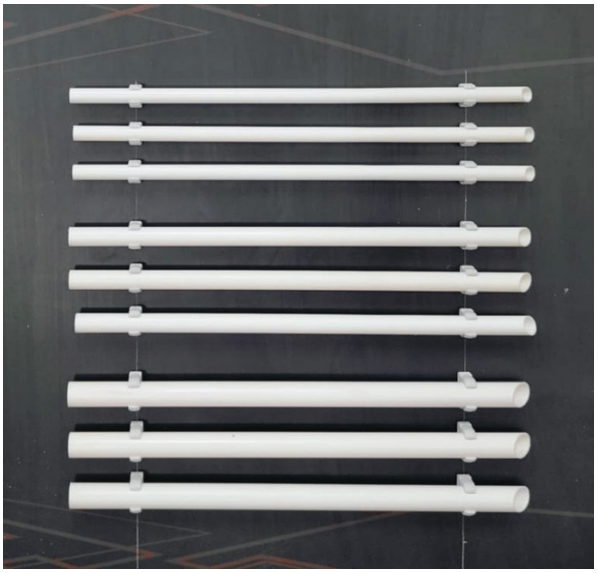
USP: Comprehensive range of relays required for transmission and distribution segments; limited OEMs have this protection relay range.

OBO BETTERMANN INDIA PVT LTD

PVC Rigid Conduit Pipes

OBO Bettermann India Pvt Ltd has launched **OBO PVC rigid conduit pipes** that are non-flame propagating, highly thermal resistant, durable, easy to install, has insulating properties, and are cost-effective.

Product type and segment: PVC Conduit Pipes



Industries catered to: Commercial and residential buildings, Industrial Installation, Utility services, Telecommunications.

USP:

- Non-flame propagating: These conduits are designed to prevent the spread of fire, enhancing safety in electrical installation.
- High thermal resistance: They are designed and tested to withstand significant heat, making them suitable for various electrical and construction applications. This property ensures that they can maintain their structural integrity and functionality even in high-temperature environments.
- Durability: They offer long-lasting performance and can withstand physical impacts without damage.
- Ease of installation: PVC conduits are lightweight and easy to handle, which simplifies the installation process
- Insulating properties: They provide excellent electrical insulation, reducing the risk of electrical hazards
- Cost-effective: PVC conduits are generally more affordable compared to metal conduits, offering a cost-effective solution for electrical installations.

SELEC CONTROLS PVT LTD

150kVAr Advanced Static VAr Generator Module

Selec Controls Pvt Ltd has launched **150kVAr Advanced Static VAr Generator Module.** An advanced static VAR generator (ASVG) is a state-of-the-art reactive power compensation device designed to provide real-time, dynamic, and precise power factor correction, voltage stabilisation, and harmonic filtering. Unlike conventional capacitor banks or older static VAr compensators (SVCs), an ASVG leverages advanced power electronics and digital control algorithms to optimise power quality in industrial, commercial, and renewable energy applications.

Product type and segment: Advanced static VAR generator

Industries catered to: Industrial plants, data centres, renewable energy (solar/wind), EV charging stations, hospitals and commercial buildings.

USP: Ultra-fast real-time reactive power compensation, advanced harmonic filtering and low THD, works in both leading (capacitive) and lagging (inductive) modes, no risk of overcompensation or switching transients, handles unbalanced and asymmetrical loads, lower energy bills by reducing reactive power penalties, modular and scalable design, maintenance-free operation, remote monitoring and smart control, voltage stability and regulation.

VALMONT

Solar Luminaire Solutions

Valmont has launched **Solar Luminaire,** a sustainable lighting solution designed for energy efficiency and reliability. Powered by high-efficiency solar panels and advanced battery technology, it ensures uninterrupted illumination even in remote locations. Featuring intelligent dusk-to-dawn operation and motion-sensing capabilities, solar luminaire optimises energy consumption while enhancing safety. With a sleek, corrosion-resistant design, it is ideal for highways, urban streets, and industrial areas, reducing dependency on grid power and lowering carbon footprints.

Product type and segment: Sustainable lighting solution

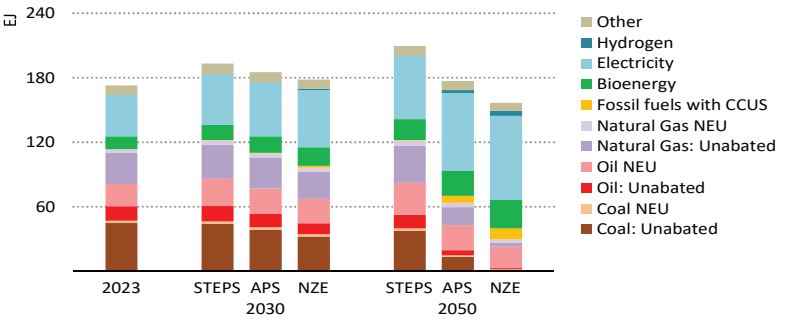
Industries catered to: Highways, urban streets and industrial areas

USP: Designed for energy efficiency and reliability, powered by high-efficiency solar panels and advanced battery technology, optimises energy consumption, enhances safety, corrosion-resistant design.

Global Scenario

Energy Scenario - World

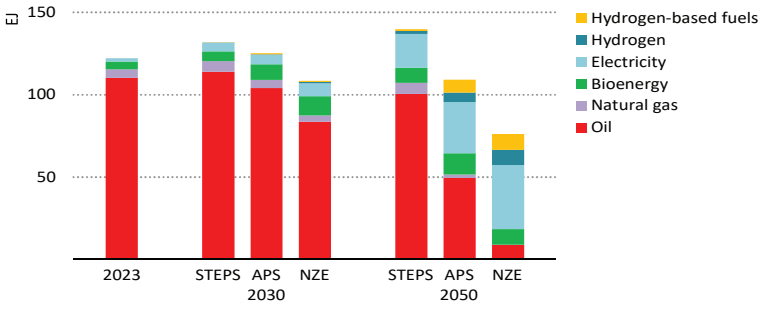
Figure 3.15 ▷ Energy demand in industry by fuel and scenario, 2023-2050



Fossil fuels continue to dominate energy demand in the industry sector until the end of this decade; electrification, bioenergy and CCUS reduce this reliance after 2030 in the APS

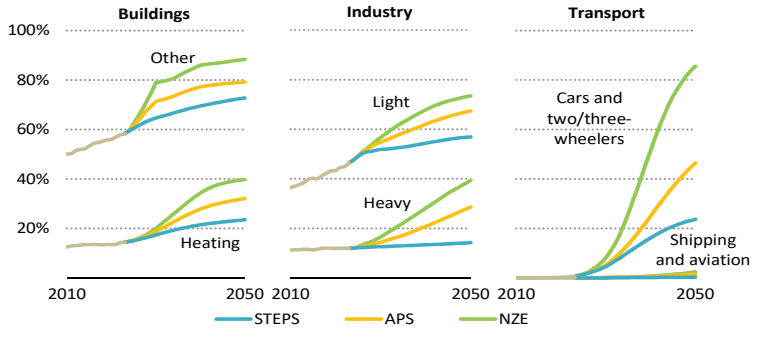
Notes: CCUS = carbon capture, utilisation and storage; NEU = non-energy use. Where low-emissions hydrogen is produced and consumed onsite at an industrial facility, the fuel input, such as electricity or natural gas, is reported as final energy consumption, not the hydrogen output.

Figure 3.9 ▷ Energy demand in transport by fuel and scenario, 2023-2050



Electricity reduces the dominance of oil across scenarios, while hydrogen and hydrogen-based fuels contribute to aviation and shipping

Figure 3.8 ▷ Share of electricity in total final consumption by end-use sector and scenario, 2010-2050



End-use electricity demand increased in recent years, with substantial growth projected to 2050; the more climate-aligned a scenario, the more electricity demand rises

Note: The analysis shown does not cover the full scope of the industry or transport sectors.

Source: WEO_2024

Indian Scenario

6.8 India

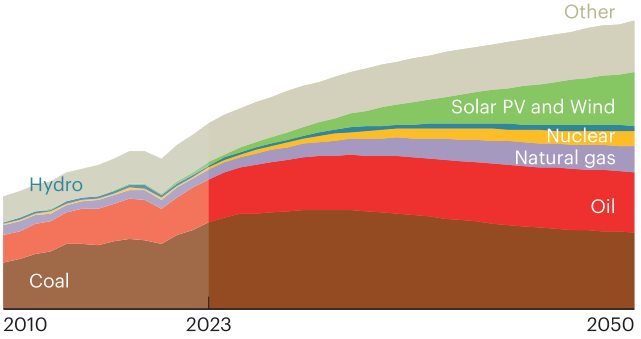
Population
Million people

2023	2050
1 429	1 670

GDP
Trillion USD (2023, PPP)

2023	2050
13.3	47.8

Energy demand in the Stated Policies Scenario
80 EJ



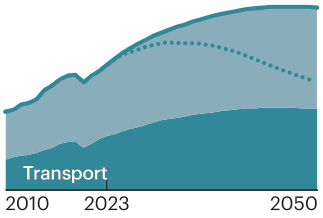
2070
Net zero emissions target

50%
Share of total power generation capacity targeted to be non-fossil by 2030

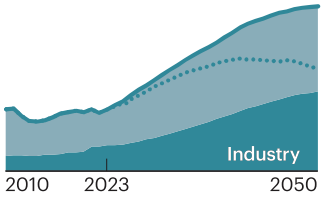
8.2 Billion USD
Earmarked for subsidies under the Production Linked Incentives (PLI) Scheme for low-carbon vehicles, solar PV and battery sectors

20 750 ckm
Intra-state Green Energy Corridor electricity transmission lines completed or planned to be completed by 2026.
ckm = circuit kilometres.

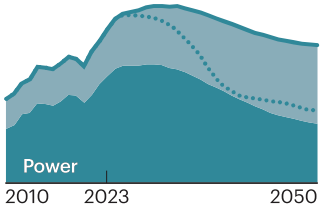
Oil demand
8 mb/d



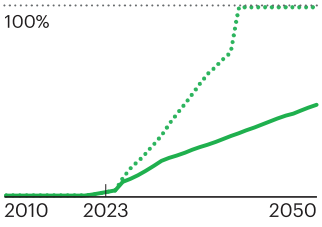
Natural gas demand
200 bcm



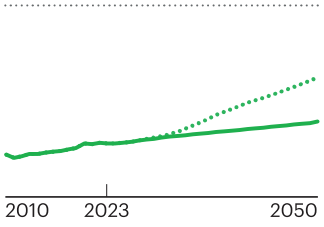
Coal demand
900 Mtce



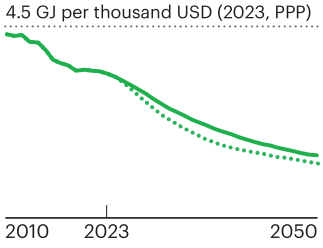
Zero-emissions vehicles in car sales
100%



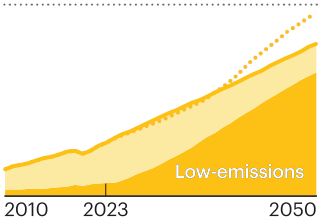
Low-emissions energy in industry
100%



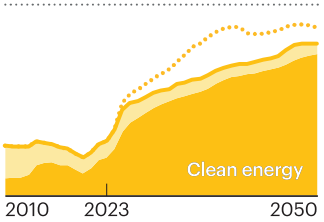
Energy intensity of GDP
4.5 GJ per thousand USD (2023, PPP)



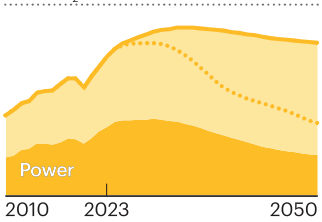
Electricity generation
8 000 TWh



Investment
350 Billion USD (2023, MER)



CO_2 emissions
4 Gt CO_2

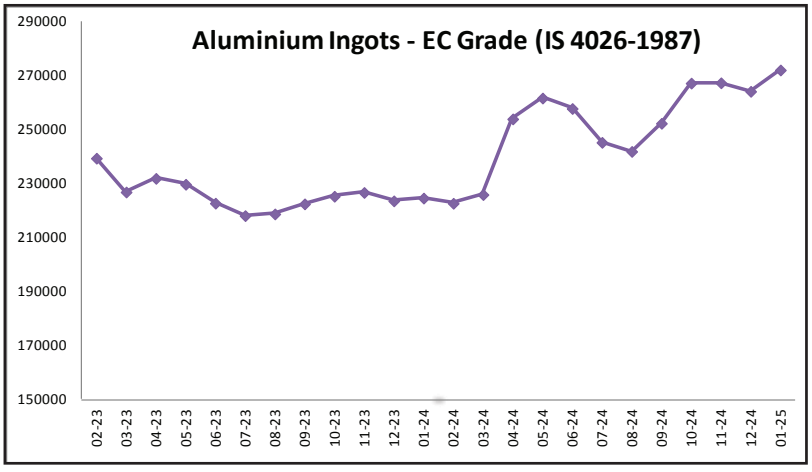


Stated Policies Scenario Announced Pledges Scenario

Source: WEO 2024

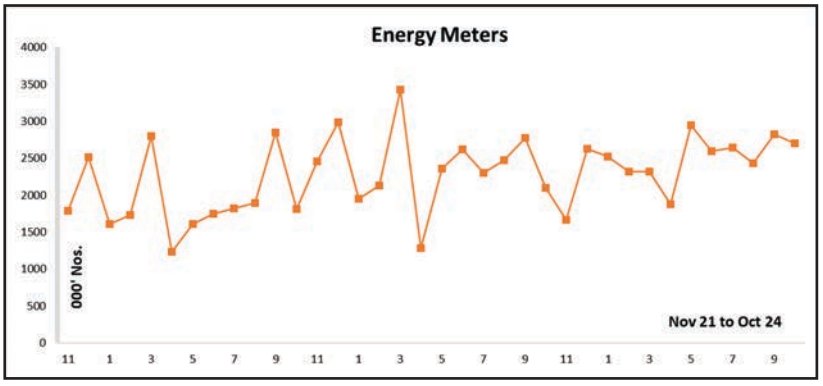
Basic Prices and Indices

	as on January 1, 2025
IRON, STEEL & STEEL PRODUCTS	
BLOOMS (SBLR) 150mmX150mm	44367.00
BILLETS (SBIR) 100MM	47297.00
CRNGO Electrical Steel Sheets M-45,C-6 (Ex-Rsp)	112.23
CRGO Electrical Steel Lamination	667286.00
NON-FERROUS METALS	
Electrolytic High Grade Zinc	304600.00
Lead (99.97%)	197600.00
Copper Wire Bars	820975.00
Copper Wire Rods	837521.00
Aluminium Ingots - EC Grade (IS 4026-1987)	272018.00
Aluminuium Properzi Rods - EC Grade (IS5484 1978)	277768.00
Aluminium Busbar (IS 5082 1998)	333000.00
OTHER RAW MATERIALS	
Epoxy Resin CT - 5900	766.00
Phenolic Moulding Powder	114.00
PVC Compound - Grade CW- 22	159825.00
PVC Compound Grade HR - 11	160825.00
Transformer Oil Base Stock (TOBS)	93709.00
OTHER IEEMA INDEX NUMBERS	
IN-BUSDUCTS (BASE August 2000=100) FOR THE MONTH November 2024	376.63
IN - WT (BASE JUNE 2000=100)	380.15
Wholesale price index number for 'Insulators' (Base 2011-12 = 100) for the month November 2024	130.50
Wholesale price index number for 'Manufacture of Basic Metals (Base 2011-12 = 100) for the month November 2024	138.60
Wholesale price index number for' Fuel & Power (Base 2011-12 = 100) for the month November 2024	149.90
ALL INDIA AVERAGE CONSUMER PRICE INDEX NUMBER FOR INDUSTRIAL WORKERS (BASE 2016=100) November 2024	144.50
# Estimated, NA: Not available	



Source: IEEMA

Production Statistics



Name of Product	ACC Unit	Production		Highest Annual Production
		For the Month October-24	From Nov 23 to October 24	
Electric Motors				
AC Motors - LT	000' KW	1,531.00	19,799.00	19,195.00
AC Motors - HT	000' KW	355.00	4,944.00	5,273.00
DC Motors	000' KW	25.00	457.00	618.00
Switchgears *				
Contactors	000' Nos.	1,373.00	17,722.00	16,503.00
Motor Starters	000' Nos.	172.00	2,578.00	2,427.00
SDF	000' Nos.	54.00	648.00	752.00
Circuit Breakers DIN Rail Mounted	000' Poles	18,761.00	232,499.00	221,179.00
Circuit Breakers - LT	Nos.	498,656.00	6,063,458.00	5,703,052.00
Circuit Breakers - HT	Nos.	8,335.00	95,166.00	119,282.00
Custom Built Product	Rs. Lakhs	44,899.00	311,981.00	452,536.00
HRC Fuses & Overload Relays	000' Nos.	1,320.00	15,753.00	17,246.00
Power Cables *	KM	86,798.00	1,128,548.00	1,052,205.00
Power Capacitors - LT & HT	000' KVAR	4,813.00	65,686.00	65,385.00
Transformers *				
Distribution Transformers	000' KVA	4,380.00	57,586.00	58,341.00
Power Transformers	000' KVA	22,498.00	227,728.00	234,922.00
Instrument Transformers				
Current Transformers	000' Nos.	781.00	3,800.00	1,390.00
Voltage Transformers	Nos.	16,918.00	207,352.00	217,752.00
Energy Meters	000' Nos.	2,704.00	31,030.00	28,579.00
Transmission Line Towers *	000' MT	91.00	1,109.00	1,250.00

**** Weighted Production***

Source: IEEMA

Export and Import

Import Export data - Apr 24 - Dec 24

ITC Codes	Product Groups	Apr - Dec FY 2024-25		Apr - Dec FY 2023-24		Apr - Dec 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	6544	4439	5894	3605	11	23
850423	Power TRF	429	994	64	824	570	21
850421-22, 850433-34	Distribution TRF	811	3100	842	2911	-4	6
853210	Capacitors	264	367	454	328	-42	12
8535, 853720	HV SWGR incl. Panels	2312	2898	1359	2204	70	31
8536, 853710	LT Switchgears incl Panels*	14321	7934	13913	10088	3	-21
854442/49/60	Cables - LV & HV	1736	6521	1593	6121	9	7
902830	Energy Meters	66	430	42	234	57	84
73082011/19	Tr. Line Towers	18	2450	13	2653	38	-8
7604 & 7614	Conductors	800	3431	685	4318	17	-21

* EXIM data for HSN Code - 85371000 for FY25 is not available at DGCIS

Top Ten countries - IMPORT Rs. Lakh				
Country	Apr - Dec 24		Country	Apr - Dec 23
CHINA P RP	4841752		CHINA P RP	4205066
GERMANY	675484		GERMANY	759495
KOREA RP	564035		KOREA RP	640735
SINGAPORE	559351		SINGAPORE	578466
Hong Kong	514058		Hong Kong	554019
U S A	459367		JAPAN	517311
JAPAN	441594		U S A	501006
RUSSIA	327464		RUSSIA	307596
FRANCE	190217		VIETNAM SOC REP	206738
VIETNAM SOC REP	182975		U K	174628

Top Ten countries - EXPORT Rs. Lakh				
Country	Apr - Dec 24		Country	Apr - Dec 23
U S A	1783680		U S A	1735653
GERMANY	503911		U ARAB EMTS	413803
U ARAB EMTS	447680		GERMANY	403129
U K	311165		U K	402907
FRANCE	237239		AUSTRALIA	244720
SAUDI ARAB	220706		FRANCE	207452
CHINA P RP	190917		NETHERLAND	206041
AUSTRALIA	180493		BANGLADESH PR	198431
NETHERLAND	177769		CHINA P RP	195908
ITALY	172453		NEPAL	164320

Export and Import

Top Ten products - IMPORT Rs. Lakh

HS Code	Description	Apr - Dec 24		HS Code	Description	Apr - Dec 23
85076000	LITHIUM-ION	1810256		85076000	LITHIUM-ION	1862441
85044090	OTHERS - Industrial Electronics	821751		85044090	OTHERS - Industrial Electronics	763197
85369090	OTHER - LV SWGR	627302		85371000	BORDS ETC FOR A VOLTAGE<=1000 VLTS	597108
98010013	POWER PROJCTS	500771		85369090	OTHER - LV SWGR	575982
85049090	PRTS OF OTHR ELECTRIC PWR MCHNRY OF HD8504POWER MACHINERY OF HDG 8504	483705		90328990	OTHR ATMTC RGLTNG/CNTRLNG INSTRMNTSANDAPPRTS	397197
85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	366608		98010013	POWER PROJCTS	392628
90328990	OTHR ATMTC RGLTNG/CNTRLNG INSTRMNTSANDAPPRTS	358950		85322990	OTHER FIXED CAPACITORS	378121
85322990	OTHER FIXED CAPACITORS	351924		85049090	PRTS OF OTHR ELECTRIC PWR MCHNRY OF HD8504POWER MACHINERY OF HDG 8504	358784
85365090	OTHR SWITCHES	237775		85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	288358
85322400	OTHR FXD CAPACITORS,CERAMIC DIELECTRIC,MULTILAYER	230017		85365090	OTHR SWITCHES	224150

Top Ten products - EXPORT Rs. Lakh

HS Code	Description	Apr - Dec 24		HS Code	Description	Apr - Dec 23
85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	678257		85030090	PARTS OF OTHR ROTATING ELECTRC PLANTS	652114
85044090	OTHERS - Industrial Electronics	543882		85044090	OTHERS - Industrial Electronics	455759
85369090	OTHER - LV SWGR	306863		85371000	BORDS ETC FOR A VOLTAGE<=1000 VLTS	378361
85044010	ELECTRIC INVERTERS	281717		85044010	ELECTRIC INVERTERS	301468
85072000	ELECTRIC ACCUMULATORS, INCLUDING SEPARATORS THEREFORE, WHETHER OR NOT RECTANGULAR (INCLUDING SQUARE) OTHER LEAD-ACID ACCUMULATORS	273410		85444920	PAPER INSULATED CNDCTRS FR VLTGE <= 80 V NOT FITTED WITH CONNECTORS	255085
85444920	PAPER INSULATED CNDCTRS FR VLTGE <= 80 V NOT FITTED WITH CONNECTORS	259401		73082011	T0WERS FOR TRANSMISSI0N LINE W/N ASSEMBLED	235358
85443000	IGNTN WIRING SETS AND OTHR WIRING SETS OF A KIND USED IN VEHICLES AIRCRAFT/SHIPS	214480		85369090	OTHER - LV SWGR	234785
73082011	T0WERS FOR TRANSMISSI0N LINE W/N ASSEMBLED	214470		85072000	ELECTRIC ACCUMULATORS, INCLUDING SEPARATORS THEREFORE, WHETHER OR NOT RECTANGULAR (INCLUDING SQUARE) OTHER LEAD-ACID ACCUMULATORS	216471
85049010	PARTS OF TRANSFORMERS	206129		76141000	STRANDED WIRE,CBLS ETC WTH STEEL CORE	198610
76141000	STRANDED WIRE,CBLS ETC WTH STEEL CORE	173717		85443000	IGNTN WIRING SETS AND OTHR WIRING SETS OF A KIND USED IN VEHICLES AIRCRAFT/SHIPS	190850

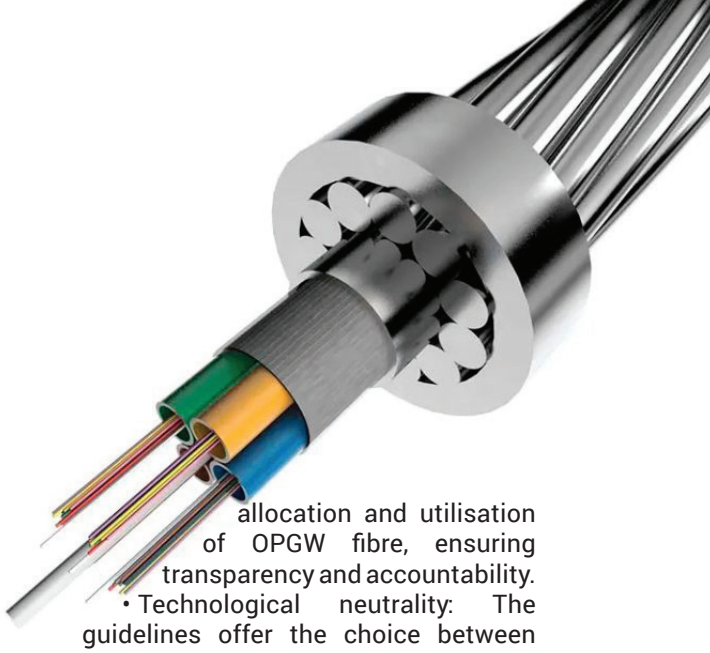
CEA issues guidelines for usage and sharing of fibre cores of OPGW and UGFO cables

The Central Electricity Authority (CEA), under the Ministry of Power (MoP), has issued 'Comprehensive guidelines for the usage and sharing of fibre cores of optical ground wire (OPGW) and underground fibre optic (UGFO) cables for power system applications'. The guidelines have been formulated with collective efforts of a committee constituted under the chairmanship of Member (Power Systems), CEA with representatives from central transmission utility, state transmission utilities, Grid Controller of India Ltd, transmission service providers, and other key stakeholders.

These guidelines aim to provide a clear and standardised framework for the allocation and sharing of fibre cores of OPGW/UGFO cable deployed across power transmission network, thus balancing the commercial prospects of fibre usage with the imperative of maintaining secure, reliable, and scalable grid operations. It establishes a structured approach to fibre allocation, safeguarding power system communication needs and mitigating future conflicts.

Key highlights include:

- Prioritising grid needs: The guidelines prioritise fibre allocation for critical grid communications, ensuring free spare fibre for future grid needs.
- Sharing framework: A well-defined framework has been outlined to facilitate the sharing of spare fiber capacity among various stakeholders, including Central Transmission Utility (CTU), State Transmission Utilities (STUs), Transmission Service Providers (TSPs), and other entities.
- Commercial utilisation with safeguards: Leasing of spare fibre for non-grid applications permitted, provided it does not compromise future grid requirements. All leasing contracts to include a termination clause, mandating at max of 18-month notice period to reclaim fibre cores for grid applications whenever required.
- Due diligence and compliance: It emphasises the need for assessment of future grid communication needs and adherence to applicable CEA, CERC or SERC regulations.
- Scalability for future needs: Utilities encouraged to plan and install OPGW with 48/96 fibre cores to provide sufficient capacity for last-mile connectivity, future expansions, and LILO requirements, leveraging the right of way (RoW) effectively.
- Maintenance of database: A comprehensive database to be maintained to monitor the allocation and utilisation of OPGW fibre, ensuring transparency and accountability.
- Technological neutrality: The guidelines offer the choice between IEEE C37.94 protocol over shared fibre or separate optical fibre, thus ensuring flexibility and adaptability in the implementation of differential protection schemes.



By promoting efficient allocation, sharing, and utilisation of optical fibre, the guidelines will contribute to a more reliable, resilient, and future-ready power grid and efficient resource management across the power sector.

Launch of National Critical Mineral Mission approved to reduce country's dependence on import of critical minerals for EVs

India is largely dependent on other Asian countries for raw materials, mineral processing, battery and other basic requirements for production and promotion of electric vehicles (EVs) in the country, as the basic raw material for producing EVs is lithium, among other critical materials. At present, investments in manufacturing and overall value addition for advanced chemistry cells (ACCs) are negligible in India and almost entire domestic demand of ACCs is still being met through imports. To reduce the dependency of imported ACC battery for EVs, the government, on May 12, 2021, approved a production-linked incentive (PLI) scheme for manufacturing ACCs in the country. The total outlay of the scheme is Rs18,100 crore for five years.

As per PIB, the Union Cabinet has on January 29, 2025, approved the launch of the National Critical Mineral Mission (NCMM), for seven years – from 2024-25 to 2030-31, with a proposed expenditure of Rs16,300 crore and an expected investment of Rs18,000 crore by PSUs and other stakeholders. The NCMM aims at securing a long-term sustainable supply of critical minerals and strengthening India's critical mineral value chain encompassing all stages – from mineral exploration and mining to beneficiation, processing, and recovery from end-of-life products.

In Union Budget 2025-26, the government proposed to fully exempt cobalt powder and waste, the scrap of lithium-ion battery, lead, zinc and 12 more critical minerals to secure their availability for manufacturing in India.

PM Surya Ghar: Muft Bijli Yojana crosses milestone of 10 lakh installations

PM Surya Ghar: Muft Bijli Yojana (PMSGMBY) – the world's largest domestic rooftop solar initiative – has achieved a significant milestone by completing 10.09 lakh installations across the country as on March 10, 2025. The scheme, launched in February 2024, aims at providing free electricity through rooftop solar systems to 1 crore residential households and reducing the dependence on conventional power sources while enabling citizens to become energy producers.

The scheme, implemented by the Ministry of New and Renewable Energy (MNRE), has received 47.3 lakh applications; 6.13 lakh beneficiaries have successfully received subsidies, amounting to Rs4,770 crore.

The scheme has seen remarkable progress across several states. Notably, Chandigarh and Daman & Diu have achieved 100 percent of their government building rooftop solar targets, leading the country in clean energy adoption. States like Rajasthan, Maharashtra, Gujarat, and Tamil Nadu are also performing exceptionally well, contributing significantly to the overall installation figures. The government is actively monitoring the progress across all states to ensure the smooth and timely execution of the scheme, with the goal of reaching 1 crore households by 2026-27.

The scheme has a total outlay of Rs75,021 crore. To facilitate easy financing, Union Minister of New and Renewable Energy Shri Pralhad Joshi recently held a meeting with top bankers at National Workshop on Mobilising Finance for Renewable Energy in Mumbai, urging them to ensure the hassle-free disbursement of loans under the scheme.

The government is also extending the rooftop solar initiative to public infrastructure, promoting the installation of solar systems on government buildings. This effort not only reduces operational energy costs but also serves as a model for commercial and industrial sectors, encouraging a broader adoption of solar power across the country.

The PM Surya Ghar: Muft Bijli Yojana supports domestic manufacturing by mandating the use of solar modules and cells produced in India. As on March 10, 2025, the scheme has facilitated the

installation of over 3 GW of rooftop solar capacity, with an additional 27 GW targeted by March 2027. This initiative is also driving the local production of inverters and balance of plant (BoP) components, further strengthening India's renewable energy ecosystem and enhancing the Make in India vision.

Government initiatives to promote gas-based power generation

Gas-based plants in the country are operating at a low plant load factor (PLF). To enhance the availability of natural gas for power generation, the government has placed liquefied natural gas (LNG) under the open general license (OGL) category, thus allowing power plants to import LNG as per their requirements on mutually agreed commercial terms with suppliers. The gas imported by power plants during 2024-25 (April-January), is about 9.58 MMSCMD.

As per a PIB release, various steps taken by the government for increasing the share of natural gas in the energy basket, inter-alia, include expansion of national gas grid pipeline, expansion of city gas distribution (CGD) network, setting up of liquefied natural gas (LNG) terminals, allocation of domestic gas to compressed natural gas (transport) or piped natural gas (domestic) CNG(T)/PNG(D) on priority, allowing marketing and pricing freedom with a ceiling price to gas produced from high pressure or high temperature areas, deep water and ultra-deep water and from coal seams, sustainable alternative towards affordable transportation (SATAT), initiative to promote bio-CNG, among others.

Incentivising manufacturers of EVs

The government, as per a PIB release, has concurred that by incentivising manufacturers of electric vehicles (EVs), components, and charging or swapping infrastructure, several players will be drawn into the market with prospects of long-term viability and significant future growth potential for EVs in the country.

The government has taken several steps to promote adoption and strengthen the EV ecosystem in India, as per a PIB release, details of which are as below:

- Production-linked incentive (PLI) scheme for automobile and auto component industry in India (PLI-Auto): The government approved this scheme on September 15, 2021, for the automobile and auto component industries for enhancing India's manufacturing capabilities for advanced automotive technology (AAT) products with a budgetary outlay of Rs25,938 crore.

- Faster adoption and manufacturing of (hybrid) EVs in India (FAME India) Scheme Phase-II: The government implemented this scheme from April 1, 2019, with a total budgetary support of Rs11,500 crore to incentivise e-2Ws, e-3Ws, e-4Ws, e-buses, and EV public charging stations.
- PLI scheme for national programme on advanced chemistry cell (ACC) battery storage: The government, on May 12, 2021, approved the PLI scheme for manufacturing of ACC in the country with a budgetary outlay of Rs18,100 crore. The scheme aims at establishing a competitive domestic manufacturing ecosystem for 50 GWh of ACC batteries.
- PM electric drive revolution in innovative vehicle enhancement (PM E-DRIVE) scheme: This scheme, with an outlay of Rs10,900 crore, was notified on September 29, 2024, to support EVs, including e-2W, e-3W, e-trucks, e-buses, e-ambulances, EV PCS and upgradation of vehicle testing agencies.
- PM e-Bus sewa-payment security mechanism (PSM) scheme: This scheme notified on October 28, 2024, has an outlay of Rs3,4333 crore and aims at supporting the deployment of more than 38,000 electric buses. The objective of the scheme is to provide payment security to e-bus operators in case of default by public transport authorities (PTAs).
- Scheme for promotion of manufacturing of electric passenger cars in India (SPMEPCI): This scheme was notified on March 15, 2024, to promote the manufacturing of electric passenger cars in India. This requires applicants to invest a minimum of Rs4,150 crore and achieve a minimum DVA of 25 percent at the end of the third year and DVA of 50 percent at the end of the fifth year.

NATIONAL

Madhya Pradesh launches Renewable Energy Policy 2025

The Madhya Pradesh Government has launched the Madhya Pradesh Renewable Energy Policy 2025, with an aim of sourcing 50 percent annual power consumption from renewable energy (RE) by 2030. The policy is valid for five years and applies to all RE projects of at least 500 kW, excluding decentralised systems. The target for Madhya Pradesh is a reported 20 percent, 30 percent, and 50 percent RE mix by FY24, FY27, and FY30, respectively. The target for the state government departments is to achieve 50 percent compliance by 2027 and 100 percent by 2030. Additionally, the state is also aiming at developing 10,000 MW of RE parks and hybrid parks by FY27 as well as establishing 4,000 MW of RE projects for power export outside the state by FY24, expanding to 10,000 MW by FY 2027.

NGEL and CSPGCL sign JVA for RE projects

NTPC Green Energy Limited (NGEL) has reportedly signed a joint venture agreement (JVA) with Chhattisgarh State Power Generation Company Limited (CSPGCL). The JVA aims at developing, operating, and maintaining RE projects, including solar, wind, hybrid, and floating solar, with a total capacity of up to 2 GW in Chhattisgarh and other identified locations. A joint venture company (JVC) with NGEL holding 74 percent and CSPGCL holding 26 percent will reportedly be formed. As reported, the JVC will supply renewable power to CSPGCL or discoms of Chhattisgarh and commercial and industrial customers across India.

REC signs MoU with EMC to finance PSPs in Kerala

REC Limited has signed a Rs 183.6-billion agreement with Energy Management Centre (EMC), Government of Kerala, to finance pumped storage projects (PSPs) in the state over five years. The PSPs are expected to improve grid stability and support the integration of renewable energy sources. EMC is an autonomous body under the Kerala's Department of Power and will oversee the planning and implementation of these projects in collaboration with the Kerala State Electricity Board Limited.

IRFC extends Rs75 billion loan to NTPC Green Energy

The Indian Railways' dedicated funding arm – Indian Railway Finance Corporation (IRFC) – is expanding into the renewable energy sector as part of its strategy to finance industries linked to rail operations. The company has reportedly secured a bid to extend a rupee term loan of Rs75 billion to NTPC Green Energy Limited. In addition, it is also lending Rs31 billion to a thermal power generation subsidiary of NTPC. IRFC has also partnered with Railway Energy Management Company Limited to finance RE projects awarded for supplying power to the railways. Moreover, as reported, the company is actively exploring opportunities to fund RE requirements for metro-rail projects.

NTPC REL commissions 105 MW Shajapur Solar Project

NTPC Renewable Energy Limited (NTPC REL) has commissioned the 105-MW Shajapur Solar Project (Unit-I) in Shajapur Solar Park, Madhya Pradesh. The project has been developed in two phases – the first phase of 55 MW achieved commercial operations in November 2024 while the balance 50 MW has been commissioned in March 2025.

SJVN and Chhattisgarh Govt sign MoU for pumped hydro storage project

SJVN Limited has signed a MoU with the Government of Chhattisgarh and Chhattisgarh State Power Generation Company Limited (CSPGCL). The MoU is for developing a 1,800-MW pumped hydro storage project at Kotpali. SJVN will reportedly invest Rs95 billion in the off-stream closed-loop project in Balrampur district as per the agreement.

IREDA issues Rs12.47 billion perpetual bonds to strengthen tier-I capital

The Indian Renewable Energy Development Agency (IREDA) has launched its first-ever perpetual bonds worth Rs12.47 billion at an annual coupon rate of 8.40 percent. The move comes as the agency plans to optimise its capital structure and leverage favourable market conditions. As reported, the bond issuance is a strategic move to enhance IREDA's Tier-I capital, reinforcing its financial foundation to support India's growing green energy infrastructure.

HERC notifies amendments to HERC (Green Energy Open Access) Regulations, 2023

The Haryana Electricity Regulatory Commission (HERC) has notified amendments to the HERC (Green Energy Open Access) Regulations, 2023. The amendments clarify that consumers with a contracted demand of 100 kW and above – either through a single connection or multiple connections within the same electricity operation division of a distribution licensee – will be eligible for green energy open access. Additionally, offshore wind projects commissioned until December 2032 will be exempted from additional surcharges when supplying power to open access consumers, extending the previous exemption deadline of December 2025.

Andhra Pradesh issues operational guidelines for Integrated Clean Energy Policy, 2024

The Andhra Pradesh Energy Department has issued operational guidelines under the Integrated Clean Energy Policy, 2024, covering resource allocation, land allotment, grid connectivity, open access, banking facilities, and project migration. The New and Renewable Energy Development Corporation of Andhra Pradesh will develop a unified portal for applications, approvals, and implementation of clean energy projects and renewable manufacturing plants.

INTERNATIONAL

Thailand commits to US$ 1.8 billion AI-powered smart grid transformation

The Thailand Government has announced a US$ 1.8-billion agreement with Gorilla Technology Group for implementing an AI-driven smart grid initiative over 15 years. The programme aims at modernising the nation's electricity distribution, enhancing energy security, and optimising efficiency through advanced automation and AI-driven analytics.

Reports indicate that the project is financed through a performance-linked model, ensuring long-term returns tied to efficiency gains. As reported, revenue is projected to scale up significantly from 2026-2027 as the infrastructure reaches full operational capacity. Over the project's life-cycle, multi-billion-dollar cumulative returns are expected.

Indonesia unveils third-largest floating solar plant

Marking a major step in its RE transition, the Indonesia Government has launched a massive floating solar plant 107 km southeast of Jakarta, on the Cirata Reservoir. Covering 4 per cent of the reservoir's surface, the plant reportedly consists of 13 arrays capable of generating 192 MW, which it makes it the world's third-largest floating solar installation. The project has been developed through a partnership between Indonesia's state-owned utility company and UAE-based renewable firm Masdar. At present, 12.3 percent of Indonesia's electricity is from renewable sources, with plans to add 60 GW by 2040 at an estimated US$ 172 billion investment.

China commissions 500 kV Bayue-Chenjiaqiao II transmission line

The State Grid Corporation of China (SGCC) has commissioned the 500-kV Bayue-Chenjiaqiao II transmission line, also known as the Yuechen II line, in Chongqing. The 55-km transmission line connects the 1,000-kV Bayue substation to the 500-kV Chenjiaqiao substation. The line is expected to enhance Chongqing's grid structure and facilitate clean energy transmission from Sichuan. This is reportedly the third outbound line from the Bayue substation and will help improve power supply to the city's core and support the Chengdu-Chongqing Twin Cities Economic Circle.

Malaysia's 1.2 GW Pulau Indah Power Plant commences operations

Worldwide Holding Bhd's 1.2 GW Pulau Indah combined cycle gas turbine (CCGT) power plant has commenced operations, supplying energy to 2.5 million households in Malaysia. The plant is located 60 km from Kuala Lumpur and is equipped with two GE Vernova 9HA gas turbines, known for

high ramp rates and fast start-up times to meet fluctuating power demand. As reported, the facility's HA units can burn up to 50 percent hydrogen, thus supporting future energy transition goals.

CORPORATE

Avaada Electro inaugurates 1.5 GW solar module facility and 5 GW solar manufacturing unit

Avaada Electro has inaugurated its 1.5 GW solar module manufacturing facility in Noida and laid the foundation stone for a 5-GW integrated solar manufacturing unit in Greater Noida. The 1.5 GW photovoltaic (PV) module manufacturing facility in Dadri was constructed in three and a half months and is now fully operational. It specialises in TOPCon N-Type bifacial glass-to-glass PV modules with multi-bus bar configurations, producing 5,800 modules daily. The upcoming 5-GW integrated solar manufacturing unit in Ecotech-16, Greater Noida, will focus on high-efficiency TOPCon N-Type solar cells.

Torrent Green Energy incorporates subsidiaries for RE business

Torrent Power Limited's wholly owned subsidiary – Torrent Green Energy Private Limited – has incorporated Torrent Urja 39 Private Limited and Torrent Urja 40 Private Limited at an investment of Rs500,000 each, subscribing to 50,000 equity shares of face value Rs10 each. These special purpose vehicles (SPVs) will focus on generating electricity from RE sources. The SPVs will engage in producing, processing, trading, and distributing hydrogen, its derivatives, natural gas, and other RE-related products, along with generating, transmitting, and distributing power.

Jakson Green to invest Rs86.66 billion for RE portfolio expansion

Jakson Green, a wholly owned subsidiary of Jackson Group, has planned investments up to Rs86.66 billion over four years for expanding its RE portfolio. The investment will reportedly be financed through a combination of debt and equity. The company diversified into RE in the past two years and its portfolio now includes distributed energy, solar modules and inverters, biofuels, infrastructure, and engineering, procurement, and construction (EPC) projects. The company has an EPC portfolio of more than 5 GW and operates six manufacturing plants across India.

CCI approves JSW Neo Energy's acquisition of O2 Power

The Competition Commission of India (CCI) has given its approval for JSW Neo Energy Limited to acquire a 100 percent shareholding in O2 Power Midco Holdings Pte Limited and O2 Energy SG Pte Limited. JSW Neo Energy is a wholly owned subsidiary of JSW Energy Limited, which is engaged in power generation and transmission through conventional and non-conventional sources. O2 Power Midco Holdings and O2 Energy SG – through their subsidiaries – are involved in renewable power generation, including wind and solar energy.

Gentari acquires 1.6 GW renewable portfolio from Brookfield in India

Gentari Renewables India has acquired a 1.6 GW portfolio of solar and wind assets from Brookfield Asset Management, strengthening Gentari's RE footprint in India. The transaction is structured in two phases, with the first phase involving the acquisition of 1 GW of operating assets now complete. The portfolio comprises a mix of solar and wind assets, aligning with Gentari's strategy to expand its clean energy capacity. Brookfield, with approximately 40 GW of wind and solar assets in operation, construction, and development, remains a key investor in India's renewable sector.

CCI approves ONGC NTPC Green's acquisition of Ayana Renewable Power

The Competition Commission of India has given its approval for ONGC NTPC Green Private Limited to acquire a 100-percent shareholding in Ayana Renewable Power Private Limited. ONGC NTPC Green is a joint venture (JV) between ONGC Green Limited and NTPC Green Energy Limited, wholly owned subsidiaries of Oil and Natural Gas Corporation Limited and NTPC Limited, respectively.

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SHOCKS and SPARKS

General Gags

A son of a businessman asked, "Papa, what is business morality?"

"Well, explained the father, "It is like this. A customer comes in the shop and makes a purchase. He gives me a brand new hundred rupee note which is just the right amount and starts out. I am putting the note in the cash box and discover that it is not one, but two one hundred rupees notes stuck together.

Now comes the business morality. Should I tell my business partner?"

A motorist had a flat tyre in front of a mental hospital. He took the wheel off. But all the bolts that held the wheel rolled down into a gutter. He tried to recover but gave up after making a mess of himself.

An inmate looking through the fence suggested the man take one bolt from each of the remaining 3 wheels, to hold the spare wheel in place until he can reach a workshop.

The motorist thanked him profusely and said, "I don't know why you are in that place."

The inmate replied, "I'm here for being crazy, not for being stupid."

Suresh was ready to leave for the office when his wife gave him a beautifully wrapped box to be opened in his office.

"Is it my birthday?" he asked puzzled, "Or our wedding anniversary?"

"Neither," she said.

"Then why the gift?"

"Oh, it's a hair tonic, to stop hair from falling."

Suresh was even more surprised.

"Is my hair falling?" he asked, patting his well-groomed hair.

No, not yours. But you can present it to your secretary," replied the wife very coolly, "when I brush your coats, I find her hair all over."

Marriage is such a life imprisonment, where only bad behaviour can get you freedom.

A wealthy Frenchman's beautiful wife had died and while the husband stoically controlled his grief thorough out the funeral proceedings, the wife's lover, sobbed loudly and made an open display of his loss.

The husband observed this demonstration patiently and when the service was over, walked over to the young man, put his arm around him and said, "Don't be so upset, my friend, I plan to marry again."

If you tell a human being that the sky has three hundred billion stars, he will immediately agree with you without even a thought.

But if it is written, 'Wet Paint' on a bench, he will admit it only after touching it.

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