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National Smart Grid Mission
Ministry of Power
Government of India

SMART GRID

TOWARDS AN INTELLIGENT FUTURE

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ABOUT THE USAID PACE-D TECHNICAL ASSISTANCE PROGRAM

The USAID Partnership to Advance Clean Energy - Deployment (PACE-D) Technical Assistance (TA) Program is the flagship program under the U.S.-India Energy Dialogue. The six year program, implemented in collaboration with the Ministry of Power (MOP) and Ministry of New and Renewable Energy, has three key components: energy efficiency (EE) including Smart Grid, renewable energy (RE) and cleaner fossil technologies. The Program's focus is on institutional strengthening, capacity building, technology pilot projects, innovative financing mechanisms and increasing the awareness of clean energy technologies.

The overall aim of the PACE-D TA Program is to accelerate the deployment and use of clean energy and facilitate exchange of information and best practices. The Program works with policy makers, regulators, state agencies, private companies, investors, clean energy associations, and other stakeholders to create an enabling environment to increase the uptake of EE, Smart Grid and RE technologies in India.

OVERVIEW

India has an installed capacity of 334 GW of power and generates over 1,140 billion units of electricity annually, of which around 23 percent is lost in aggregate technical and commercial (AT&C) losses. The AT&C losses due to pilferage, defective meters, and errors in meter reading, result not only in wastage of electricity that could otherwise be used productively, but also hamper the growth of distribution utilities and deplete state finances.

While utilities are undertaking several measures to reduce the AT&C losses, adoption of Smart Grid technologies can assist them to achieve their goals in a more cost effective and reliable manner. Smart Grid solutions can monitor measure and control power flows in real-time, which in turn can help identify and reduce losses, optimize operational performance, and reduce costs for both the customers and distribution utilities. At the same time, these technologies enable multiple solutions, including distributed generation, storage, etc. to coexist in an integrated manner that could not be envisaged earlier.

The PACE-D TA Program supported the MOP and National Smart Grid Mission (NSGM) on a range of interventions to establish a strong foundation and enabling framework for Smart Grid deployment in India. The interventions included the design of the regulatory framework for Smart Grid, pilot projects, capacity building of utilities, design of implementation framework for the NSGM, cost-benefit analysis and learnings for scale-up of Smart Grid in India. These interventions helped in creating awareness and knowledge base among Indian utility professionals to effectively design, implement and monitor their Smart Grid projects.

MODEL REGULATIONS

PILOT PROJECTS

COST-BENEFIT ANALYSIS

CAPACITY BUILDING

NSGM IMPLEMENTATION FRAMEWORK

MODEL REGULATIONS

India is at an early stage of creating a smart, modern electric grid network that uses information and communication technologies to enable real-time, two-way exchange of information and electricity between generation supply and demand resources. A Smart Grid not only benefits utilities by making their systems more efficient, reliable and secure, but it also empowers consumers to monitor and manage their energy use.

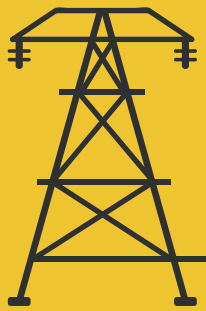
An effective regulatory framework is thus required to strike a balance between the costs, benefits and social impact of Smart Grid deployment, and spur investments in related technologies and projects.

MODEL REGULATORY FRAMEWORK

The PACE-D TA Program provided support to the NSGM, MOP to develop model Smart Grid regulations. The regulations, applicable to all generating companies, transmission licensees, distribution licensees and consumers in a state and connected to the state grid, were developed under the guidance of the technical committee constituted by the NSGM, MOP. The Smart Grid Regulations were submitted to the Forum of Regulators (FOR) in 2014 and were formally adopted by the FOR in June 2015.

The key objective of these regulations is to enable integration of various Smart Grid technologies such as Automated Metering Infrastructure, Demand Response, Distribution Management, Peak Load Management, and Outage Management, amongst others. The model Smart Grid regulations will help utilities to improve efficiency in their generation, transmission and distribution operations, and improve consumer service levels.

The model Smart Grid regulations have now paved the way for State Electricity Regulatory Commissions (SERCs) to adopt them with changes to suit statespecific requirements.



SERCs of Tripura, Karnataka, Madhya Pradesh and Haryana have already finalized Smart Grid Regulations and are considering new investments under the regulatory framework adopted.

KEY GUIDELINES

Constitution of Smart Grid Cell, its Roles and Responsibilities
The licensees need to set up a Smart Grid Cell within three months of notification of the Smart Grid regulations. A dedicated pool of resources will facilitate better coordination, implementation and monitoring of Smart Grid programmes.

Baseline Study and Development of Data
The licensees need to undertake baseline study to identify the targets and final outcomes for its Smart Grid programmes. The baseline study will help the licensees to effectively assess the progress of Smart Grid projects and design further programmes accordingly.

Formulation of Smart Grid Plan, Programmes, and Projects
The licensees need to submit an integrated Multi-Year Smart Grid Plan along with Multi-Year Tariff Petition or Annual Revenue Requirement Petition. Such a plan will help the licensees to effectively design and monitor their Smart Grid programmes and get the buy-in of stakeholders.

Approval of Smart Grid Plan, Programme, and Project Document
The Commission will approve a Smart Grid Programme or Project only if it conforms to the objectives set in the regulations. It may also specify financial incentives/dis-incentives to participating licensees and consumers. An effective approval process can ensure successful implementation of Smart Grid programmes and projects.

Execution of Smart Grid Programmes and Projects
The licensees need to normally adopt the system standards as per regulations notified by the Central Electricity Authority and if those are not established, they need to follow the standards specified by the Commission. Similarly, for network, communication, products, interoperability and cyber security, the standards as provided by the Bureau of Indian Standards or such appropriate authority shall be adopted. The licensees will also need to ensure that customer data protection and privacy.

Mechanism for Cost Recovery
The licensees need to identify the net incremental costs related with planning, design and implementation of Smart Grid programmes and also propose methodologies to recover the same. Since Smart Grid investments are capital intensive, such a guideline will help licensees to explore innovative ways to recover additional costs.

Smart Grid Programme and Project Completion Report
The licensees need to prepare and submit a detailed completion report to the Commission stating the expenses, achievements and challenges relating to the Smart Grid project. These reports can help in the design and implementation of future Smart Grid programmes and projects.

Monitoring, Evaluation, Measurement and Verification of Smart Grid Programme and Project
All Smart Grid programmes and projects will be monitored and evaluated based on methodology identified by the Commission. The licensees will also need to prepare and submit an evaluation report providing details of the lessons learnt and way forward. Effective monitoring can ensure timely tracking of performance and review of results.

PILOT PROJECTS

Smart Grid projects typically require replacement or upgrading of infrastructure, inclusion of digital technology, and use of innovative business models. These interventions are not only capital intensive but also complex in nature, particularly during the evolving stage of the market when there is lack of awareness and documented best practices.

To address these challenges, the Government of India selected a number of electricity distribution utilities to implement Smart Grid pilot projects, to allow for evaluation of the technological and commercial benefits and assess the potential of wider nationwide roll-out.

The PACE-D TA Program supported the Government of India on two Smart Grid pilot projects - Tripura State Electricity Corporation Limited and Ajmer Vidyut Vitran Nigam Limited. These projects aimed to prove the technical and financial viability of select Smart Grid components and evaluated them in a practical environment. The pilot projects also provided an opportunity to engage stakeholders across the Smart Grid value chain and disseminate information about tools, technologies, costs, performance, and measurement and verification data over a period of time.

TRIPURA STATE ELECTRICITY CORPORATION LIMITED (TSECL)

TSECL is the state power utility responsible for implementing the Smart Grid pilot project in Agartala, Tripura. The pilot project at TSECL envisaged establishment of control center along with supply, installation, testing and commissioning of complete Advanced Metering Infrastructure (AMI) and Peak Load Management system involving smart meters, Data Concentrator Units, Meter Data Acquisition System, Meter Data Management, communication system, hardware and software for control center, etc. along with integration of Geographic Information System mapping and billing and collection with AMI system.

AJMER VIDYUT VITRAN NIGAM LIMITED (AVVNL)

AVVNL is responsible for electricity distribution and supply in 11 districts of Rajasthan. The utility has AT&C losses ranging around 27 percent. The objective of the pilot programme was to demonstrate benefits of select functionalities (automatic energy audit and loss reduction analytics) to the utility by implementing a proof of concept on a selected feeder (1,000 consumers). As a part of this pilot, two different technologies (Smart Meters and M2M over-the-top devices) were tested and deployed on approximately 500 consumers for each of the technologies.

TA PROVIDED TO TSECL

- Strategy for measurement and verification and baseline development
- Capacity building of TSECL's Smart Grid project team (four workshops held)
- Smart Grid Data Analytics report formats
- Development of IT Guidelines
- Lessons learned and Best Practices Document

IMPACT

- Trained ~25 professionals who were a part of TSECL Smart Grid project team
- 21 Data Analytics report formats developed to aid TSCEL in decision making in areas of AT&C losses, power quality and reliability, load management and asset optimization
- IT guidelines enabled confidentiality, integrity and availability of TSECL's critical IT infrastructure (including Smart Grid)
- M&V Strategy Report and Excel Tool for AMI enables TSECL to evaluate project benefits and obtain regulatory approvals for Smart Grid investments

TA PROVIDED TO AVVNL

- Baselining and pre-implementation analysis
- Equipment installation - Smart Meters and M2M over-the-top devices (retrofit communication adapters)
- Analytics software/mobile application for generating periodic reports and alerts related to energy audit, energy theft, load violation, etc.
- Program management and monthly analytics report for loss reduction strategies
- Cost-benefit analysis

IMPACT

- Project analytics dashboard enabled regular monitoring of project area parameters and helped take corrective action if required
- Regular analytics and reporting helped identify loss reduction opportunities and strategies thereof to AVVNL management
- 6.5 percent AT&C loss reduction estimation – from 20 percent to 13.5 percent, (with one of the DT losses being reduced from 60 percent to 25 percent)
- Total estimated annual savings: INR 12 lakhs (for 1,000 consumers) with total utility cost: ~INR 40 lakhs
- Investment payback for AVVNL established as three years
- Structured system and analytics training, including sharing national and international experience; and case studies helped build the capacity of AVVNL officials in the pilot area

INSIGHTS FROM PILOT PROJECT

Over the last few years, several Smart Grid pilot programs have been initiated by the Government of India, which are at various stages of execution. The vast body of knowledge existing within these utilities provides vital insights into the challenges, solutions and lesson learned at various stages of Smart Grid project planning and execution. This becomes important as the Government of India looks to accelerate Smart Grid implementation, with practical inputs playing a key role in overcoming the existing commercial, managerial and technological barriers.

In this context, the PACE-D TA Program provided support to the NSGM, MOP to: a) capture the rich and diverse experience being offered by various Smart Grid pilot projects right from the planning till the implementation stage; and b) prepare a set of learnings for the utilities for implementing large-scale Smart Grid projects.

APPROACH

For this activity, an analytical approach was adopted in identifying the Smart Grid projects learnings. A data collection and analysis framework to study the different phases of project lifecycle viz. planning, bidding, implementation, operations and scale-up was also developed.

FRAMEWORK APPROACH

- Review of past pilot studies and other project specific documents was undertaken.
- An exhaustive set of questionnaire was developed for data collection for select pilots at advanced stages of implementation.
- A stakeholder workshop was also conducted by the NSGM, MOP and visits were undertaken by PACE-D TA Program team at the select pilots to understand their experience.

OUTCOME

This report makes an attempt to capture some of these learnings for consideration of all stakeholders for scaling up Smart Grid projects in the country. Specifically, utilities planning for large-scale Smart Grid initiatives may consider these insights as a checklist while designing and implementing projects.

The learnings developed as part of this activity for scaling up Smart Grid projects would help the stakeholders in avoiding implementation bottleneck and improving project efficiency. The insights from this document aim to be of value in guiding scaling up at various stages—whether one is only beginning to think about it, or has already selected a model for expansion or is in the midst of scaling up.

PILOT PROJECT STAGES

PHASE 1

PLANNING

- Project objective and area selection criteria
- Pre-feasibility cost-benefit studies & DPR preparation
- Regulatory & statutory compliance/approvals
- Business model selection

PHASE 2

BID DEVELOPMENT

- Scoping
- Financial and technical requirements
- Bid evaluation vendor participation

PHASE 3

IMPLEMENTATION

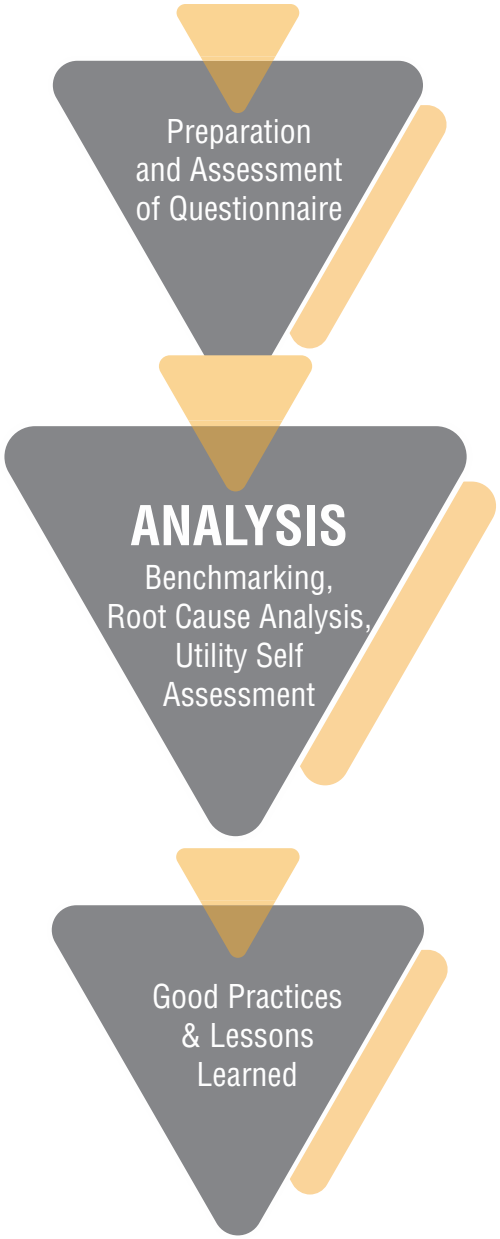
- System integration and interoperability
- Testing, supply, installation
- Employee capacity building and up-skilling/trainers
- Consumer engagement

PHASE 4

OPERATIONS & MONITORING & SCALE-UP

- Performance of system
- Measurement and verification
- Technology adoption in business process
- Analytics and action implementation
- Scale-up assessment

OUTPUT



COST-BENEFIT ANALYSIS OF SMART GRID PILOTS

Several utilities in India have taken up Smart Grid investments in their respective areas of supply. Additionally, the NSGM, MOP has also been receiving proposals from utilities to support Smart Grid investment. A Cost-Benefit Analysis (CBA) of the envisaged investments provides a clear basis of taking up such projects, and helps build confidence among stakeholders on the usefulness of the investments. CBA would allow utility to determine financial feasibility of the project as well as help them gain regulatory approval for the investments. Insights provided by the CBA would also provide the basis for undertaking future Smart Grid investment by the utilities.

In this context, the PACE-D TA Program provided support to the NSGM, MOP to: review and document the key learnings from CBA of Smart Grid projects undertaken internationally (including both developed and developing countries); and undertake CBA of two ongoing Government of India Smart Grid Projects (CESC, Mysore, and Kala Amb Industrial area in HPSEB). The interventions included:

- Baselining: Prepared baseline formats for data collection and established pre-deployment baseline for the pilot area (to the extent available)
- Quantification of Cost and Benefit
- Cost-benefit analysis to determine project NPV and IRR

CESC, Pilot Project – Mysore

The pilot project at CESC, Mysore is implementing key Smart Grid functionalities including Advanced Metering Infrastructure, Peak Load Management, Outage Management System and Distributed Generation/ Micro Grid for a consumer base of 21,824 consumers. The project is implemented at a capital expenditure of INR 32 crores.

HPSEB, Pilot Project – Kala Amb

The Smart Grid pilot project at HPSEB has implementing Advanced Metering Infrastructure, Peak Load Management, and Outage Management System for a consumer base of ~1,500 consumers. The pilot area consumption is driven mainly by industrial consumers. The project is implemented with a capital expenditure of INR 18 crore.

Impact

Established return on investment to build evidence for utility, government, investors and regulators to undertake large-scale Smart Grid projects.

CAPACITY BUILDING

Smart Grid encompasses a wide range of technologies, substation automation, software and hardware. Utility engineers not only need to know how to operate the new systems but also how to maintain and monitor them for higher efficiency.

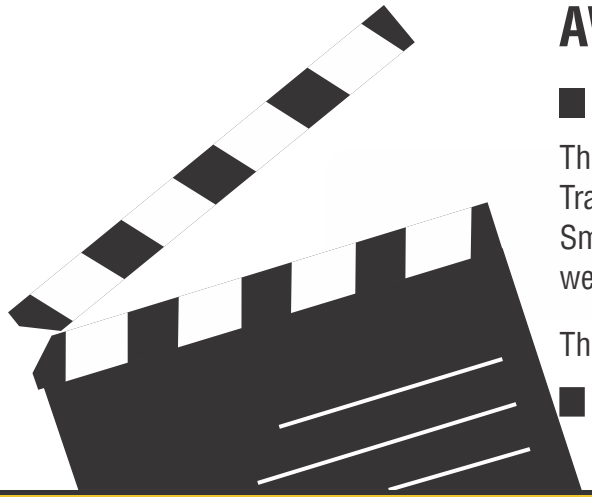
Training and capacity building has been identified as one of the key strategic areas under the NSGM with a target of training 10 percent of utility technical staff on Smart Grid technologies.

The PACE-D TA Program provided support to the NSGM, MOP to build the capacity of utility engineers and facilitate knowledge transfer of industry best practices and project implementation methodologies. The training interventions aimed to equip the utility participants with the technical, commercial and regulatory knowledge essential to effectively plan and implement their respective Smart Grid projects.

As a part of its capacity building initiative, the Program organized several training programs with specific themes such as issues faced by utilities during the pre-award stage and the importance of communication technology in the successful deployment of Smart Grid projects. Workshops also included field trips to Tata Power Delhi Distribution Limited, Puducherry Electricity Department, Paschimanchal Vidyut Vitran Nigam Limited, and the Smart Meter manufacturing facility of Secure Meters which helped the participants (nodal officers of the Smart Grid pilot utilities) to understand the practical issues faced during the conceptualization and implementation phase of Smart Grid.

14	366	5,295
TRAINING PROGRAMS	PARTICIPANTS	PERSON HOURS OF TRAINING

As of December 2017



AWARENESS FILM

The Program, in collaboration with the NSGM, MOP has developed a short film on "Smart Grid and its Transformative Impact on Utility Operations and Customer Energy Empowerment'. The film, shown during Smart Grid training programs, provides an overview of what is a Smart Grid and how it can transform the way we generate and use electricity.

The film can be accessed at: https://www.youtube.com/watch?v=MWUkGaMBsuU

SMART GRID TRAINING NETWORK

The PACE-D TA Program in collaboration with the NSGM, MOP has developed a basic Smart Grid course for utility personnel. The course is relevant to the Indian context and has a mix of lecture and practical insights and cases, both national and international. The objective of the course is to develop a foundation course that would provide a well-rounded exposure to the utility participants on varied aspects of Smart Grid planning and deployment. The course is designed at two levels:

A half-day orientation module for the top management (Chairman, Managing Directors and Directors) of the distribution companies. The orientation workshop, held in January 2016, sensitized the senior-level managers on the planning and implementation of Smart Grid projects, as well as benefits of such projects to both the utilities and their customers.

A three-day Smart Grid foundation course for utility professionals to sensitize them on Smart Grid technologies and related operational issues. The Program provided assistance to the NSGM, MOP to organize two training programs for utilities. The first three-day training was held in July 2016 at CENPEID campus of Tata Power, Delhi and the second three-day training was held in December 2016 at the Central Power Research Institute campus in Bengaluru.

SMART GRID FOUNDATION COURSE MODULES

- Introduction To Smart Grid
- Building Blocks Of Smart Grid
- Peak Load Management &
- Demand Response (DR)
- Smart Grid Readiness Assessment &
- Maturity Model

- Loss Reduction, Asset Monitoring & Optimization, & Outage Management System
- Grid Integration of Renewables & Energy Storage
- Smart Grid & Quality Of Supply & Service
- Communications Technology

- Cyber Security
- Customer Engagement & Participation
- Smart Grid Analytics & Data Management Issues
- Smart Grid & its Role in Smart City Context

Going forward, these training programs will be rolled out with support from partner institutions by establishing a network of these institutions (Smart-NET) that will work with the National Smart Grid Knowledge Centre under the NSGM. The proposed training programs will facilitate dissemination of tools, approaches and methodologies used for planning and designing Smart Grid projects, and build the capacity of utility professionals.

STUDY TOURS

As India endeavors to find the solutions for a nationwide Smart Grid infrastructure, it needs to imbibe relevant experiences, good practices, technologies and initiatives adopted internationally. The PACE-D TA Program organized two study tours to facilitate such knowledge transfer and provide participants an opportunity to obtain first-hand experience of large-scale Smart Grid projects globally.

STUDY TOUR TO THE U.S.

The first study tour was to the U.S. in January 2014 in which the participants primarily comprised of key officers of the distribution utilities responsible for carrying out the implementation activities under the Smart Grid program. The primary objective of the study tour was to facilitate knowledge transfer of industry best practices, Smart Grid project implementation methodologies, and first-hand experience of the latest Smart Grid technologies.

KEY OBJECTIVES

- Various Smart Grid technologies in place and their functionalities
- Costs and benefits of the technologies adopted
- Smart Grid interventions such as DR, outage management system (OMS), synchrophasor measurement unit, asset management, etc.
- Practical implementation issues/challenges through interactions with utility personnel
- Regulatory and policy-level challenges encountered during implementation
- Customer expectations and strategies for customer engagement
- Advanced Smart Grid technologies and their applicability
- Exposure and access to good practices, new technologies and data analytics

As a part of the study tour, the participants visited and met with personnel of a variety of utilities, power system operators, research institutions, and regulators and governmental authorities, as well as with vendors of Smart Grid solutions and services.

OUTCOMES

1. **Communication Infrastructure** – Mesh network with radio frequency is a technology to consider. Cellular technology should be considered for rural areas. If fiber optics is considered as communication infrastructure, then bundled service can be sold for unused portion to reduce the cost of implementation. Wi-max has not been successful from cost point of view.
2. **Customer Engagement** – Most important for success of the program. Education/training prior to project start and timely feedback are very important for customer acceptance. Green Button initiative is an important aspect of customer engagement.
3. **Micro-grid Projects** – Micro-grid projects should be considered with the option of switching on and out of the grid to minimize burden on the transmission grid and reducing generation reserve requirement.
4. **Dynamic Pricing Programs for DR** – This can be successful if properly implemented (technical requirement: interval metering).
5. **Smart Meters** – Smart meters help system reliability, tamper detection, and outage reduction.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STUDY TOUR TO SPAIN, ITALY AND FRANCE

The second study tour was organized in December 2017 where key senior officials of the MOP, NSGM, Central Electricity Regulatory Commission, Central Electricity Authority, and distribution utilities visited select Smart Grid installations and firms in Spain, Italy and France. The study tour participants met with senior personnel of both public and private utilities, power system operators, research institutions, and meter manufacturers to learn about Smart Grid programs that provide a diverse range of implementation experience and perspectives.

KEY OBJECTIVES

- Initiatives undertaken by the countries and the role of various stakeholders (Government, regulators, utilities, etc.) for implementation of large Smart Grid projects and their relevance to India.
- Business case, implementation approaches, challenges, consumer engagement strategies and best practice to deploy large-scale Smart Grid project.
- Project impact and learnings (for both consumers and utilities) that provided business case for large-scale deployment.
- Implementation of Smart Grid functionalities like DR, Smart Grid analytics, electric vehicles (EVs), etc. aided by live demonstrations of such interventions.
- Business case, implementation approaches, challenges, consumer engagement strategies and best practice to deploy large-scale Smart Grid project.

OUTCOMES

1. Achieving end-to-end system interoperability is a key enabler for reducing costs. Interoperability in the European model has been achieved by development of standards in-house by utilities and creating an ecosystem of manufacturers who conform to the standards.
2. Sustainable R&D ecosystem needs to be created and encouraged to provide proactive technology solutions for electricity distribution sector which are suited for Indian context.
3. Skilling for utility sector needs to address technology knowledge gap at various levels to enable current and future workforce to effectively and efficiently apply digital initiatives in the distribution sector.
4. There is need for establishing few Smart Grid demonstration projects with technology partnership from Centre for Development of Telematics, Centre for Development of Advanced Computing and/or IITs.
5. Future Smart Grid initiatives to include DR programmes, RE integration at medium and low voltage.
6. Learnings from smart metering and analytics platform are now guiding the utilities to focus and invest in similar asset-oriented services such as EVs infrastructure.
7. Smart Grid demonstration projects covering technologies such as EV, RE integration, Energy Storage, DR, etc. have provided the required experience for utilities to excel in Smart Grid sector.

OPINION PAPERS

The PACE-D TA Program developed several opinion papers on Smart Grid to facilitate knowledge dissemination amongst stakeholders. These papers were developed after reviewing existing literature, national and international case studies and regulations, and consultation with Smart Grid experts. They helped in creating awareness and knowledge base among Indian utility professionals, and can be used as a reference material for implementation and academic purpose.

- **Communication and Application Interoperability:** This paper contains a framework for communication and application interoperability, current interoperability status analysis of India and gap analysis and road map with an introduction to necessary standards.

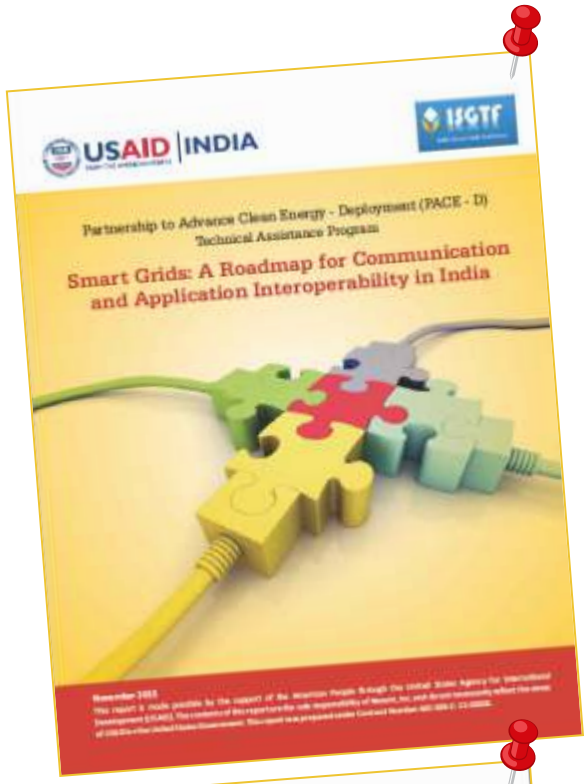
- **Approach for Dynamic Pricing:** This paper elaborates various approaches for dynamic pricing of Smart Grid Pilot referring to Indian context.

- **Smart Imperatives for Grid Integration of Renewables:** This paper focuses on imperatives to address short term issues for renewable integration such as forecasting and planning, scheduling and dispatch of RE generation, charging mechanism for RE integration, imbalance settlement mechanism, imbalance settlement in “Green” accounts, system operation design and provision of flexibility in the system. Imperatives to address long term issues have also been discussed in the paper.

- **Demand Response in the Indian Context:** This paper elaborates key design characteristics of demand response, energy performance analysis, program design for demand response, cost benefit analysis, infrastructural requirements for demand response, administrative and institutional framework, regulatory requirements and performance evaluation aspects to monitor demand response.

- **Design Evaluation, Monitoring and Verification (EM&V) Framework for Smart Grid Projects:** This paper elaborates the need of EM&V, integrated EM&V framework, evaluation process for Smart Grid Projects, and balancing uncertainties in EM&V.

- **Leveraging R-APDRP Infrastructure for Smart Grid Projects:** This paper provides an overview of the applications of Smart Grid, synergies between R-APDRP and Smart Grid, and Smart Grid as an option for leveraging R-APDRP.



These papers are available on the Program website (https://www.pace-d.com/resources/).

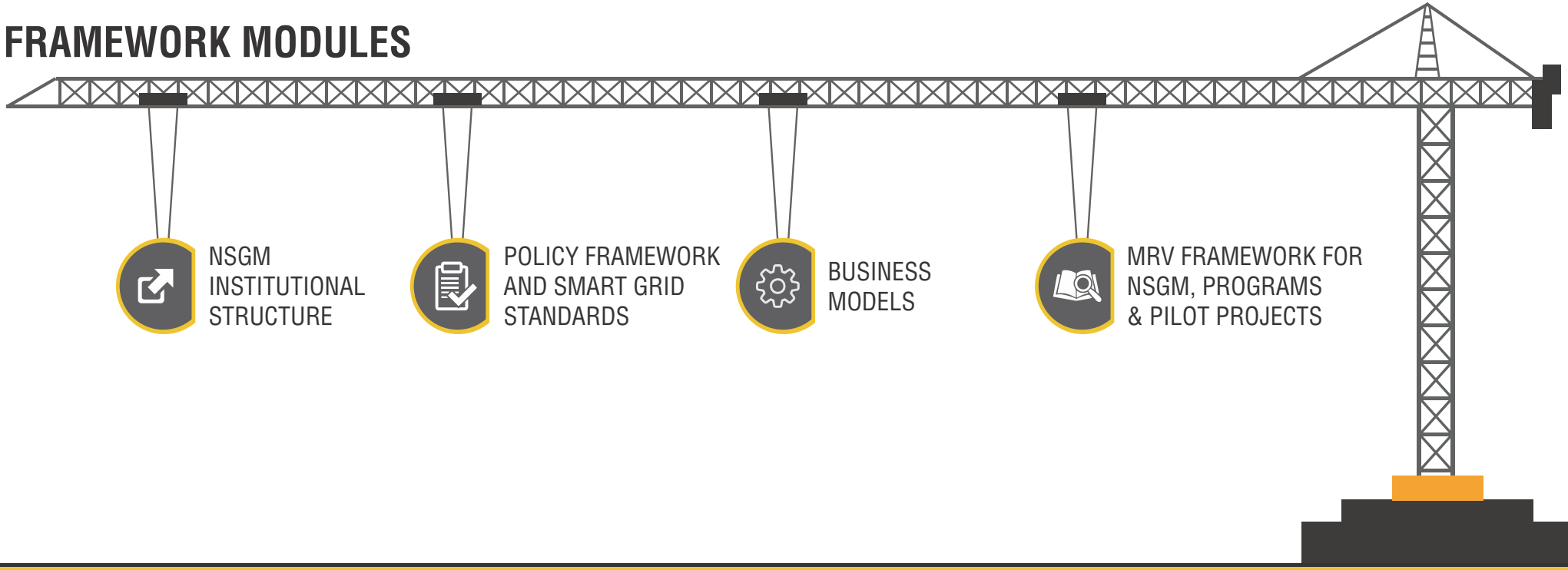
NSGM IMPLEMENTATION FRAMEWORK

The MOP established the NSGM in March 2015 for planning, implementation and monitoring Smart Grid activities in India. To ensure effective rollout of the NSGM activities and day to day operations, MOP required the NSGM to have a comprehensive Implementation Framework that details the institutional structure, key decision-making and activity stages.

The PACE-D TA Program provided support to the NSGM to develop the Implementation Framework, which includes:

- Roles, goals and processes for various functional processes within the NSGM and its relationships with the states, the utilities and other stakeholders.
- Long-term roadmap and immediate priorities for roll out of policies, standards, programs, projects, research and demonstration and development, and capacity building initiatives.
- Business models for public, private and public-private partnership modes of investing in various domains of Smart Grid starting with Smart Meters.
- Monitoring Review and Verification (MRV) framework for the NSGM activities as well as for programs and projects supported by it.

FRAMEWORK MODULES



MODULE 1: NSGM INSTITUTIONAL STRUCTURE

- Sets a vision and objective for improving the quality, reliability and access of power.
- Details the role of the center and states in governance structure and the actions to be taken to achieve the roll out of Smart Grid in the country.
- Spells out operations and process flows of four core operational units (Project Planning and Monitoring Unit, Information and Cyber Security Unit, Technology and Standards Unit, and Capacity Building and Communication Unit).
- Provides a structure of the human resources required for each operational unit.

OUTCOMES

- Streamlined operations at the NSGM.
- Coordination across the four NSGM Project Management Units (NPMUs).

MODULE 2A: POLICY FRAMEWORK

- Establishes the scope, principles and process of policy development.
- Outlines policies relating to information and operational technologies such as interoperability consumption.

- Robust processes for policy formulation.
- Faster formulation and adoption of policies at the national and state levels.

MODULE 2B: SMART GRID STANDARDS

- Sets the scope, principles and process of standards development.
- Identifies Smart Grid standards' requirement and gaps that need to be addressed.

- Faster rollout of standards.
- Economies of scale resulting in competitive markets for Smart Grid.
- Boost to public & private sector technology.

MODULE 3: BUSINESS MODELS

- Outlines potential Smart Grid Programs.
- Provides Business Model Framework (features, value derived, and potential sources of revenue, savings, costs and sharing of risk rewards across participants).

- Development of market-based approaches for Smart Grid programs.
- Increased investment in Smart Grid programs.

MODULE 4: MRV

- Lists performance indicators that are essential for the monitoring of activities under the four units of the NPMU.
- Describes MRV framework for Smart Grid Rollout, Programs, Policies, Standards and Financing.

- Appropriate performance goals.
- Baseline information for measuring benefits.
- Framework for review and monitoring.
- Learning for future roll out.

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