Intelli mart
A JV of NIIF and EESL

KXCHANGE

3rd ANNIVERSARY

Dear Readers

Knowledge is the cornerstone of progress and empowerment! It was this belief that propelled IntelliSmart Infrastructure Pvt Ltd, India's leading smart metering and digital solutions provider, to establish K-Xchange three years ago. We are now proud to announce the third anniversary of K-Xchange.

Since its inception, K-Xchange has strived to be a trusted platform for exchanging knowledge on important power sector developments. It stands as a testament to IntelliSmart's commitment to being a leading source of reliable information. We take pride in publishing high-quality interviews and articles authored by industry experts, covering a wide range of topics and perspectives -- from smart metering and energy transition to the power sector's digitalisation journey.

But none of this would have been possible without the support of our valued partners, stakeholders, and, above all, our readers. Your trust, loyalty, and interest in our work have been instrumental in our success, and we extend our heartfelt thanks to all of you.

As we look forward, we remain dedicated to continuing our growth and broadening our outreach to connect with new audiences. Once again, we thank our readers, partners, and stakeholders for their invaluable contributions to our success, and we look forward to continuing this journey with all of you.

Thank you for being a part of the K-Xchange community.

Happy reading!

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Publishing Team

Renu Kumari
AGM, IntelliSmart

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Manager, IntelliSmart

ENCOURAGING WORDS FOR K-XCHANGE

Ministry of Power

I commend the outstanding efforts of your team for providing insightful information and knowledge about the power sector. This magazine has emerged as a vital forum for fostering innovation and sharing expertise in smart metering.

Shri Sanjeev Hans
Principal Secretary, Energy Dept, Bihar

"K-Xchange has consistently delivered highquality content on smart metering and its role in implementing advanced digital technologies. It's an essential resource for professionals seeking to stay at the forefront of industry trends."

Shri Niraj Verma
Additional Secretary, Department of Telecommunications

"K-Xchange is an empowering tool who are passionate about driving positive change in the power sector. It equips us with the necessary information and resources to engage with stakeholders for sustainable and equitable energy practices."

Shri Vishal Kapoor
Chief Executive Officer, EESL

"K-Xchange is playing a crucial role in keeping us informed about the latest developments in smart metering. It is an important platform for fostering collaboration and empowering stakeholders."

Shri Arun Kumar Mishra
ED - GA&C, ERP & IT, NSGM

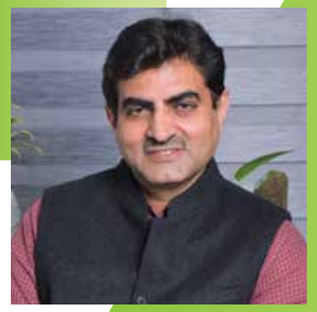
"K-Xchange continues to offer a wealth of information on smart metering and insight on broader energy transition. It's inspiring to witness the power sector's collaborative spirit in sharing knowledge and fostering innovation through this platform."

Mr. Parag Baduni
Partner- Master Fund, NIIF

"I appreciate the quality content and in-depth analysis K-Xchange provides. It keeps us updated on the advancements in smart metering and digitalisation, enabling us to stay ahead in the industry."

Shri Atul Bali - Director
National Smart Grid Mission & ESGM

"K-Xchange is an informative and accessible newsletter that educates consumers about the benefits of smart metering. It empowers individuals to make informed choices and actively participate in the energy transition."



Securing Energy, Empowering Consumers: Journey and Learnings so far in RDSS Program

Shri Anil Rawal
MD & CEO, IntelliSmart

India has seen tremendous growth in energy demand in recent years, driven by the post-pandemic resurgence of the economy. The global geopolitical scenario, along with surging energy demand, has significantly increased the reliance on electricity for ensuring energy security for the world's fastest-growing economy, with over 1.4 billion citizens. While the commitment to energy transition remains critical, ensuring energy security is also non-negotiable for India.

To manage the twin targets of energy security and energy transition, India has undertaken the ambitious challenge of digitalizing at the grassroots level by targeting 250 million smart pre-paid meters nationwide. This initiative is spearheaded by the aspirational Revamped Distribution Sector Scheme (RDSS). Set to become one of the world's largest digitalization drives, this initiative aims to impact the psyche of the population, creating a sense of ownership and responsibility towards energy usage.

Democratizing Electricity: Empowering Consumers

The RDSS program is a tool for democratizing electricity, empowering consumers with control over their power consumption. The successful implementation of this program requires first working on the minds of the masses before it works on the ground. The success of the program hinges on the willingness of India's more than 1.4 billion consumers to embrace electricity as a valuable service, delivered with a commitment to quality and at a fair price.

RDSS – Journey So Far

The program has taken significant strides with more than half of the smart meters of total target already been awarded and under implementation, based on the Standard Bidding Document (SBD) issued by the Government of India. The program has attracted massive investments from global investors and has triggered the 'Make in India' initiative in smart metering and related digital solutions. Over 15 strong domestic and international companies have either built their portfolio in the sector or are eyeing further expansion. Competitive forces are in full swing, driving innovative solutions to reduce costs and pass on the benefits to Discoms.

Experiences and further Evolution required

This program has the potential to transform the electricity distribution sector in India and create a culture of energy conservation and efficiency. With reasonable experience on the program so far and the first RDSS project already commissioned in Assam, several learnings need to be incorporated to enhance efficiency and leverage the investments made.

Simplification of Tariff Rules

Each Discom has multiple complex tariff scenarios, accumulated over the years depending upon the various situations. It may not be any more relevant to take all of them forward in the digital solutioning. A deeper evaluation of building them per se in the digital prepaid mode is required. The multiplicity and complexity of these multiple tariff situations is taking a lot of time to replicate in the smart metering prepaid mode. Simplifying these tariffs will reduce pressure on solutioning and infrastructure of the Discoms, expediting the integration of billing systems.

Billing System Upgrades required for the Discoms

There is serious need to fortify and upgrade the billing systems of Discoms. While state-of-the-art infrastructure is sought through smart metering SBDs, the corresponding billing and revenue management systems are either absent or inadequate in the Discoms. This technological gap needs addressing as the number of smart meters increases.

Specifications and micromanagement

Update specifications to the present context and make the inspection regime more implementation-friendly to avoid micromanagement. The controls have to more liberal as the program would need significantly higher pace and faster roll out to be finished in time. 100% testing of meters and similar other less than most efficient control measures need be liberated. These are ownership-based projects where delivery for 10 years is the responsibility of service providers. Service providers should be paid based on the success of the program measured through agreed SLAs. Time is being lost on multiple prescriptions and inspections, delaying program implementation.

Commercial Framework for Data Utilization and application of AI/ML

Building a commercial framework around the humongous data generated through smart meters is imminently required. Currently, there is no current commercial incentive for service providers to create value-added services for Discoms or home solutions for consumers. Utilizing consumption data form smart meters can aid in understanding consumer behaviour, predictive theft detection, efficient demand-side management, power purchase optimization, network asset management, and much more.

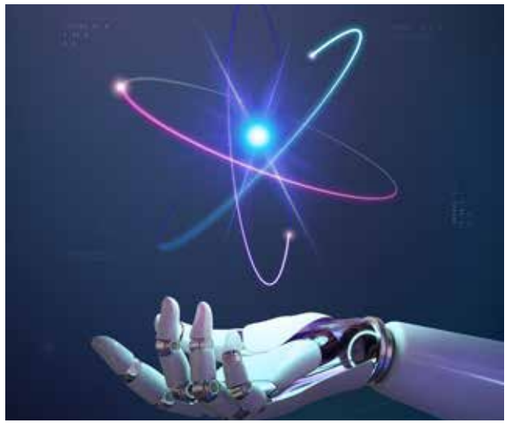
Uniform Integration Protocols

Developing uniform integration protocols for various meters and Head-End Systems (HESs) shall help in faster integration of multiple meters with multiple HES, that would enhance options for consumers and fast pacing the roll out. This will result in faster integration and hasten program implementation once awarded.

Regulatory Intervention for Time-of-Day Tariffs

Implementing a universal Time-of-Day (ToD) and Time-of-Use tariff regime is the next important intervention in the program. This would enable the consumers to differentiate between peak and non-peak tariffs, incentivise targeted consumption and driving traction towards smart meters. It also helps manage demand peaks for Discoms using smart meters.

The RDSS program is a pioneering effort in India's energy sector, with the potential to revolutionize electricity distribution and foster a culture of energy conservation. By addressing the lessons learned and implementing the suggested improvements, India can ensure the success and sustainability of this ambitious initiative, paving the way for a stronger and more resilient energy future.



OUR JOURNEY SO FAR

NOVEMBER 2019 — Company Incorporation

JULY 2021 — Achieved 98% bill reads in more than 1 million Smart Meters

SEPTEMBER 2021 — Commissioned India's first SMOC (Smart Meter Operation Centre) in Haryana

DECEMBER 2021 — Won Assam Tender for installation of 0.62 Million Smart Meters in TOTEX mode

SEPTEMBER 2022 — Achieved 3 Million smart meter installation across India with 2 Million Smart Meters during Covid

FEBRUARY 2023 — Received 'IND A/ Stable' Credit Rating from India Rating

APRIL 2023 — Received LOA from PVVNL for 6.7 Million Smart Meter Project

JULY 2023 — Conferred with ISGAN award for AI/ML-based pilot project

NOVEMBER 2023 — Secured order Book of 20 Million smart meters

MAY 2024 — Completed first RDSS project in Assam by installing 0.62 Mn smart meters

Interview

Shri Vivek Kumar Dewangan
Chairman & Managing Director, REC Limited

What is REC's current exposure and future plans regarding renewable energy financing, and how does the organization intend to expand its portfolio in this space?

REC has been a key player in India's electrification journey, leading initiatives like DDUGJY and SAUBHAGYA for last-mile connectivity to every Indian. As a nodal agency for RDSS, REC contributes to improve health of DISCOMS and to ensure quality, reliable power supply nationwide. With the country moving towards a cleaner and green future, REC has positioned itself as a leader in driving India's energy transition:

- REC has a renewables loan portfolio of 38971 crore by FY 2023-24 end, which is about 8% of total loan book.
- In line with the country's energy transition goals, REC as a leading financer in India's power sector targets improve its green finance loan portfolio to 30% of total loan (i.e. about Rs. 3 lakh Crore) by the FY 2030 from current level.
- REC has sanctioned ~Rs. 1,36,516 Cr. renewables projects during the FY 23-24. REC's renewable energy sanction has seen an astonishing 533% Y-o-Y growth, while overall sanction has grown by 34% Y-o-Y. Over the next few years, REC aims to maintain its push towards renewables sector. The sanction growth shall be reflected in company's loan book in the coming years.
- REC has hosted Green Finance Summit in July'23 on the side lines of India's G20 presidency and signed MoUs worth Rs. 2.85 lakh Cr with various developers of green projects. The commitment made is likely to bring significant financing opportunities.
- REC is financing the entire renewables vertical which includes Solar & its Module manufacturing, Wind & wind turbine, Hybrid, PSP, Green H2/Ammonia, E-mobility, etc.

REC has recently been appointed as the National Program Implementing Agency for the "PM Surya Ghar: Muft Bijli Yojana," a scheme launched by the Hon'ble Prime Minister in Feb' 2024. The scheme aims to install rooftop solar systems on 1 crore households, targeting a total capacity of 30GW with an allocated budget of Rs. 75,021 crore. This scheme is anticipated to play a pivotal role in the nation's energy transition while aiding households in reducing their electricity bills.

With the increasing focus on domestic manufacturing of solar cells/modules, how does REC view the financing opportunities in this sector, and what role does the organization aim to play in supporting such initiatives?

Government of India has initiated the Production Linked Incentive (PLI) Scheme with a budget outlay about Rs. 24,000 Cr to boast the domestic manufacturing of High Efficiency Solar PV Modules at GW scale. REC has strategically positioned itself to capitalize on the growing focus of GoI on domestic manufacturing of solar cells and modules. As the sector gains momentum, REC views the financing opportunities in this area as substantial and multifaceted. During FY 23-24, REC sanctioned projects amounting Rs. 21,565 crores for domestic manufacturing of solar modules. These projects includes financing for new Solar PV modules manufacturing facility, upgrading existing facilities and also financing for Integrated Ingot-Wafer Cell Module Manufacturing.

What is your outlook for the power sector in India, and how does REC envision its role in driving sustainable growth and development within the sector?

The power sector witnessed a remarkable surge in 2023-24, with all around performances from all the stakeholders involved. The total power generation reached 1738 BU, marking a 7% Y-o-Y growth. Total installed capacity stood at 442 GW by FY end with 243 GW of thermal 8 GW nuclear and 191 GW renewables capacity. The Peak electricity demand met continued to increase consistently over the years and reached all time high of 240 GW in Sept'2023. CEA further projected peak demand to reach 256.5 GW during the FY 2024-25.

To achieve the target of 500 GW of installed power capacity from non-fossil fuel sources by 2030, an additional 296 GW of renewable energy capacity and 7 GW of nuclear capacity is expected in line with CEA optimal mix report. Even though the majority of new generation capacity is expected to come from renewable sources, to meet the demand surge and support country's economic growth in near terms adequate coal capacity addition will also be essential. This anticipated growth in country's electricity generation segment is poised to catalyse substantial investment. The required augmentation and expansions in existing transmission and distribution infrastructure will also attract significant investment. REC as a leading financer in the country will play its part to drive the sectors growth and development momentum by financing the entire entire power sector value chain viz. generation, transmission & distribution and most importantly the renewable energy sector.

What are some of the unresolved challenges or issues that REC perceives in the power sector, and how is the organization addressing these challenges to ensure the sector's sustainable growth?

Power distribution is the final and most crucial link in the electricity supply value chain which is directly connected to the consumers. Over the years, distribution sector has faced various challenges like unreliable power supply, high AT&C losses, old and overloaded network, low cost recovery, low consumer satisfaction, etc. resulting poor financial health of Discoms. Recently in last few year, the distribution sector has received greater attention and various reforms measures/ Rules have been notified by Ministry of Power, GoI for improving financial viability of distribution utilities and equipping them to provide 24x7 reliable & quality power to consumer.

"To achieve the target of 500 GW of installed power capacity from non-fossil fuel sources by 2030, an additional 296 GW of renewable energy capacity and 7 GW of nuclear capacity is expected in line with CEA optimal mix report. Even though the majority of new generation capacity is expected to come from renewable sources, to meet the demand surgeand support country's economic growth in near terms adequate coal capacity addition will also be essential."

Government initiatives, including DDUJGY, SAUBHAGYA & RDSS have resulted in transforming the sector. AT&C losses are coming down, ACS-ARR gap are being reduced, DISCOMs are gradually clearing overdue payments to generation companies, and all are indicating major improvements. REC as a nodal agency for DDUJGY, SAUBHAGYA and nodal agency for few states for RDSS, has contributed majorly shifting this tides of changes.

India's renewable energy sector has struggled with a heavy reliance on imported components, including solar cells, modules, wind turbines, and inverters. To address this, the government has introduced the Production Linked Incentive (PLI) Scheme, allocating a budget of Rs. 24,000 crore to boost domestic manufacturing of high-efficiency solar PV modules. REC is contributing to this initiative by offering financial support for the domestic production of solar PV cells and wind turbines.

What are the emerging trends and developments in renewable energy open access, and how are they shaping the transition towards a greener energy landscape?

Indian Government has a major step by adopting the Green Energy Open Access Rules, 2022 for promoting generation, purchase and consumption of green energy including the energy from waste-to-energy plants through open access. MoP has notified Grid Controller of India Limited as Central Nodal Agency to operate Green Open Access Registry portal. The Green Open Access is allowed to any consumer and the limit of Open Access Transaction has been reduced from 1 MW to 100 kW for green energy, to enable small consumers also to purchase renewable power through open access. Under these rules, consumers can engage in open access by setting up their own RE plant, entering into a power purchase agreement (PPA), procuring green energy from power markets, purchasing from DISCOMs. These Rules have streamlined the overall approval process for granting open access. To enhance the RE adoption, GoI has set Renewable Purchase Obligation targets for DISCOMs and progressively increasing these targets from 29.91% in FY 25 to 43.33% by FY 2030. Consumers to be given Green Certificates if they consume green power. This rules is expected to bring down the power cost significantly and also expected to contribute to the country's energy transition goals.

Awards and Accolades

Smart meter as the foundation for Smart Grid and Digitized Power sector

Shri Rahul Dwivedi
CEO, RECPDCL

Indian Power sector has been conventionally recognized as a monopolistic, highly regulated & capex-intensive business with geographically widespread asset base. Historically, the sector's business model, especially that of the distribution space, has remained majorly unchanged for years now. With the advent of digitization slowly penetrating its way into the power landscape, the sector is observing a once-in-a-decade shift across every aspect of its business processes, from network/ asset planning to O&M to consumer services.

The power distribution sector in India stands out as the weakest link in the power value chain, posing a significant challenge to the success of ongoing energy transition efforts. The sector's ability to achieve financial and operational efficiency improvements will be crucial for realizing these transitions. While technology has been instrumental in transforming various segments of the power industry, the distribution sector has lagged in leveraging technology for transformative purposes. However, with the implementation of policies and regulations aimed at enhancing systemic efficiency, coupled with financial commitments from the central government, there is now a widespread recognition within the sector that modernizing the power distribution system is essential.

Smart metering – a critical digital initiative that is shaping the future of the power distribution landscape, will play as a catalyst for pacing up the digital transformation journey across the tpower value chain. Distribution utilities traditionally considered the consumer as the 'meter' itself and had little incentive to understand the individual or business behind it. However, Smart metering opens an ambit of opportunities as well as service offerings for the utilities to tap into the Behind-the-meter segment and also has the potential to disrupt the traditional business model, thereby paving the way for innovative revenue streams for the utilities as well as provide an avenue for consumers to play a greater role in shaping sectoral trends.

To leverage this untapped potential that comes along with Smart metering, Government of India through Ministry of Power has launched the Revamped Distribution Sector Scheme (RDSS), a results-oriented outcome-based initiative. It is noteworthy that nearly 50% of the investments planned under RDSS, i.e., approx. INR 1.5 Lakh Crs, is earmarked towards driving large-scale adoption of consumer smart metering across the Indian electricity landscape over next 3-5 years. As on date, ~10.84 million smart meters have been installed across states like Bihar, Uttar Pradesh, Haryana, Delhi, Rajasthan, Assam etc.

Further, Power sector's long-term path is being overhauled by 3 key trends/disruptions:

I. **Decarbonization –** Greater penetration of Distributed energy sources in the power ecosystem to align with the India's net-zero vision.

II. **Decentralization -** Greater adoption of self-sustainable energy systems like battery storage, off-grids, solar rooftops etc. to meet the growing energy demand in a sustainable manner, and,

III. **Digitization –** Shifting focus towards real-time data-driven insights by interconnecting network assets / nodes through smart grid technologies.

To navigate through this disruption and achieve the Nation's net-zero vision, it is imperative for utilities to pace up the implementation of smart metering, which indeed serves as a linchpin in the sector's energy transition and digitization pathway. Additionally, Smart metering opens a bouquet of use cases for utilities, which would in turn help in establishing the foundation for sector's transformational journey towards building robust smart grid network and ultimately digitizing the entire power value chain. Some critical and priority use cases of smart metering are:

- **Granular Data Collection:** Smeters provide detailed, real-time data on energy consumption at the individual consumer level across various time-blocks. This data granularity is crucial for utilities to understand usage patterns, identify inefficiencies, and optimize energy supply across the grid.
- **Two-way communication:** Unlike traditional meters, smart meters enable two-way communication between consumers and utilities. This facilitates real-time monitoring of outage detection, electricity thefts, and enables more efficient resource allocation.
- **Enhanced Billing and Customer Services:** Smart meters enable accurate and automated meter readings, eliminating the need for manual readings and estimated bills. This leads to improved billing accuracy and customer satisfaction. Additionally, smart meters provide consumers with access to detailed energy usage data, empowering them to manage their consumption more effectively. Further, with the focus of the government on installation of smart meters in prepaid mode, this would help ease the working capital burden on utilities and help eradicate the concept of electricity dues in the long run.
- **Remote Monitoring and Management:** Smart meters enable utilities to remotely monitor energy usage and manage the grid more efficiently. They can detect outages, meter tampering, or irregularities in consumption patterns, allowing for faster response times and improved service reliability.
- **Demand Response Programs:** With smart meters, utilities can implement demand response programs that incentivize consumers to reduce or shift their electricity usage during peak demand periods. By providing real-time pricing information, smart meters empower consumers to make more informed decisions about their energy usage.
- **Integration of Distributed Energy Resources and Net Metering:** Smart meters facilitate the integration of DERs into the grid. They enable utilities to monitor and manage distributed energy resources effectively, ensuring grid stability and reliability as the share of intermittent energy sources grows in the overall generation mix. Further, the success of implementation strategies such as gross metering, net metering, and net billing heavily relies on widespread adoption of smart meters and robust supportive infrastructure systems. Also, smart meters shall play a crucial role in facilitating the integration of solar power by enabling monitoring of generation, balancing consumption, and grid integration, particularly in initiatives like the Pradhan Mantri Surya Ghar Muft Bijli Yojana which aims to install 1 Cr rotop solar in India.
- **Grid Optimization and Resilience:** By providing real-time data on energy flows and consumption patterns, smart meters help utilities optimize grid operations and improve overall system resilience. They enable better load balancing, voltage regulation, and fault detection, leading to a more reliable and efficient grid.
- **Drive adoption of Electric Vehicles (EVs):** Smart meters play a crucial role in supporting the integration of electric vehicles into the grid. They enable utilities to manage EV charging loads, implement time-of-use pricing for charging, and coordinate charging schedules with renewable energy generation, promoting sustainability and grid stability.

Challenges and Future Prospects

While smart meters offer numerous benefits/ use cases, there are also challenges to overcome, such as data privacy and security concerns, the high cost of infrastructure upgrades, interoperability and the need for standardization across the industry. However, with ongoing technological advancements and increasing demand for sustainable energy solutions, the adoption of smart meters is growing continuously.

India's imperative for smart metering and digitalizing its grid network extends beyond mere operational efficiency. As a responsible nation, India is actively pursuing measures to diminish its carbon footprint and foster sustainable development in the fight against global climate change. With commitments to achieve net-zero emissions by 2070 and 50% of energy from renewable sources, the grid must attain demand-side flexibility. Effective demand-side management of the grid, facilitated by granular data collection and the establishment of digital infrastructure components, stands as the sole means to address these challenges, and fulfill decarbonization objectives.

In the future, smart meters will play an even more integral role in shaping the power sector. As more homes and businesses adopt smart meters, the vision of a fully digitalized and resilient power sector becomes increasingly achievable. By serving as the foundation for smart grids and digitalized energy management, smart meters are key to a more sustainable and efficient energy future.

Interview

Shri Vishal Kapoor
CEO, Energy Efficiency Services Limited

What strategies is EESL employing to enhance EV charging infrastructure in India, and how does the organization foresee the nationwide evolution of EV charging infrastructure? Additionally, how is EESL addressing challenges to scale up EV charging infrastructure?

At EESL, we are committed to catalyzing the growth of electric mobility in India through strategic interventions to enhance EV charging infrastructure. Our approach revolves around a combination of innovative strategies aimed at fostering the widespread adoption of electric vehicles (EVs) across the nation.

To enhance EV charging infrastructure, EESL is implementing a multipronged strategy that includes deploying of public charging stations (PCS) across key locations in India, including highways, cities, government buildings and public parking areas. Through our robust network of PCS, we aim to provide convenient and accessible charging infrastructure to EV users, thereby addressing range anxiety and promoting EV adoption. Till date, we have installed 441 Public Charging Stations (PCS) across India of which 294 nos. are operational and rest are in the process of pre-commissioning.

We are also collaborating various stakeholders, including government agencies, utilities, OEMs, and technology providers, to accelerate the deployment of EV charging infrastructure. We are adopting advanced technologies and smart solutions to optimize the efficiency and effectiveness of EV charging infrastructure.

As for the nationwide evolution of EV charging infrastructure, EESL envisions a dynamic and inclusive ecosystem characterized by widespread coverage, interoperability, and accessibility. We anticipate a significant expansion of EV charging infrastructure across urban and rural areas, supported by policy incentives, public-private partnerships, and technological innovations.

Through strategic interventions, collaborative partnerships, and innovative solutions, we are confident in our ability to address challenges and accelerate the transition towards a cleaner, greener, and more sustainable mobility future.

Please share your view on emerging technologies or trends that will be the next significant disruptors in the energy efficiency space within the power sector.

Amidst the backdrop of the urgent climate crisis and the imperative to shift towards cleaner energy sources, India's energy sector is experiencing a notable transformation driven by emerging technologies. With the country's energy demand on the rise and increasing recognition of the environmental drawbacks of coal-based energy, there's a palpable momentum towards diversifying the energy mix. The government's commitment to constructing 500GW of renewable energy capacity by 2030 underscores the growing significance of these emerging energy technologies.

Among these technologies, green hydrogen stands out as a beacon of sustainable energy solutions. India's ambition to produce 5 million tonnes of green hydrogen by 2030 signifies a dedicated push towards cleaner alternatives. Similarly, the exploration of geothermal energy, exemplified by projects underway in Ladakh, represents a strategic shift towards harnessing renewable energy sources. By tapping into the Earth's heat, India aims to join the league of nations utilizing geothermal energy on an industrial scale.

Moreover, the surge in demand for electric vehicles is driving innovation in battery technologies. Indian startups are spearheading efforts to develop energy - efficient batteries, with a focus on prolonging battery life and exploring alternatives to conventional lithium-ion technology, such as aluminium fuel cells.

Furthermore, advancements in energy storage solutions, including batteries and pumped hydro storage, are reshaping the power sector. These cost-effective storage systems can store excess energy generated during off-peak hours and release it during peak demand periods, thereby balancing supply and demand and increasing overall efficiency. Collectively, these emerging technologies hold immense potential to revolutionize the energy efficiency landscape within the power sector, offering sustainable solutions to meet growing energy demands while mitigating environmental impact.

Reflecting on EESL's achievements over the past year, could you highlight some key milestones and discuss the organization's future plans and focus areas?

The year 2023 looked encouraging in the energy efficiency sphere. As the world's largest Energy Service Company (ESCO), EESL is actively advancing towards turning this vision into a tangible reality. For this, we introduced induction-based cookstoves, offering a cost advantage of 25-30% over traditional cooking methods. Going forward, by deploying 20 Lakh induction cookstoves across India, EESL seeks to reduce the environmental impact of cooking methods, ensuring cleaner air and improved health for citizens. Under NECP, the company has recently distributed 2000 induction cookstoves to Anganwadi workers in Ladakh.

Additionally, EESL's push for inverter bulbs has also gained momentum in recent times in line with our commitment to innovative energy solutions. These bulbs offer enhanced energy savings and durability, and in the coming year, EESL aims for a widespread adoption strategy, envisioning every Indian household benefiting from their efficiency.

With the support of the Bureau of Energy Efficiency, Ministry of Rural Development, and the Asian Development Bank, we are implementing a pilot project for enhancing the livelihood of SHG women by addressing their mobility challenges through electric bicycles. The project will cover 1,000 SHG women from select districts of Bihar and will involve capacity development of SHG women as Energy Champions in green mobility along with the development and implementation of a business model.

More importantly, EESL's e-marketplace is set to revolutionize access to energy-efficient appliances. This user-friendly platform will directly link consumers with manufacturers and distributors, streamlining the process and ensuring transparent pricing. This initiative not only empowers consumers but also fosters a thriving market for clean energy products, making them accessible to everyone.

Going forward, EESL is preparing for a significant year in 2024-25, with a focus on advancing energy efficiency and sustainable practices to help India move closer to its goal of achieving Net Zero emissions. The company is setting ambitious new year goals, including the deployment of 10 million energy-efficient fans across India. These fans, leveraging Brushless Direct Current (BLDC) technology, consume only 35 Watts while delivering comparable performance to conventional fans consuming 70 to 80 Watts, potentially cutting electricity consumption by 50%.

We are also focusing on rolling out the National Program on Electric Bicycles as an environment-friendly micro-mobility solution aimed at reducing carbon emissions and providing convenient transportation for short distance travel. CESL is in consultation with various Central Government Ministries, Public Sector Units, and Government Department for demand aggregation. The first tender for 2,500 electric cycles has already been initiated in February this year, as part of a larger plan to procure 25,000 electric cycles in the fiscal year 2024–25. In addition to this, we are also supporting the central government for scaling up the solar PV modules and inverter.

What are your foremost priorities for EESL in the coming years, particularly in terms of advancing energy efficiency and sustainability initiatives?

For EESL, the foremost priorities in the coming years revolve around advancing energy efficiency and sustainability initiatives, particularly focusing on two key areas: energy-efficient fans and electric cooking, specifically induction cookstoves.

The emphasis on energy-efficient fans, particularly those utilizing BLDC (brushless direct current) technology or achieving five-star ratings, stems from their ubiquitous presence in Indian households. Recognizing their significant energy consumption, EESL aims to drive widespread adoption of BLDC fans, which could potentially reduce energy usage by up to two-thirds per fan. Initiatives are underway, such as a bid targeting 2 million fans, with plans to reach around one crore customers in Phase 1 and distributing 20 lakh induction cookstoves throughout the country.

Additionally, EESL recognizes the substantial energy consumption associated with common household appliances. The data suggests that approximately 45% of global energy consumption stems from just 20 basic appliances, with a significant portion used in both commercial and domestic settings. Hence, EESL underscores the importance of targeting the retail sector. To address this, we are establishing an energy-efficient appliances marketplace (EESLMart), catering to both B2C and B2B segments. This marketplace will serve as a comprehensive platform for procuring energy-efficient appliances, with plans to expand its offerings to include small projects.

By focusing on these initiatives, EESL aims to facilitate a mass movement towards energy efficiency and contributing significantly to sustainability efforts in both domestic and industrial sectors.

How do you envision EESL's evolving role within the broader context of India's power sector transformation, and what contributions do you envision the organization would make towards achieving the nation's energy objectives?

At EESL, we recognize the pivotal role that energy efficiency plays in India's broader power sector transformation. As the nation progresses towards a sustainable energy future, EESL is committed to driving significant contributions towards achieving India's energy objectives.

We envision EESL's evolving role as multifaceted within the context of India's power sector transformation. Firstly, leveraging our 3A's framework, we aim to ensure Availability through Efficient Supply Chains. By streamlining our procurement processes and enhancing supply chain efficiencies, we can make energy-efficient technologies more accessible and readily available to consumers across various sectors.

Secondly, we prioritize Adaptability through capacity building initiatives. Through extensive training programs and knowledge sharing, we empower stakeholders to adopt and implement energy-efficient practices effectively. By building capacity at all levels, from government agencies to end-users, we foster a culture of sustainability and resilience.

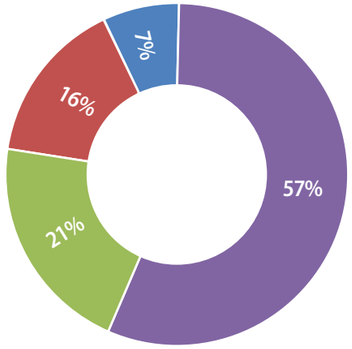
Lastly, we emphasize Affordability through low-cost demand aggregation strategies. By leveraging economies of scale and strategic partnerships, we drive down the costs of energy-efficient technologies, making them affordable for a wider range of consumers. This approach ensures that energy efficiency solutions are not only accessible but also financially viable, thereby accelerating their adoption and impact.

Moreover, EESL is committed to promoting energy conservation and sustainability through enabling large scale adoption of energy efficient technologies, capacity building programs, demand aggregation and industrial partnerships. In alignment with the nation's energy objectives, EESL will continue to prioritize initiatives that promote energy security, affordability, and environmental sustainability. By harnessing the power of innovation, collaboration, and inclusive growth, we are confident in our ability to drive transformative change and contribute significantly to India's journey towards a cleaner, greener, and more resilient energy future.

IntelliSmart
A JV of NIIF and EESL

Smart Metering Tender Progress and Status in India

- Ongoing Tenders
- Tenders Under Evaluation
- L1 Decided/ LOA Under Process
- Tenders Awarded



Floated Total Quantity - ~19 Crore

Tenders Awarded

State	Discom	Meters Quantity (Lakh)	Mode	Status
Andhra Pradesh	APCPDCL, APEPDCL, APSEPDCL	35	TOTEX	Awarded
Andhra Pradesh	APCPDCL, APEPDCL, APSEPDC	16	OPEX	Awarded
Assam	APDCL	65	TOTEX	Awarded
Bihar	NBPDCL & SBPDCL	150	TOTEX	Awarded
Chhattisgarh	CSPDCL	82	TOTEX	Awarded
Delhi	BSES	10	CAPEX	Awarded
Gujarat	PGVCL	24	TOTEX	Awarded
	GVCL	18	TOTEX	
	PGCIL	53	CAPEX	
Himachal Pradesh	HPSEB (South)	9	TOTEX	Awarded
Jammu & Kashmir	Power Development Department J&K	6	TOTEX	Awarded
Jammu	JPDCL	8	TOTEX	Awarded
Kashmir	KPDCL	8	TOTEX	Awarded
Maharashtra	BEST	11	TOTEX	Awarded
	MSEDCL	225	TOTEX	Awarded
	MPPKVVCL, Indore	10		
Madhya Pradesh	MPMKVVCL, Bhopal	11	TOTEX	Awarded
	MPMKVVCL, Jabalpur	18		
Punjab	PSPCL	8	CAPEX	Awarded
Uttarakhand	UPCL	16	TOTEX	Awarded
Uttar Pradesh	PVVNL	67	TOTEX	Awarded
	DVVNL	62	TOTEX	Awarded
	MVVNL	79	TOTEX	Awarded
	PuVVNL	78	TOTEX	Awarded
Other States	Other DSICOMs	10	CAPEX/ TOTEX	Awarded
Total		**1079**		

XCHANGE 3rd ANNIVERSARY

Tenders L1 Decided and LOA under Process

State	Discom	Meters Quantity (Lakh)	Mode	Status
Himachal Pradesh	HPSEB	19	TOTEX	L1 Decided/ LOA under Award
Maharashtra	MSEDCL	17	TOTEX	L1 Decided/ LOA under Award
Gujarat	PGCIL	47	CAPEX	L1 Decided/ LOA under Award
Jharkhand	JBVNL	14	TOTEX	L1 Decided/ LOA under Award
Manipur	MSPCL	2	TOTEX	L1 Decided/ LOA under Award
West Bengal	WBSEDCL	45	TOTEX	L1 Decided/ LOA under Award
Puducherry	PED	4	TOTEX	L1 Decided/ LOA under Award
Punjab	PSPCL	90	TOTEX	L1 Decided/ LOA under Award
Rajasthan	JVVNL	49	TOTEX	L1 Decided/ LOA under Award
	AVVNL	56	TOTEX	L1 Decided/ LOA under Award
	JdVVNL	43	TOTEX	L1 Decided/ LOA under Award
Other States	Other DISCOMs	7	TOTEX/ OPEX	L1 Decided/ LOA under Award
Total		**393**		

Tenders Under Evaluation

State	Discom	Meters Quantity (Lakh)	Mode	Status
Arunachal Pradesh	Department of Power	3	TOTEX	Under Evaluation
Andaman & Nicobar	Power Department	1	TOTEX	Under Evaluation
Meghalaya	Power Department	5	TOTEX	Under Evaluation
Sikkim	Power Department	2	TOTEX	Under Evaluation
Tamil Nadu	TANGEDCO	300	TOTEX	Under Evaluation
Total		**311**		

Smart Meter Ongoing Tenders

State	Discom	Meters Quantity			Total	No of Packages/ Tenders	Mode	Due Date
		Consumer	DT	Feeder				
Goa	Electricity Department Goa	7,41,160	8,369	829	7,50,356	1	TOTEX	16.07.2024
Gujarat	PGVCL	33,11,031	15,000	-	33,26,031	1	TOTEX	04.07.2024
	DGVCL	23,91,869	1,500	-	23,93,369	1	TOTEX	03.07.2024
Haryana	DHBVNL	31,42,249	1,34,002	14,100	32,90,351	4	CAPEX	15.07.2024
	UHBVNL	25,93,754	79,665	12,775	26,86,194	5	CAPEX	15.07.2024
Total					**1,24,46,301**			

Note: The data shown in this section excludes small capacity tenders and covers tenders from September 2021 to till date. The variation in floated quantity is due to cancellation of some tenders in past months.

Interview

Shri Rakesh Kumar
Managing Director, APDCL

Assam is one state that features prominently in India's smart metering journey. How, do you think, it has impacted Assam's energy landscape and what are the key learnings and outcomes from this initiative?

In its effort to provide better and reliable services to its citizens, Govt. of Assam is implementing smart metering projects across the state since the last three years. During the last three years, the state power distribution utility, APDCL has installed over 20 lakh smart meters across the state.

Installation of smart meters is hugely beneficial for the consumers as these meters result in accurate and error-free billing facility through automatic meter reading without manual intervention. Moreover, consumers only need to pay for the electricity used by them resulting in savings for them. Consumers can also monitor their daily electricity consumption and recharge their prepaid meters through a mobile app.

Installation of smart prepaid meters is changing the energy landscape of Assam. It has resulted in reduction of technical and commercial losses in the areas where smart meters are installed leading to considerable savings in power purchase cost and other operation and maintenance cost for the Company. This has also enabled APDCL to take up various other projects to provide 24x7 quality and reliable power throughout the state.

The key learnings and outcomes of the smart metering journey so far includes the following:

- The consumers have become conscious towards saving of electricity after installation of smart prepaid meters as they could monitor their daily consumption through mobile app. They are also able to plan their monthly electricity budgets using the historical consumption trend available in the mobile app. We have observed that around 50% of the consumers have reduced their electricity consumption in 2023 compared to similar periods in 2022 when they were using postpaid meters
- One of the major outcomes of the smart metering project is the significant reduction in AT&C losses in the project areas where smart prepaid meters have been installed. We have observed that the AT&C losses of these project areas has been reduced to around 8-9% from the earlier levels of 16-17% due to the following factors:
  a) Eliminating commercial losses such as theft of power, unbilled energy etc.
  b) Ensuring 100% revenue collection due to operation in prepaid mode.
  c) Energy auditing at Feeder and Distribution Transformer Level for accurate analysis of loss-making areas and plugging the leakage points.
- Another major landmark is the recovery of the past arrears of the defaulting consumers in daily installments through smart prepaid meters. This has resulted in reduction in debtor days of the Company for such consumers and the liquidity flow has been improved.
- Moreover, due to graduation transition towards the prepaid nature of retail business, there is going to be reduced requirement of working capital by DISCOMs which may be considered by the Regulatory commission to pass on to the consumers in the form of reduced tariff.

As Assam transitions towards a smarter and more resilient power grid, what role do you see emerging technologies such as artificial intelligence, Internet of Things (IoT), etc. playing in optimizing grid operations, enhancing reliability, and improving customer service?

The increased granularity of electricity consumption allows DISCOMs to pinpoint areas of inefficient system operation and predict future system upgrade requirement better. Having near real-time information of energy consumption and flow across the networks also gives DISCOMs very valuable information to aid in system planning for load growth.

With so much granular information available with the DISCOMs and with growing adoption of emerging technologies such as artificial intelligence, machine learning etc. for utilising this information efficiently, it will be possible to move towards a smarter grid wherein we can accurately forecast the power demand and save the power purchase costs of the Company. This will also help the DISCOMs to plan their infrastructure expansion efficiently leadings to savings in Capital Expenditure.

With smart meters, we can also implement efficient demand response (DR) programs wherein we can incentivize the consumers to shift their loads from the peak or critical period. This will help the DISCOMs to flatten their load curve.

Moreover, with smart meters, it is possible to monitor the power quality parameters of all consumers and alert them about any abnormalities. This will help the DISCOMs for taking preventive actions and also reduce the number of calls at the customer care center.

Please share your views on the barriers that usually block the path to transformation of power sector and what are the state's strategy to address them?

In my opinion, the major factors that impede the transformation of power sector includes:

a) **Ageing Infrastructure:** The old infrastructure of the DISCOMs pose significant challenges to modernization efforts, hindering the adoption of advanced grid management systems and renewable energy integration. To resolve these challenges, the Govt. of India is investing heavily in upgrading and modernizing our power infrastructure under the RDSS scheme. APDCL is also taking major steps for upgrading its distribution infrastructure under various Externally Aided Projects (EAP) and State Govt. sponsored projects.

b) **Climate change:** It is one of the foremost challenges in the energy sector. As India has committed to achieve net zero emissions by 2070 as a part of India's climate action plan at the CoP-26, therefore, we must act towards achieving towards that goal. Govt. of Assam is taking major steps to reduce the dependence on the fossil fuel based power. Under the Mukhyamantri Soura Shakti Prokolpo, APDCL is constructing a 1000 MW solar power plant in Assam. Moreover, APDCL has also commissioned a number of solar based power plants across the state to increase the share of renewables in its energy basket and achieve net zero emissions.

c) **Financing:** In order to have an efficient and resilient power sector, affordable financing is the key for all DISCOMs. Therefore, DISCOMs need to explore the innovative models for financing. The DBFOOT model adopted by the Govt. of India under the RDSS Smart Metering Project is one such initiative wherein the private investment and the technological knowledge of the DISCOMs are being channelled towards the objective of achieving 100% smart metering in the country.

d) **Change management:** With growing adoption of technology, change management of DISCOM personnel is one of the most important factors for proper utilization of these technologies. The capacity building exercise of the DISCOM personnel should be a continuous process. They need to be made aware of the upcoming challenges in the power sector and proper training should be imparted to make them future ready. APDCL is regularly organising various technical workshops with the aid of the AMISPs to impart necessary technological know how about the smart meters and smart grids to its employees.

Given the increasing importance of renewable energy in the transition towards a sustainable energy future, what are APDCL's plans and initiatives to accelerate the adoption of solar, wind, and other clean energy sources?

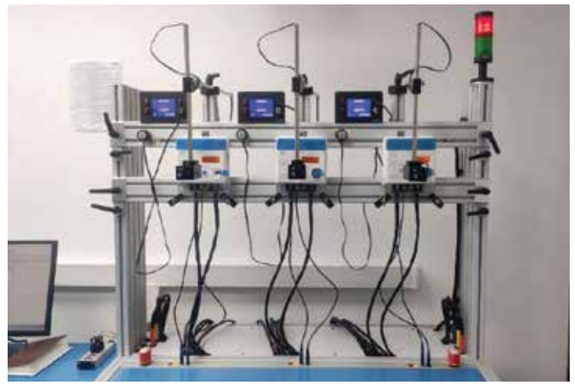
As I mentioned earlier, we must act together towards achieving the target of net zero emissions by the year 2070. This will only be achieved if we diversify our energy basket to increase the share of renewables. Towards this objective, Govt. of Assam is taking major steps to accelerate the adoption of solar and other clean energy sources.

One of the major steps taken in this regard, is the upcoming 1000 MW solar power plant in Assam under the Mukhyamantri Soura Shakti Prokolpo. Moreover, APDCL has also commissioned another 7 solar projects across the state with a combined generation capacity of 175 MW.

Moreover, Assam is also implementing the Roof Top Solar (RTS) connection scheme across the State under the Pradhan Mantri Surya Ghar Muft Bijli Yojana. Under this scheme, Assam has targeted installation of 1,00,000 RTS connections with a total estimated capacity addition of approx. 300 MW.

Govt. of Assam has also published the Assam Renewable Energy Policy' 2022 wherein we have set the target of achieving 200 MW RTS capacity addition in the state government buildings and industrial consumers, 620 MW of Solar Park and Solar Plants, 80 MW of off-grid solar, 200 MW of other renewable energy sources (small hydro, pump storage, biomass, solid waste etc.) by 2026-27.

In-House Excellence: NABL-Accredited Smart Meter Test Lab at IntelliSmart

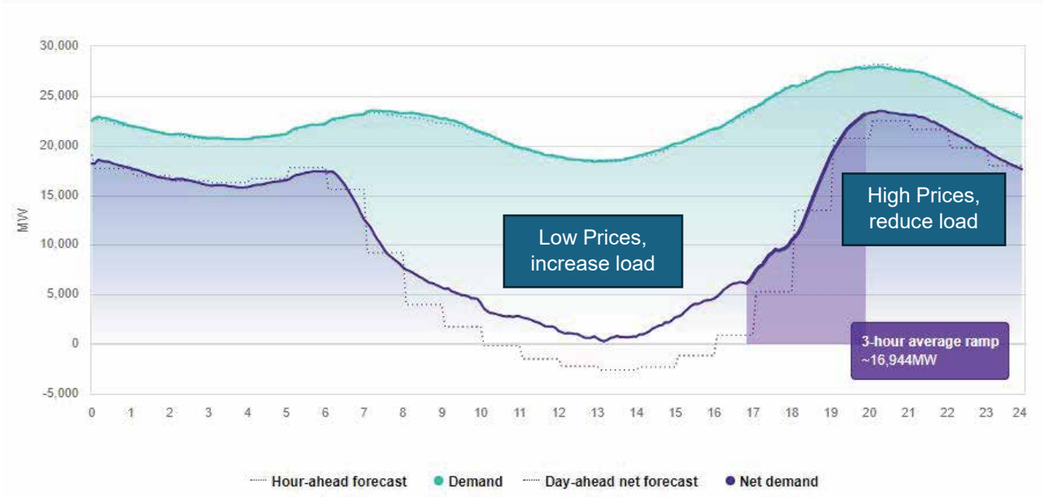


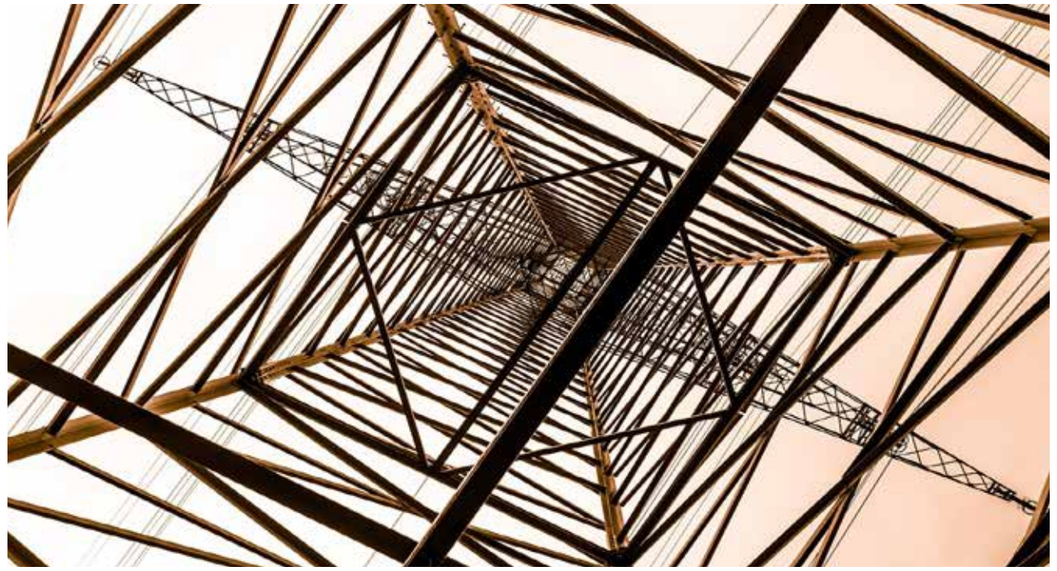
The Role of Demand Response in Balancing Renewable Energy

Shri Manish Kumar Tiwari,
Sr. General Manager, POWERGRID Energy Services Limited

Power sector dimensions in India have taken paradigm shift in recent years and share of renewable energy has increased significantly. As of 30.04.2024, renewable energy capacity was 145 GW (excluding Hydro) against the total installed capacity of 443 GW. Renewable generation from solar & wind is inherently intermittent, variable and non-predictable in nature. These characteristics of renewables pose challenges in the form of wide variations of output in short duration, unavailability of continuous power output, non-scheduling, non - dispatchability etc., which cause threat to stability & reliability of grid. Therefore, grid balancing mechanisms in the form of flexible generation/loads, better forecasting technologies, real time situational awareness & visualization etc. are required for integration of renewables into grid without affecting stability & reliability.

Demand response is one of the mechanisms through which flexibility in load is provided. Here, consumer engagement becomes part of the grid management process, and consumers are encouraged to shift their load during short supply periods to over supply periods so that the load curve is flattened and variation in renewables are absorbed. Increase/decrease of the temperature setpoint of air-conditioning, increase/decrease lighting levels, controlling non-essential machines, heaters, EV Chargers etc. are some of the actions which are taken by consumers to provide flexibility in demand. Consumers are provided financial incentives for such load shifting at predetermined rates



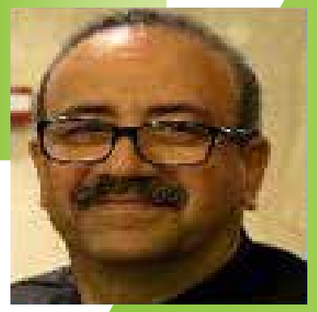


for which contracts are executed between high load consumers and Discoms. A more general way of implementing demand response is using Time of Use (ToU) Tariff / Critical Peak Pricing / Real Time Pricing with higher prices during supply shortage and lower prices during supply abundance.

Deployment of Smart Energy Meters has enabled a universal approach towards demand response mechanism. Earlier some high load customers were engaged for demand response. But the availability of Smart Meters for residential consumers has made them empowered to participate in this process. For the success of demand response mechanism, it is very important to incentivize consumers on their participation. Smart meters have a facility to record consumers energy data every 15 minutes and through smart Meters, such participation is recognized by knowing load of consumer before and after triggering demand response signals and output can be integrated with billing systems easily. Further, Smart Meter Infrastructure facilitates implementation of different types of tariff mechanisms like ToU Tariff, Critical Peak Pricing, Real Time Pricing etc. allowing natural modification in load with respect to price of energy inter alia related to demand supply conditions.

Balancing renewables with demand response can be seen from the following figure. During daytime due to availability of solar power net demand (total demand – renewable power) is very low and to keep base load plants running load addition may be required. Hence consumers may be asked to increase their load by providing incentives / low prices. On the other hand, in evening when renewable power availability diminished due to no solar power, consumers may be incentivized to reduce their load.

It is basically a win-win situation for both distribution companies as well as consumers. Distribution companies benefit as purchase of higher priced energy during peak load scenario is avoided whereas consumers benefit from reduced electricity bills obtained by incorporating incentives or lower off-peak tariff. Some studies have shown that about 15 % load reduction is possible through demand response. It is very effective mechanism to naturally modify the demand to reduce gap between supply and demand. When renewable energy penetration is higher into the grid, occurrence of variation in demand supply gap is more predominant and hence demand response technologies become important for future Grids.



Smart Grid Implementation in India: Examining the current status, challenges, and future prospects of smart grid deployment across India

Shri Atul Bali
ED POWERGRID /Dir NSGM-PMU & EGSM
Vice Chair-ISGAN Executive Committee

Smart Grid Implementation in India: Overview

A Smart Grid is a digitally enabled electrical grid that facilitates two way real time exchange of data as well as electricity to improve the efficiency, reliability and sustainability of associated power system. Countries across the globe are modernizing their electricity grid to monitor, measure and control power flow in real time and optimize the operational performance of their grid. India's journey towards establishing a smart grid infrastructure has been a significant one in order to modernize its electricity grid, enhance energy efficiency, and integrate renewable energy sources.

The Government of India have taken several initiatives for Smart Grid deployment in distribution sector with sanctioning of Smart Grid pilot projects across different geographical locations. As of now, the Eleven (11) smart grid pilots have been completed. The demonstration of smart grid technologies through these pilots triggered the need for concerted focus on Smart Grid deployments in India and accordingly the Government of India established National Smart Grid Mission (NSGM) in 2015 to plan and monitor implementation of policies and programs related to Smart Grid activities in India.

The Smart Grid activities aim at making Indian power infrastructure cost effective, responsive, reliable and self-healing. NSGM efforts over the years have led to development of AMI ecosystem and Demonstration of Smart Grid functionalities viz

Development of Smart Metering Ecosystem

- Indian Standards for Smart Meters i.e., IS 16444 and IS 15959, released by BIS.
- Model Smart Grid Regulations released by Forum of Regulators.
- Smart Grid Training Program developed for Utility professionals.
- Smart Meter Rollout Plan was developed.
- Model Standard Bidding Documents for Appointment of Implementing Agency for Advanced Metering Infrastructure (AMI) developed.
- AMISP SBD for pre-paid smart metering on TOTEX model has been further adopted in RDSS Scheme by REC.

Demonstration of Smart Grid functionalities

- Successful Go-Live of 11 Nos Smart Grid (SG) Pilot projects across various States-demonstrating important functionalities viz. AMI, Peak Load Management, Net Metering, Outage Management System, Roof Top solar integration etc..
- Around 1.56 lakh Smart Meters installed under these SG Pilots. All type of communication technologies viz. Radio, PLC and GPRS tested successfully first time in India.

- Successful Integration of Metering Billing & Collection System with AMI/ Smart Metering in India in SG Pilot Projects.
- Smart Grid Knowledge Centre (SGKC) at Manesar developed with support from POWERGRID as Resource Centre for NSGM with the functionalities of Advance Metering Infra (AMI), Outage Management System (OMS), Micro grid/ Distributed generation (MG/DG), Home energy management system (HEMS), & Training Infra etc. The SGKC is being developed as a Center of Excellence and Incubation Center with support from MoP and USAID. Virtual SGKC has been developed and launched by Hon'ble Minister of Power in March 2022.

Smart Metering & SCADA/DMS

The Revamped Distribution Sector Scheme seeks to improve the operational efficiencies and financial sustainability, by providing financial assistance to DISCOMs for strengthening of distribution supply infrastructure based on meeting pre-qualifying criteria and achieving basic minimum benchmarks in reforms. Under RDSS ,prime focus has been given on installing prepaid smart meters for all consumers(~250 million) along with associated AMI, communicable meters for DTs & Feeders, ICT including Artificial Intelligence (AI), Machine Learning (ML), etc. based solutions for power Sector alongwith Distribution Infrastructure Strengthening including SCADA/DMS etc.. All these measures aims at Improving quality, reliability and affordability of power supply to consumers, reducing AT&C losses to pan-India levels of 12-15%, reducing ACS-ARR gap to zero and in turn leading to a financially sustainable and operationally efficient Distribution Sector. At present more than 10.8 million have already been rolled out and tenders for another ~110 million smart meters have already beetn awarded.

Smart Distribution/Grid Modernization:

Smart Distribution aims at development of a robust electric network equipped with automation, communication & IT system enabling a two-way flow of electricity and data to ensure reliable and quality power supply. Smart Distribution encompasses implementation of state-of-the-art technologies namely Advanced Metering Infrastructure (AMI), SCADA/DMS/OMS with Distribution Automation, GIS based Substations & Switchgears including Containerized E-House substations, Smart Packaged Substations, Power Quality and Voltage Management of LV grid, DT Health Monitoring, Peer-to-Peer (P2P) Energy Trading, Demand Response, Drone-based Asset management, LV Network & Consumer Data Analytics and Energy Storage system among others. NSGM is designated to lead the assessment of Smart Distribution cities. The expert group (constituted under chairmanship of chairperson CEA) recommended smartgrid implementation framework for implementation of the Smart Power Distribution technologies. Further, in under guidance of MoP, Smart Distribution rollout is being fast tracked for key cities viz., Varanasi, Guwahati , Indore, Patna and New Delhi (NDMC area).

Training and capacity Building:

NSGM in collaboration with USAID has developed a Basic Smart Grid Training Course for utility professionals and in collaboration with SGKC, POWERGRID is continuously conducting 3 days training programs in the field of Smart Grid for utility/CPSU professionals. The topics covered broadly are Advanced metering Infrastructure (AMI), Role of AI/ ML in Smart Meter Data Analytics, Smart meter operation center (SMOC), Smart metering implementation case studies/challenges, Feeder Automation, Energy storage system, Distribution system operator (DSO), Regulatory Considerations in Smart Grid Projects & Cyber security in power sector etc. So far, 11 batches consisting of approx. 280 executives from 50 different Indian Utilities/DISCOMS participated. Moreover, more than 600+ executives from 24 Indian state utilities along with international executives from Sri Lanka, Nepal, Bhutan, US etc. have visited SGKC. In FY2023-24, the capacity building program was imparted to 115 nos. of participants.

Overall, smart grid deployment in India is an ongoing process characterized by collaboration among government agencies, utilities, technology providers, and other stakeholders. As the country continues to modernize its electricity infrastructure, smart grids will play an increasingly vital role in building a more resilient, efficient, and sustainable energy ecosystem. The evolution from a traditional grid to the deployment of Advanced Metering Infrastructure (AMI) and ultimately leading to adoption of Smart Grid represents a significant transition in the electricity distribution sector.

Challenges & Opportunities

The most challenging link in the Indian power sector value chain is at the distribution level where the utilities are grappling with operational and financial issues viz. higher aggregate technical and commercial (AT&C) losses due to factors like poor billing, theft, losses, power quality issues etc. and aging infrastructure as well as financial constraints. The Discoms are also grappling with major issues like resource adequacy , energy access, reliability, and sustainability while driving economic growth and innovation.

The bottlenecks in metering can be handled well through smart metering as this facilitates automatic meter reading, transparent billing, monitor tamper events, energy accounting/ auditing etc. which not only help in identification/checking of revenue spillages but also leads to consumer empowerment. Further, Smart Metering as a key technological intervention under Smart Grid also provide more flexibility for advanced functionalities like dynamic tariffs, demand response, net metering etc. Smart Grids also facilitates monitoring of other aspects like power factor improvement, reliability and quality of supply etc.

The rollout of Smart Grids in India has faced several challenges at all stages of deployments be it project designing, or project initiation or project execution followed by their operations. Financial constraints pose a significant hurdle, as infrastructure upgrades are capital intensive and utilities are already struggling with limited resources and face difficulty in selecting suitable business/financial model . Technical limitations such as poor network connectivity and interoperability issues between different ICT systems within a utility also need to be addressed. Moreover, consumer resistance and concerns over privacy and data security require adoption of suitable cyber security measures alongwith effective communication and consumer - engagement.

Way Forward

The increasing RE penetration in the Grid is necessitating flexibility of different nature (Power, Energy, Transfer Capacity and Voltage) in the Grid. The adoption of Smart Grid technologies can facilitate flexible grid operation to accommodate intermittent and unpredictable renewable generation as well as consumer engagement thru Demand Response program for grid support functions. This adoption can be accelerated when all stakeholders of the ecosystem i.e. utilities, manufacturers, standard making bodies and regulators have congruity of goals and strive together to meet larger objective of reliable and quality power supply to end Consumers.

India has been actively pursuing demand flexibility to enhance its energy efficiency, grid resilience, and integration of renewable energy. Some key initiatives include:

Leapfrog to Smart prepaid metering: Under the flagship scheme of MoP, Revamped Reforms-based and Results-linked, Distribution Sector Scheme i.e., RDSS; India has adopted Smart Prepaid metering for all the households (250 million consumers) with targeted completion by 2026. Smart Meter is an essential part of Smart Grid and NSGM has been the key enabler in the deployment of Smart Metering/Advanced Metering Infrastructure (AMI) through Smart Grid Pilots across India. As of Apr'2024, more than 10 million Smart Meters have been installed in India as reported by stakeholders (REC, PFC, EESL, Utilities etc.) at NSGM (https://www.nsgm.gov.in/en/ state-wise-map)

Modernization of Power Grids: Continued initiatives to modernize power grids by incorporating digital technologies, automation, AI/ML and advanced communication systems to enhance efficiency and reliability, facilitate real-time monitoring and optimize demand-side management.

Peak Load Management through Demand response: Utilities are exploring demand-response programs (few demo pilots already undertaken), encouraging consumers to reduce their electricity usage during periods of high demand. This can involve incentives or discounts for shifting usage to off-peak times.

Energy Efficiency Programs: Implementation of energy efficiency programs and policies aimed at optimizing energy usage across various sectors and reducing overall energy consumption.

Continued Electricity Market Reforms: Ongoing reforms in electricity markets to foster competition, attract investments, and improve the financial health of power distribution companies.

Energy Storage Advancements: Growing interest and advancements in energy storage technologies, particularly batteries, to mitigate the intermittency challenges associated with renewable energy and improve grid stability.

Strategic Roadmap with focus on People, Process & Policy may be adopted considering following:

- Constitution of an integrated Cell supporting the Distribution Control Centre (DSO) function comprising of members from IT, O & M, Commercial for better coordination and utilization of resources based on data analytics from GIS, SCADA, Smart Metering, Smart Inverters etc.
- Formation of target driven Strategic Business Units (SBU's) with defined roles, functions and KPI's
- Capacity building planning for focused upskilling of team as per the requirements of their current as well as upcoming anticipated roles and responsibilities.
- Baseline data to be maintained by discom for parameters like DT Failure rate, reliability indices i.e., SAIDI, SAIFI, CAIDI, CAIFI, AT&C loss, ACS-ARR gap, Energy Not Served, Consumer satisfaction etc. on periodic basis which will act as Key Performance Indicator's (KPI's) to evaluate the outcomes of Smart distribution technologies implementation.

To overcome the challenges and further accelerate Smart Grid deployment in India, a multi-pronged approach is required. Policymakers and regulators need to facilitate /incentivize utilities to invest in Smart Grid infrastructure, offering financial assistance through innovative business models. Suitable Technical standards and interoperability guidelines would ensure compatibility and seamless integration of different ICT systems. Robust data privacy and cybersecurity frameworks need to be implemented to address consumer concerns and protect sensitive information in line with critical infrastructure safeguardivng guidelines. Moreover, awareness campaigns must be undertaken to sensitize consumers about the benefits of Smart Metering/Smart Grid. Collaborative efforts among multiple stakeholders, including utilities, regulators, policy makers and technology providers, will be crucial in realizing India's vision of a smarter and sustainable energy ecosystem leading to Self-sustainable power distribution system.

Blockchain Technology in Energy Trading Facilitating Peer-to-Peer Transactions and Grid Integration

Shri Reji Kumar Pillai
President – India Smart Grid Forum
Chairman – Global Smart Energy Federation

Ever since the introduction of renewables onto the grid, there have been associated and anticipated problems: issues such as intermittency, inertia deficits and transmission/ distribution line congestion (also called grid congestion). While the classical response to this is to build bigger and more infrastructure, the cost of this has led many to see a distributed architecture of the grid as the sensible solution. In order for it to work properly, without spending a fortune on unlimited batteries, we need a very agile market. In this future you have distributed energy and decentralized markets that include energy, ancillary and network services.

Although that proposition is not controversial, there are those that say that a conventional system will suffice while we and others argue that only a decentralized blockchain system will prove to be better and efficient. We argue that the rapidly emerging and more complex energy landscape demands a shift from traditional centralized databases to blockchain and the new and decentralized markets they unlock. Realizing this is fundamental to saving lots on battery capacity by using the existing resources better.

While we unpack how these issues could be solved by blockchain technology, there is also a stronger claim to be made about the appropriateness of next-generation blockchain to mitigate the problems of the grid. Some commentators see the agile market evolving, becoming more sophisticated and offering significant new functionalities. Not just peer exchanges of electricity in real-time, but also forward booking of electricity slots with the cost depending on how far in the future you are booking. In some ways, much more like an airline ticket than a conventional electricity bill.

In this future of the grid with forward booking, auctioning and re-booking slots with penalty clauses and bonus offers, you will need a real-time high-volume Gen 3 blockchain to manage this market. In this world, the consumer (everyday person who consumes electricity) becomes increasingly responsible, de-facto, for the balancing markets that make a grid work. They will not only consume but also provide services like frequency response, reserve, reactive power, and system restoration. Put another way, the prosumer (everyday person who also generates electricity e.g. using rooftop solar) gets involved with the financial instruments behind the grid. Just as the advent of the smartphone created more than just a camera on a phone, but opened an era of social media, so we can expect a plethora of new services that solve old problems, and blockchain technology is a necessity if we are to successfully create a distributed agile grid.

Blockchain is a market making platform that will help bridge network gaps and make it more flexible and open. Peer-to-Peer (P2P) power trading is a form of blockchain enabled distributed structure that empowers prosumers to transact energy amongst themselves at commonly agreed prices. Renewable Energy (RE) industry in India is currently undergoing in a double flux where in addition to the transition towards renewable sources, digitalization is increasing the pace of implementation and improving the management and benefit realization of the RE systems. The booming demand and increased growth of Distributed Energy Resources (DERs) such as solar photovoltaic (PV) systems, batteries, microgrids, electric vehicles (EV) and EV charging infrastructure (EVSE) and embedded networks has moved the power balance from central authorities to the edges of the grid, which people govern. The future of the energy system is being co-created by the prosumers and investors who determine where and when to deploy DER. Demand for digital technologies and declining costs generate more digitally driven energy systems, have increased opportunities for decentralization, consumer input and control, and become less resource dependent and more technology dependent.

P2P energy trading empowers 'prosumers' to trade green energy in local communities mutually agreed prices. P2P energy trading is implemented through smart contracts on blockchain platform that self-execute when specified conditions are met. Promotion of P2P trading of green energy will help scaleup RE connected to the grid faster. Increasing number of governments and organizations around the world are planning to pass regulatory legislations on blockchain and have demonstrated pilot projects based on blockchain technology. India can leverage blockchain technology to optimise process and to integrate hyperconnected services based on trust and accountability. Blockchain has attracted the attention of the power industry with its potential to support various use cases including electricity trading, green energy certificates, smart meter operations etc. Among the blockchain use cases in the energy sector, P2P trading of solar rooftop PV (SRTPV) energy on blockchain platform is gaining attention globally. This will also open the option to charge EVs with green energy soon. India Smart Grid Forum (ISGF) has successfully implemented three pilot projects on P2P trading of rooftop solar energy on blockchain platforms - in Lucknow, Delhi, Kolkata in the past 3 years. Uttar Pradesh Electricity Regulatory Commission (UPERC) has issued regulations for P2P trading of solar energy on blockchain platforms in April 2023, which is the first of such regulations anywhere in the world. ISGF also currently implementing a demonstration project on EV charging with green electricity and generation of green certificates on blockchain platform which will go-live in Delhi in second-half of 2024.

Opportunities for P2P Trading

The P2P trading model provides an online marketplace where prosumers and consumers can exchange electricity at mutually agreed rates, without the use of an intermediary. Further, P2P trading has the potential to provide following benefits for a utility:

- **Consumer and Prosumer Empowerment Boosting Renewables and Flexibility:** P2P trading platforms can provide a marketplace for prosumers to exchange renewable energy produced at a lower cost, facilitating distributed generation deployment. Similarly, P2P trading gives customers more leverage over their energy use and price, increasing system flexibility. P2P trading also enables participants to benefit their local communities by allowing them to absorb RE and gain more from their distributed generation, whether or not storage facilities are used. At the same time, through P2P trading, customers without renewable generation facilities can buy green power directly from local renewable generation.
- **Balancing and Congestion Management on the Distribution Grid Through Better Operation of Distributed Energy Resources:** P2P trading platforms enable better management of decentralised generators by matching local electricity demand and supply. Along with increased local consumption of RE, P2P trading will help reduce investments in generation capacity and transmission infrastructure required to meet peak demand, resulting in lower AT&C losses owing reduced congestion on transmission and distribution networks.
- **Provision of Ancillary Services to the Main Power Grid:** The P2P network operators can also allow peers to provide ancillary services to the main grid in addition to allowing P2P transactions, provided if the prosumers deploy energy storage systems. As EV rollout is scaling up in India, the vehicle to grid (V2G) technologies will facilitate aggregation of large number of EV batteries and other distributed energy storage systems at prosumer premises as virtual power plant (VPP). The VPPs, which are formed by self-organized consumers, could provide ancillary services to the grid.

P2P Pilot Projects Executed in India

1. MVVNL, Lucknow - Uttar Pradesh:

- Pilot project was implemented under the regulatory sandbox approach to test the technical feasibility and customers willingness to participate in such programs
- 12 participants were identified and recruited in the pilot project – 9 of them with Rooftop PV and 3 of them net buyers
- Pilot project price discovery was around INR 5.60/kWh (Rs 2/kWh is the price the utility pays to prosumers for the surplus power from rooftop PV fed to the grid, while average consumers are paying about Rs 9/kWh. The P2P price of Rs 5.6/kWh is a win-win for both prosumers and consumers)
- Project Go-Live: December 2020
- UPERC issued regulations facilitating scaling up of P2P trading in April 2023

2. TPDDL, Delhi:

- P2P trading of solar power from over 2 MW of solar PV between 117 participants in North Delhi with Tata Power Delhi Distribution Ltd
- Sell excess energy to other residents and commercial sites in dynamic pricing environment
- Participants can set their prices to buy and sell, these are matched on platform on auction pool
- Project Go-Live: January 2021
- Delhi Electricity Regulatory Commission (DERC) issued draft regulations which are expected to be finalized soon

3. CESC Ltd, Kolkata:

- P2P trading of solar power from over 21 MW of solar PV between 1000+ participants in Kolkata with CESC Ltd
- Piloting multiple trading logics such as fixed price, dynamic price, preferential and gifting/donating of excess energy
- Detailed project report submitted to CESC for implementing P2P as a market-based mechanism instead of net metering

Digital Payment Layer – a New Innovation on the P2P Blockchain Platform

UPERC regulations prescribes following provisions:

- The prosumer (seller of energy) and the consumer will pay Rs 0.21/kWh each to the blockchain platform services provider
- The buyer will pay Rs 0.92/kWh to the DISCOM as wheeling charges
- The energy charges for the P2P trading (Rs per kWh) will be mutually agreed between the prosumer and consumer for each trade
- The UPERC regulations fix the responsibility on the DISCOM to:
  - Collect the energy charges from buyer and pay to the prosumer
  - Collect the platform fee from buyer and seller and pay to the platform service provider - Rs 0.21/kWh each from buyer and seller
  - Collect Rs 0.92/kWh from the buyer as wheeling charges for the DISCOM

Although regulations fix the responsibility on DISCOM to collect the above fee as part of the regular monthly electricity bills, the matter involves complexities and uncertainties on the DISCOM processes, ISGF with our partner s have devised a new framework for collection of all the above charges related to P2P trading on a digital platform that will be integrated with the blockchain platform. How the proposed scheme will work is explained below:

a. ISGF and partners will build prosumer side and consumer side digital platforms (called consumer platforms and prosumer platforms hereafter) enabled with Beckn protocol[1] to establish a network that facilitates the transaction between consumer and prosumers. This will construct the transaction layer of the network. Principally, other digital platforms can also connect to the same network as long as they talk Beckn protocol.

b. The blockchain platform/layer that acts as a trust layer for all transaction data and meter data

c. The meter data of the prosumers and consumers participating in the P2P trading will be extracted from the utility's MDM and recorded in the Blockchain Platform

d. The prosumers and consumers can discover each other from their digital platforms and execute trades. The trades will result in micro-contracts established over the Beckn protocol. These platforms will be regularly posting the transaction data and reading meter data from the blockchain layer to verify and confirm the actual fulfilment of trades.

e. Once the transactions are completed, the prosumers and consumers can make the payment to respective agencies (prosumer, platform providers and the DISCOM) through any digital payment channels on their respective digital platforms. The money against the P2P sale of electricity will be paid by the consumer to the prosumer directly; the platform fee will be paid by the consumer and prosumer to the consumer platform and prosumer platforms facilitating the trade; and the wheeling charges will be paid by the consumer to the DISCOM – all direct transactions through their digital platforms for each trade.

f. The DISCOM's billing system will read the trading data from the blockchain platform (provider to open APIs for the same) to make right adjustments to the MDM data records and bill the prosumers or consumers only for the energy bought from the grid.

The digital architecture of the trading network is presented below:

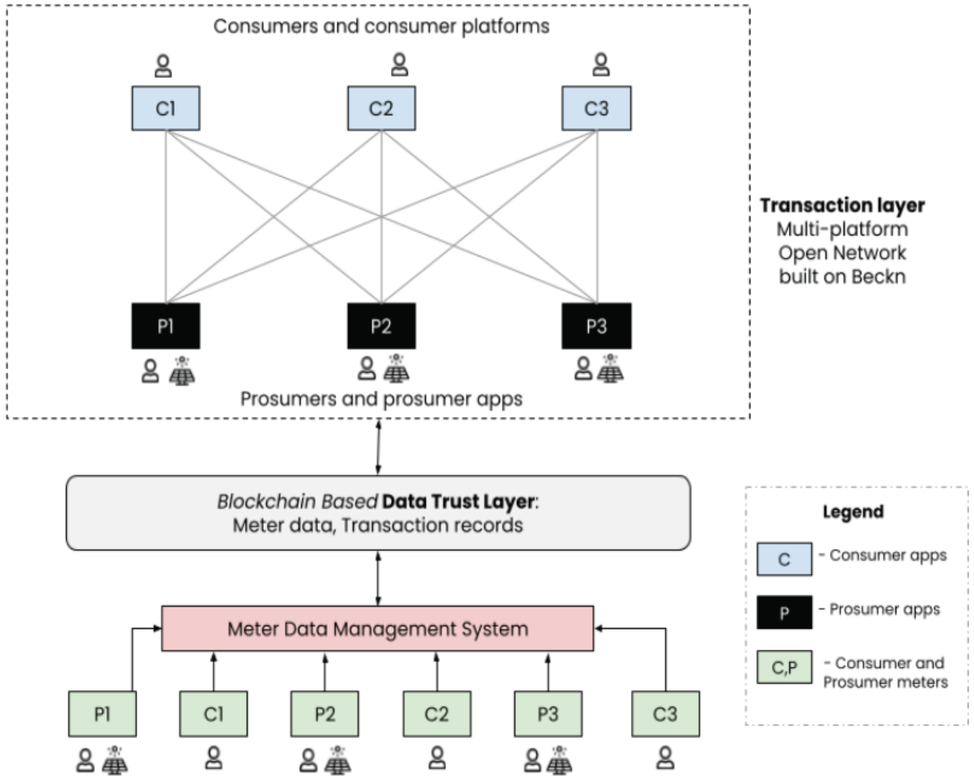


Figure 1: Digital Architecture of Trading Network

The consumers can connect to the network through their choice of consumer platforms while the prosumers through theirs. These platforms can be the same or different for the two sides. These platforms together build a network, which can be orchestrated and managed by the DISCOM with programmable policies and rules of engagement.

The proposed solution is expected to unleash an energy revolution globally laying the foundation of an energy internet.

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[1]Beckn Protocol, first published in October 2019, is governed under a Creative Commons Licence and maintained as a digital public good. Beckn is an economic resource transaction protocol and represents a paradigm shift from platforms to open protocols, offering universality and decentralization modelled on the design principles of the Internet.

Beckn has seven live open networks across geographies (India, Gambia, Kenya, Brazil, Netherlands) and explorations in 15+countries (in Asia, Europe, Africa, US, Latin America)- across 15+ diverse sectors such as commerce (ONDC with 8 million monthly transactions in ~600 cities), mobility (Namma Yatri, 340k+ drivers),, green energy, emobility, climate action & sustainability, agriculture, etc.

NEWS FLASH BULLETIN

India targets 70% increase in nuclear power capacity by 2029, plans to add 7 new reactors

Union Minister Jitendra Singh after reviewing the 100-day action plan of the Department of Atomic Energy (DAE), said that the country's nuclear power generation capacity will increase by 70% in the next five years.

India plans 80 GWof new thermal power capacity by 2032 to meet surging demand

India is gearing up to enhance its thermal power capacity by 80 GW by 2032, in response to consistently rising electricity demand. This ambitious target was highlighted during a webinar on the trends and outlook of the thermal generation and power distribution sectors by the ICRA.

Favorable Policies Spark Solar Open Access Growth Across India

India achieved 1.8 GW of solar open access capacity in the first quarter of 2024, doubling from 909.3 MW in Q4 2023, according to the Q1 2024 Mercom India Solar Open Access Market Report. Installations increased by 152% year - over - year.

MERC Allows Compensation for Renewable Energy Developer on GST Rate Change

The Maharashtra Electricity Regulatory Commission (MERC) ruled in favor of TP Saurya (TPSL), a subsidiary of Tata Power Renewable Energy, declaring the increase in GST rates as a "Change in Law" event for its 300 MW wind-solar hybrid power project.

MNRE Launches Portal to Verify Domestic Content in Solar Cells and Modules

MNRE has developed an online portal to ensure the traceability of domestically manufactured solar photovoltaic (PV) cells and modules and to assist in the verification of Domestic Content Requirement (DCR) in solar PV modules deployed across the country.

Govt approves Rs 200-cr fund for green hydrogen valley projects in four states

The Department of Science and Technology (DST), Ministry of Science and Technology, Government of India, has approved funding of Rs 50 crore each for four upcoming green hydrogen valley projects in India.

Renewables can cut 17% of India's heavy industry emissions by 2030: Ember

Industry growth projections, electricity demand for heavy industries is expected to rise by 45%. Meeting this increased demand with Renewable Energy could help to avoid 180 million tons (Mt) of CO2, equivalent to the total annual emission of the Netherlands

MNRE Sets Guidelines for Solar Modules and Inverters under PM Surya Ghar

MNRE has released a framework for the enlistment of solar PV modules and inverters under the PM-Surya Ghar: Muft Bijli Yojana to assist consumers in making informed choices when selecting high efficiency products with better warranties for their rooftop solar installations.

Smart metering inching closer to 1 billion units in Asia-Pacific

Smart electricity metering in Asia-Pacific is expected to grow at a rate of over 6% from 818.6 million units in 2023 to nearly 1.2 billion units in 2029, Berg Insight has reported. In south Asia, the most significant growth is expected in India, which is targeting 250 million smart prepayment meters.

EU Modernisation Fund disburses €3bn for grid upgrades and renewables

The European Union has disbursed €2.967 billion via the Modernisation Fund to support 39 energy projects in 10 EU Member States. The largest disbursement from the Modernisation Fund to date, the investments will support the modernisation of energy systems, reducing greenhouse gas emissions, while improving energy efficiency.

Mr. Mayank Gupta,
Head – BD & Strategy, IEX

Mr. Vishu Vishal,
Sr. Manager – Strategy, IEX

Modernizing Discoms to ensure Energy Security & supporting Net Zero target

In the recent years, India has witnessed unprecedented increase in electricity demand at ~ 8-9% and as per Central Electricity Authority (CEA) estimates, the electricity demand growth is expected to remain robust with projected demand of 2280 BU and Peak demand of 335 GW by 2030 from current demand of 1624 BU & peak demand of 240 GW during FY24. Amidst the increasing demand, India has also set ambitious targets to decarbonize the Power Sector by increasing share of non-fossil-based generation capacity to 50% and reducing emission intensity to GDP by 45% by 2030 w.r.t. 2005 level, resulting in Distribution utilities facing dual challenge of meeting higher demand and predominantly through cleaner sources. Accordingly, it is imperative that effective planning and actions are undertaken to ensure that Discoms which are already facing challenges such as high AT&C losses, non-reflective tariffs etc. can meet the aforesaid challenges.

We understand that Discoms will be required to undertake work on various levers such as:

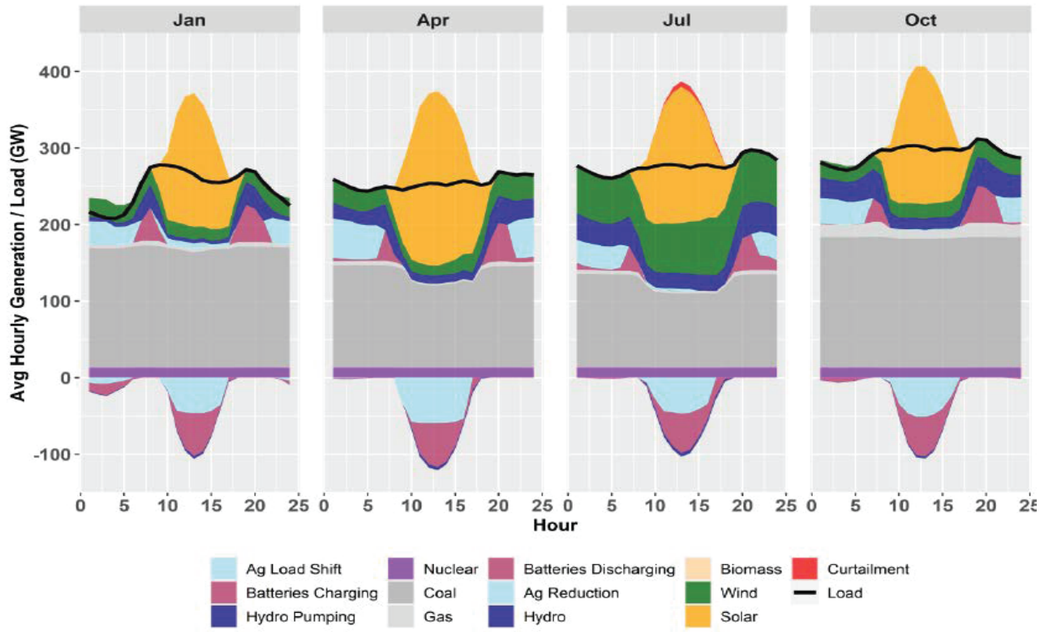
- Accurate forecasting of demand for mid to long term on a granular basis, incorporating changing consumption patterns due to C&I decarbonization efforts, new age industries, increased cooling demand, Electric Vehicle, Roof-Top Solar etc.
- Power procurement planning to meet projected energy demand & climate commitments (~ RPO) in a cost-effective and reliable manner.

The foregoing will require various initiatives and many such initiatives are already under progress. Key initiatives are as follows:

Demand forecasting: Use of AI/ML and Smart Meter data can be leveraged to forecast the demand by Discoms on a more granular level. Further, increasing disruptions due to energy transition such as rising share of behind the meter resources such as Roof-top-Solar, battery storage systems, EV charging and V2G etc. needs to be factored in to optimally plan for capacity tie up under short term, medium term, and long term. Also, changes in the load curve due to various policy interventions such as load shifts (Agri, C&I etc.) and ToD implementation should be effectively captured to determine projected load curve and net load curve for each discom.

Demand side interventions: It is being observed that market with higher solar generation such as Australia, Germany, ERCOT, CAISO witnesses declining Net load curve and resulting in lower Wholesale market price during solar hours. Implementation of Time of the Day (ToD) tariff for all consumer segments is necessary to incentivize load shift to solar hours. As per Ministry of Power (MoP) Rule, 2023, the same is expected to be implemented for Residential segment as well, from FY26 onwards. Country-wise implementation of ToD tariff is crucial to minimize the Duck curve phenomenon in India.

As per simulation study by Lawrence Berkley for least cost pathways for India'sPower Sector 2030, to avoid curtailment



Ref: LBNL, least cost pathways for India's Power Sector 2030

of RE, Agri-load shifting of ~ 50 GW and Industrial load shifting ~ 10 GW shall be essential. Further, such measures will reduce the requirement of energy storage and the overall cost of RE integration.

Entering into FDRE / RTC RE supply : With the expected demand growth of ~ 6% CAGR and RPO target of ~ 43% by 2030, Discoms will face challenge in terms of integrating higher RE share over the years. Therefore, Discoms are preferring firm & dispatchable RE tenders, with than 12 GW of FDRE & RE RTC tenders being auctioned during FY24 and such tenders are further expected to gain traction going forward.

Measure to integrate RE through storage solutions: Discoms will require supporting storage solutions including BESS, pump storage etc. to manage variability of growing share of RE in the supply mix. GoI has already announced a VGF based scheme for addition of 4000 MWh of BESS with up to 40% of capital subsidy. So far, two large scale utility scale BESS tenders have been awarded by SECI (1000 MWh) and by GUVNL (500 MWh). Further, there has been a sharper decline in BESS capex over the last year with discovered L1 tariff in GUVNL being Rs 4.48 Lacs/MW/Month from SECI's Rs 10.83 lacs/MW/Month. This translates to LCOS (including round trip efficiency) of Rs 11.18/kWh of SECI's tender and Rs 4.63/kWh for GUVNL's tender. Further, as per CATL's estimates BESS system level capex is further expected to decline from ~ $200/kWh to $150/kWh by end of 2024, making BESS more viable. Other Discoms are also expected to come up with standalone BESS tenders for managing & optimizing variable RE in the supply mix. Further, with reducing BESS cost, FDRE & RTC tenders are also expected to get more competitive vis-à-vis conventional generation. Also, with the projected decline in the cost of BESS, the arbitrage opportunity (~ Rs 6-7/kWh) will provide a viable option even for single cycle BESS operation i.e. by charging BESS during Solar hours anddischarging during non-solar hours/Peak hours.

Effective optimization as well as procuring of Green Power / Green instruments from market: Market products such as REC market provides opportunity to meet the shortfall in green power procurement. The minimum RE consumption target at ~43% by 2030 as per Energy Conservation Act 2022 entails maximum penalty of Rs 3.7/kWh on Discoms (designated consumers) for non-compliance. The lower cost of RECs provides flexibility to Discoms to optimize power procurement and to meet the RE purchase obligation. Further, it is evident that during Solar hours, in DAM, the typical sell volume available is in the range of 18000-22000 MW and the typical buy volume is in the range of 8000-10000 MW, indicating sell being 2X buy and resulting in lower MCP. Therefore, Discoms can optimize the procurement during Solar hours through surplus sell available in the market at competitive rates by ensuring technical minimum schedule for thermal stations.

It is evident that with increasing share of solar generation, the sell bids during solar hours will continue to far outweigh the buy bids, creating opportunities for optimization. For instance, as per chart below for FY24, the uncleared Sell volume during Solar Hours (9-17) shows a significant potential for optimization.

Designing & upgrading distribution networks in line with changing consumption pattern and changing energy mix: Amongst many initiatives undertaken by the Government is Revamped Distribution Sector Scheme (RDSS), 2021 which aims to achieve Zero ACS-ARR gap by FY25 & to reduce AT&C loss to the level of 12-15% by FY25. The modernization of the distribution network along targeted installation of 25 crores Smart Meters will not only help to further improve the AT&C losses but will also open opportunities for innovative models such as Peer-to-Peer (P2P) trading. Smart Meter infrastructure can be leveraged to integrate with P2P platform, thereby creating a local energy market for trading of surplus solar generation from roof-top-solar within the Discom. P2P trading shall also help to gradually transition from the subsidy driven Net Metering scheme to market-based model. Further, introducing the concept of Aggregator for distributed energy resources shall help to develop more vibrant local energy markets which can further

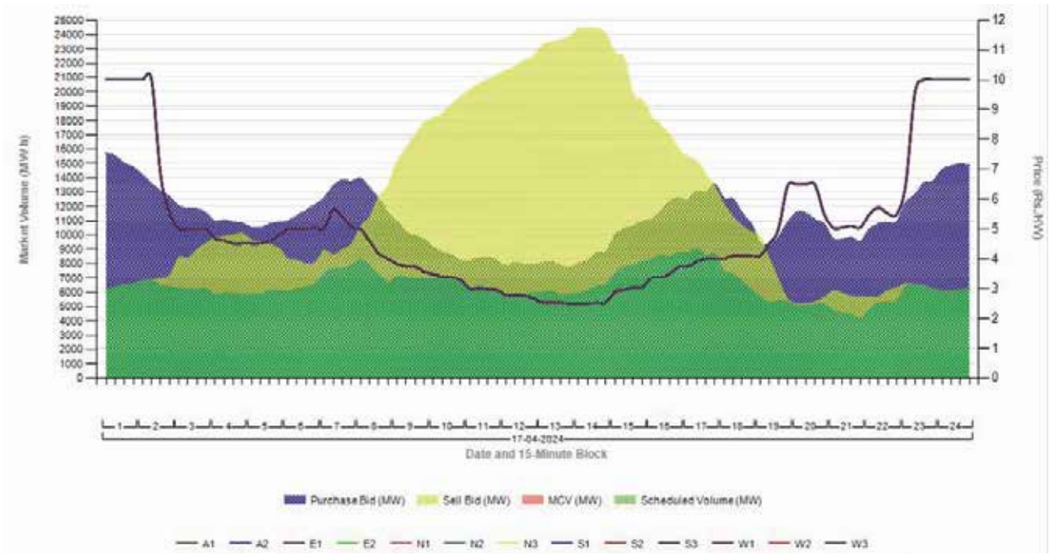
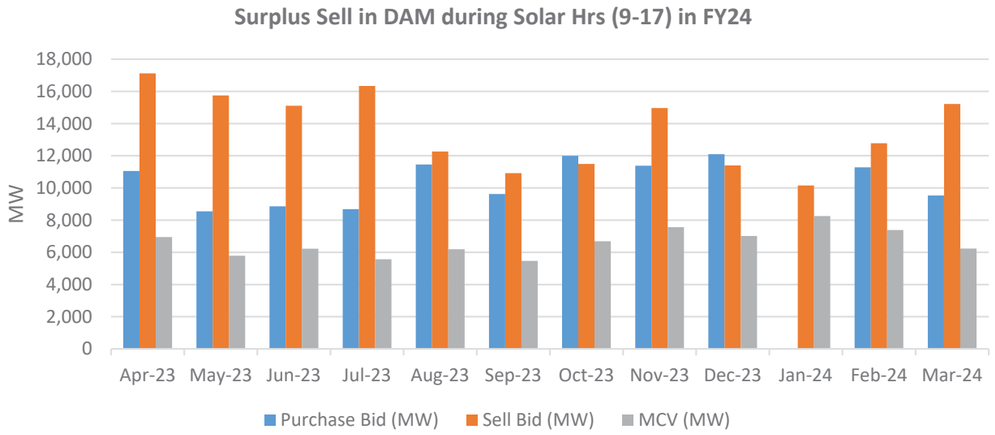


Fig: Surplus sell during Solar hours in DAM, IEX



integrate with Wholesale market. RDSS scheme also aims to drive segregation of Agriculture feeders which shall be crucial for Solarization as well as shifting of Agriculture load to solar hours. Shifting of Agri-load to solar hours will help Discoms to absorb more solar power, reduce overall balancing cost and reduce subsidy for Agri-consumers.

The journey ahead to meet the twin objectives of Energy Security and Net Zero would be challenging and a holistic & timely implementation of above measures would be crucial.

Revolutionizing India's Smart Metering Landscape

Mr. Ajoy A Rajani,
Addl. MD & CEO, CyanConnode India

As we witness the unfolding of a new era in energy management, the smart metering industry stands at the forefront of this transformation. India's ambitious goals to upgrade its utility infrastructure and enhance energy management systems are driving significant advancements in smart metering technology. IntelliSmart, led by its MD & CEO, Mr. Anil Rawal, has been a pivotal force in this revolution, setting new benchmarks for the industry.

The Growth of Smart Metering in India

The smart metering market in India is poised for remarkable growth, driven by the government's vision of deploying 250 million smart prepaid meters over the next few years. This initiative aims to revolutionize the energy sector by enabling real-time data collection, enhancing billing accuracy, and reducing AT&C losses. The implementation of smart meters is not merely about technological advancement; it is about fostering a more efficient, reliable, and sustainable energy infrastructure.

IntelliSmart has been instrumental in advancing the smart metering landscape in India. Their projects across various states have demonstrated the practical benefits of smart metering, including significant improvements in billing efficiency and reductions in energy losses. Under Mr. Anil Rawal's leadership, IntelliSmart continues to drive innovation and excellence, contributing significantly to the success of India's smart metering program.

The Importance of an Integrated Ecosystem

The success of the smart metering initiative relies on a robust and integrated ecosystem. This ecosystem comprises various stakeholders, including utilities, technology providers, regulatory bodies, and consumers. Each plays a crucial role in ensuring the seamless implementation and operation of smart metering systems.

Utilities and DISCOMs: Utilities are at the heart of the smart metering ecosystem. They are responsible for deploying and maintaining the smart meters, ensuring that the data collected is accurate and used effectively to manage energy distribution. Several Utilities across India have shown how effective deployment and management can lead to significant operational efficiencies.

Technology Providers: Companies providing smart metering technologies, such as CyanConnode, play a critical role in this ecosystem. Their innovative solutions, like the Omnimesh RF technology, are designed to address the unique challenges of India's diverse terrain, ensuring reliable connectivity and data transmission across urban and rural areas.

Regulatory Bodies: The success of the smart metering program also hinges on the support and regulation provided by government bodies. Organisations such as CEA, WPC, BIS, MTCTE, CERT-In, CEA, led by Ministry of Power and Department of Telecommunications (DoT) have established guidelines to ensure the

secure and efficient deployment of smart metering systems. The use of license-exempt spectrum for smart metering, for example, has been a crucial factor in reducing costs and fostering innovation.

Consumers: Finally, consumers are key beneficiaries of the smart metering program. Smart meters provide consumers with real-time data on their energy usage, enabling them to make informed decisions and potentially reduce their energy bills. This transparency and control over energy consumption are essential for driving consumer engagement and satisfaction.

Challenges and Opportunities

The deployment of smart meters across India is not without its challenges. Geographic and demographic diversity pose significant hurdles, requiring tailored solutions for different regions. For instance, deploying smart meters in remote and semi-urban areas necessitates innovative communication technologies like long-range RF solutions, which can overcome geographical barriers and ensure reliable connectivity.

Despite these challenges, the opportunities presented by smart metering are immense. Beyond electricity, there is potential for applying smart metering technologies to other utilities such as gas and water, further enhancing the efficiency and sustainability of resource management. Additionally, the data generated by smart meters can be leveraged to support broader smart city initiatives, such as street lighting automation, traffic management and waste management.

Looking Ahead

The future of smart metering in India is bright. With continued support from all ecosystem players, the country is well-positioned to achieve its ambitious goals. The lessons learned from successful projects, such as those led by IntelliSmart, provide valuable insights that can be applied to future deployments. Moreover, the ongoing innovation in smart metering technologies ensures that India remains at the cutting edge of this global movement.

As we move forward, the focus must remain on fostering collaboration across the ecosystem, ensuring regulatory support, and maintaining consumer engagement. By doing so, we can create a smart metering infrastructure that not only meets the immediate needs of energy management but also supports the long-term vision of a smart, sustainable India.

The smart metering revolution in India represents a significant step towards a more efficient and sustainable energy future. IntelliSmart, CyanConnode and other key players in the ecosystem are driving this change, demonstrating the potential of smart metering to transform the way we manage and consume energy. Together, we are building a foundation for a smarter, more connected world.

Journey from Information Technology (IT) to Digital Technology (DT) in the Era of AMI

Mr. Gautam Kumar
Chief Technology Officer (CTO), IntelliSmart

Utilities, as one of the oldest industries, have evolved significantly over time, carrying with them legacy systems and traditional mindsets. In today's hyper-connected world, compounded by environmental factors such as severe weather and climate changes, these legacy operating models and IT solutions will not suffice for the future sustainability of utilities.

Advanced Metering Infrastructure (AMI) represents a major disruptive technology intervention. It offers significant operational benefits, such as collecting interval reads, power-quality information, and remote Connect/Disconnect capabilities. Consumers, in turn, benefit by being able to track their consumption and shift their energy usage.

The way forward to maximize the benefits from these substantial AMI investments is to embrace digital technology. The convergence and adoption of digital technologies enable the transformation of AMI's digital information to perform tasks, communicate, and process data. This paves the way for next-level innovations, efficiencies, and decarbonization objectives. Consumers will benefit from more personalized information, while utilities will gain from harnessing the growth of rooftop solar and managing electric vehicles, which draw significant energy off the grid.

Many potential grid resiliency issues arising from climatic conditions and the intermittency of distributed and renewable sources can be addressed through next-generation digital technologies. With the intermittent behavior of renewable and distributed energy resources, coupled with dynamic consumption patterns, utilities face challenges in balancing electricity demand and supply. This is particularly because the majority of electricity generation from renewable sources is no longer under the utility's control but is instead left to the forces of nature. To manage this demand elasticity, information logged on the behavior of energy sources and loads, integrated with enterprise systems and real-time predictive algorithms, will result in a harmonized grid scenario.

Some digital tools and systems worth investigating for critical digitalization use cases include:

Cloud: Hyperscale cloud infrastructure, serverless compute platforms, and high-performance storage like SSDs, NVMe, parallel file systems, and cloud-based object storage.

Networking and Communication: High-speed data streaming, data compression, globally connected devices, low latency, and greater connectivity through 5G.

Data Management and Analytics: Advanced data management technologies are essential for handling the increasing volume, variety, and velocity of data from AMI systems. Specialized time-series databases like TimescaleDB, Big Data platforms such as Hadoop, NoSQL databases like MongoDB, Cassandra, and Redis, as well as data pipelines/streaming platforms like Apache Kafka and Airflow, are vital for storing, mining, and analyzing the time-stamped data from smart meters.

Artificial Intelligence (AI) and Machine Learning (ML): These frameworks will drive the next wave of digital disruption in predictive analysis and decision-making tools.

Blockchain and Digital Payment Systems: These will create new business opportunities, such as peer-to-peer energy exchange and innovative payment models for utility consumers.

These technologies are set to transform how we live, work, and interact, driving innovation and efficiency. Next-generation electricity utilities need to operate as digital, information-age enterprises to handle an integrated energy system—from generation to customer—and drive towards the goals of customer centricity and sustainability.

India is at the Cusp of a Major Transformation

Mr. Abhishek Biswal
Chief Business Officer, Digital Services, Airtel

With a booming population and growing urbanization, the demand for reliable and efficient utility management is skyrocketing. Powering a nation of over 1.4 billion people demands a robust and intelligent infrastructure.

In India, a staggering 23% of electricity is lost due to commercial losses, often attributed to outdated metering systems and energy theft. This translates to billions of dollars lost annually and unreliable power supplies for millions.

One of the most exciting opportunities lies in the digitalization of India's utilities sector. The government's ambitious plan to implement a nationwide smart grid with 250 million smart meters presents a game-changer. This initiative will not only address India's growing energy demands but also significantly reduce energy losses.

The journey begins with smart meters in every household. This is the foundation for digitizing the power sector and establishing a pan-India smart grid. Smart meters will lead to a more balanced demand-supply equation, easing pressure on the grid and enabling power generation companies to optimize production based on real-time needs. Additionally, initiatives like Time of Day pricing will empower consumers and promote renewable energy adoption.

At Airtel Business, we're leveraging our technological expertise to simplify smart meter deployments for our customers. With a revolution brewing on the horizon in the form of Narrowband-Internet of Things (NB-IoT), we are prepared to enable the Government of India's vision of digitizing 300 million smart meters by 2027 with Airtel's Utilities Management Solutions.

With multiple connectivity options to choose from like NB-IoT, 4G, 5G and 2G, the ability to connect millions of smart meters across vast areas with low power consumption makes it ideal for India's unique infrastructure landscape. By enabling real-time data collection and tamper-proof metering, smart metering has the potential to significantly reduce energy theft, improve grid stability, and empower consumers with better energy management tools.

We've gone a step further by developing tools for large-scale deployments. These tools enable deployment feasibility studies directly from the platform, saving our customers valuable resources by reducing the need for expensive field surveys. Additionally, our advanced analytics solutions empower them to monitor network uptime and service level agreements (SLAs) effectively. These real-time insights provide valuable data on device behaviour and network performance, enabling data-driven decision making.

A prime example of our commitment is our collaboration with Intellismart, a leading smart metering solutions provider. We have bundled our core connectivity and cloud capabilities, making it easier and more cost-effective for them to deploy their smart metering solutions. Additionally, we are providing Intellismart with our Head End System (HES) application hosted on the secure Airtel cloud. With Airtel being the single solution provider, all of this could be deployed 50% faster.

By harnessing the power of the Smart Utilities solution, we can unlock immense potential for India's growth. At Airtel Business, we have deployed more than 1 Mn Smart meters on NB-IoT and 50 Mn smart meters are currently under deployment.

We are determined to play a pivotal role in India's transformation journey, building the infrastructure and solutions that empower businesses and revolutionize industries. We are confident that together, we can create a smarter, more efficient, and sustainable future for India.

India: A Gas based economy – Outlook & Challenges

Mr. Jitendra Raheja
Head, Corporate Affairs, IntelliSmart

India steps on the pedal with a $67 billion investment in natural gas sector, looking to double its reliance on the cleaner burning fuel. GOI has announced plans to invest $67 billion in the natural gas sector over the next five to six years as it looks to promote clean energy. It will play a crucial role in developing the country's energy infrastructure. This move is part of the government's strategy to attract global investors to its energy sector. The plan is to increase the share of natural gas in its energy mix to 15% from the current 6%, boosting the share of clean energy in India's energy portfolio.

Natural gas is regarded as the most environment-friendly fossil fuel because it emits 50–60% less carbon dioxide compared with coal or petro fuels, and its greenhouse gas emissions have a shorter lifespan. As a non-renewable energy source, natural gas could be a key element in achieving a sustainable future.

As the world's fastest-growing major economy, it is imperative for India to accelerate its transition to green energy to meet its escalating energy demands. Currently, India is the third largest consumer of energy and oil globally.

According to the International Energy Agency's (IEA) Gas Market Report, India's natural gas demand is projected to increase by 6% in 2024, driven by higher consumption in the fertilizer, power generation, and industrial sectors. Despite rising demand, India imports 44% of its natural gas, as domestic production falls short of meeting its needs.

Liquefied natural gas (LNG) imports grew by 7% year-on-year to 29 billion cubic meters last year, with the power and fertilizer sectors being significant contributors to this increase. Notably, power companies imported 2.32 billion cubic meters of LNG in 2023, accounting for about 9% of total imports - a 76% increase from the previous year.

Efforts to boost domestic production are underway, with a 6% year-on-year increase to 35 billion cubic meters. Despite the government's ambitious plans, challenges remain. Concerns exist around ensuring fair competition and transparency in the newly liberalised gas market. Streamlining regulations and expediting approvals for exploration and production projects are crucial to accelerate domestic gas production. Additionally, attracting investments for developing LNG terminals and storage facilities is essential to meet future demand spikes.

Last year, India approved the mandatory blending of compressed biogas into its domestic gas supply, effective from 2025. Initially set at 1% of total consumption, this mandate will gradually increase to 5% by 2028-29.

The IEA has also acknowledged various reforms India has undertaken to improve its gas sector. These include the introduction of a unified pipeline tariff system, benefiting consumers distant from gas sources or LNG terminals. The Unified Tariff Policy creates a single, equitable tariff structure for nationwide natural gas transportation, covering

approximately 90% of pipelines either operational or under construction.

The "One Nation, One Gas Grid" initiative is a significant step towards enhancing natural gas accessibility in India, involving the construction of a 33,592 km pipeline network. With 23,173 km already operational and an additional 12,206 km under construction, this project lays a strong foundation for expanding the gas network. In line with the GOI mission, PNGRB has authorized 307 GAs > 88% of geographical areas (GAs) and 98 percent of the population to various CGD's up to 12th Round. The city gas distribution (CGD) industry is adopting advanced technologies/ smart metering to bring down cost, enhance efficiency and elevate customer service levels. However, the biggest challenge is sustainable growth with fair profit margin. Industry is looking for partners who can provide technological support along with asset service providers, who can help them manage the system with efficiency as well as ensure customer satisfaction.

The asset service providers having previous experience in power sector can play a crucial role in achieving the ambitious targets of GOI besides ensuring sustainable growth & positive outlook in the gas sector.

India is also exploring the establishment of strategic gas reserves to improve supply security and aims to become a leading producer and exporter of hydrogen. To achieve the targeted increase in the energy mix from 6% to 15%, several initiatives have been launched, including the expansion of the National Gas Grid Pipeline, City Gas Distribution (CGD) network, and the establishment of Liquefied Natural Gas (LNG) terminals. Additionally, the government has granted marketing and pricing freedom for gas produced from specific sources, encouraging domestic exploration and production.

The government's initiatives have been well-received by the industry. However, further measures are essential for India to transition fully to a gas-based economy. India's gas sector stands at a pivotal juncture. The government's proactive approach presents exciting opportunities for investors and stakeholders. Successfully navigating the challenges and capitalising on these opportunities will be key to achieving the targeted 15% gas share in the energy mix. This transition would not only fuel India's economic growth but also contribute significantly to its clean energy goals, paving the way for a more sustainable future.

The Digital Transformation of India's Power Sector

Mr. Suvojoy Sengupta
Partner, McKinsey & Co.

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Engagement Manager, McKinsey & Co. Energy Practice

The world is firmly on the path of economic digitization, with digital systems expected to drive over 30% of the global economy by 2030. In India, numerous sectors such as retail, financial services, travel, and media have undergone significant digital transformations. The power sector, too, is experiencing a shift towards smart technologies, driven by initiatives like IPDS, RAPDRP and the RDSS scheme launched in 2021. The RDSS scheme, the largest of its kind globally, aims to install 25 crore smart meters, promising far-reaching implications for reducing AT&C losses and enhancing the financial profitability of the power distribution sector. Additionally, the PM Rooftop Solar Scheme, targeting 1 crore households, is set to propel the case for smart meters with added net metering functionality.

Smart meters offer substantial direct benefits, including digital meter logging to prevent billing disputes, instant issue notifications, and the digitization of the entire billing and collection process. The prepaid functionality could help improve the working capital requirements of discoms. States like Uttar Pradesh, Assam, and Haryana have already showcased the self-sustainability of smart meters driven by reduction in AT&C losses.

However, for smart meters to be truly transformational, discoms need to implement advanced analytics solutions using the data generated by these meters. It is estimated that such solutions can unlock value pool of more than INR 1 lakh crore for the discoms. There are four main categories where these solutions can benefit the discoms.

Firstly, **AT&C loss reduction:** Smart meter data can flag potential cases of power theft by analyzing consumption trends v/s historical or benchmark trends, outlier demand, and voltage drops. Analytics can also identify consumer likely to default on payments through clustering algorithms, or consumers mis-using tariff categories to pay lower fixed charges, or lower tariffs (by using residential tariff for commercial / industrial purpose).

Secondly, **technical network optimization:** Smart meter data can be leveraged to identify pockets or feeders with high technical losses by comparing meter and network data at granular time intervals. Predictive maintenance of key equipment done by building advanced analytics on sensor-based data, can optimize maintenance cost and improve SAIFI/SAIDI. Data on consumption and network loading trends can help utilities forecast spatial demand growth and plan capex in distribution infrastructure.

Thirdly, **power purchase costs optimization:** Algorithms trained on historical demand trends, weather forecast, and regional profiles can produce granular demand forecasts. This would enable discoms to optimize power procurement mix across long, medium, short sources, as well as reduce Deviation Settlement Mechanism penalties.

Fourthly, **consumer-driven solutions:** Smart meters empower consumers to understand their power consumption in real time, including appliance wise consumption, and thus often leading to lower power consumption as consumers become more aware of their usage. Customized recommendations for energy savings (e.g., appliance efficiency, bill comparison) and planning high-usage activities with time-of-day tariffs are also established use cases.

These solutions have already been implemented in many developed economies, enabled by high level of smart meter penetration. In Singapore, the utility prepares half-hourly demand forecasts for the next fortnight, to help plan power generation. Further, it has built granular solar forecast model using satellite imagery, meteorological data, and machine learning algorithms to predict irradiance with an error rate of less than 10 percent. In Italy, the utility has deployed IoT platform which captures 2 trillion rows of data annually to generate predictions across smart meters, renewable assets, and predictive maintenance. In United Kingdom, demand flexibility service was launched using smart meters, which financially rewards consumer for reducing electricity consumption during peak demand periods.

Encouragingly, these solutions are nearing implementation in India as well. Both domestic and global firms, across information technology, cloud systems, data analytics, and smart metering are eyeing the vast opportunity, banking on the widespread installation of smart meters. Given world class talent in software solutions, advanced data analytics, India very well has the potential to emerge as a global hub for these solutions.

The onus now lies with the discoms to integrate these analytics solutions in their operations. The financial benefits, along with improved operational convenience and consumer satisfaction, far outweigh the costs. The RDSS initiative is already accelerating meter installations, and a similar approach is needed for deploying analytics solutions. It is expected that the solutions ecosystem would comprise of multiple SaaS (Software as a Service) providers with implementation capability, thus allows utilities to outsource deployment of prioritized solutions. In USA for instance, the initial uses cases were on efficient billing, and demand response management, but now shifting to distributed energy management, and edge analytics using IoT devices.

In preparation, discoms must establish support systems, including high-capacity data storage systems, data sharing protocols to maintain privacy, digitally skilled workforce, and protocols to ensure inter-operability. This presents a unique opportunity for discoms to collaborate and support each other in developing these solutions, setting the distribution sector on a path to enhance performance smartly.

Smart Metering Milestone: IntelliSmart Makes History in Assam

In India's smart metering initiative, which has gained significant momentum since the introduction of the Revamped Distribution Sector Scheme (RDSS) in 2021, Assam stands as a remarkable success story — both for IntelliSmart and for the nation.

A hilly state nestled in India's northeast, Assam has successfully completed the first smart metering project awarded under RDSS despite facing topographic and weather challenges. The project involved the installation of 620,000 smart meters across 19 circles of Assam. The implementation of the project was spearheaded by state utility - Assam Power Distribution Company Limited (APDCL), whose support has been instrumental in the project's successful execution.

Smart meters – an opportunity to drive Discom efficiency

In a state like Assam, there are two major challenges in controlling distribution losses. The first challenge is managing commercial losses, a common issue faced by Discoms across India. The second challenge stems from the state's difficult terrain. The hilly regions and low population density in certain areas make Assam particularly susceptible to higher distribution losses. According to a 2020 CAG report, as of March 31, 2020, the Aggregate Technical & Commercial (AT&C) losses for APDCL were 22.29 percent.

In such a scenario, the national smart metering programme presented a significant opportunity for the state distribution sector to leverage consumer data and develop strategies aimed at safeguarding and optimising Discom revenues. In just two years, the project improved the financial health of the Discom significantly. The smart metering technology ensured generation of accurate and error-free electricity bills, allowing consumers to pay online through a mobile application, similar to mobile phone top-ups. As a result, the Discom saw a substantial boost in their monthly revenue.

Challenges & their mitigation

The implementation of the project hasn't been easy, and to understand why, we must consider Assam's challenging topography. Located in the northeastern part of India, Assam is the most populous state in the region and the second largest by area, covering 78,438 sq km. The state's rugged terrain and remote locales present significant hurdles in executing any development initiatives.

The project encountered a range of challenges - from technical issues to field-related obstacles. But our project teams effectively ensured that each obstacle is dealt with in a timely manner, ensuring the seamless implementation of the project.

Technical challenges

Interoperability issues:

Challenge: Ensuring compatibility among various nodes such as smart meters, HES, MDM, billing systems, and WFM tools.

Mitigation: We standardised the metering equipment and communication protocols across the network. We also conducted rigorous testing and certification processes were established to ensure all devices met the required standards.

Data management and integration:

Challenge: Managing the data generated by smart meters and seamlessly integrating it with existing IT systems. deployed robust cyber security measures, including encryption, security communication channels and regular security audits. We also established a dedicated cybersecurity team to monitor and respond to potential threats.

Communication network reliability:

communication approach that includes RF (Radio Frequency) mesh networks and cellular networks to ensure consistent data transmission. We installed repeaters and signal boosters in areas with weak signal strength.

Field-based Challenges

Geographical and climatic challenges:

Challenge: Difficult terrain in places like Mankachar (Bangladesh border), Haflong, Diphu (Nagaland border and hilly terrain) and adverse weather conditions affecting the installation and maintenance of smart meters.

Mitigation: We deployed special field teams equipped with appropriate tools and vehicles to handle meter installations in challenging areas. Additionally, scheduling installation and maintenance activities during favourable weather conditions whenever possible.

Shortage of skilled workforce:

Challenge: Lack of adequately trained personnel to install, maintain, and manage smart meter systems, coupled with a high churn rate of resources.

Mitigation: We established comprehensive training programmes for our existing staff and actively recruited new technicians with the necessary expertise, besides partnering with technical institutes to source skilled technicians. Additionally, we trained and deployed over 4,500 field resources of around 20 partners. We have also developed more than 300 in-house teams to control the high churn rate, fostering stability and ensuring a reliable, proficient workforce to support our smart meter systems.

Innovation helped in end-to-end execution

The Assam project stands as a significant example of IntelliSmart's innovative capabilities. One of our groundbreaking innovations has been the Smart Meter Operations (SMO) app, a first-of-its-kind technological intervention, to strengthen end-to-end execution process in the

state. The SMO app was developed with the objective to carry out centralised management and monitoring of consumer indexing, meter installation, operation and maintenance, and other critical field activities. The solution uses the power of a GIS platform, which further supports correct data collection, workflow optimisation and visualisation of information/data and analysis for improved control and accuracy, while all along maintaining adequate focus on security.

Additionally, we implemented process innovations by leveraging our extensive experience to address workflow inefficiencies and strengthen the end-to-end execution process. These innovations have set an industry benchmark for the national programme.

Consumer awareness

Our consumer awareness programme in Assam has been instrumental in the smooth rollout of the project. Ensuring the consumer is at the forefront of any large-scale programme is crucial for its success. Our efforts in understanding the local community and addressing their energy needs have played a pivotal role in the project implementation.

The key elements of our consumer connect programme included area meetings with the local administration and Discom, audio relay, pamphlet distribution, placing standees and banners, smart meter display wall and real-time feedback mechanism.

Way forward

With the initiation of the smart metering programme, Assam has paved the way for modernising its power sector. The next step is to leverage advanced technologies and harness meter data for more than just billing and cost savings. The true potential of smart meters lies in leveraging cutting-edge technologies such as AI and ML tools to create value for utilities and boost energy efficiency. By utilising AI algorithms and the Internet of Things, utilities can gain real-time insights into energy consumption patterns, encouraging the adoption of energy-efficient practices and ultimately contributing to reduced carbon footprint.

Scaling up the innovation agenda: Key to accelerate energy transition

Mr. Vikas Gaba, Partner and National Head,
Power & Utilities, KPMG in India

Why innovation in energy transition technologies important for India?

India is undergoing a massive transition towards clean energy. By 2047, the renewable energy capacity is likely to grow to 13 times the current, energy storage by 65 times, nuclear power by 8 times, power generation output by 4 times and an annual production capacity of 25 MMT of green hydrogen. These will require corresponding investments in electric and hydrogen grid infrastructure expansion. Global investments of ~USD 4.5 trillion are likely to be required annually until 2050 for the energy transition. India will be a key part with average annual investment of USD 350-400 bn in energy transition technologies in this period.

This massive capital allocation for energy transition provides great opportunities, but also carries significant risks. There is massive concentration of clean energy manufacturing in China. This exposes India and the world to both price and supply chain risk. Considering the economies of scale achieved by China, it is difficult to imagine a shift away from China on market factors alone. However, recent events have underlined the risks of geopolitically concentrated supply chains and overreliance on a single country. India could step in as a credible alternative, if it gets its innovation story right.

India's challenge on innovation?

India's R&D intensity is one of the lowest amongst leading economies. Developed countries like United States, Sweden, and Switzerland spend about 2.9%, 3.2% and 3.4%, respectively. Israel spends 4.5% of its GDP on R&D, the highest in the world. India's GERD as % of GDP remained at ~0.7% during the last 3-4 years, i.e. lowest in the World as per study conducted by NITI Aayog (with World avg. at 1.8%). This is even lower than the BRICS nations. For India to achieve its goal of a $5 trillion economy, India's GERD needs considerable improvement and needs to touch at least 2%.

Participation of business enterprise and higher education sector in the total R&D expenditure remains low. Besides low spend base, the participation of business enterprise and education system is among the lowest compared to developed economies. Business enterprises spent >75% for China, Japan, US and South Korea. Education sector in several matured economies like UK, Spain, Australia, Canada and Germany has contributed significantly.

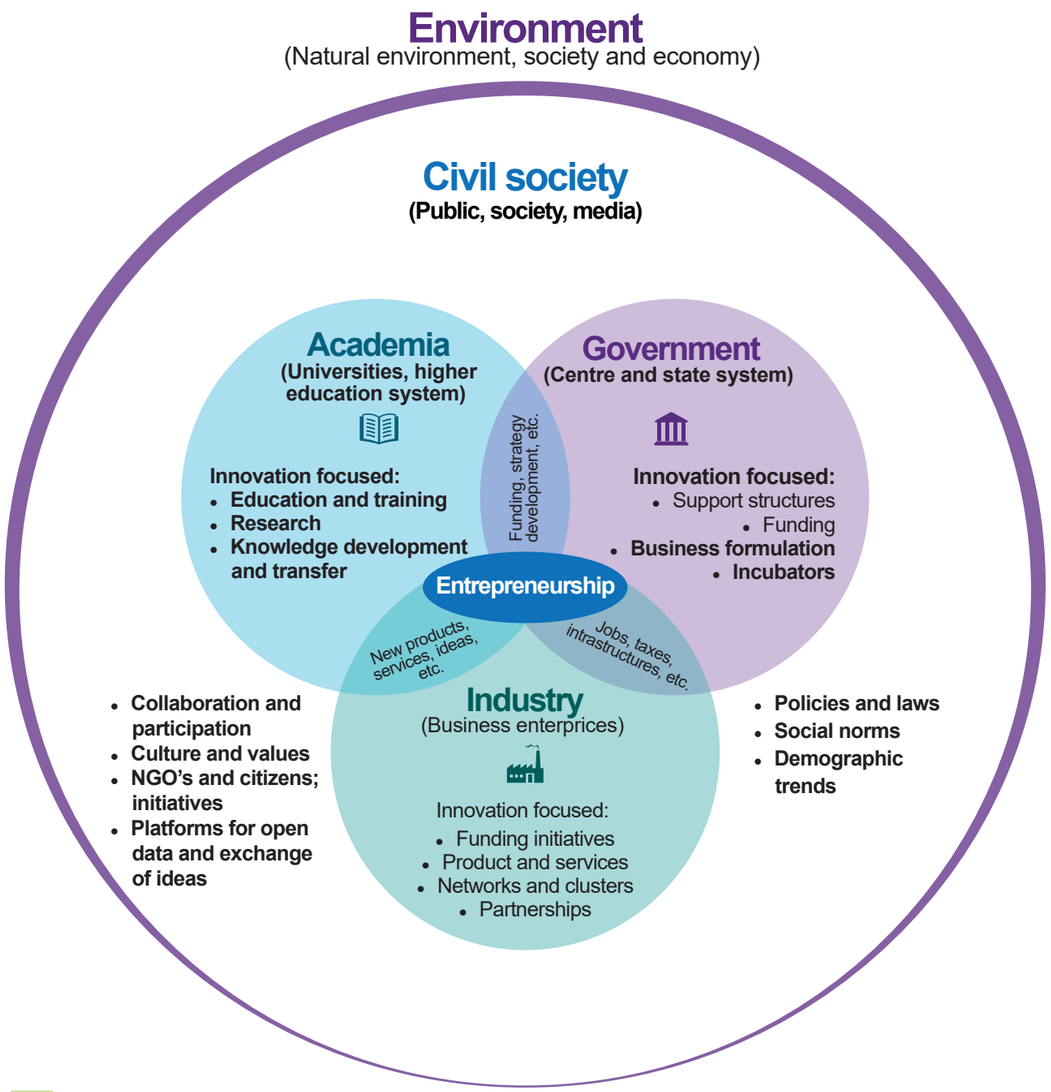
India's share of global patent filings is significantly low (at 0.25%) compared to Japan (30.25%), US (24.68%) and China 8.06%)[1]. While the Indian government supports clean energy R&D through initiatives like the Innovation Fund for Clean Energy, private sector investment remains comparatively low. In contrast, China and the

Statista 2024

US boast robust participation from both public and private players, leading to more innovation and patenting activity.

Among various theatres of collaboration University-industry collaboration remains the weakest. According to the Global Innovation Index 2023[2], **India ranks 66th in university-industry R&D collaboration, dropping from 42nd position in 2022.** While the rank on overall innovation index has remained same at 40th (in 2023 over 2022), it is up from 48th in 2020. India also seems to be doing better on innovation outputs (i.e. patents, citable documents, unicorn valuation, software spending; intellectual property receipts) where the rank is 35th than inputs (i.e. researchers FTE per mn population; ICT access; expenditure on R&D; expenditure on education; finance for start-ups; etc) where the rank is 46th.

Understanding the Innovation ecosystem and pathways for India

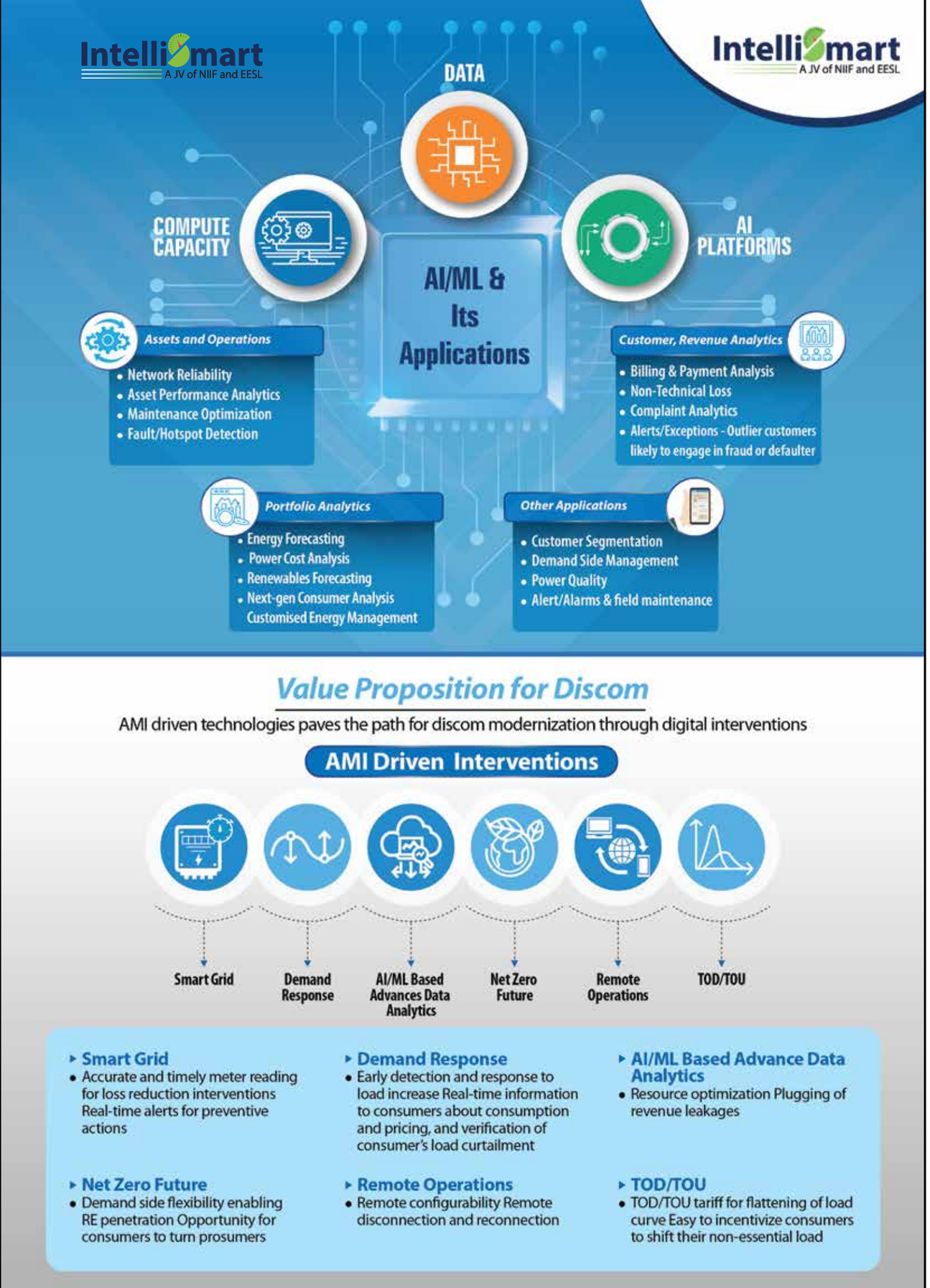


Key aspects to chalk out pathways that India can take to upscale the innovation is to develop a deeper understanding of the innovation ecosystem and how it needs to come together. **The triple helix model of innovation provides an analytical framework that captures relationship between innovation actors at the system level.**

Typically, the core the innovation ecosystem comprises **'academia/research'** – that engages in providing knowledge and new ideas; **'industry'** – that focuses on producing commercial goods and deployment at scale; and **government/policy** – that creates a regulating market environment to foster economic and social development. In the emerging context of energy transition, more advanced version of triple helix integrates additional dimensions i.e., **public, civil society and media at large** (quadruple helix or 4-helix); and fifth dimension i.e., **natural environment** (quintuple helix or 5-helix) to the framework. The model has been widely adopted in different forms across US, China, Sweden, South Korea, Germany and the like[3].

The Indian govt. has been proactive, the industry needs to respond. For instance, the PLI scheme for manufacturing of advanced solar cells or ACC for battery storage, solar bidding, biofuels under SATAT Programme, etc. are all examples of active support. Likewise, India's start-up ecosystem is a case in point where active government sponsorship has led to the creation of 400+ incubators supporting entrepreneurs, start-ups and students with promising ideas. However, the osmosis between start-up and corporate systems is weak. Barring exceptions, even the public sector start-up programs have largely stopped at grants and passive investments rather than inducting innovative technologies to drive transformative change.

Rapid transition has to be led by deep cultural transformation. China has quickly transitioned itself from being a global manufacturing hub to hub of future looking innovations. Strong government support, impressive innovation speed and culture4, high growth environment, and scale offering fierce competition, feedback, and mass adoption, are some of the factors that have helped China's transition. For India to emerge as a clean energy leader the corporate and innovation ecosystems have to come together actively. India needs capability to scale up, draw sustenance from academic research (producing original patents, not PhDs alone), obtain funding for moonshot ideas, get corporate support in the development, find spaces for collaborative development with Corporate India, get inducted into those ecosystems without backbreaking bureaucratic burdens.



Skill Development and Capacity Building in Smart Metering

Mr. Anurag Mehrotra
Chief Human Resources Officer, IntelliSmart

In the FY2021-22 budget speech, the finance minister announced the launch of a revamped, reforms-based, result-linked scheme aimed at addressing critical challenges in India's power distribution sector. This initiative seeks to bolster the viability of Distribution Companies (DISCOMS) by supporting infrastructure enhancements, including the adoption of prepaid smart metering and feeder separation, alongside system upgrades. Central to this scheme is the imperative to reduce Aggregate Technical and Commercial (AT&C) losses, align Aggregate Cost of Supply (ACS) with Average Revenue Realized (ARR), and foster institutional capabilities.

Moreover, the revised plan places significant emphasis on process optimization and human capital development, offering consultancy services to facilitate these transitions. This includes enhancing technological prowess in smart grids and integrating cutting-edge technologies such as cloud computing and cybersecurity.

As a leading Advanced Metering Infrastructure Service Provider (AMISP), IntelliSmart has taken charge of driving these skill advancements. From mobile applications to connectivity technologies and the deployment of smart meters, IntelliSmart oversees the end-to-end implementation of AMI systems. Their initiatives extend to specialized IT solutions tailored for industry-specific needs like HES, MDM, workforce management, and consumer applications, as well as broader IT domains such as cloud computing and cybersecurity—crucial in safeguarding consumer data handled by AMISP organizations. To bolster these innovations sector-wide, IntelliSmart collaborates with top-tier IT solution providers.

To support these efforts, IntelliSmart has forged strategic partnerships, including a Memorandum of Understanding (MoU) with TPDDL and ISGF, focusing on skill development and capacity building within the Power Distribution Sector. This initiative aims to deliver specialized training courses, real-time simulation programs, and knowledge-sharing platforms tailored for DISCOMS and allied organizations. The overarching goal is to elevate industry standards collectively rather than in isolation.

By 2025, the deployment target of 25 crore meters under the aforementioned reforms underscores the monumental task ahead,

exacerbated by the sector's scarcity of skilled manpower. Addressing this, IntelliSmart emphasizes the critical role of skill development, particularly for field force personnel tasked with critical installation and maintenance operations. The organization advocates for comprehensive training programs designed to enhance employability and career progression within the industry.

Crucially, adopting a **"First Time Right"** approach becomes paramount to the success of the RDSS program, ensuring accurate meter installation and data transmission essential for billing and revenue realization. This mindset necessitates meticulous planning and standardized processes, underpinned by rigorous training to equip field personnel with the requisite competencies.

Safety remains another cornerstone of IntelliSmart's operational ethos, given the inherent risks in the electricity distribution sector. Emphasizing a **"Safety First"** culture, IntelliSmart mandates regular health and safety training for all personnel across field operations, technical teams, and warehouse staff. These initiatives not only promote a secure working environment but also enhance confidence and operational efficiency.

Conclusion: IntelliSmart's proactive approach to skill development, technological integration, and safety underscores its commitment to transforming India's power distribution landscape. By fostering industry-wide collaboration and investing in human capital, IntelliSmart paves the way for sustainable growth and innovation in the sector.

The Domino Effect: How Small Oversights Can Derail Major Projects

Mr. Sanjeev Suhag
DGM – IT Operations, IntelliSmart

The 2003 Columbia Space Shuttle disaster serves as a stark reminder of how seemingly minor incidents can precipitate catastrophic outcomes. A piece of foam insulation, no larger than a briefcase, struck the shuttle's wing during launch. This ostensibly trivial event compromised the shuttle's thermal protection system, triggering a chain reaction that ultimately led to its tragic disintegration upon re-entry.

In large-scale projects such as the AMI program, minor services might appear negligible. The unavailability of a critical workforce management application, an IMD service, or a missing adapter service could easily be dismissed. However, these ostensibly minor components are often the linchpins holding the entire project together. Their absence can cause delays, halt progress, and ultimately derail the entire project timeline.

This is not merely a theoretical risk. The 2010 Deepwater Horizon oil spill was not caused by a single, monumental failure. Instead, it resulted from a series of oversights and minor equipment malfunctions. A malfunctioning blowout preventer, a critical safety device, failed to activate, allowing oil to gush uncontrollably and leading to an environmental catastrophe.

The domino effect extends far beyond physical objects. In the intricate world of smart metering technology, an adapter service—a seemingly minor software component—plays a vital role in ensuring smooth data communication between meters and the central network. A malfunctioning adapter could disrupt the entire system's ability to collect energy usage data, impacting everything from billing to conservation efforts.

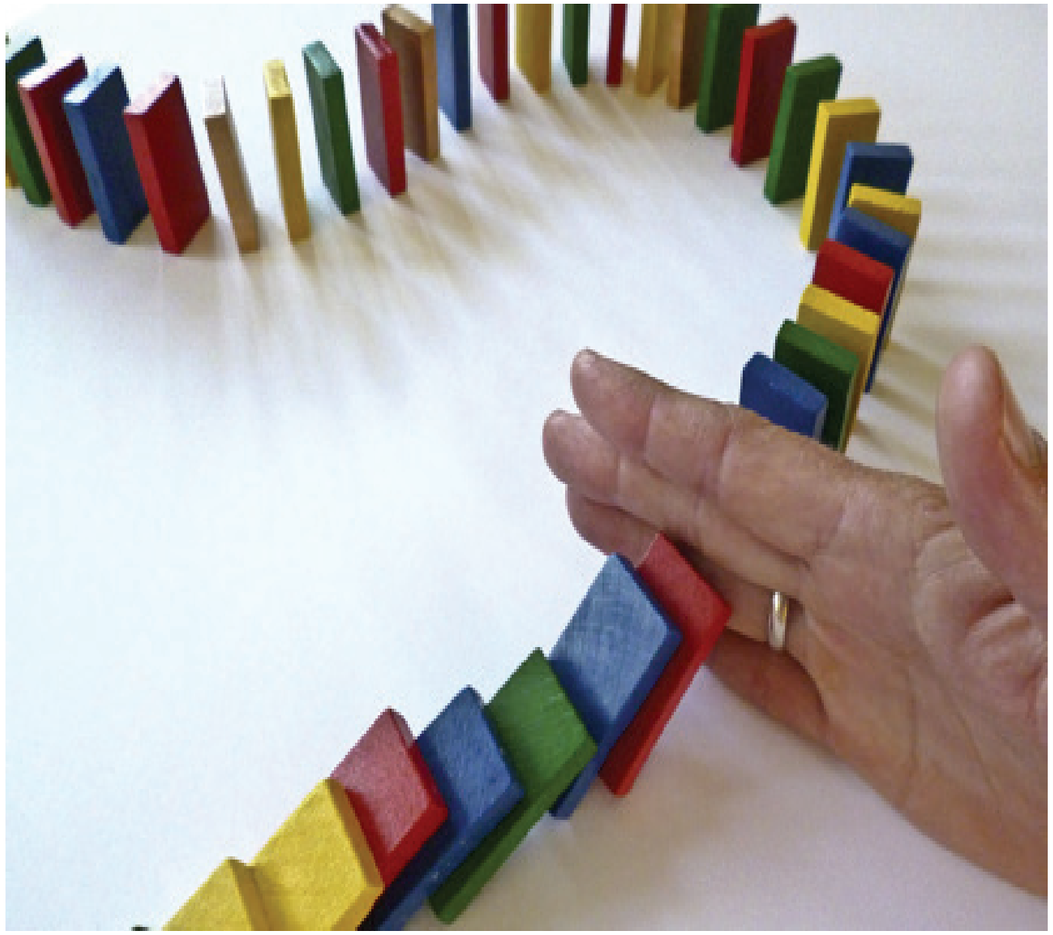
Despite their vastly different contexts, these examples share a common truth: small failures can trigger catastrophic consequences.

The Columbia Space Shuttle disaster, the Ocean Gate submarine implosion, and the Deepwater Horizon tragedy offer invaluable lessons. They emphasize the importance of:

- **Meticulous attention to detail:** Every aspect of a project, no matter how small, requires thorough scrutiny.

- **Robust risk assessment:** Proactively identifying potential issues is crucial for mitigating risks.
- **Strong safety protocols:** Implementing rigorous safety measures can prevent accidents and save lives.
- **Effective communication:** Clear communication between all stakeholders ensures timely identification and resolution of problems.
- **Proactive risk management:** A proactive approach to risk management helps prevent small issues from escalating into major disasters.

Recognizing the potential consequences of seemingly insignificant details is essential for fostering a culture of safety and vigilance in complex projects. By learning from past mistakes and implementing proactive measures to mitigate risks, we can strive to prevent future catastrophes and ensure the success of our projects.



India's green transition: Battery energy storage systems holds the key

Debalina Dey
Manager, Corporate Communications & PR, IntelliSmart

India's clean energy transition is rapidly accelerating, outpacing that of any other major economy. Globally, India is now third-largest solar power generator. With a record addition of 18 GW of capacity in FY 2024, renewable energy is experiencing unprecedented growth in the country. This momentum is expected to continue this year, with 103 GW of renewables, 18 GW of hydro, and 8 GW of nuclear energy already in the pipeline.

India is also aiming to achieve a domestic renewable energy target of 500 GW by 2030, a bold commitment that necessitates significant efforts to rapidly increase the share of clean energy in its power mix. Solar and wind power, both intermittent energy sources, are poised for substantial growth as India endeavours to expand its renewable energy capacity. As these variable renewables scale up, it will drive up flexibility requirements, highlighting the importance of energy storage to dispel intermittency challenges and ensure grid stability.

Pioritising energy storage will help India unleash the full potential of renewable energies and achieve the goal of Net Zero emissions set for 2070. The Central Electricity Authority (CEA) projected that by 2047, India's energy storage requirements will soar to 320 GW (comprising 90 GW from Pumped Storage Projects (PSP) and 230 GW from Battery Energy Storage Systems) This will equate to a storage capacity of 2,380 GWh (with 540 GWh from PSP and 1,840 GWh from BESS), driven by the substantial addition of renewable energy to meet Net Zero goals.

Policy support for BESS

Recognising the importance of storage solutions, India has recently focused on battery energy storage systems (BESS) and the market is likely to grow significantly in the coming years, propelled by the evolving demands and necessities of the power sector. A recent report on 'Batteries and Secure Energy Transitions' by International Energy Agency (IEA) estimated that India would be the world's third-largest market for utility-scale batteries by 2030. IEA's India Energy Outlook 2021 estimated that by 2040, India is expected to establish a battery storage capacity of 140 GW, making it the largest of any country.

There is no doubt that globally, and in India too, the progressive fall in battery costs have cut down energy storage costs and enabled BESS projects. According to ICRA, the cost of storage using BESS has decreased from over Rs 8-9 per unit in 2022 to Rs 6.0-7.0 per unit currently. It is, however, still relatively high compared to the Rs 5 per unit cost for Pumped Storage Projects (PSP) hydro.

According to a 2023 report by the Central Electricity Authority (CEA), India will need about 41.65 GW of BESS by 2030 to meet its electricity demand. The Government of India

has recently approved viability gap funding of Rs 3,760 crore to develop 4,000 MWh of BESS projects by 2030-31. Furthermore, the government has mandated newly established renewable energy plants (excluding hydropower) to integrate at least 5 percent of their installed capacity with storage solutions.

The Ministry of Power has also outlined a long-term trajectory for Energy Storage Obligations (ESO) to guarantee adequate storage capacity among obligated entities. According to this trajectory, the ESO will incrementally rise from 1% in 2023-24 to 4% by 2029-30, with an annual increase of 0.5%. Fulfilment of this obligation will only be recognised when at least 85% of the total stored energy is sourced from renewable energy annually.

Huge economic opportunity & way forward

Energy storage presents a significant economic opportunity for India. With the continuous capacity additions of renewable energy, it becomes imperative for India to establish domestic manufacturing capacity in this sector to bolster the transition towards clean energy. This would yield benefits, including reduced reliance on oil imports and greater integration of renewable energy sources into the grid.

As per a NITI Aayog report, India's cumulative battery requirements from 2026 to 2030 are projected to be at least 2,410 GWh. If India manufactures both cells and packs and imports only cathodes, the country may capture ~80 percent of the total economic opportunity, representing an economic value ranging from Rs 9.3 to 13.7 lakh crore.

India has rightly allocated USD 2.46 billion under the production-linked incentive scheme to promote the domestic manufacturing of advanced chemistry cells. India now needs to prioritise research and development in various battery technologies to foster a robust domestic manufacturing ecosystem.

There's no doubt that energy storage is essential for India's transition to clean energy. As the country overhauls its power infrastructure, it will need a diverse set of storage solutions to address the varied needs of different regions and consumer bases, effectively paving the way towards Net Zero emissions future.

Company Highlights: Events and Celebrations

Madhyanchal One Infrastructure Pvt. Ltd., a wholly owned subsidiary of IntelliSmart Infrastructure Pvt. Ltd., has successfully conducted walk-in interviews for the position of Field Engineer.

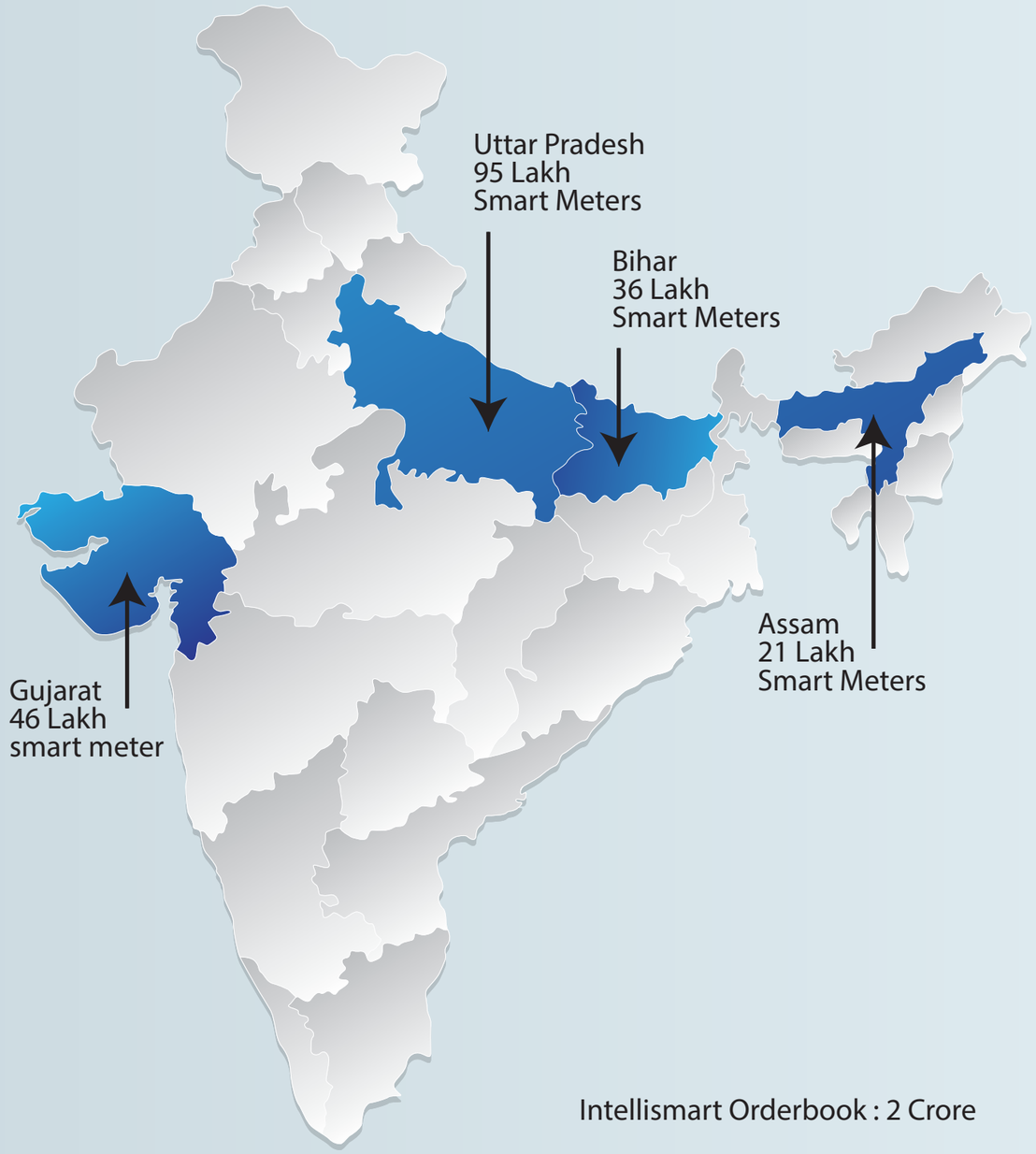
IntelliSmart and its subsidiaries are providing opportunities for individuals to join the flourishing smart metering sector through walk-in interviews.

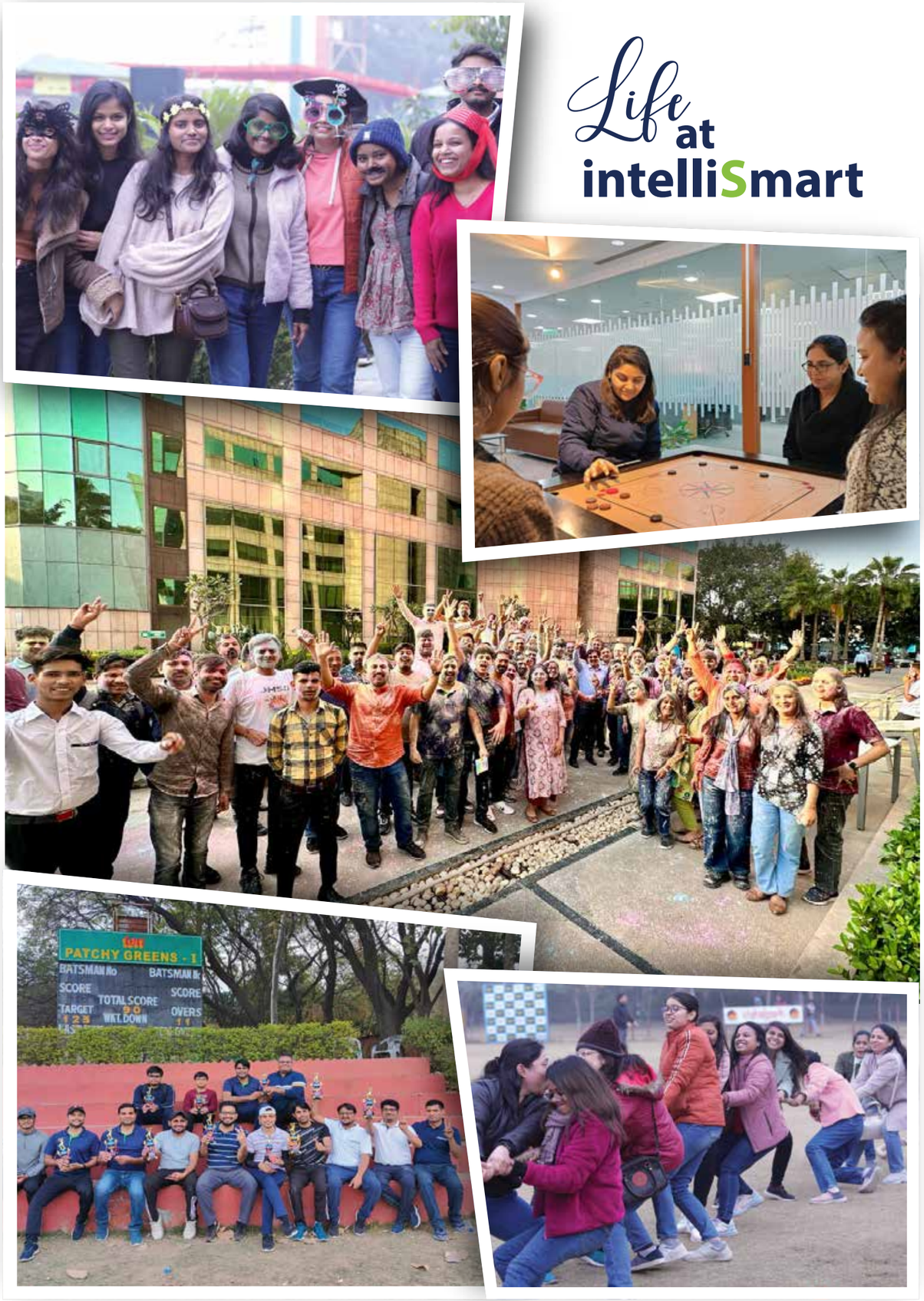
The first smart prepaid meter was installed in Mohania block of Kaimur district, and Nalanda Circle as part of IntelliSmart Infrastructure Pvt. Ltd.'s project for South Bihar Power Distribution Company Limited (SBPDCL).

On World Environment Day, IntelliSmart's subsidiaries and state teams planted saplings, distributed saplings, and pledged to protect the environment.These initiatives are steps toward a greener and more sustainable future. IntelliSmart will continue to promote environmental stewardship and encourage others to join in preserving our planet.

IntelliSmart has achieved the milestone of installing one lakh smart prepaid meters in Bihar. In celebration of this achievement, Mr. Sanjeev Hans, Principal Secretary of the Bihar Energy Department and CMD of Bihar State Power Holding Company Limited, led the ceremony. It was joined by Mr. Vijaya Kumar, Director (Operations) of SBPDCL, Mr. Bhupendra Kumar, Mr. Vinit Kumar, and the IntelliSmart team.

IntelliSmart Footprint





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IntelliSmart would like to express sincere gratitude to all the contributors of K-Xchange. Your contributions have played a vital role in driving sectoral transformation and enabling our readers to stay up-to-date with the latest industry trends and developments.

We would like to extend our heartfelt thanks to all the contributors for their time and effort in sharing their thoughts and opinions with our readers.

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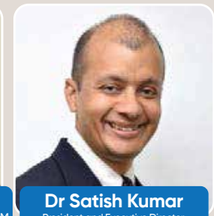

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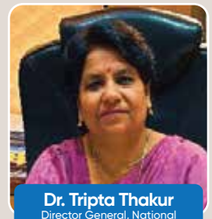

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