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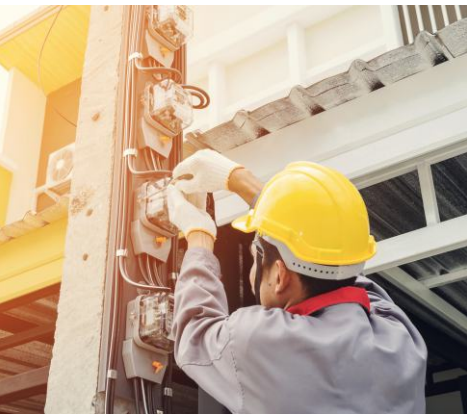
**SDA**  
Smart Distribution Alliance



GOVERNMENT OF INDIA  
MINISTRY OF POWER

**CASE STUDY**

**SMART METERING  
MARKET  
TRANSFORMATION  
IN INDIA**



## About SAREP

The South Asia Regional Energy Partnership (SAREP), a flagship program to advance objectives of the U.S. Government's Clean Asia Enhancing Development and Growth through Energy (Clean EDGE), is a five-year initiative (2021-26) that aims to improve access to affordable, secure, reliable, and sustainable energy across six South Asian countries—Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka—in line with these countries' climate and clean energy priorities.

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# Abbreviations

ACS	Average Cost of Supply
AI	Artificial Intelligence
AMI	Advanced Metering Infrastructure
AMISP	Advanced Metering Infrastructure Service Provider
ARR	Average Revenue Realized
AT&C	Aggregate Technical and Commercial
AVVNL	Ajmer Vidyut Vitran Nigam Limited
BIS	Bureau of Indian Standards
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
DBFOOT	Design, Build, Finance, Own, Operate and Transfer
DPR	Detailed Project Report
DT	Distribution Transformer
EESL	Energy Efficiency Services Limited
ESCO	Energy Service Company
FoR	Forum of Regulators
Gol	Government of India
IPDS	Integrated Power Development Scheme
ISGTF	India Smart Grid Task Force
IT	Information Technology
MoP	Ministry of Power
NIIF	National Investment and Infrastructure Fund
NSGM	National Smart Grid Mission
OEM	Original Equipment Manufacturer
PE	Private Equity
PPP	Public Private Partnership
QoSS	Quality of Service and Supply
RDSS	Revamped Distribution Sector Scheme
RE	Renewable Energy
SBD	Standard Bidding Document
SG	Smart Grid
SGKC	Smart Grid Knowledge Centre
SLA	Service Level Agreement
SMNP	Smart Meter National Programme
SOP	Standard Operating Procedure
UDAY	Ujwal Discom Assurance Yojana
USAID	United States Agency for International Development

# Context Setting

The Indian power sector is undergoing rapid transformation driven by sustained economic growth and rising customer aspirations. Revamping power distribution has been high on Government of India's (GoI's) agenda. Accordingly, a number of reform initiatives have been implemented in the last few years to improve operational and financial performance of distribution utilities (DISCOMs). This includes massive rural electrification and last mile connectivity; network strengthening and IT enablement; performance improvement of DISCOMs; enabling digitization; improving end use energy efficiency, among others.

Despite these interventions, DISCOMs continued to face challenges related to (i) financial sustainability; (ii) quality of service and supply (QoS); (iii) integration of renewable energy (RE); and (iv) customer centricity. One of the key root causes for weak performance had been absence of real time measurement of data from distribution assets and end-to-end energy accounting. To address this root cause, smart metering was introduced to address both legacy issues as well as pave way for modern services to customers.

Distribution Challenges	Solutions offered by Smart Metering
<b>Financial sustainability of DISCOMs</b> <ul style="list-style-type: none"> <li>High distribution losses</li> <li>Tariff not reflective of costs</li> <li>High accumulated losses hampering investments in upgradation and modernisation</li> </ul>	Enables real time energy audit and subsequent reduction in commercial losses.
<b>QoS</b> <ul style="list-style-type: none"> <li>Ensure 24x7 reliable power supply</li> </ul>	Enables faster resolution of outages through outage management system.
<b>Integration of RE</b> <ul style="list-style-type: none"> <li>Ambitious targets of RE installation</li> <li>Intermittent nature of RE</li> </ul>	Enables RE integration when coupled with net metering.
<b>Customer centricity</b> <ul style="list-style-type: none"> <li>Poor customer services</li> <li>Lack of real time analytical insights</li> </ul>	Enhances customer experience by enabling advanced use cases such as revenue management through Gen AI, customer loyalty programs etc.

Smart metering started small with few pilots and players in 2012, and as learnings emerged, it gradually transformed into a full-scale national rollout with large number of developers, private equity (PE) firms, manufacturers, and equipment providers. India's smart metering program is the largest in the world (250 million+) being implemented on public private partnership (PPP) basis. While new developments are still unfolding, this case study depicts the phase-wise journey of smart metering in India and brings out key lessons thus far.

# The Smart Metering Journey

Smart metering journey of India, can be categorized into three phases as described below:

## Initiation Phase (2010 – 2014)

This phase involved setting up of institutional structure to drive smart metering in a phased manner to build confidence among the stakeholders. Key initiatives included:

- **Formation of the India Smart Grid Task Force (ISGTF)** - Gol constituted ISGTF in 2010, to serve as the focal point for all activities related to smart grids (SG). As a first step, SG pilot projects were taken up to: (i) test various SG technologies/ use cases; (ii) identify suitable policy/ regulations/ business models for large scale implementation; and (iii) understand operational/ deployment issues related to smart metering. ISGTF was later subsumed into National Smart Grid Mission (NSGM), which was established to act as the nodal entity for planning, monitoring, and implementing SG policies and program.
- **Launch of Smart Grid Pilot Projects** - Gol implemented 12 SG pilots starting from 2012. These SG pilots provided insights on cost, business models, communication technologies, standardization of specifications, etc. for defining approaches for scale-up.

## Foundation Phase (2015-2019)

Recognizing the benefits of smart metering, several measures were taken to promote large scale smart meter installation. Stakeholder-wise measures were as follows:

### > Ministry of Power (MoP)

- Launch of NSGM in 2015
- 4 Large scale SG projects sanctioned under NSGM in capex mode
- Target of 35 million smart meters installation under Ujwal DISCOM Assurance Yojana (UDAY) scheme & funds provided under Integrated Power Development Scheme (IPDS)
- Smart metering standards released by Bureau of Indian Standards (BIS)
- Advanced Metering Infrastructure (AMI) specifications released by Central Electricity Authority (CEA)

### > Central Electricity Regulatory Commission (CERC) / Forum of Regulators (FoR)

- Model smart grid regulations issued by FoR and adopted by 3 states
- Mandate to transition to smart prepaid metering introduced in Revised Tariff Policy 2018

### > Energy Efficiency Services Limited (EESL)

- Launched large-scale tender for installation of 10 million smart meters in Uttar Pradesh and Haryana in 2017 on Build Own Operate and Transfer (BOOT) Model
- Implemented smart metering projects in Andhra Pradesh, Bihar, Delhi, Madhya Pradesh, etc.

Currently, Intellismart, a joint venture of EESL<sup>1</sup> and the National Investment and Infrastructure Fund (NIIF), implements all smart metering projects originally undertaken by EESL.

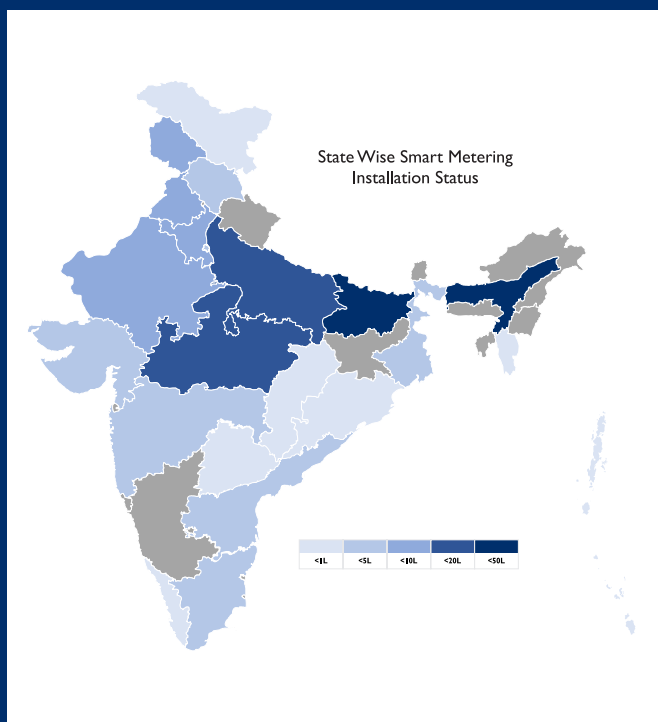
### Scale-up Phase (2020-Ongoing)

Though the foundation phase laid the groundwork for scale-up initiatives, challenges related to utility readiness and limited private sector participation remained. In this regard, MoP organized a national consultative workshop in 2019, with support from the United States Agency for International Development (USAID), to identify interventions for scaling up smart metering in India.

USAID supported GoI on several interventions to enable smart metering ecosystem. These included: (i) model smart grid regulations; (ii) smart grid training course; (iii) formulation of Standard Bidding Documents (SBDs); (iv) web-based investment analysis tool for utility modernization projects; (v) consumer engagement toolkit; and (vi) roadmap for Smart Grid Knowledge Centre (SGKC). The change from capex to PPP implementation model for smart metering projects has been one of the most significant contributions, which has helped expand the Indian smart metering market.

#### These Interventions were as follows:

- **Formulation of Standard Bidding Documents (SBDs) –** Model SBDs for implementation of Advanced Metering Infrastructure Service Provider (AMISP) projects on Design, Build, Finance, Own, Operate and Transfer (DBFOOT) model were formulated in 2020 to standardize the procurement process. SBDs embedded the lessons learnt from various past deployments such as: (a) no upfront capex requirement by utilities to reduce their financial burden; (b) innovative payment security mechanism in the form of direct debit facility for AMISP to ensure smooth investment recovery; (c) creation of pre-payment infrastructure to ensure customer convenience, etc. among others.



State Wise Smart Metering Status<sup>2</sup>

<sup>1</sup> Energy Efficiency Services Limited (EESL) is a government owned Energy Service Company (ESCO), enabling customers, industries, and governments to manage their energy needs through energy efficient technologies. About Us - Energy Efficiency Services Limited (eeslindia.org)  
<sup>2</sup> NSGM's State Wise Smart Metering Status; Accessed on 9 January 2025

- **Release of Electricity (Rights of Consumers) Rules, 2020** – The rules mandated smart prepayment meters for new connections. It also focused on empowering customers by providing real-time access of energy consumption data to customers.
- **Amendment to Electricity Act 2021** – The amendment focused on enhancing operational efficiency and financial sustainability of DISCOMs through smart metering. It also removed provision of security deposit for smart pre-paid meters to facilitate adoption.
- **Launch of Revamped Distribution Sector Scheme (RDSS) in 2021** – RDSS was a reforms-based and results-linked scheme with objectives to: (i) improve power quality, reliability, and affordability; (ii) reduce AT&C losses; and (iii) reduce Average Cost of Supply (ACS) and Average Revenue Realized (ARR) gap to zero. RDSS comprised of two parts i.e. (i) Metering and distribution infrastructure works including installation of 250 million+ smart pre-paid meters for customers and communicable meters for DT/ feeders; and (ii) Training, capacity building and other enabling and supporting activities including augmentation of SGKC and development of Artificial Intelligence (AI) applications for power distribution.
- **Empanelment process for AMISPs in 2022** - AMISPs needed to successfully demonstrate their end-to-end AMI solution in a controlled test environment or in a live project prior to participate in smart metering tenders under RDSS. Market, which used to be led by very few Original Equipment Manufacturers (OEMs), saw over 59 public and private entities including large project developers, PE players, manufacturers, etc. participating in smart metering tenders<sup>3</sup> due to visibility of large market size under RDSS.
- **Participation by large project developers and PE firms** - Tenders for 132 million smart meters have been awarded till date under RDSS.<sup>4</sup> Top entities that have won these contracts include large project developers such as Adani, Intellismart, Genus Power, NCC, Polaris, etc. Furthermore, several PE firms have also started to directly invest in smart metering companies to participate in these tenders. Few examples include \$100 million investment in Gram Power by I Squared Capital, partnership between Singapore’s sovereign wealth fund GIC and Genus Meters to create \$2 bn smart metering platform, etc.<sup>5</sup>

## Factors driving private sector participation



Standardization  
of  
procurement



Visibility of  
large  
market size



Risk-balanced  
innovative  
business model



Supportive  
policies/  
regulations

<sup>3</sup> AMI Test Demonstration (recindia.nic.in); Last updated on 20th September, 2024; Accessed on 9th January, 2025 (NSGM Dashboard)

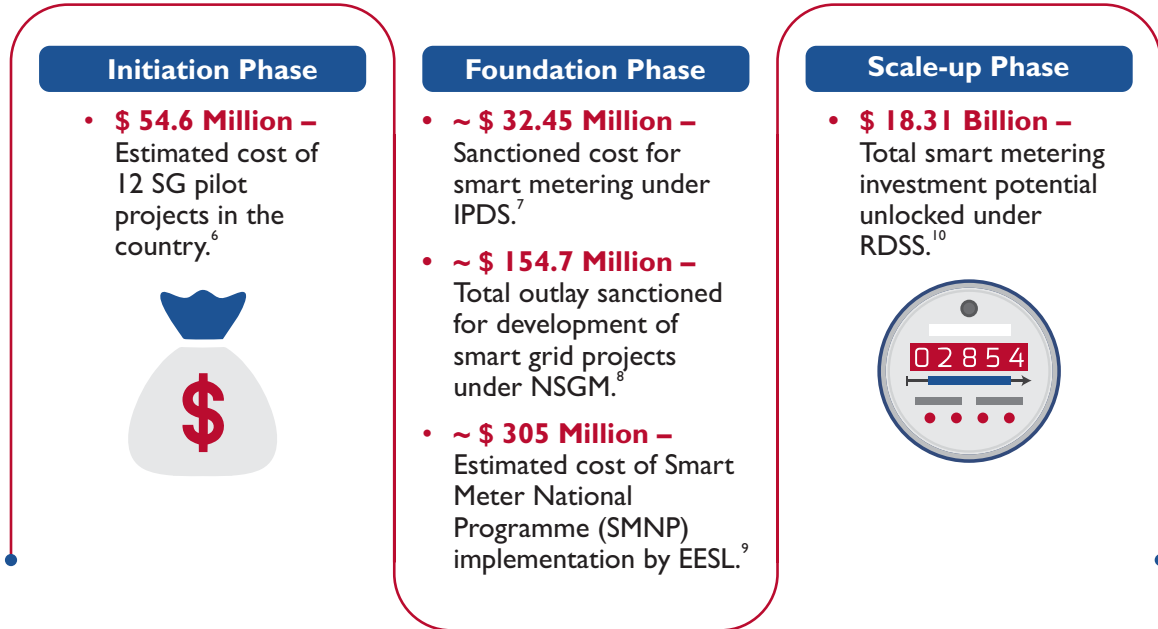
<sup>4</sup> Powerline | Smart metering market set for exponential growth; Published on 13th November, 2024; Accessed on 9th January, 2025

<sup>5</sup> Total Expenditure (TOTEX) business model is a combination of both OPEX and CAPEX business models which includes a certain amount of upfront lumpsum payment as well as fixed monthly annuity payments.



## Indicative Investments

The phase-wise details of smart metering investments are provided below:



## Achievement, Impact and Benefit

Immediate benefits realized by the DISCOMs have included the following:



6 Home | National Smart Grid Mission, Ministry of Power, Government of India (nsgm.gov.in); Status of SG Projects; Status of Smart Grid Pilots and NSGM Smart Grid Projects; Published in April 2017; Accessed on 9th January, 2025

7 Home | INTEGRATED POWER DEVELOPMENT SCHEME (IPDS) | All India Status; Conversion rate of 2019 at US\$ 1 = INR 70.414; Accessed on 9th January, 2025

8 Home | National Smart Grid Mission, Ministry of Power, Government of India (nsgm.gov.in); Conversion rate of 2019 at US\$ 1 = INR 70.414; Accessed on 9th January, 2025

9 SMNP - Energy Efficiency Services Limited (eeslindia.org); (Total 35.75 lakhs meters installed, cost of smart metering assumed to be INR 6,000 per meter); Conversion rate of 2019 at US\$ 1 = INR 70.414; Accessed on 9th January, 2025

10 Press Release: Press Information Bureau (pib.gov.in); Article - National Level AT&C Losses in Power Network down from 22.3% in 2020-21 to 16.4% in 2021-22; Conversion rate of 2021 at US\$ 1 = INR 73.940; Published on 11th August, 2023; Accessed on 9th January, 2025

# Learnings from the India Experience



## **Strong government commitment**

Sustained policy push at the federal level starting from creation of dedicated institutional structure for planning, implementing, and overseeing the smart metering projects in the country. The institutional structure was gradually strengthened through measures such as allocation of funds for scale-up.

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## **Pilots for learnings and boost investor confidence**

Pilot projects were taken up to test/ demonstrate the efficacy of various smart metering technologies and document their learnings w.r.t. to business model, communication technologies, implementation issues, etc. These projects provided key insights/ inputs for defining the pathways for scale-up initiatives.

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## **Clear implementation mandate**

Implementation of smart metering was made mandatory for all state utilities through modification of the metering regulations by the CEA. Additionally, release of funds under RDSS (15% government budgetary support with rest coming from private sector) was made contingent upon utilities implementing smart metering in their respective states.

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## **Standardization of bidding framework**

Technical standards for smart meters and functional requirements for AMI were finalized prior to scale-up phase. Furthermore, the model SBDs provided standard terms and conditions for contracting for smart metering projects which utilities were obligated to follow. This helped increase the vendor base and private sector participation in project implementation.

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## **Strong government-utility-industry interface**

Extensive and structured stakeholder consultations were conducted to design an acceptable and responsive tendering framework. The standard SBD terms/ clauses were deliberated across stakeholders to ensure buy-in on the SBDs and project framework.

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## **Unique PPP approach backed by strong digitally enabled payment security mechanism**

Flexibility to choose technology/ technology providers to best meet the project SLAs. Direct debit facility ensures seamless recovery of investments with minimal utility intervention. The improvement in credit quality has led to enhanced bankability of projects.

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## **Enhancing utility preparedness**

Model documents/tools were provided to the state utilities to manage smart metering projects. These included: (i) model template Detailed Project Reports (DPRs); (ii) web-based tool to perform cost-benefit analysis; (iii) model SBD; (iv) SOPs for installation, monitoring and evaluation of projects; and (v) consumer engagement toolkit.

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## **Customer engagement embedded right from onset**

Value proposition of smart meters for customers were communicated prior to the deployments to mitigate customer resistance and ensure active participation. A consumer engagement framework and toolkit were created to help raise consumer awareness and engage consumers proactively.

# Way Forward

## Implementation focus and debottlenecking



Strong project management will be critical for ensuring timely implementation of projects. As the pace of implementation increases, several challenges will emerge that will require rapid debottlenecking through an empowered mechanism. Furthermore, ensuring not only debottlenecking strategies but also new learnings are embedded in ongoing/ subsequent deployments.

## Customer feedback loop and new services



It will be critical for AMISPs and utility officials to gather customer insights and opinions to design new services and improve existing business processes. The feedback mechanism needs to be continuous to cater to the changing customer demands and aspirations. Additionally, hyper personalized services to customers such as access to energy usage data, payment of bills, notifications/ alerts, etc. would ensure active participation by consumers in various smart metering initiatives.

## Use of data and enablement of new use cases



The real value of smart metering is generated through new use case enablement. This includes: (i) direct utility-linked use cases such as revenue management, customer engagement and loyalty programs, peak load management, outage management, network analytics etc.; and (ii) non-utility use cases such as insurance, payments, smart home and automation, e-market place for energy efficiency services, etc., enabled through authorized access of smart metering data with third parties.

## Tariff reforms



The new customer data stream and high visibility of supply side data collectively will make it possible to progressively introduce advanced dynamic tariff schemes. It will be critical to work towards introducing these schemes with the aim of creating a more efficient, reliable, and affordable power system.





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0.9.2 - data

1500 imp/kWh



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Disclaimer: This study/report was produced for review by the United States Agency for International Development. It was prepared by RTI International for the South Asia Regional Energy Partnership (SAREP) activity, task order number 72038621F00002.

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