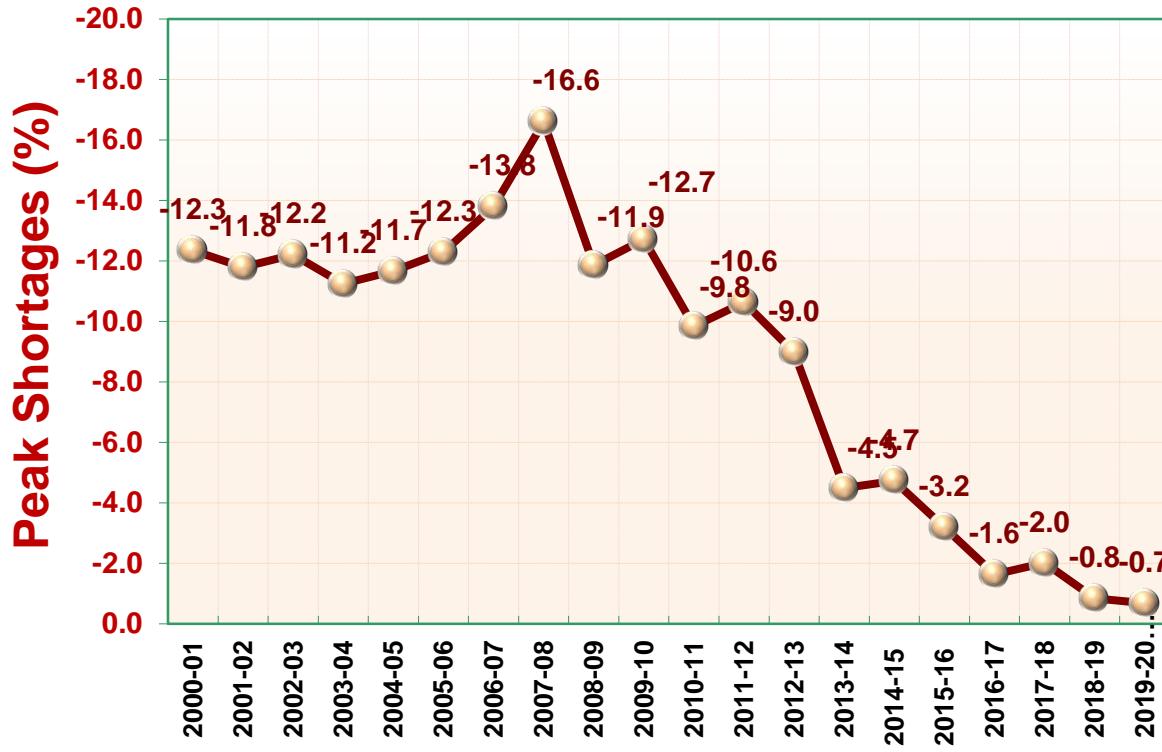


NSGM & Smart Grids

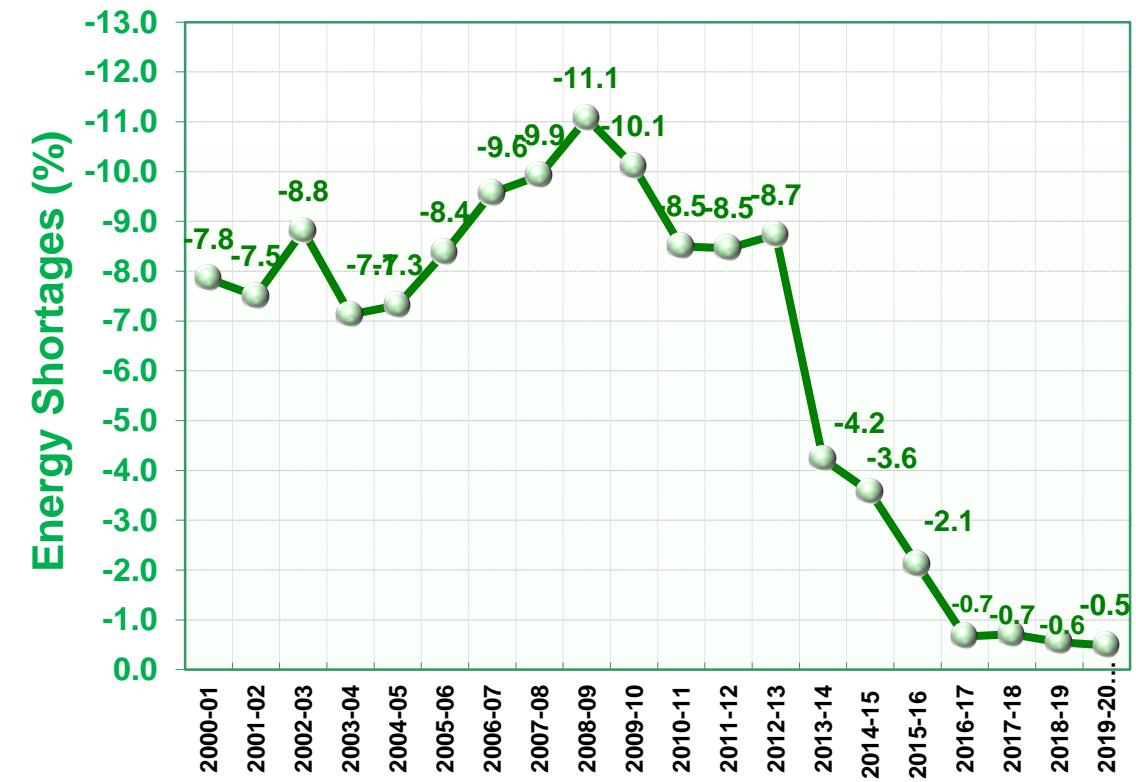
A.K.Mishra
Director, NPMU

Historical trends

Peak Shortages

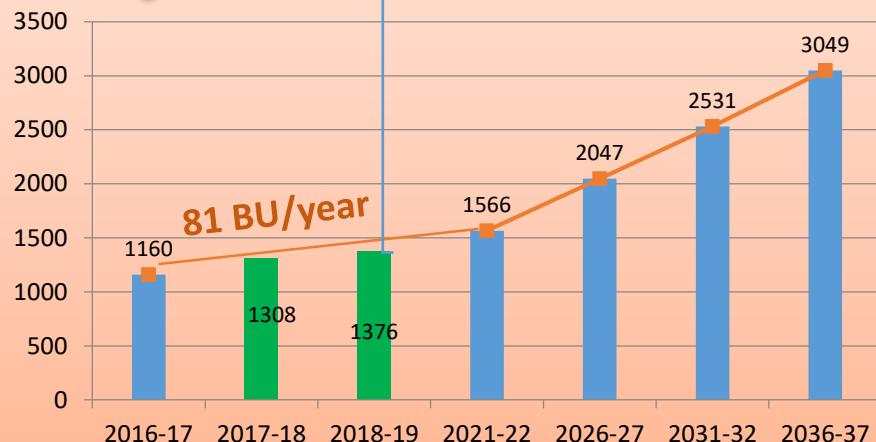


Energy Deficit

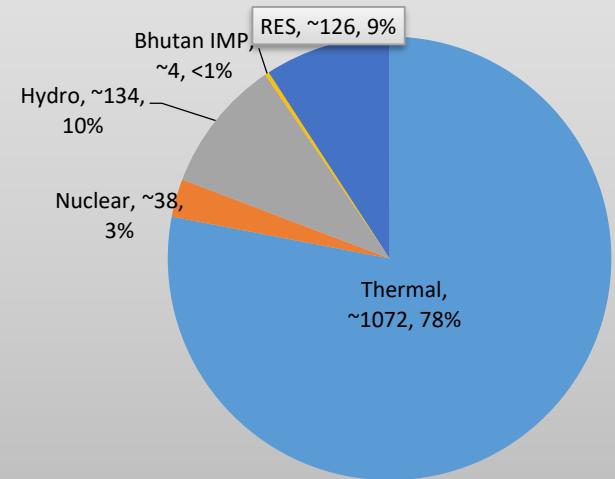


Electrical Energy in BU

Electrical Energy Requirement Projected and Actual data*



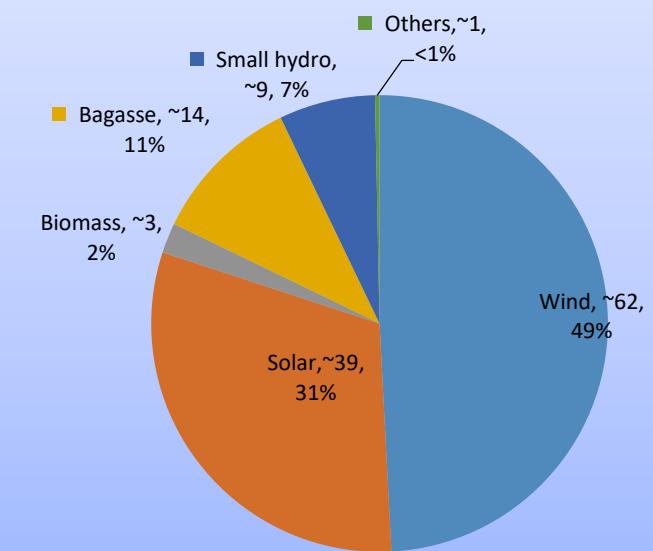
Details of Electrical Energy in 2018-19*



*19th EPS & CEA Annual Report

* CEA Annual Report

Details of RES 2018-19*



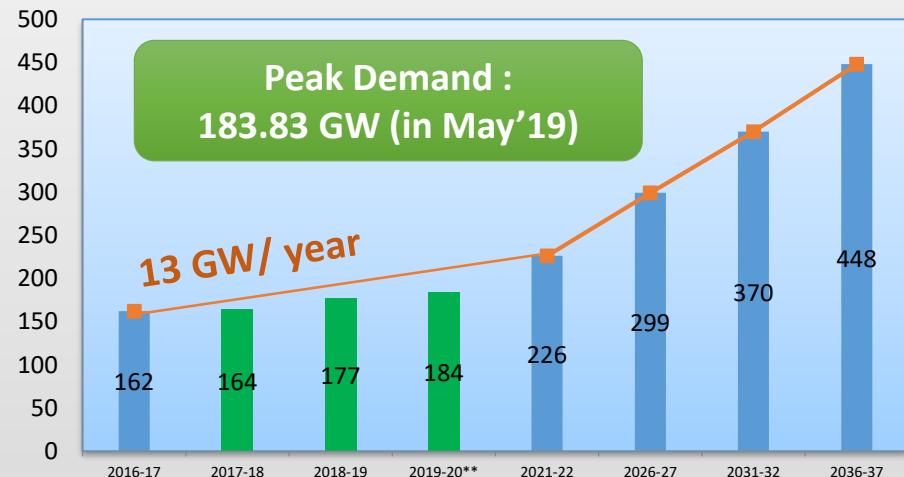
*CEA Annual Report

Energy Capacity in GW (Sep'19)



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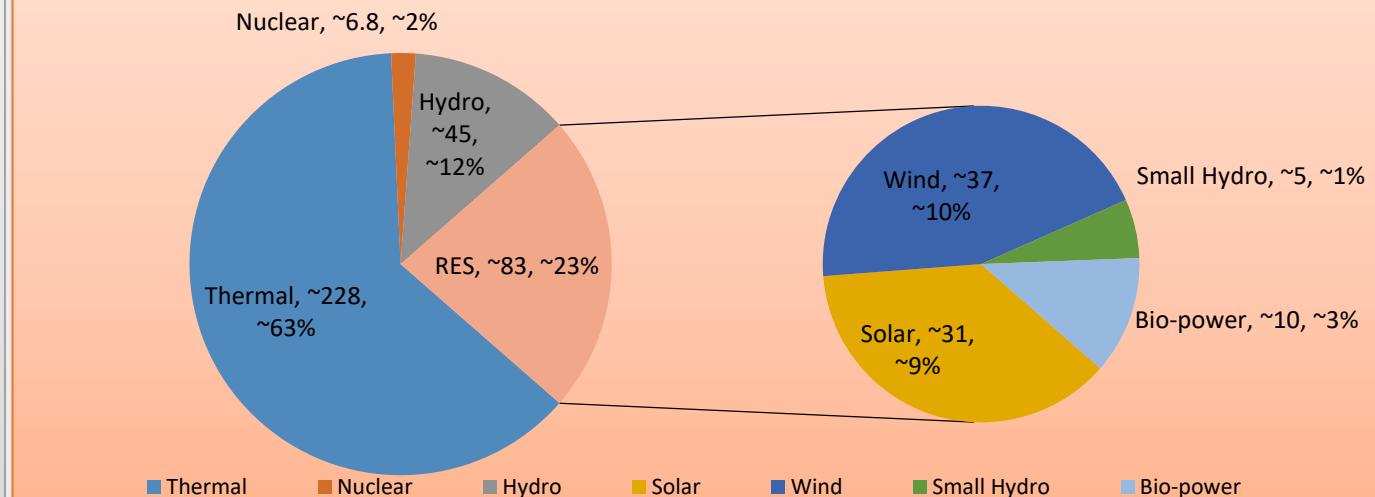
Peak Demand Projection* and Actual data**



*19th EPS & CEA Annual Report

** upto Sep'19

All India installed capacity (in GW) 363.36 GW



*CEA monthly report

RE & Smart Grid

EU India joint c
Integrated Loca
for DISCOMs to
convert challen



on smart &
opportunity
emia and
ortunity



One
Pri

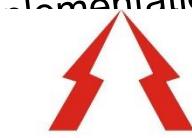


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One-Sun, One-Grid



WBSEDL



MAHA VITARAN

Maharashtra State Electricity Distribution Co. Ltd.

Emerging S



Power prices (< Rs.3 / unit)

Reality is with limitation of Sun Light

Target to achieve all time low Tariff in the
Country:
Solar Power: Rs 2.44/W
Wind Power: Rs 2.44/W



- Wire & Supply segregation
- Interoperability
- Emerging role of DSO supporting Eco-s
y as a service



Emerging Scenario

- 100% electrification
- Growing AMI and Renewable Energy
 - Need for cost effective interoperable devices
- Demand side management and demand response program
 - Need of advanced Load segregation algorithms
 - Transition from Blackout's to Managed Services with Consumers
- Emerging role of DSOs
- Separation of Content & Carriage
- Micro grids and self sustainable local grids
 - Consumers as participants to local grid management program
- Proliferation of EVs, storage and their charging infrastructure

Smart Grid Vision for India

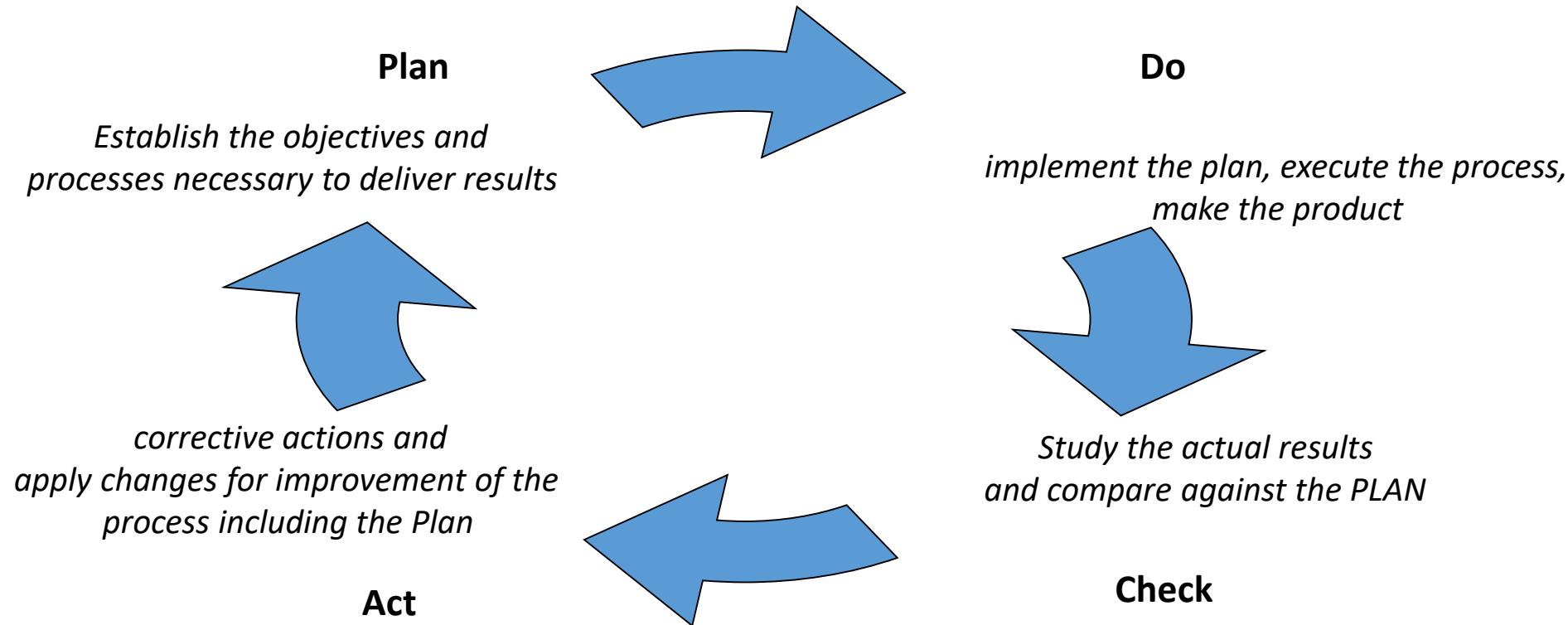


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*Transform the Indian power sector into a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with **active participation of stakeholders***



The efficient system

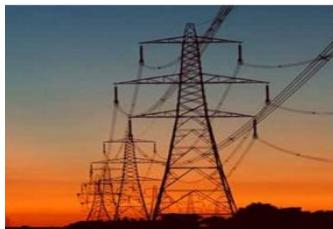


For any system to be more Efficient the **feedback loop** is important

Traditional vs Smart Grid

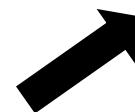
Traditional Grid

Generation- centralized

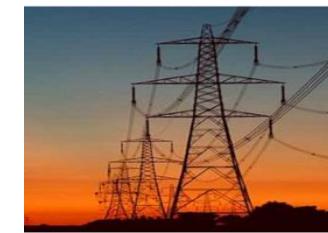


Transmission- element control / WAMS not present

Distribution- one way street, fixed role, manually operated devices



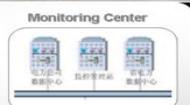
Generation- distributed



Distribution- automated devices
(FRTUs, RMUs, TMUs, etc)



Transmission- element control / WAMS enabled

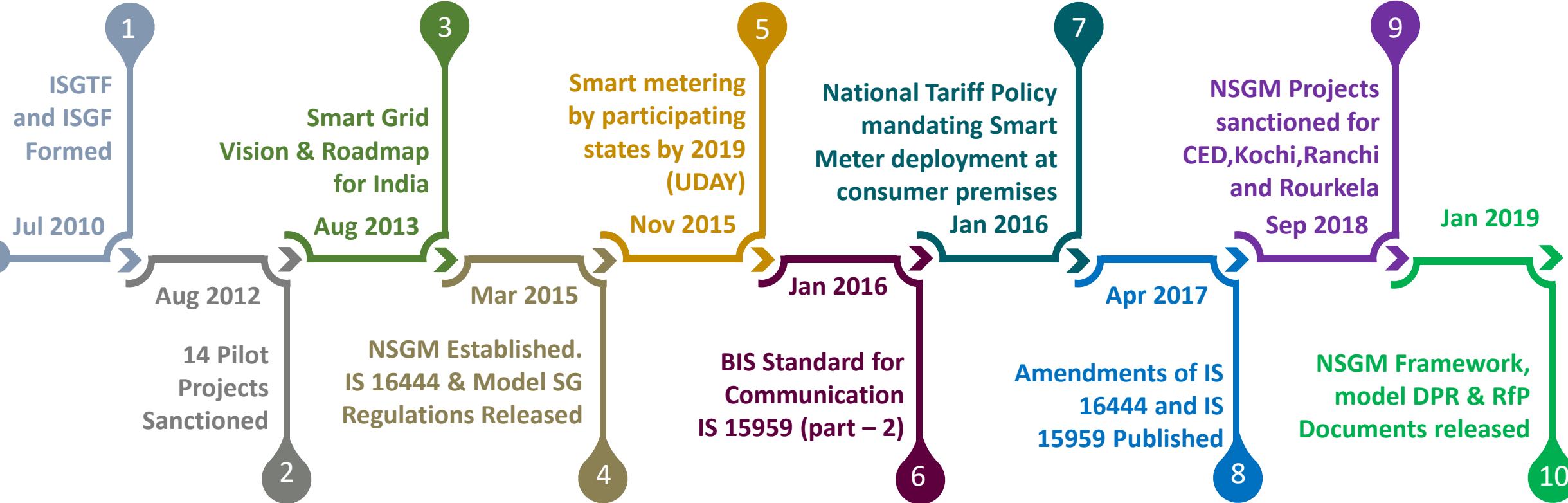


Smart Grid

Smart Grid Initiatives - Historical perspective

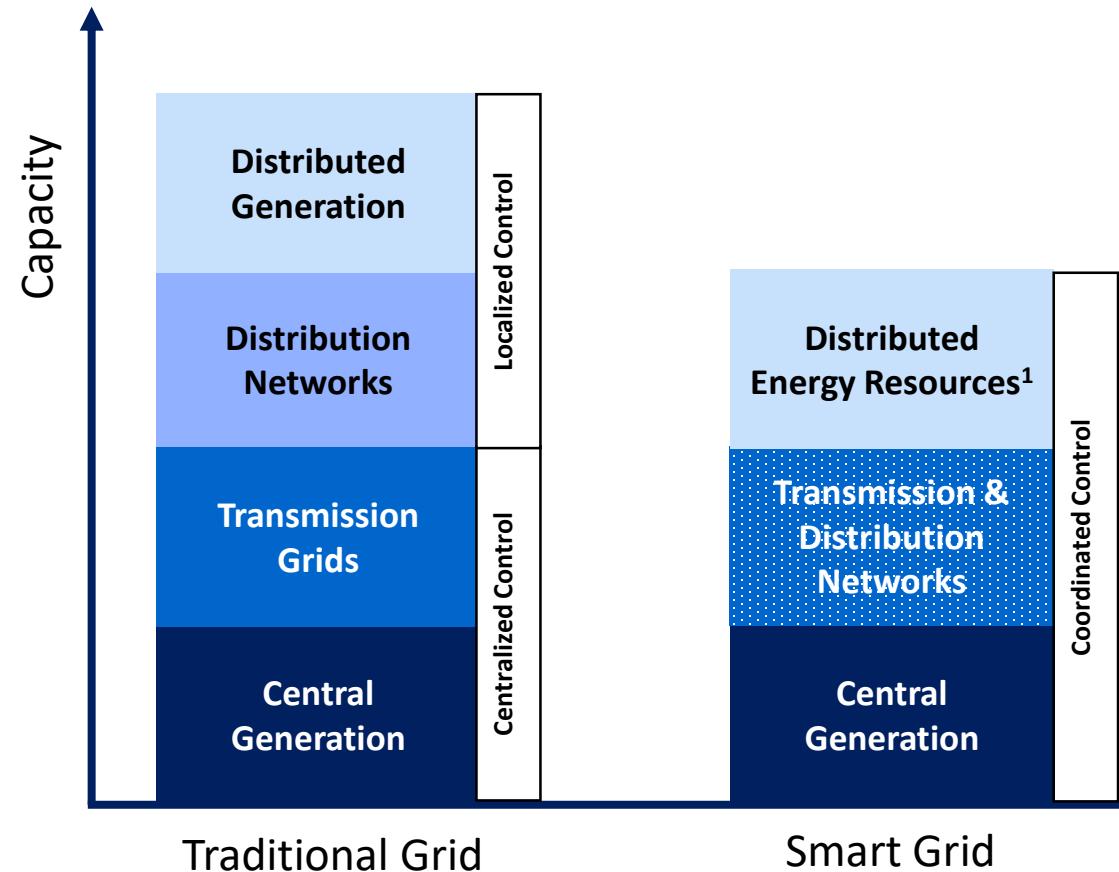


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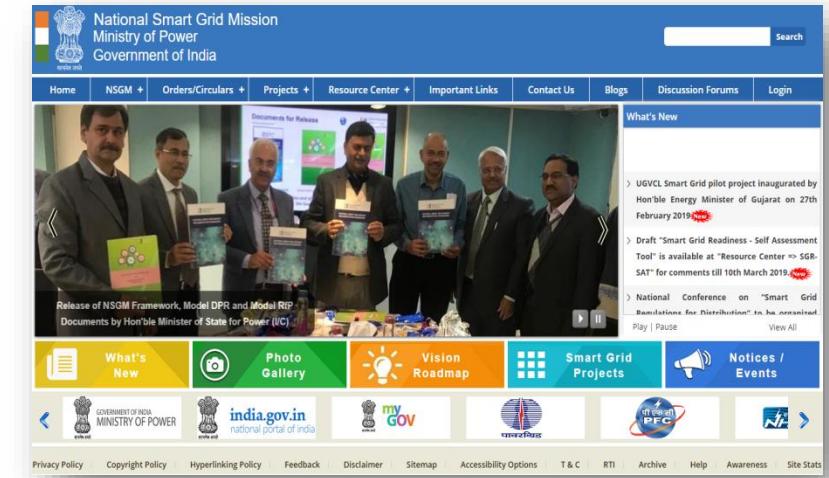
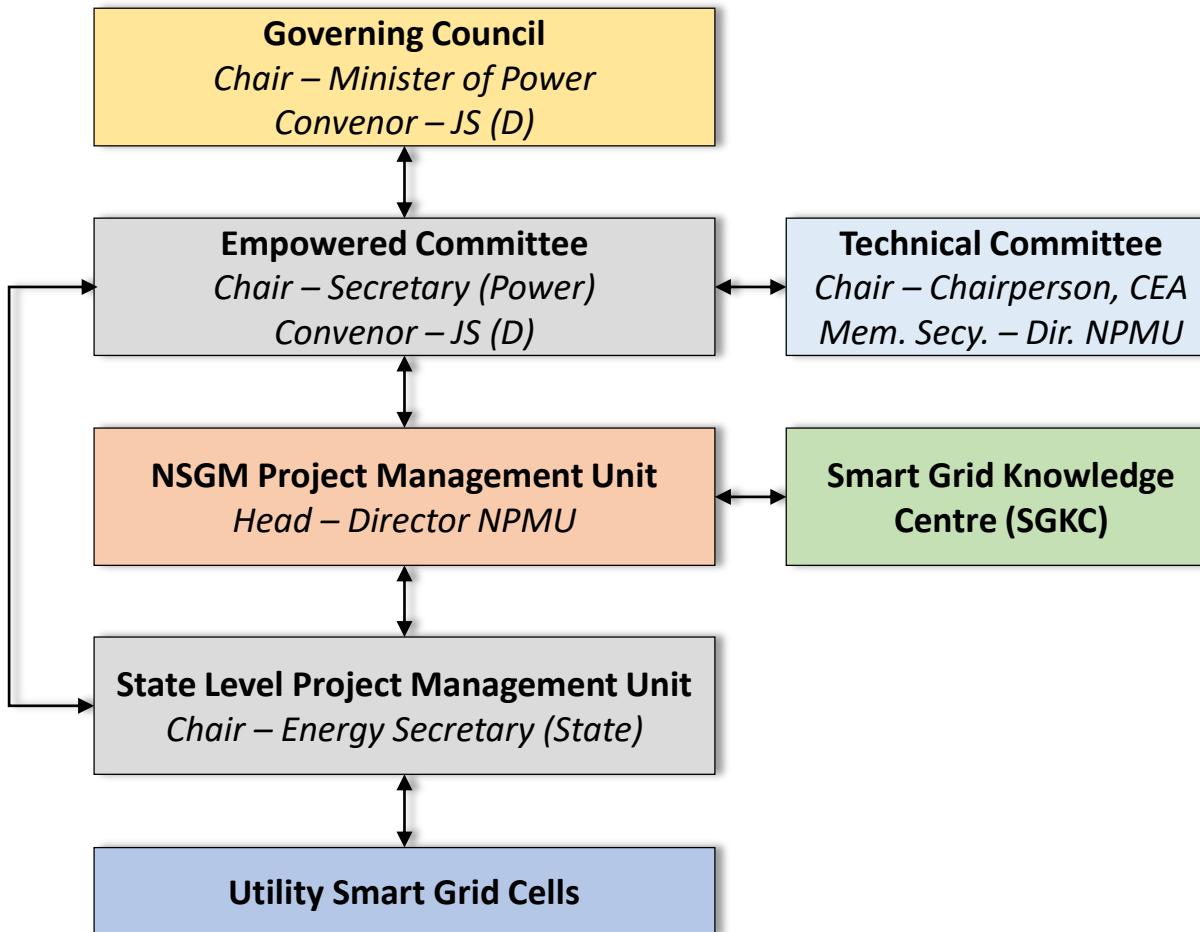
Effect of Smart Grids on Overall Network



¹ DERs can be renewable/non-renewable sources

National Smart Grid Mission

NSGM has been established in March 2015 with institutional framework as follows:



Bilingual website
 www.nsgm.gov.in

Need of SLPMU

- Every state is to have a State Level Project Management Unit (SLPMU) chaired by Power Secretary (or equivalent) of the state
- SLPMU will be the apex body for steering the state level programs
 - State DISCOMs
 - Regulators
 - State Power And Finance Departments
 - Academia (IIT/NIT/IIM Etc.)
 - Prominent NGOs etc.
- Expected to meet @ Quarterly
 - Address technical and commercial implications
 - Interact with possible development partners/ agencies
 - Mobilize cooperation
 - Analyze as is state
 - Enable informed goals for SG
 - ARU – Feeder/ Consumer Groups
 - Pricing
 - Reliability
 - Temps+Reliability
 - Feeder Load profile
 - Confirmative to DISCOM average
 - Contrarian



NSGM Support for Smart Grids

- Funding of projects (up to 30%)
- Assistance in formulation of projects including
 - pre-feasibility studies, technology selection, cost benefit analysis, financing models etc.
- Training and capacity building for State Level PMUs & project implementation teams
- Technology selection guidelines and best practices
- Facilitate consumer awareness initiatives
- Project appraisal post implementation



NSGM Documents



Smart Meter Rollout Report

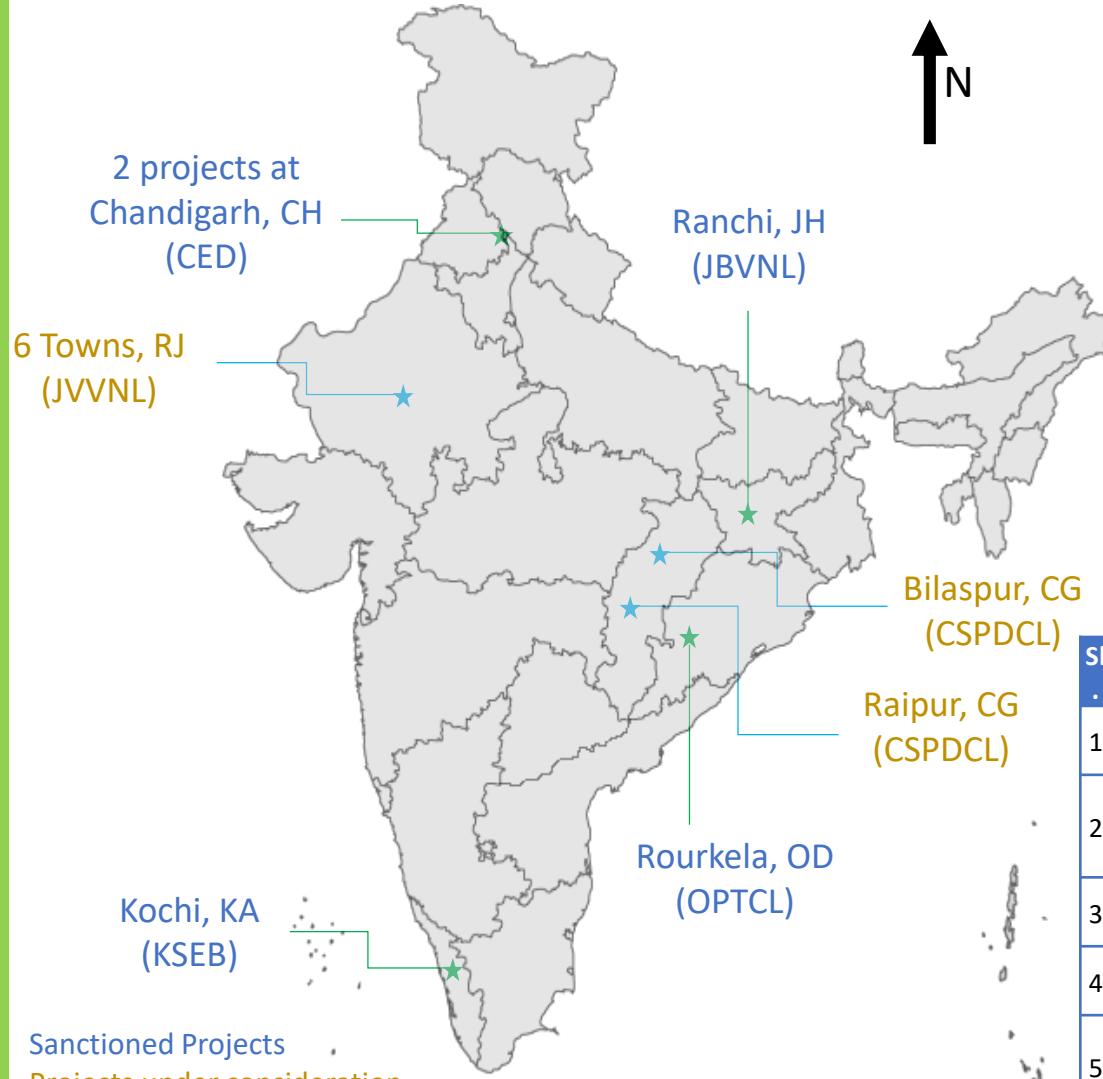


Funding Models

NSGM Documents were released by Hon'ble MoSP (I/C) on 16th January 2019 and are available at our website
www.nsglm.gov.in/en/nsqm-documents



Smart Grid Projects under NSGM



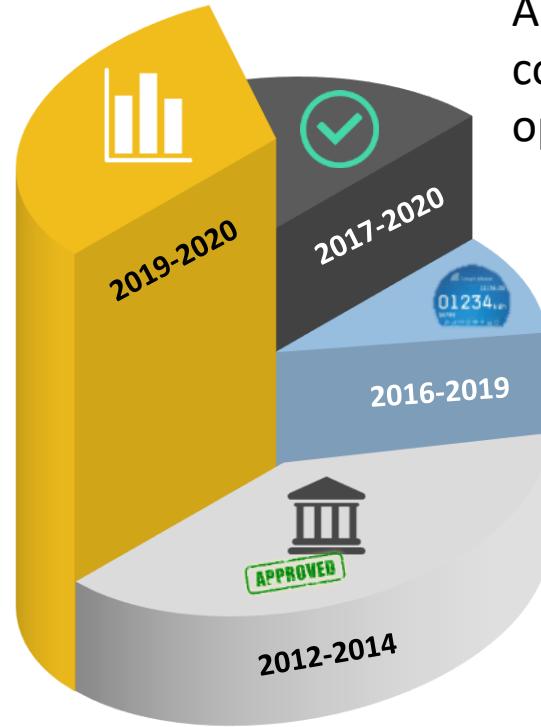
Sanctioned Projects
Projects under consideration

Map not-to-scale & Old Map J&K
changes to be updated

SI	Utility	Functionalities	Cost (₹ Cr)	Consumers	Status
1	Chandigarh, CED (SD-5)	AMI, SCADA	28.58	29,500	Implementation In Process
2	Ranchi, JBVNL	AMI, DTMU	228.69	3,60,000	Technical bid evaluation in progress
3	Rourkela, OPTCL	AMI, SCADA, DTMU	96.97	87,000	Tendering in process
4	Chandigarh, CED (City)	AMI, SCADA, DTMU	241.49	1,84,000	Sanctioned
5	Kochi, KSEB	AMI, PLM, DTMU, EVCI, PV	90.87	90,000	Sanctioned
Total			686.60	7,50,500	

Smart Grid Pilot Projects

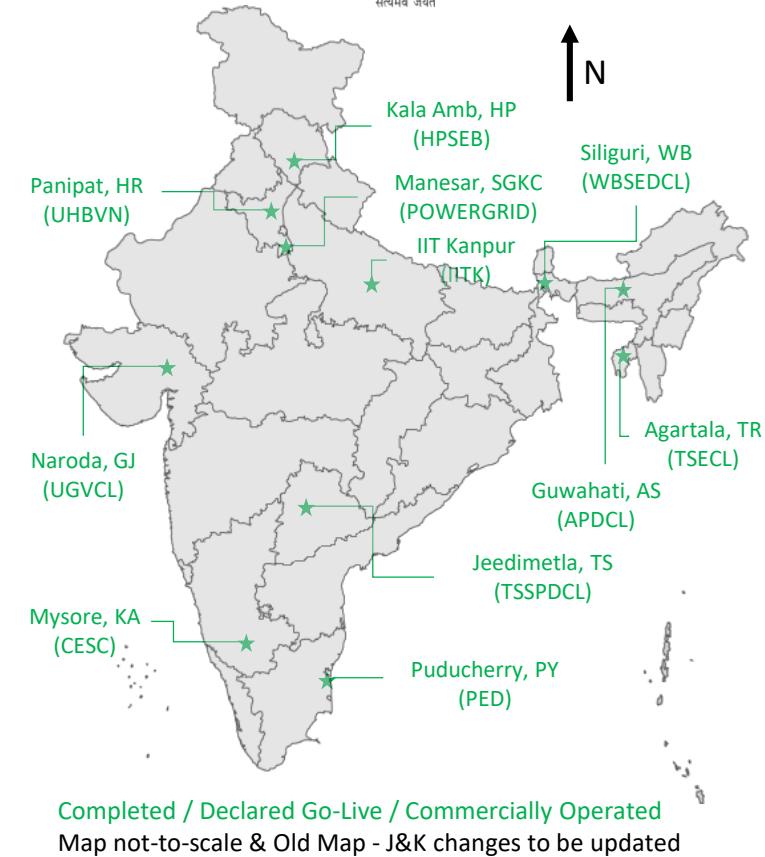
Impact assessment



All pilots declared go-live / completed / commercially operated

~1.6 lakh Smart Meters installed

11 pilots including SGKC



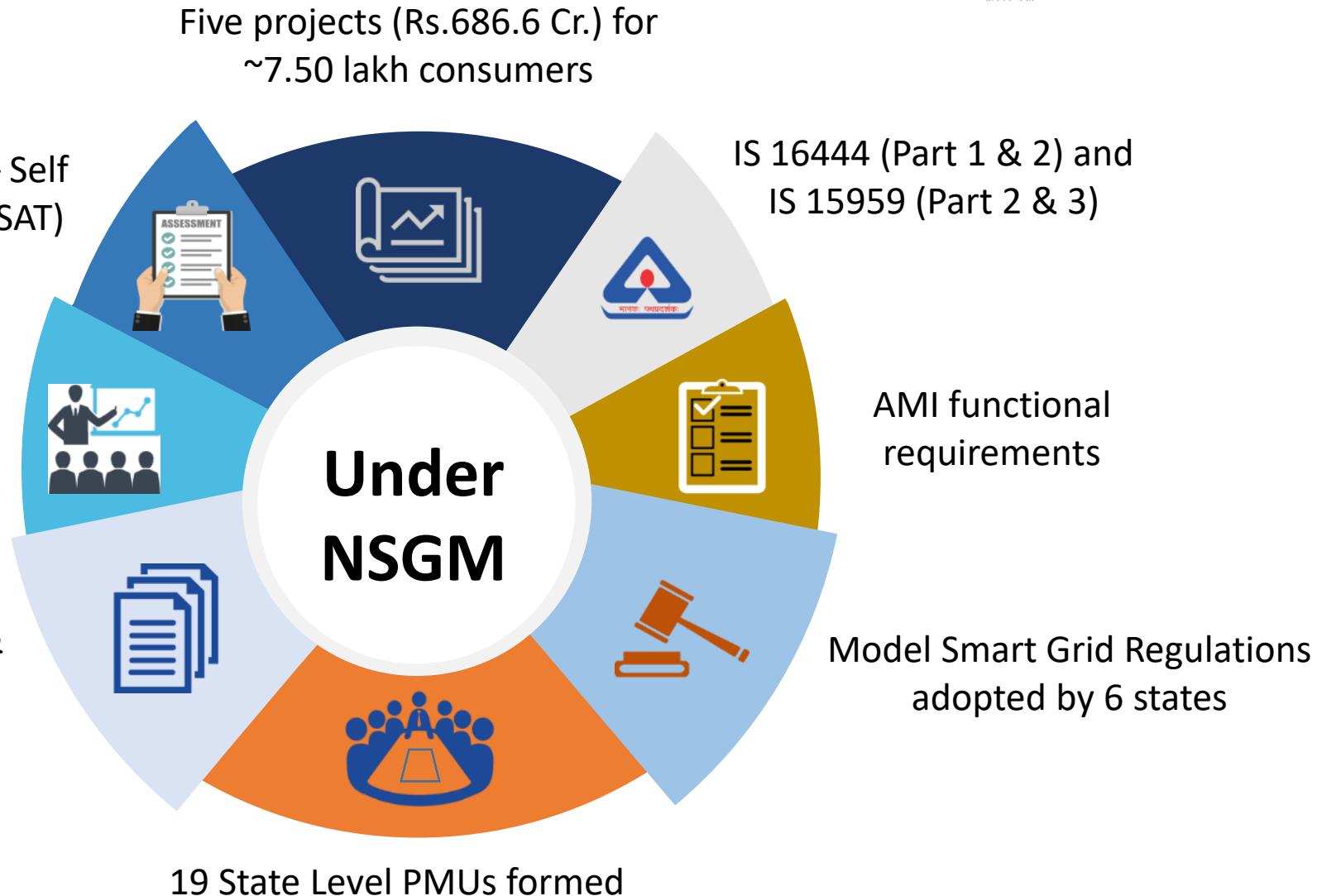
- New generation communication technology with improved performance based on RF mesh developed as an evolution of Technology deployed at CESC, Mysore
- Undue doubt on DISCOMs infrastructure w.r.t. PLC technology was negated – performed well in Tripura SG Pilot
- **Two new product** (Smart Meter) developed & deployed
- Developed Products Sustainability especially in International Cooperation – Panipat Pilot Exp



NSGM Achievements

- Smart Grid Readiness – Self Assessment Tool (SGR-SAT)
- 6 National & 3 International workshops
- SG Course Developed
- 10 Training programs for utilities
- 2 Brainstorming sessions

- NSGM Framework, Model RfP & Model DPR released
- Smart Meter Rollout plan submitted





Smart Grid Knowledge Centre – SGKC

- ✓ The center was inaugurated by Hon'ble Union Minister of State for Power, New & Renewable Energy (I/C) Shri R.K. Singh on 19th Sept 2018.

- ✓ Periodic training programs scheduled for Utility officials and other stakeholders on residential basis.
 - Total 5 programs conducted and 120 executives trained.

- ✓ Four Site visit and detailed demonstration carried out
 - 25 senior officials from Discoms /regulators/ CEA on 12th Mar'2019.
 - 60 delegates from IEEMA Metering India 2019 edition on 10th Aug'2019
 - 30 officials from BSES Rajdhani Ltd. on 13th Aug'2019
 - Foreign delegation from USAID on 21st Aug'2019

Smart Grid Knowledge Centre



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Focus Areas

Advanced Technologies, Innovations & Demonstrations



Innovation Park

Platform for live demonstration of new and innovative products and technologies relevant to the power sector



Technology Incubation

Supporting innovative ideas to progress in their journey from concept to market.



Demand Based Research

Prepare fact sheets and direct the research to appropriate agencies to support informed policy and regulatory decision making.

Partnerships / Alliances



Twining Arrangements

Building network with national and international agencies to leverage complimentary expertise of partner institutions across all key activities

Capacity Building & Outreach



Training Hub

Tailored training programs on relevant topics for various stakeholders including utilities, policy makers and regulators.



Outreach

Technical webinars /Conferences/ Industry conclaves/digital presence/international forums /research events etc.



Exchange Programs

International exchanges for knowledge & resources sharing, showcasing latest know-how & facilities at the center, focused discussions/panel discussion, etc.

Key Activities

NSGM: Training & Capacity Building Activities



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- Two Interactive session ‘Manthan’ with Industry/multiple stakeholders in Smart Grid conducted in March 2016 and May 2016 respectively
- Basic Smart Grid Training Program & course material for Utility Professionals, finalized by NPMU with support from USAID, Academia and CEA
- **First** 3-day SG training program was conducted in July 2016 at CENPEID (Tata Power), New Delhi and **Second** SG training program conducted in December 2016 at CPRI, Bangalore with support from USAID.
 - Around 70 participants were trained on different facets of Smart Grids and feedback was highly positive.
- **Third** Smart Grid training program on 17th -19th Jan’2018 at IIT Kanpur

Training for KSEB Employees & Stakeholders



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- Training Program on SG Awareness on 26th and 27th Mar'18 at Thiruvananthapuram
- Participation of 43 executives from stakeholders such as Academia, Research Institutes, Kochi Smart Mission Ltd, Kochi City Corporation among others.

स्मार्ट ग्रिड जागरूकता कार्यक्रम

PROGRAMME ON SMART GRID AWARENESS

आयोजक / Organizer :

**National Smart
Grid Mission**

राष्ट्रीय स्मार्ट ग्रिड मिशन

भारत सरकार, विद्युत मंत्रालय

**GOVERNMENT OF INDIA
MINISTRY OF POWER**

स्थल: होटल उदय सुइट्स, तिरुवनंतपुरम

Venue:

Hotel Uday Suites
THIRUVANANTHAPURAM

26-27 मार्च, 2018
26-27 March, 2018



Smart Grid Knowledge Center, POWERGRID

SGKC have been established at POWERGRID R&D center, Manesar to bring awareness on the application of Smart Grid technologies and its demonstration in a holistic manner with funding support from MoP. It has following facilities to showcase:-

- ✓ Advance Metering Infrastructure
- ✓ Outage Management System
- ✓ Real life working model of multiple renewable sources acting as Microgrid
- ✓ Smart Home Energy Management System
- ✓ Electric Vehicle with renewable charging infrastructure
- ✓ DC Microgrid
- ✓ Workstations/Training Facility
- ✓ Cyber security with threat management system



SGKC - Activities so far

- ✓ The center was inaugurated by Hon'ble Union Minister of State for Power, New & Renewable Energy (I/C) Shri R.K. Singh on 19th Sept 2018.

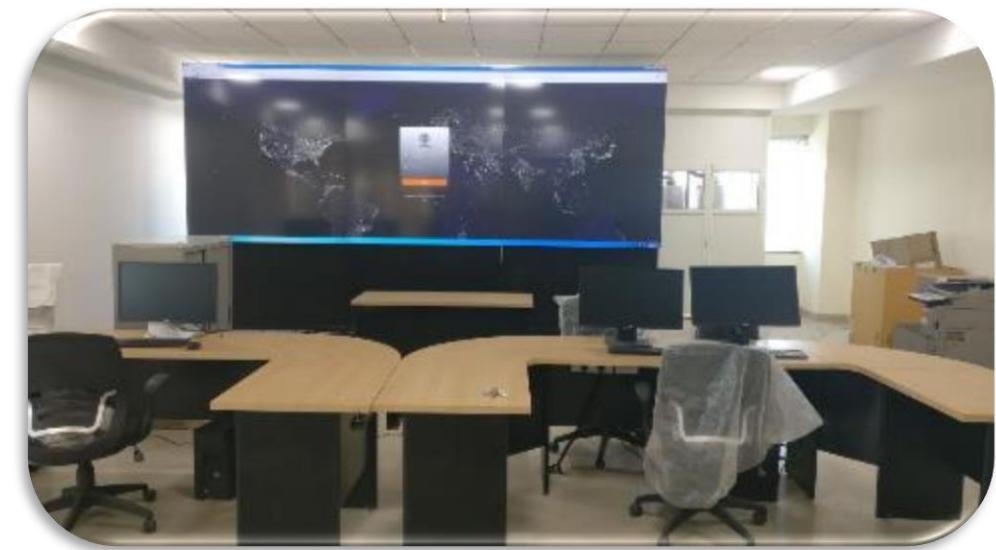
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SGKC Manesar



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SGKC Visit Snapshots



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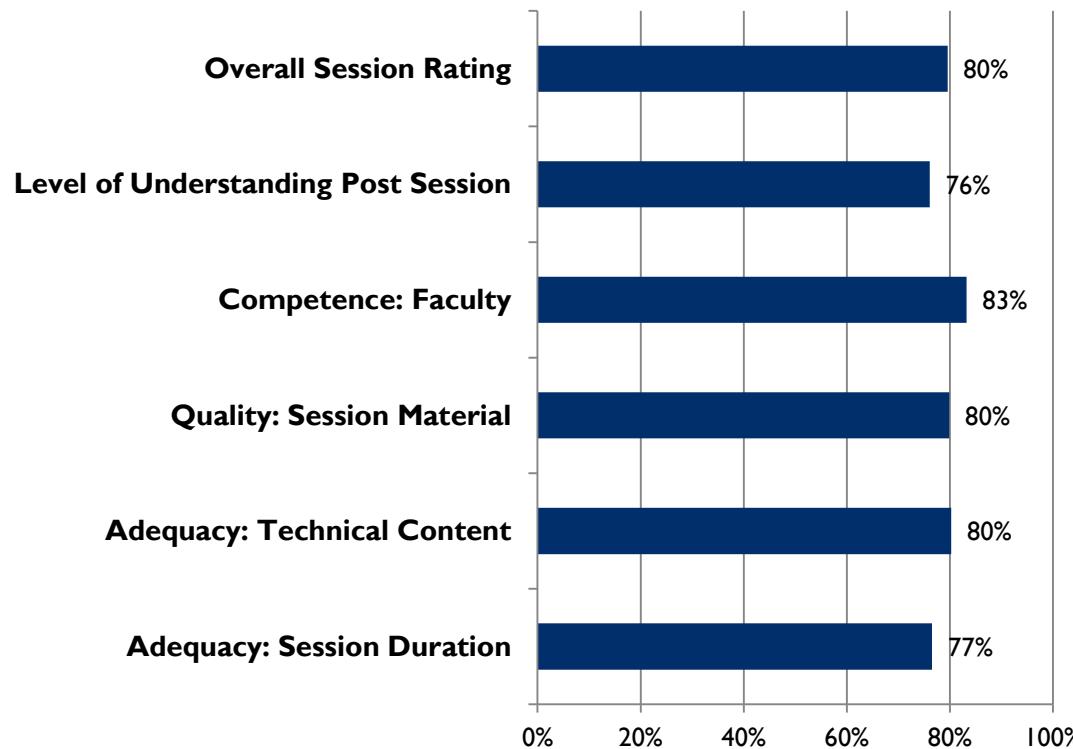


NSGM: Training & Capacity Building Activities

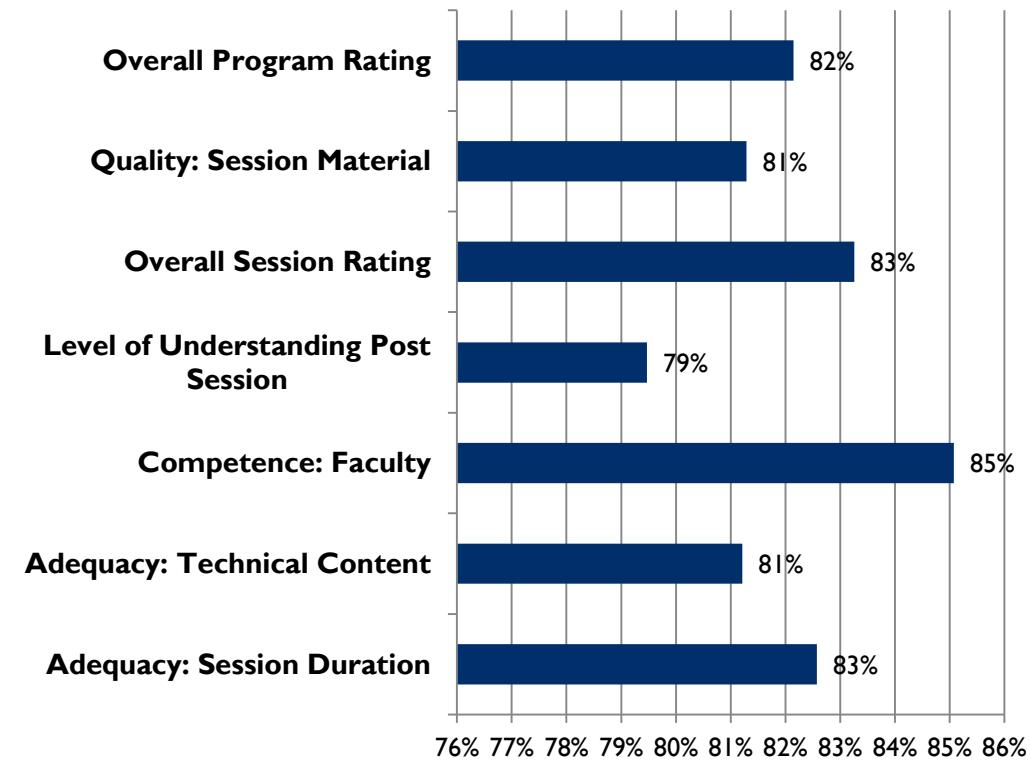
- The MoU for training with SGKC has been signed. Till now five (5) training programs have been conducted at SGKC. 6th training program scheduled from 18th-20th Nov'2019
- The MoUs with CPRI, IITK and NPTI are being expedited and thereafter regular training programs shall be organized
- Total 5 programs conducted and 120 executives trained at SGKC, Manesar with NSGM support.
- Training programs at CPRI:
 1. '3 Day Residential Training Program on Smart Grid Technologies' 22nd - 24th May 2019, at CCAR, CPRI, Bengaluru (under MoU)
 - Participants: 25 executives
 2. 3 Day Basic Smart Grid Training Program for Utility Professionals Dec 14-16, 2016, CPRI, Bengaluru

Feedback from Participants

Overall Program Rating for 1st SG Training



Overall Program Rating for 2nd SG Training



Smart Meter Roll Out



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Report on Rollout of Smart & Prepaid metering In India

Smart Meter Rollout Strategy

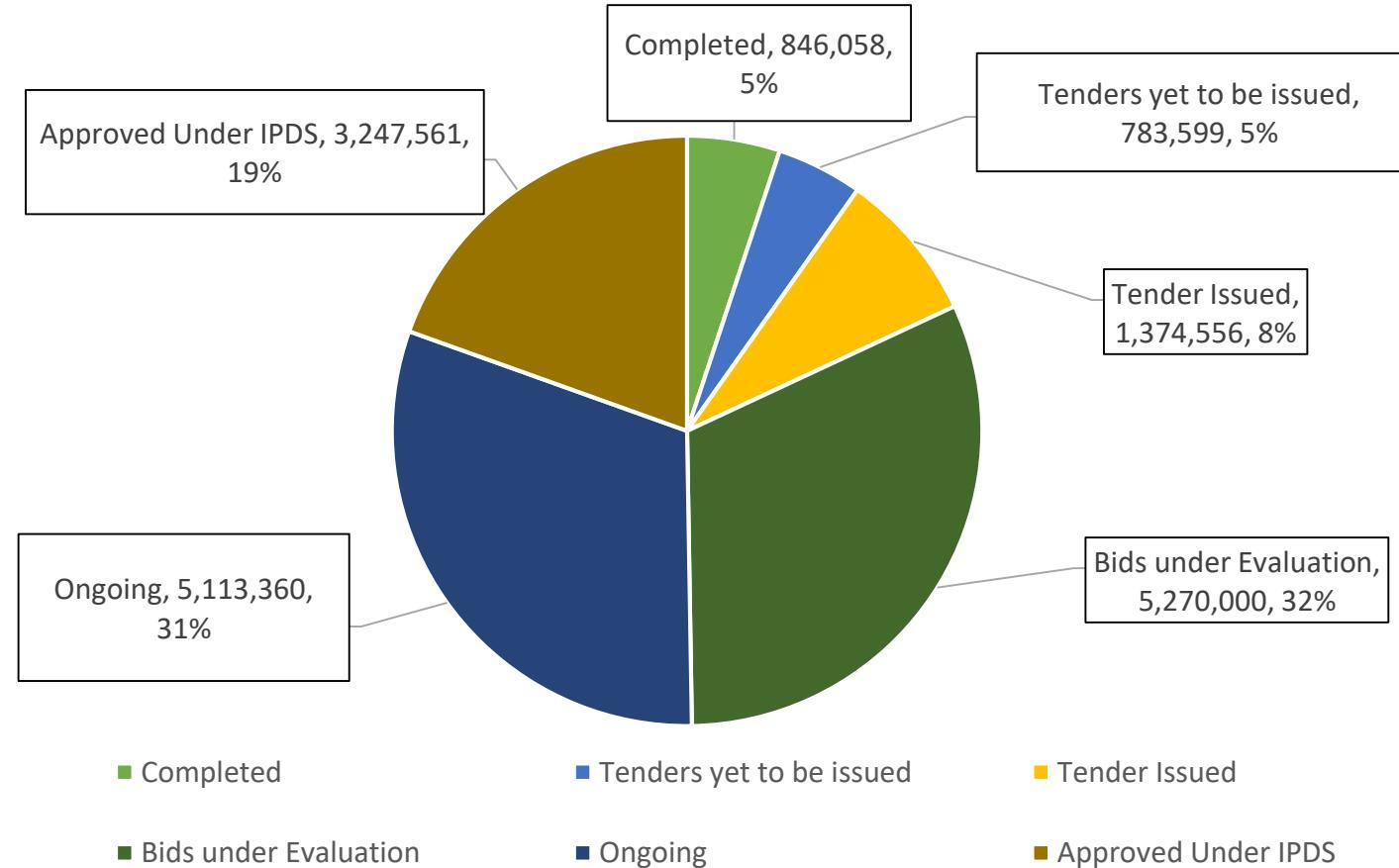
- Identifying DISCOMs areas into four zones
 - Green Zone (Smart City and State Capitals Areas)
 - Fast Track Areas (RAPDRP/IPDS Areas with Losses $\geq 15\%$)
 - Healthy Consumption Areas (Balance RAPDRP/IPDS Areas)
 - Basic Consumption Consumer Base Areas (Rural and under DDUGJY and SAUBHAGYA)
- Deployment of Smart Prepaid Meters in next three years
 - strategy,
 - partners and
 - Technologies

As these areas have heterogeneous challenge

Smart Metering Present Scenario



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International Engagement

- ISGAN is an Implementing Agreement under a framework of International Energy Agency (IEA)
 - ▶ Strategic platform to support high-level government attention and action for the accelerated development and deployment of smarter, cleaner electricity grids around the world
 - ▶ Director, NPMU is Vice Chair of ISGAN Presidium
 - ▶ NSGM has organized 13th ISGAN ExCo meeting in March 2017
 - ▶ ISGAN in collaboration with NSGM organized 3 days event for dynamic knowledge in Nov 2017 at CPRI, Bangalore- 100+ domestic & international participants
 - ▶ NSGM-USAID training module on Smart Grids and Model Smart Grid Regulations were accepted for global use adoption
- Mission Innovation (MI) is a global initiative of 23 countries and the EU to dramatically accelerate global clean energy innovation
 - DST (Department of Science and Technology) is the nodal agency in India
 - NSGM is engaged with MI and working closely with DST for early adoption of technology/(ies) under development
 - Organized SG R&D Conclave workshop jointly with DST at IIT Delhi in August 2018 (exceptional platform to bring together 177 experts from academia, R&D labs, Industry and utilities)
 - Leading Mission Innovation POW Task#2 Demand Response



International Engagement

United States Agency for International Development (USAID), USA

- AMI test pilot at AVVNL
- Basic Smart Grid Training Program for Utility Professionals
- NSGM framework document
- Digital and Behavioral Interventions to enhance customer experience and CBA tool development in progress
- SGKC roadmap development in progress

Department for International Development (DFID), UK

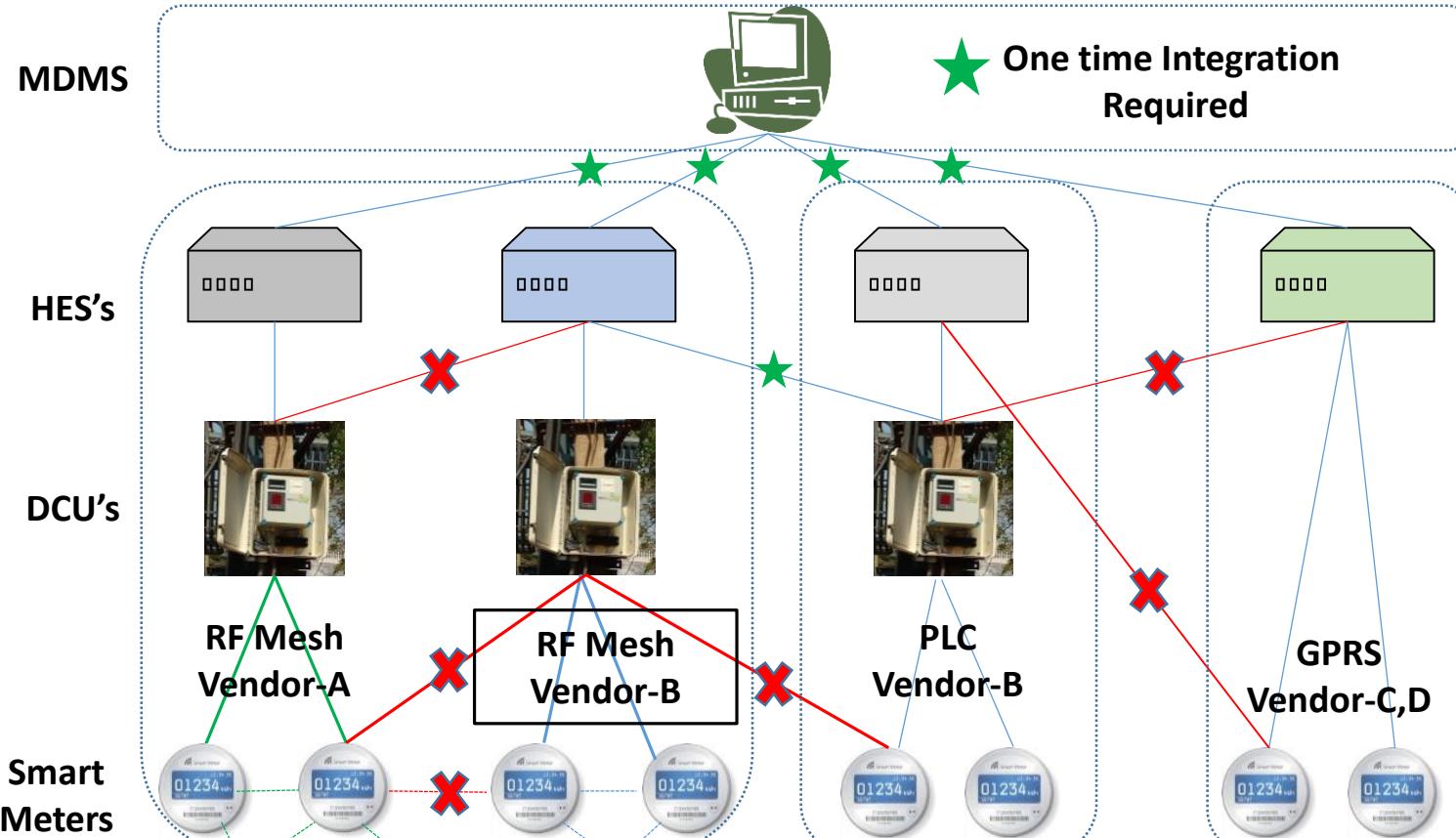
- Smart Grid Readiness and Self Assessment Tool (SGR-SAT) under finalization
- Demand Response Assessment in progress



Learning From Pilots/Projects

- **Technical:** Pilots envisaged installation of Smart Meters. Need for ‘standard’ & ‘specific tampers’ necessitated redesign of existing meters. **IS 16444 developed** and followed for NSGM projects.
- **Financial:** Delay in arranging **counterpart funding** (50% for pilot projects/ 30% for NSGM projects) from own resources/ loans/ business models etc. hampered the implementation.
- **Commercial:** Latest opportunities in smart grid is generating more interest amongst vendors. **regulatory support** for ToD metering, connect/disconnect, benefits from operational efficiency and loss reduction etc. may facilitate the same.
- **Procurement & Contractual:** Stringent technical & commercial QRs hampered **workable consortiums/JVs**. At least 5-7 years O&M be included in project for sustainability, Projects on ESCO/lease model with minimal financial risk to utilities.
- **Focus Constraints:** Utility focus remained on equipment deployment & technology demonstration. Process redesign, regulatory & requisite change management lag behind.

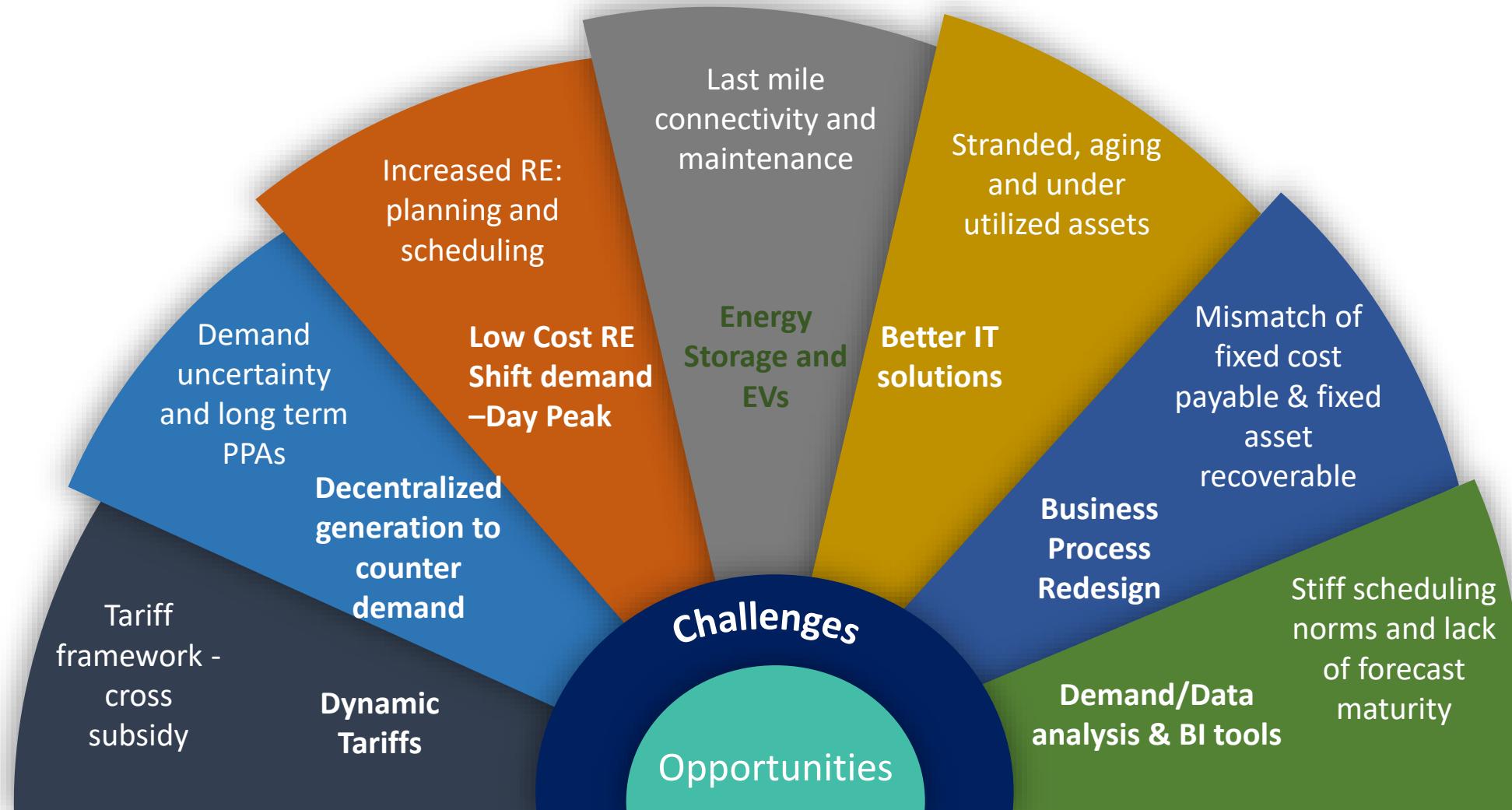
Interoperability Challenges



Where We Started	Where We Stand Now
No standards or specifications	IS 16444 and companion standards for Smart Meters
Communication	Communication <ul style="list-style-type: none"> PLC – not so reliable RF – very little market penetration GPRS – higher charges
No availability of data	Analytics and various ancillary services



DISCOM Challenges & Opportunities





National Energy Storage Mission (NESM)

- February 2018, Committee constituted by MNRE to propose draft for National Energy Storage Mission (NESM).
- Draft NESM -leadership in energy storage -enabling policy and regulatory framework - encourages manufacturing, deployment, innovation and cost reduction.
- NITI Aayog and Rocky Mountain Institute's joint report - Energy Storage Mission – 3 stage approach
 - Enabling battery manufacturing growth;
 - scaling supply chain strategies;
 - scaling of battery cell manufacturing.
 - (http://www.niti.gov.in/writereaddata/files/document_publication/India-Energy-StorageMission.pdf).
- Known Energy Storage Application :
 - integrating RE with distribution and transmission grids
 - Setting Rural micro grids with diversified loads or stand-alone systems
 - developing Storage component of electric mobility plans.
 - Infrastructure Constraint - Metro RoW → Peak Off-peak Capacity Arbitrage

R&D projects under DST involving Storage

- Reconfigurable Distribution Networks : (at IIT Kharagpur) (partners: IIT Bombay & IIT Kanpur)**

Objective: to design and develop a Microgrid test facility composed of PV, FC, Battery& Supercapacitor hybrid storage and control platforms to host prototype new devices.

The facility was designed to include Solar and Wind energy system with three layers of storage, Battery and Supercapacitor at first, Fuel Cell at second and Diesel generator at third with distributed control platforms and real time communication system.

- Intelligent MicroGrids with Appropriate Storage for Energy (IMASE) (at IIT Bombay)**

A typical urban residential scenario with load shedding is considered. This is a backup power system with different battery chemistries – VRLA, Li-ion, NiCd, NiMH, LiS, VRFB – are compared.

Technical-Environmental-Economic Analysis (TEEA) of the energy storage technologies done for the three scales of storage: quality of supply, daily storage and seasonal storage. A dedicated modeling software is also developed for design and analysis of the microgrid.



R&D projects under DST involving Storage

- **Modular Storage Element for Micro-grid Integration (at IISc Bangalore)**

Objective: develop cost-effective lead acid batteries and supercapacitors as hybrids for integration with the micro grid. HUCs and lead acid batteries were used for energy storage.

The battery solutions work efficiently within a current range (both charging and discharging). However, using HUCs extends this range effectively for both low and high currents.

it is critical to manage charge/discharge profiles of batteries to improve their life span & to improve the efficiency of the entire system by harvesting low energy sources (e.g. cloudy conditions, low winds, etc.) effectively.

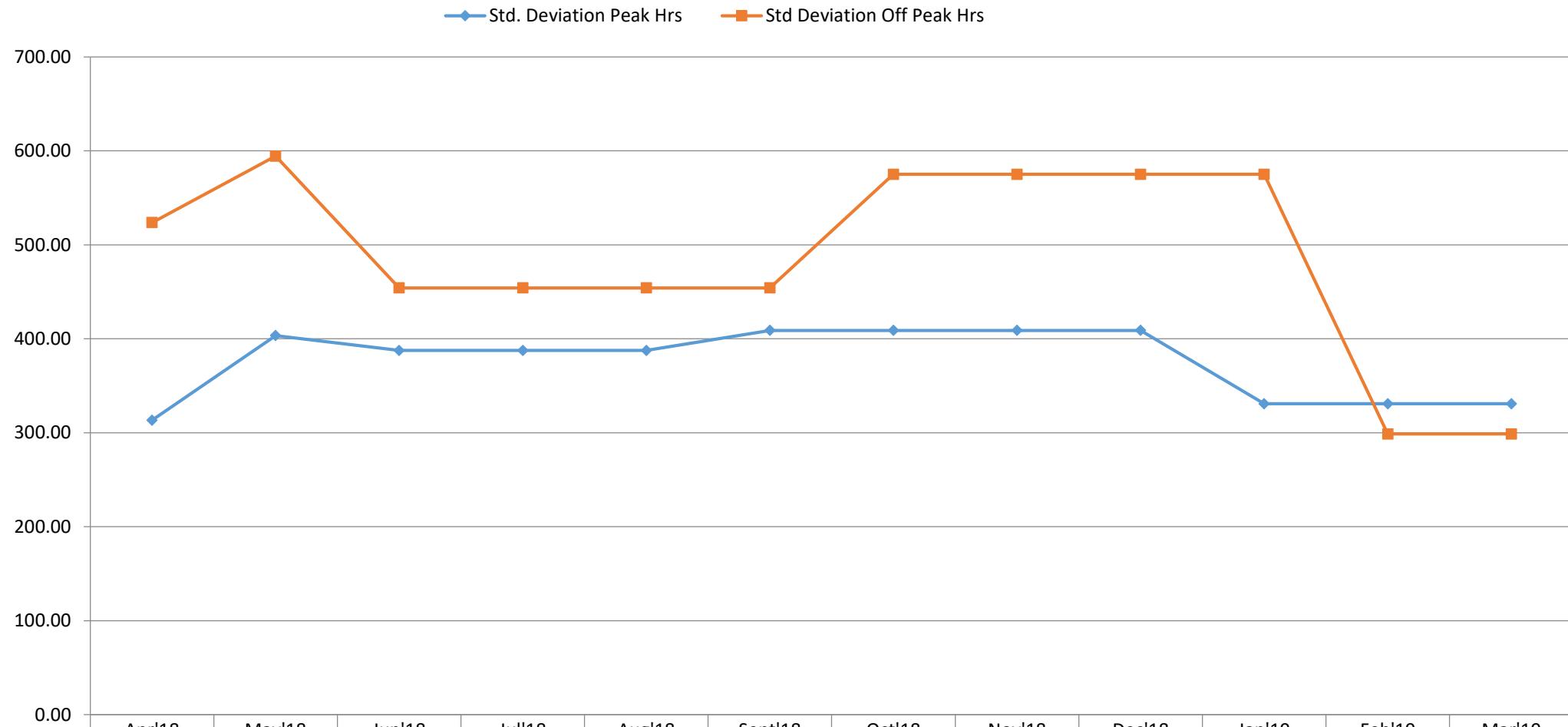
- **SMART Planning and Operations of Grids with Renewables and Storage (SPOReS)**

(At IIT Bombay) (partners: GERMI Gandhinagar)

Work carried to provide suite of tools to address planning and operational issues for facilitating transition to a large-scale deployment of renewable generation.

A lab based prototype of Smart Brown Box has been designed using embedded hardware and user interface has been developed. Algorithms for Smart Storage Manager and Smart Signalling Framework are being developed and tested.

Delhi: Std. Deviation in FY 2018-19



	Apr'18	May'18	Jun'18	Jul'18	Aug'18	Sept'18	Oct'18	Nov'18	Dec'18	Jan'19	Feb'19	Mar'19
Std. Deviation Peak Hrs	313.36	403.48	387.55	387.55	387.55	408.92	408.92	408.92	408.92	330.79	330.79	330.79
Std Deviation Off Peak Hrs	523.70	594.36	454.17	454.17	454.17	454.17	575.10	575.10	575.10	575.10	298.71	298.71

Smartness is step-by-step and continuous



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Technology Evolution

Smart

Restoration can be faster with analysis and AMI

Integrated

Appropriate

use of

work

flexible

services,

sors,

orking

bove

and

Managerial

and

Measu

analys

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system

Smart

Utilities Need to assess their current stage with help of SGR-SAT prepared by NSGM-PMU, discuss priority steps, investment requirements and likely tangible and intangible returns in SLPMU meetings

Whole network affected from fault

Fault location detection through FPI

Whole system affected till fault rectification
much delay in Restoration

Radial feeder without backup and manual fault location identification, rectification and system restoration

Smartness of the system requires

- Sensors,
- Switches,
- Software

Partially these are effective,
Together these are ultimate solution

Smart Grid Readiness – Self Assessment



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- Showcased during 1st SLPMU meeting-cum-workshop organized on 7th February 2019.
- Online SGR-SAT is ready and will be hosted on NSGM website for use by DISCOMs shortly.

HOW SMART IS YOUR GRID?

SMART GRID INDEX

The Smart Grid Index measures the electricity grid of major utilities globally, in seven key dimensions. The benchmarking results also identify best practices to drive smart grid advancement .



7 DIMENSIONS OF A SMART GRID

MONITORING & CONTROL		SCADA DMS/ADMS
DATA ANALYTICS		Smart Meter Coverage Data Analytics Application
SUPPLY RELIABILITY		SAIDI SAIFI
DER INTEGRATION		Management of DER Integration Grid Scale Energy Storage
GREEN ENERGY		Renewable Energy Penetration EV Facilitation
SECURITY		IT Cyber Security OT Cyber Security
CUSTOMER EMPOWERMENT & SATISFACTION		Real-Time Data to Customers Customer Satisfaction Feedback

Benchmarking Results 2018

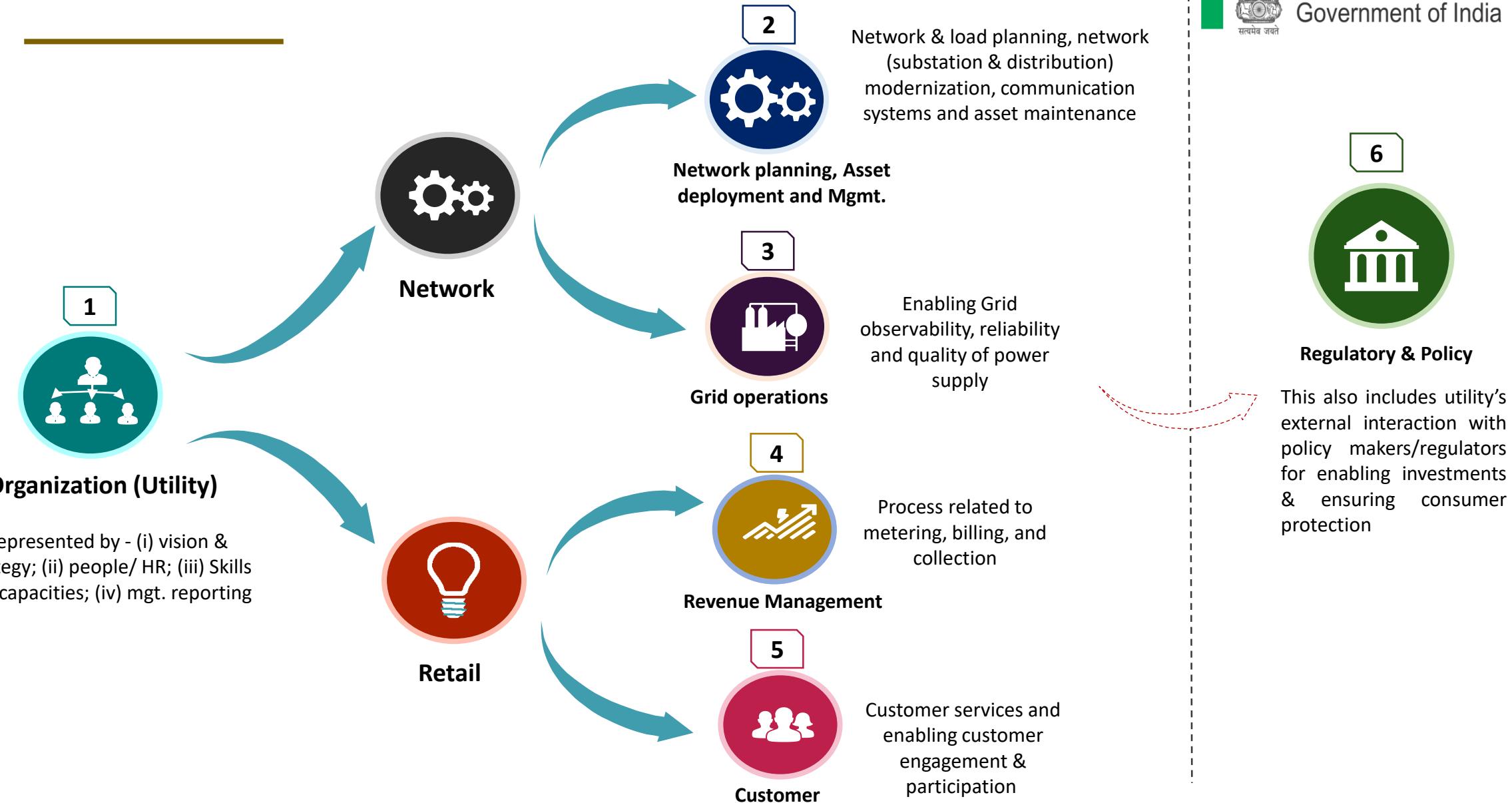
Utility	Country	Score	Best Practices
PG&E	USA	86%	    
SDGE	USA	82%	    
UKPN	GBR	79%	    
Enel	ITA	77%	    
Innogy	GER	77%	    
ComEd	USA	75%	    
EDP	POR	75%	    
SCE	USA	75%	    
Duke Energy	USA	73%	    
ConEd	USA	71%	    
KEPCO	KOR	68%	    
Ausgrid	AUS	66%	    
DEWA	UAE	66%	    
FPL	USA	66%	    
Eandis	BEL	64%	    
Tata Power-DDL	IND	64%	    
Chubu	JPN	63%	    
CitiPower	AUS	63%	    
Stedin	NED	63%	    
WPD	GBR	63%	    
TEPCO	JPN	61%	    
Hydro Ottawa	CAN	59%	    
Kansai	JPN	59%	    
Enedis	FRA	57%	    
Radius	DEN	57%	    
Helen	FIN	54%	    
Liander	NED	52%	    
CLP	HKG	50%	    
HK Electric	HKG	50%	    
SP Group	SIN	50%	    
State Grid Beijing	CHN	50%	    
State Grid Shanghai	CHN	50%	    
TNB	MAS	50%	    
Vattenfall	SWE	48%	    
CEM	MAC	46%	    
Western Power	AUS	46%	    
Eskom	RSA	45%	    
MOESK	RUS	45%	    
Wien Energie	AUT	45%	    
MEA	THA	43%	
TPC	TPE	39%	
Meralco	PHL	38%	
Vector	NZL	38%	
EVN	VIE	32%	
PLN	INA	29%	

Based on the publicly available data

Design Consideration: Six Domains reflect key utility functions



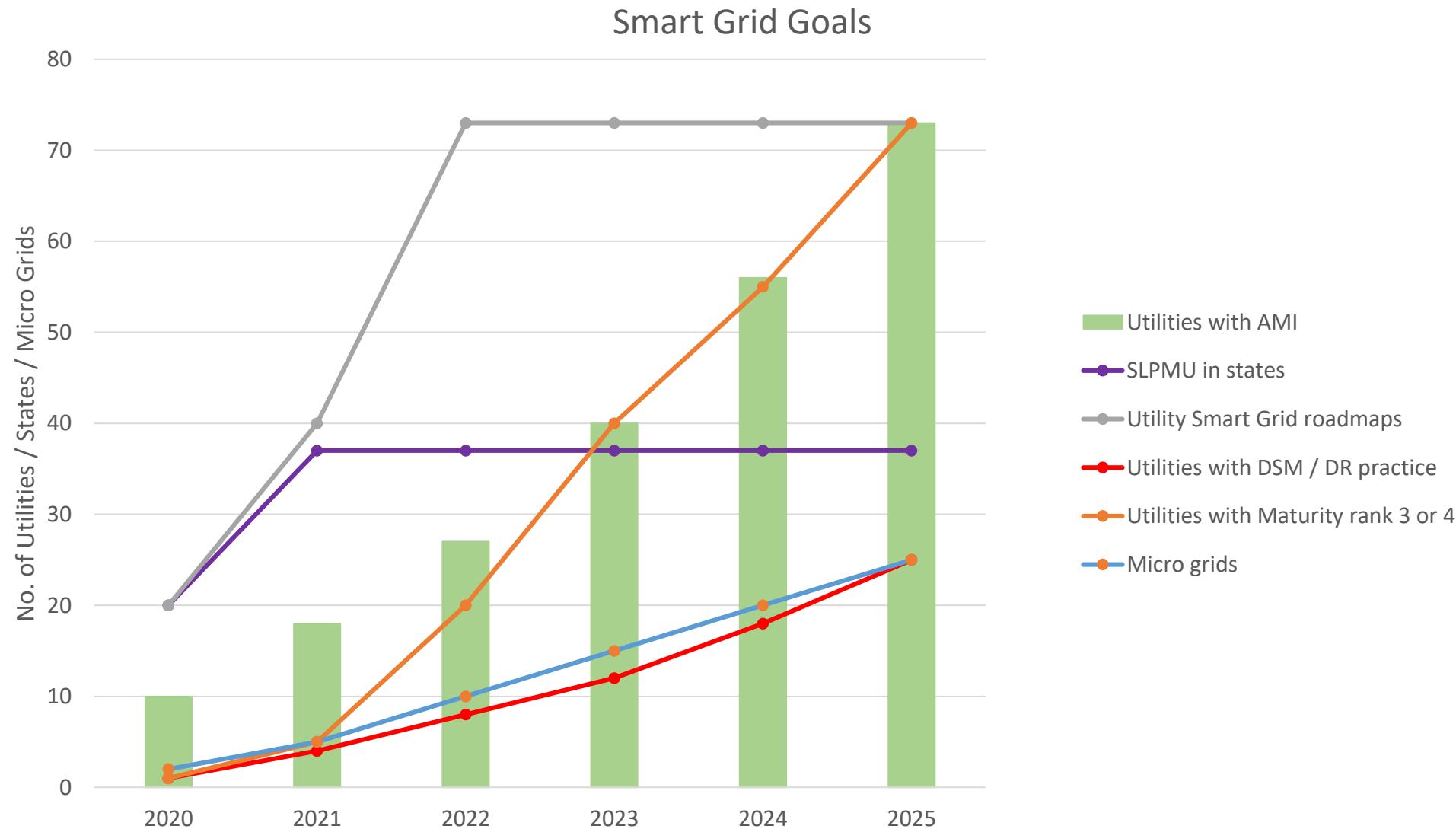
National Smart Grid Mission
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Smart Grid Goals



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Thank You



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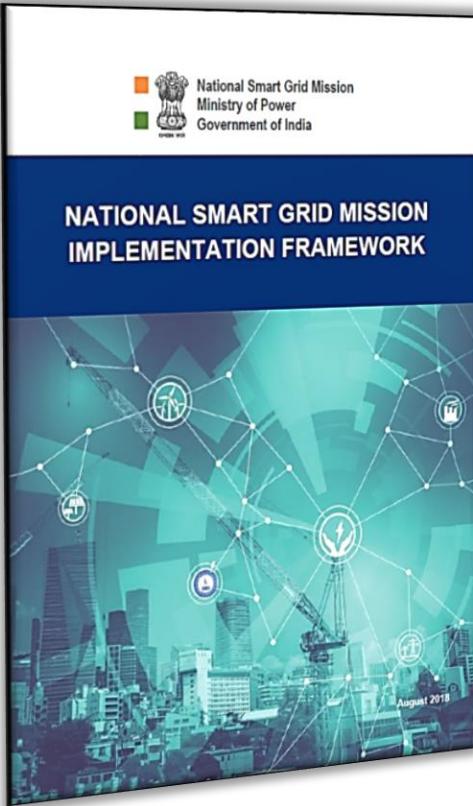
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NSGM Documents



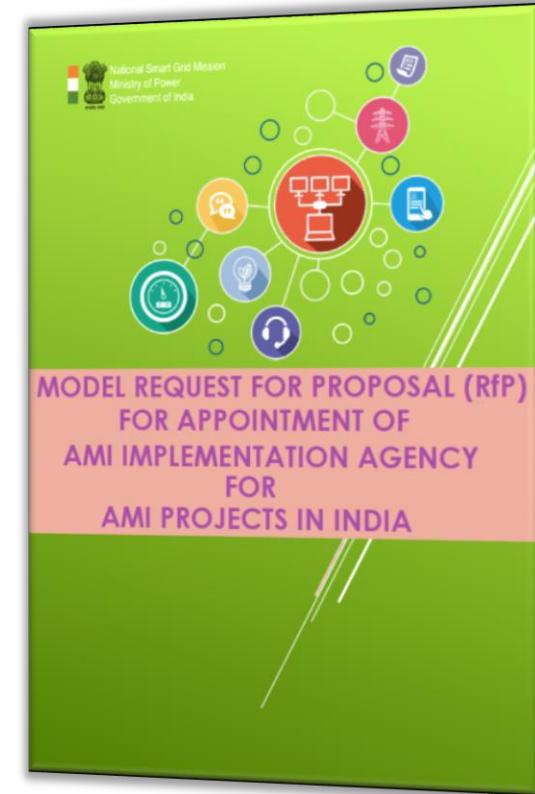
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[Model DPR for NSGM SG Projects](#)



[Model RfP for AMI Projects](#)