Workshop on Smart Grid Technologies and Implications for Inclusive Development in Sri Lanka

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Smart Grid Developments in India

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National Smart Grid Mission

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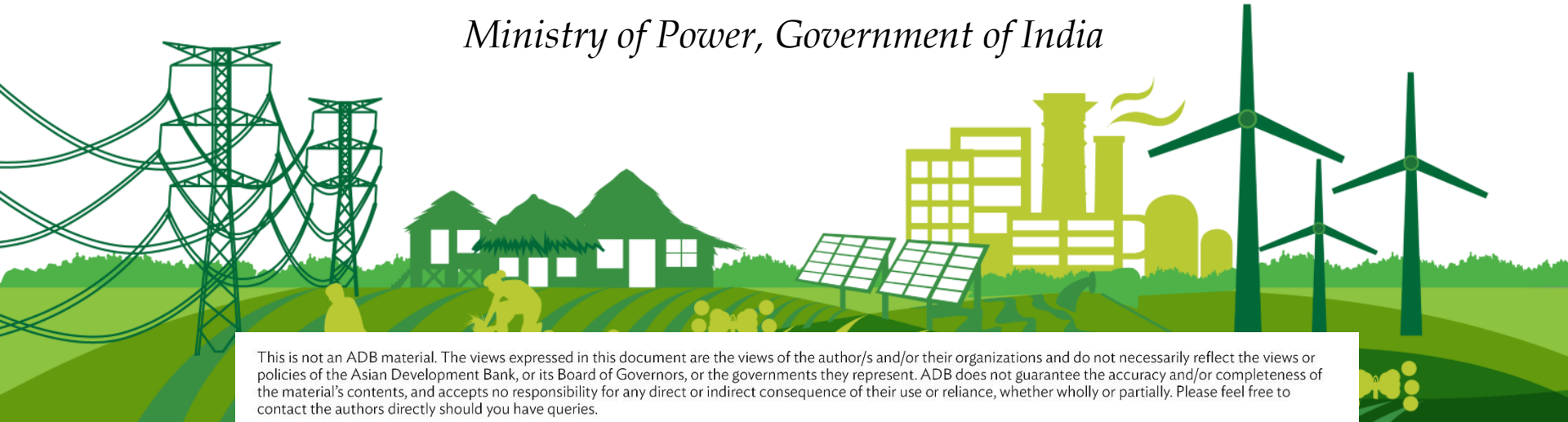

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Smart Grid Vision for India

"Transform the Indian power sector into a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active participation of stakeholders"

National Smart Grid Mission

1. Government of India approved the establishment of NSGM in March 2015- Single point contact for Smart Grid http://www.nsgm.gov.in/en/nsgm

2. NSGM to plan and monitor implementation of policies and programs related to Smart Grid

3. NSGM has its own resources, authority, functional & financial autonomy

4. The total outlay for NSGM activities for 12th Plan: Rs.980 crore with a budgetary support of Rs.338 crore

5. NSGM - Project Management Unit (NPMU) housed in POWERGRID

6. NSGM has three tier hierarchical institutional structure

National Smart Grid Mission
Ministry of Power
Government of India

NSGM Objectives

- Bringing in development of Smart Grids:
  - Enable access and availability of quality power to all
  - Loss reduction
  - AMI roll out, prosumer enablement, Demand Response (DR)/Demand Side Management (DSM)
  - Policies and tariffs – Dynamic tariff implementation, DR programs, tariff mechanisms for solar PVs
  - Renewable integration – Green power and energy efficiency
  - Electric vehicles (EV) and energy storage – EV charging stations & energy storage systems
- Capacity building in utilities and regulators for Smart Grid
- Technical cooperation, research and collaboration with national and international development partners like ISGAN,USAID, DFID, NEDO, KfW, World Bank, ADB etc.
- Facilitate consumer awareness etc.

Initiatives Till Date

- **Smart Grid Pilot Projects**
  - 12 pilots including SGKC with 50% funding (worth Rs.262 Cr.) under implementation for envisaged implementation of ~1.7 lakh Smart Meters
  - ~60,000 Smart Meters installed
  - Three pilots are under closure. Remaining are under advanced stage of implementation

- **NSGM established in 2015 to accelerate full scale Smart Grids**
  - Three projects worth Rs.258 Cr. sanctioned for ~3 lakh smart meters with 30% funding
  - IS 16444 (Part 1 & 2) for Smart Meters released by BIS
  - IS 15959 (Part 2 & 3) companion specification for Smart Meters released by BIS
  - AMI functional requirements released by CEA
  - Model Smart Grid Regulations released by FoR. Adopted by 5 states
  - State Level Project Management Units (SLPMU) formed in 14 states
  - Smart Meter rollout mechanisms mandated in National Tariff Policy 2016 and UDAY schemes

NSGM Achievements

Smart Grid Ecosystem
Formation of standards, specifications, functionalities, strategies, model documents etc.

Workshops, Communication and Outreach
Brainstorming sessions, AMI solutions, business models, ISGAN ExCo, KTP etc.

Training and Collaboration
SG training programs, MoUs, ISGAN, SGKC, SG Test Bed etc.

Standard Documents and Participation in R&D
Model RfP, model DPR, DST India report, Mission Innovation proposals etc.

Smart Grid Projects
City wise projects, phase wise rollout of Smart Grids, smart and prepaid meter rollout etc.

Smart Grid Pilot Projects
Monitoring of 12 pilot projects, learning, case studies etc.

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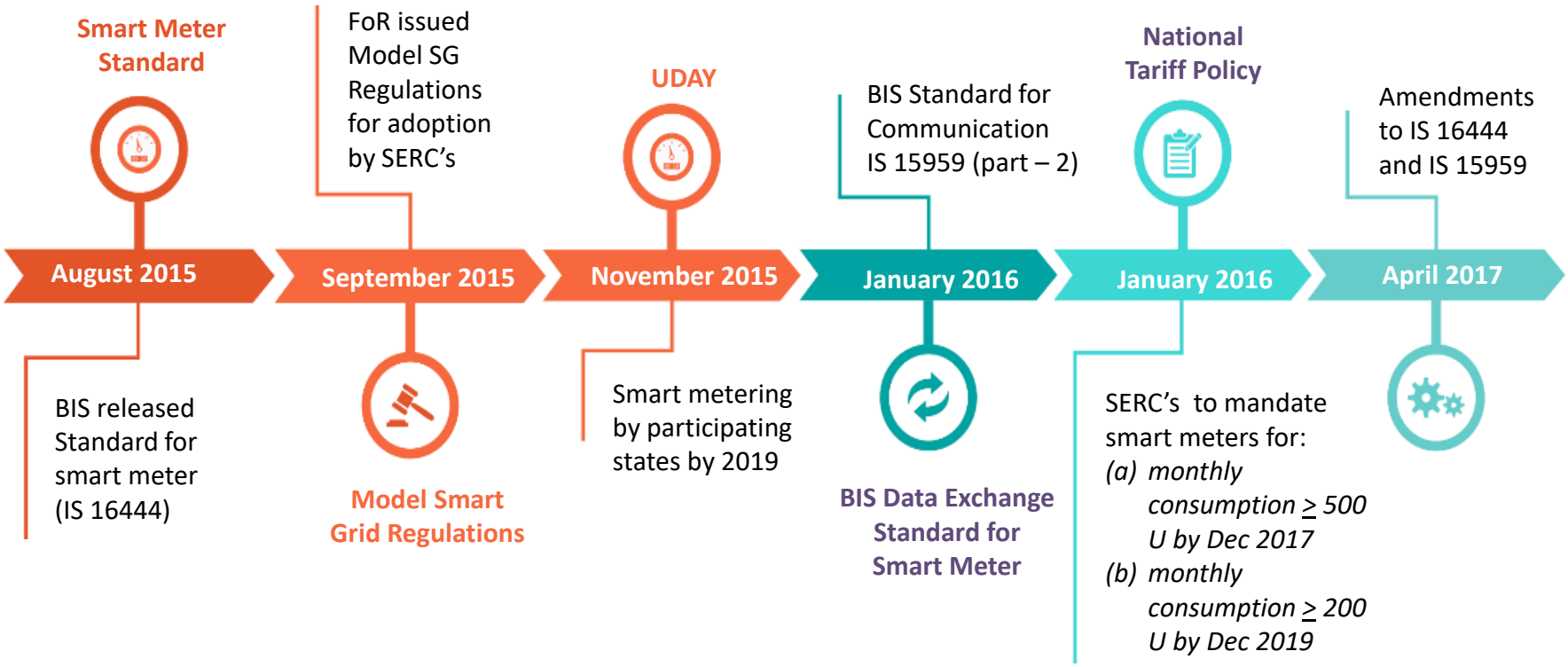
NSGM Achievements



Progress – *Smart Grid Eco System*

- NSGM Guidelines formulated in 2015
- Indicative cost for Smart Grid Projects for Estimation & Appraisal in 2016
- Functional specifications of Advanced Metering Infrastructure (AMI).
- Strategy for Roll out of AMI in States/UT in Aug 2016
- Industry engagement on Smart metering.
  - Several discussions with Smart metering Industry, testing labs, communication providers.
  - Multi sourcing: Three new manufacturers (CMS, Lotus Wireless, Sinhal Udyog)
  - Market disruption to reduce smart meter costs through EESL demand aggregation.
- Facilitated Smart Meter Testing lab preparedness for IS 16444
- Model Smart Grid Regulations by Forum of Regulators (*Adopted by 5 States so far*)
- State Level Project Management Units (SLPMU) formed by 14 States
- Development of Model RfP and Model DPR documents (under progress)

Progress – *Workshops, Comm. & Outreach*

- Revival of India's engagement with ISGAN:
  - Thirteenth Executive committee meeting hosted by India in March 2017
  - India's training program on SG shared with ISGAN – in Kind contribution
- ISGAN – India specific KTP workshop organized at CPRI in Nov 2017 wherein around 85 participants (both national and international) attended
- Indo-Japan joint Seminar on Smart Grids and Smart Meters organized
- 'Manthan' series Brainstorming Sessions with Industry/multiple stakeholders
- Four Workshops on Smart Grid /AMI solutions, Business Models & and Implementation with multiple stakeholders since 2016
  - July 2016, November 2016, May 2017, and June 2017
- NSGM website (www.nsgm.gov.in) made operational for wider information dissemination

Progress – *Training and Collaboration*

- Basic Smart Grid Training Program for Utility Professionals finalized with support from USAID, Academia and CEA
- 3-day Smart Grid training program for utility professionals; 90 professionals trained
  - July 2016 at CENPEID (Tata Power), New Delhi,
  - December 2016 at CPRI, Bangalore
  - Jan 2018 at IIT, Kanpur.
- MoU with IEEMA on collaboration in Smart Grids
  - Joint assessment, seminar, conferences, training programs, consultancy , R&D activities etc.
- Smart Grid Knowledge Center (SGKC) at Manesar by March 2018
  - Resource Centre for providing technical support
  - Capacity building & Outreach etc. (Demo for AMI, OMS, Smart Home & Microgrid)
- Collaboration with DfID on Technical support on Smart metering and Smart Grid

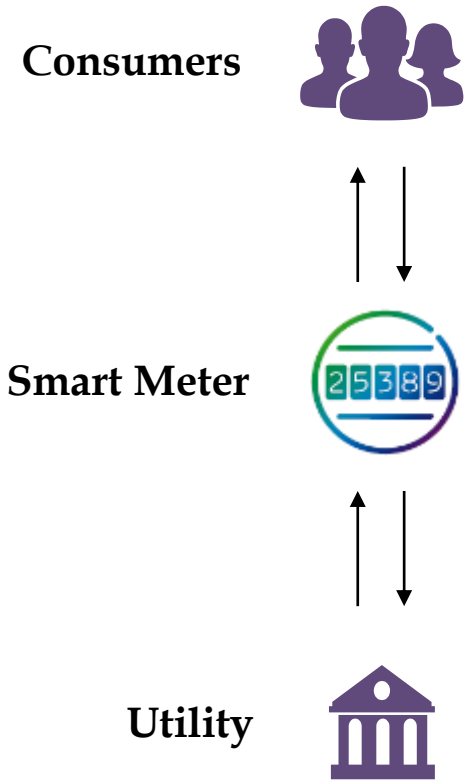
Progress – *Smart Grid Projects*

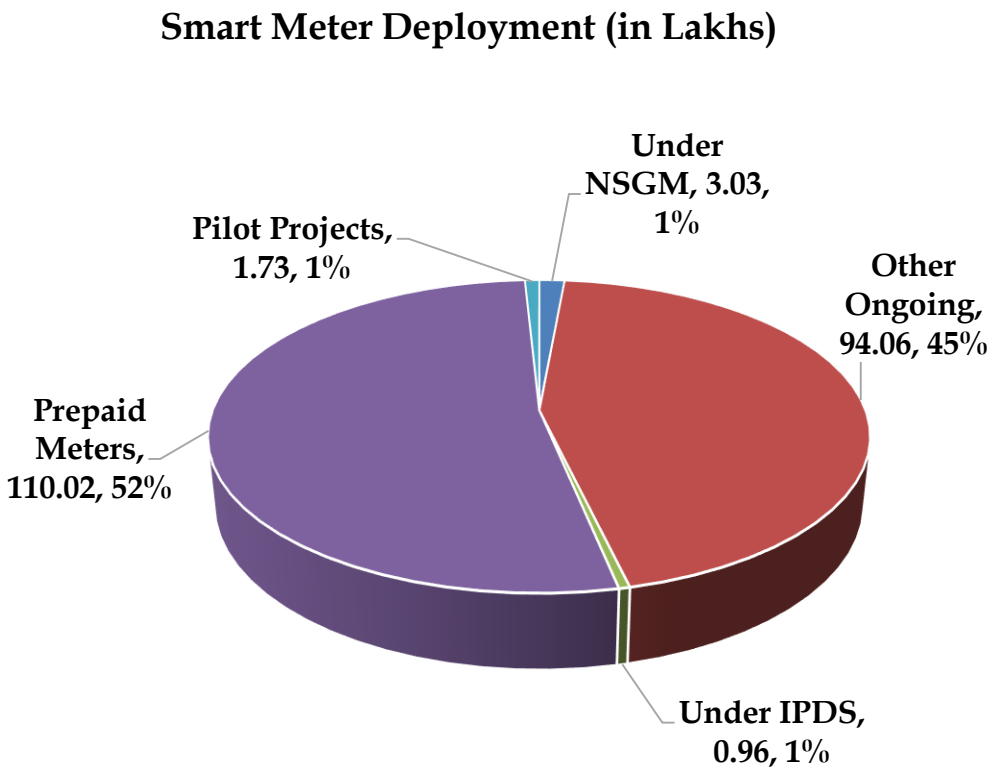
- Smart Grid projects for Amravati & Congress Nagar (MSEDCL) and Chandigarh (CED) for AMI / SCADA /DMS for ~ 3 lakh consumers sanctioned
  - Estimated cost of Rs.258 Crores with 30% GBS (Rs 173 Crore)
  - All SG Projects under tendering. Chandigarh to be awarded by March 2018
- Successfully demonstrated AMI pilot in AVVNL (Ajmer) in collaboration with USAID
- Facilitated Large Scale Roll out of Smart Meters on Business Case Model: ***Deployment of 5 Million Smart Meters by EESL for UP & Haryana***
- Accelerated implementation of Smart grid pilot projects across the country
  - SG Pilots at CESC Mysore for ~ 22000 consumers (AMI, SCADA, OMS & DTMU), at Panipat for AMI (NEDO Support) and Smart City Pilot at IIT Kanpur (AMI, SCADA, Smart Home & Rooftop Solar Integration) completed
  - SG Pilots at Kala Amb (HP) and Agartala (TSECL) in advanced stage of completion
  - A total of 12 SG Pilots under implementation. ~60,000 smart meters already installed

Progress So Far – *Others*

- Country Status Report on Smart Grids prepared with DST for Mission Innovation Challenge#1
- Co-operation with DST for 'MI Challenge#1: Smart Grids' proposals evaluation under Funding Opportunity Announcement (FOA) by DST for Indian Utility Centric Objectives w.r.t. Smart Grid Implementation
- Framework for Implementation of NSGM draft formulated after wider consultation and suggestions from stakeholders, under final deliberations.
  - Enabling Environment and Ensure Delivery of effective functions
  - Facilitate design of related policies and programs,
  - Develop New ways of financing,
  - promote New Standards and technologies,
  - Capacity building
  - Monitoring & Measurement

National Scenario of Smart/Prepaid Meters Deployment





Challenges in Smart Meter Deployment

- High meter costs
- Upfront Capex investment a challenge for utility
- Entry Barriers -requirement of varied meter standards and turnover/experience etc.
- Low utility motivation to implement the project
- Information Asymmetry on benefits of data analytics
- Limited Resource Base /Capacity Building

Précis of Smart Grid Pilot Projects

Sl.	SG Pilot	Functionality	Sanctioned Cost (₹Cr.)	No. of Consumers	Status
1	CESC, Mysore	AMI, OMS, PLM, MG/DG	32.59	21824	20496 meters installed
2	HPSEB, Himachal Pradesh	AMI, OMS, PLM, PQ	19.45	1554	1346 meters installed
3	UHBVN, Haryana	AMI, PLM, OMS	NA	11000	7044 meters installed
4	APDCL, Assam	AMI, PLM, OMS, PQ, DG	29.94	15083	13598 meters installed
5	PSPCL, Punjab	AMI, PLM	10.11	2737	Own Implementation
6	WBSEDCL, West Bengal	AMI, PLM	7.03	5265	Integrated FAT completed
7	TSECL, Tripura	AMI, PLM	63.43	45029	15049 meters installed
8	TSSPDCL, Telangana	AMI, PLM, OMS, PQ	41.82	10397	DLMS testing in progress
9	PED, Puducherry	AMI	46.11	33499	2281 meters installed
10	UGVCL, Gujarat	AMI, OMS, PLM, PQ	23.18	23760	250 meters installed
11	IIT Kanpur Smart City	AMI, HAS, SCADA, RE	12.50	20 households	Installation completed
12	Smart Grid Knowledge Centre	Lab with AMI, OMS, RE, Cyber Security	5.04	Laboratory	Installation completed
		Total	**291.20**		

Legends:

AMI	Advanced Metering Infrastructure	DG	Distributed Generation	SCADA	Supervisory Control And Data Acquisition
OMS	Outage Management System	PQ	Power Quality	HAS	Home Automation System
PLM	Peak Load Management	MG	Micro Grids	FAT	Factory Acceptance Testing
HAS	Home Automation Solution	RE	Renewable Energy	DLMS	Device Level Message Specification

Précis of SG Projects Under NSGM

Sl.	SG Project	Functionality	Sanctioned Cost (Rs. Crs.)	GoI Support (Rs. Crs.) @ 30%	Consumers	Remarks
1	Chandigarh, CED	AMI, SCADA, DTMU	28.58	8.57	30,000	Bids opened in Jan-Feb 2018. Evaluation under progress
2	Amravati, MSEDCL	AMI, OMS, DR	90.05	27.02	1.48 Lakh	Utility stuck in tendering stage
3	Congress Nagar, MSEDCL	AMI, SAS, OMS, DR	139.15	41.74	1.25 Lakh	Utility stuck in tendering stage
4	Kanpur, KESCO	AMI , PLM, DTMU	-	-	5.39 Lakh	Utility opted in favour of OPEX model through EESL
		Total	257.78			

Legends:

AMI	Advanced Metering Infrastructure	PLM	Peak Load Management
OMS	Outage Management System	DTMU	Distribution Transformer Monitoring Unit
SCADA	Supervisory Control And Data Acquisition	SAS	Substation Automation System
DR	Demand Response	OPEX	Operational Expenditure

Consumer Engagement- *Unlocking Smart Grid benefits*

Pilot Experiences

- Multiple initiatives adopted by utilities to enhance consumer awareness

- No major consumer resistance observed- but a higher level of engagement required in case of larger roll out

Design comprehensive **consumer engagement strategy focusing on awareness, participation and redressal.**

1. **Creating and disseminating project information** to build consumer understanding for the product
2. **Involving customers** actively in demand side management programs
3. **Building trust** for efficient implementation

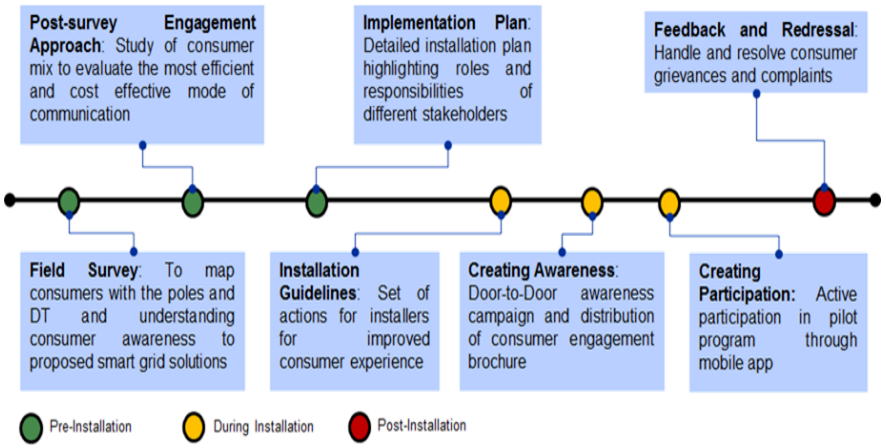
Consumer Engagement- *Unlocking Smart Grid benefits*

MYSURU

Consumer engagement programmes have been initiated before roll out of smart meters using pamphlets and public advertisements (in English and local language). A mobile application for consumers has also been developed.

AJMER

To create a positive consumer experience at all stages of smart grid technology deployment, the phase wise consumer engagement strategy adopted.



TRIPURA

TSECL has developed standard formats and templates for smart meter replacement to ensure uniformity and overall monitoring of replacement process

TSECL also optimizes installation time at consumer premises by pre-fabricating meter along with the boxes at their facility.
Reduced installation time to 5/10 mins.

HIMACHAL

To gain trust of consumers, HPSEB installed Smart Meters in parallel with existing meters. Readings from both meters would be compared and once consumer confidence is gained, old/existing meters would be removed

Business Models (PPP)- key for investment in Smart Grid Project

Pilot Experiences

- Different business models observed in pilot for 50% share contribution by states:
  - CESC - Equity Contribution
  - PED - EMI model
  - TSECL - State grant to utility
  - HPSEBL and others - Capex Model

- Shift from pilots to large scale implementation would require large upfront capex

Various **business models** can be adopted by utilities going forward, each having its own **risks and considerations**

Model	Description	Considerations
Capex Model	• Part payment on supply of material • Remaining amount structured over project deployment and operations (EMI)	• Payment linked to implementation milestone and pre-defined SLAs • Detailed BOQ needed at tender stage
Savings Model	• Minimal/ Zero upfront payment by utility • Payment based on realization of benefits	• Payment terms linked to agreed project savings KPIs • Requires creation of utility governance structure for decision making & monitoring • Requirement of clearly defined as well as agreed baseline and M&V methodology
Lease Model	• Payment over a specified tenure on a per consumer per month basis • Hybrid model possible with Capex and Savings models	• Payment terms to consider timely installation and meeting of defined equipment SLAs • Detailed BOQ may not be required for tendering however need to be specified for reference and use

Smart Grid Opportunities

24X7 Reliable power supply for all and choice of electricity supplier for consumers

Smart Grid key for introducing grid stabilizing & self-healing features through functionalities like PLM, FLISR, and ADMS.

Target of 100% village electrification by 2019 and electricity connections to 40 million urban and rural households by December 2018 under "Saubhagya" scheme

Pre-paid meters, Smart Meters, Smart Microgrids a key to achieving100% electrification.

Target to install of 35 million smart meters by 2019 under UDAY mandate and overall market size of ~250 million smart meters

Mandate to accelerate AMI in India with a estimated potential opportunity size of USD10-12 billion.

Development of 100 Smart cities

Smart Grid by grid technologies and communication network forms the backbone of any Smart City. This opportunity provides estimated investment potential of USD 7-8 billion.

RE target of 175 GW by 2022; Target of 6 million EVs by 2020 and 30% by 2030

Smart grid will provide features like DR, enhanced forecasting, Energy Management System, Energy Storage management, net metering, V2G and G2V charging for better RE and EV integration & 'prosumer' enablement.

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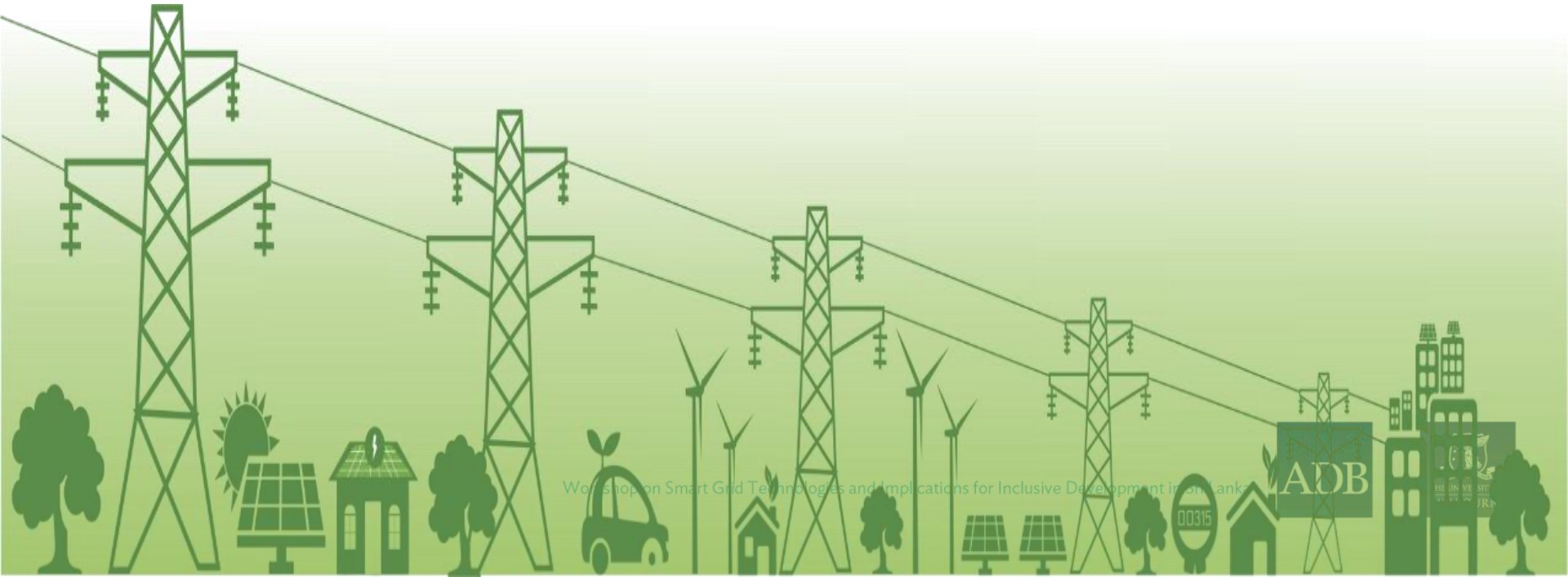
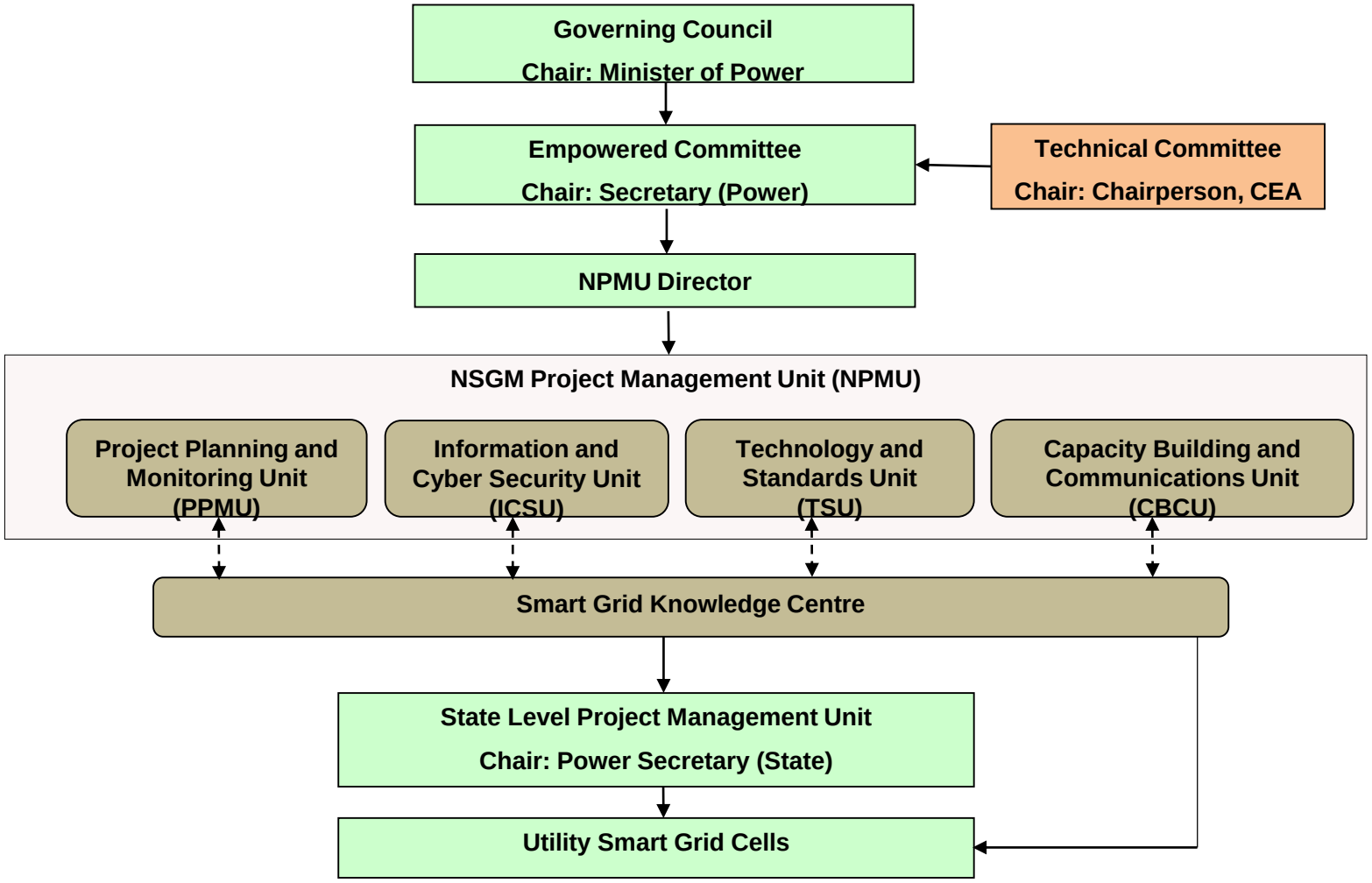


NSGM Institutional Framework



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CESC SG Pilot Snapshots

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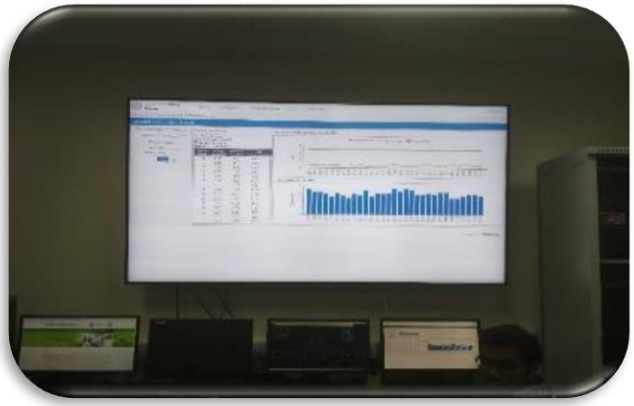
IIT Kanpur Smart City Lab Snapshots



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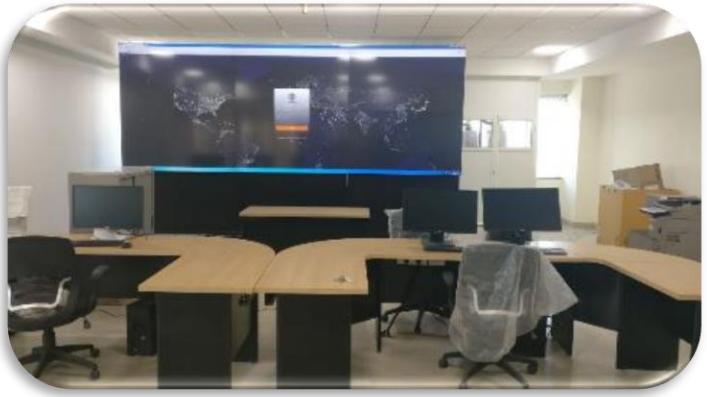
SGKC Manesar Snapshots



AMI Dashboard – *SG Pilot at AVVNL*

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