National Smart Grid Mission
Ministry of Power
Government of India

Smart Grid Readiness – Self Assessment Tool (SGR-SAT)

1st Meeting of State Level Project Management Units (SLPMU) Representatives of NSGM

PSR Programme - Supporting Structural Reforms in the Indian Power Sector

8th February 2019

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Context & Objective

Context and Objective

1. Discoms are at varied stages of development in terms of physical infrastructure and process maturity with each having their set of challenges and resources at disposal to mitigate such issues
2. Modernization to smart grid systems is a common priority for all with no. of initiatives already underway
3. A common framework that helps understand these journeys, and provides basis for discoms to - 'self asses', 'understand gaps in their areas of priorities' and 'learn from each other' is much desired
4. International frameworks exist however are not specific to the context in India
5. NSGM, MOP has identified this as a requirement under the NSGM Implementation Framework *(approved as part of the Governing Council meeting held during Jan 2019)*

Objective of developing SGR-SAT is to:

- ✓ Establish a generic reference notion of the smart grid journey;
- ✓ Use as a common framework for – (i) self assessing their readiness to implement smart grid initiatives, and (ii) support inter-se learning from each other
- ✓ Enable the utilities to define their smart grid goals, and prioritize investment/intervention areas that are relevant to their respective context

SGR-SAT Architecture

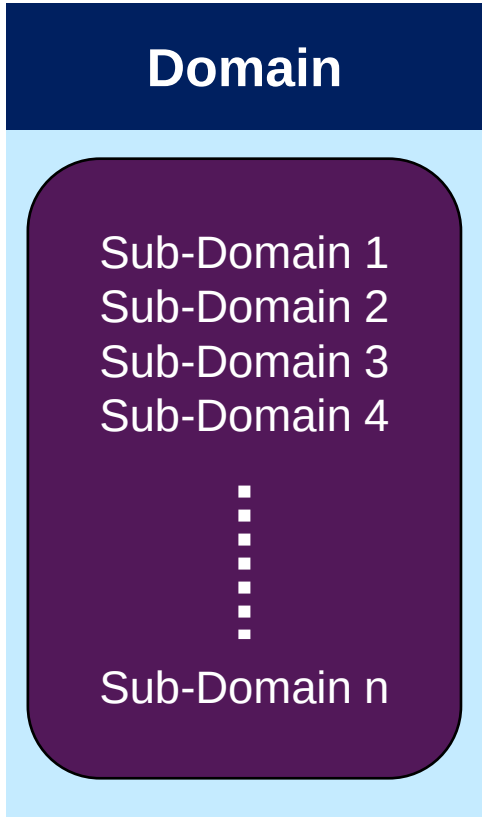
Architecture

Tool takes a systems view of the utility from smart grid perspective, and classifies it into three aspects – domain, sub-domain and maturity level

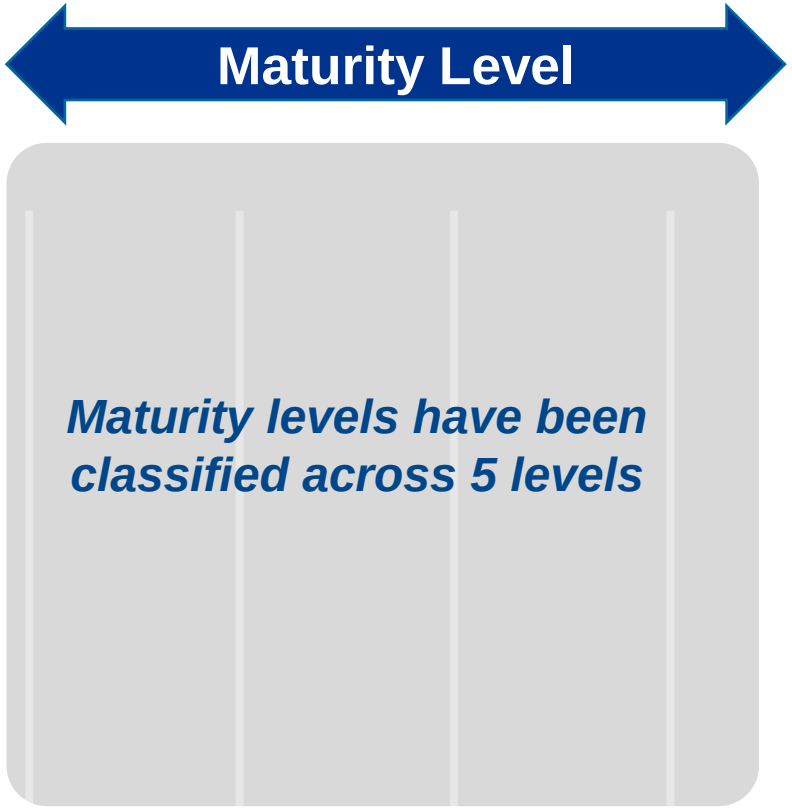
Domains are reflective of the key utility functions

(6 functions)

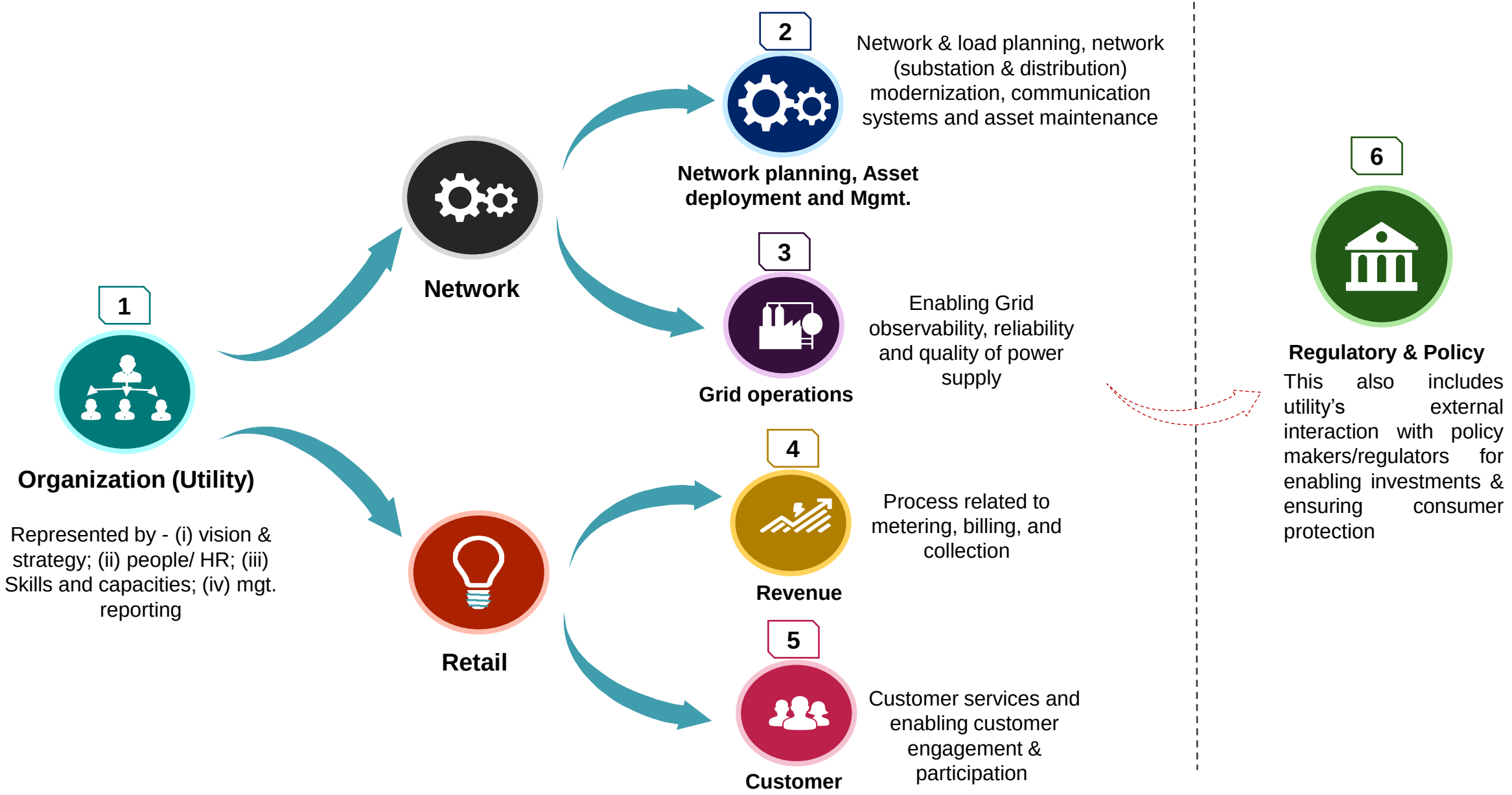
Sub-Domains are processes within each function relevant from the Smart Grid perspective *(24 sub-domains)*



Maturity level captures the progression across a defined sub-domain



Design Consideration: Six Domains reflect key utility functions



Design Consideration: Capturing the sub-processes within the core functions

Domains

1. Organization	2.Network Planning, Asset Deployment & Asset Mgt.	3.Grid Operations	4.Revenue Mgt. & Energy Audit	5.Customer	6.Regulatory & Policy
Vision & Strategy	Load Growth & Net. Expansion Planning	Grid Observability & Security Mgt.	Consumer Metering & Indexing	Consumer Connection Mgt.	Regulatory Interface
People/ Human Resources	Asset Survey and GIS	Power Quality Monitoring	DT/Feeder Metering	Customer Care Infrastructure	Data Privacy and Cyber Security
Training & Capacity Building	Substation Modernization	Outage Mgt.	MDMS and Energy Audit	Consumer Engagement Program	
Mgt. Reporting & MIS	Distribution System Modernization	Demand Response	Billing and Collection	Net Metering	
	Communication System Modernization				
	Asset Maintenance Management				

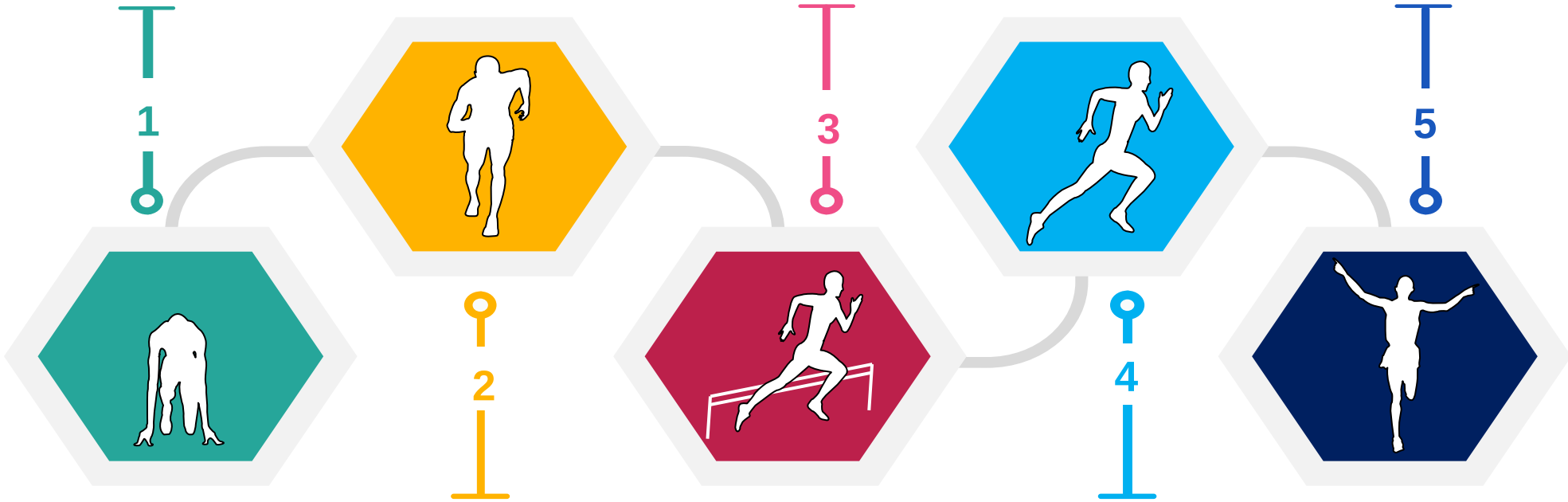
Sub-domains

Design Consideration: Levels within each sub-domain map the journeys as the process matures, hence support defining ‘To-be targets’

Core business processes and technologies that allow a utility to function are **being initiated**

Performance measures show marked improvements from baseline with visibility across the organization

Optimization of processes and technology across the entire network to yield further value



Performance measures identified in various domains and technologies are being **tested**

Successfully **implemented best available processes/ technologies at a large scale** and further performance improvement being sought

Design Consideration: Self-Assessment

- Maturity is defined by few attributes that need to be responded through Yes/No criteria

- This is **not a tool for 'Ranking'** the Discoms

- This tool emphasizes on **maturity assessment based on Discom's own set of priorities and supports 'Peer Learning'**

- Maturity Assessment Levels:
  I. Level 1 - Self-assessment by utilities
  II. Level 2 – Review/Validation of the self-assessment by NSGM (basis review of information submitted by the utility) – **Tool will have provision for submission of information from existing documents for review**

Tool Snapshot

Tool Snapshot – Domain View (1/2)

1. Organization | **2.Network Planning, Asset Deployment & Asset Mgt.** | 3.Grid Operations | 4.Revenue Mgt. & Energy Audit | 5.Customer | 6.Regulatory & Policy

Maturity levels

	L1	L2	L3	L4	L5
Load Growth & Net. Expansion Planning	○ Reactive load growth mgt. ○ No standard process for load forecasting/power flow analysis	○ Standardized processes and KPIs established for load forecasting/ modelling	○ Dedicated forecasting software deployed. On-line grid scheduling system implemented	○ Forecasting S/W integrated with smart metering data ○ Load flows basis above	○ Forecasting software integrated with AI/ML and other IT-OT systems to minimize margin of error
Asset Survey and GIS	○ No initiation of GIS deployment	○ Initial field survey complete and GIS package implemented	○ GIS database updated with consumer meters and 100% of distribution assets mapped in GIS	○ GIS integrated with AMS, and MDMS for energy audits	○ GIS integrated with ERP
Substation Modernization	○ Discom using Electromechanical/static relays ○ Load Mgt. System (LMS) under consideration	○ At least 10% of numerical relays installed. ○ Investment in LMS initiated	○ LMS integrated with SCADA. 30% of existing relays replaced and integrated with LMS.	○ 60% of existing relays replaced & integrated with LMS. SAS architecture aligned with IEC standard	○ 90% of existing relays replaced and integrated with LMS. At least 50% of PTs at SS upgraded with OLTC
Distribution System Modernization	○ FPI, Auto Recloser and RMU under consideration. Only manual Load brake switch (LBS) installed	○ Sectionalizers and RMU installed for at least 5% of total identified population or sites.	○ Incremental installation (10%) of FPI, AR, Sectionalizer and RMU	○ Incremental installation (~50%) of FPI, AR, Sectionalizer and RMU	○ Incremental installation (~90%) of FPI, AR, Sectionalizer and RMU
Communication System Modernization	○ Little or no communication with Control Centre and DA components	○ Incremental addition (5-10%) in communication link set up at CC and SS level	○ Incremental addition (10-20%) in communication link set up at CC and SS level	○ Incremental addition (~50%) in communication link set up at CC and SS level	○ Incremental addition (~100%) in communication link set up at CC and SS level
Asset Maintenance Management	○ Asset registry exists but not 100% complete. Assets maintained under reactive maintenance	○ Complete asset register developed. Asset Mgmt. System generates maintenance schedules.	○ Asset data integrated into GIS as per SOP. AMS integrated with WFMS.	○ Grid operations factor in Asset Health index	○ Predictive maintenance based tool introduced to decide on a holistic maintenance strategy

Tool Snapshot – Domain View (2/2)

1. Organization | 2.Network Planning, Asset Deployment & Asset Mgt. | 3.Grid Operations | 4.Revenue Mgt. & Energy Audit | **5.Customer** | 6.Regulatory & Policy

Maturity levels

	L1	L2	L3	L4	L5
Consumer Connection Mgt.	○ Manual process for new/existing connection mgmt.	○ Centralized new connection management activities ○ KPIs defined and monitored	○ Online services for new connection. ○ Improvement in KPIs	○ Online tracking of new connection application status available	○ Online monitoring of connection status/maximum demand ○ Analysis of customer's historical data for improving services
Customer Care Infrastructure	○ Customer help-desk established	○ Customer care centers IT enabled ○ KPIs defined and monitored (e.g.: complaint resolution time)	○ Optimum routing of consumer calls through IVRS, Computer Telephony Integration, ○ Improvement in KPIs observed	○ Call center workforce management system implemented	○ Self-service options such as chat-bots introduced
Consumer Engagement Program	○ Customer engagement on reactive basis	○ Customer segmentation ○ Trained customer care executives ○ Engagement activities for pilots ○ KPIs defined & monitored	○ Budget allocated ○ Dynamic website and CRM implemented. ○ Improvement in KPIs	○ On-demand information for consumers ○ Consumer portal available on mobile ○ Feedback/complaint mgt. system deployed	○ Social media used for creating awareness ○ Dedicated staff for handling social media accounts
Net Metering	○ Development of net metering policy under consideration	○ Net metering policy developed. ○ Manual application process ○ KPIs defined & monitored	○ Online application & payment services for net metering ○ Improvement in KPIs	○ End-to-end online process for net metering application replicated (including agreement signing)	○ Net-metering application system automatically determines feasibility

Tool Snapshot – Sub-Domain View (1/2)

Domain:

2.Network Planning, Asset Deployment & Asset Mgt.

Subdomain:

Load Growth & Net. Expansion Planning | Asset Survey and GIS | Substation Modernization | Distribution System Modernization | Communication System Modernization | Asset Maintenance Management

Maturity levels (Selection to be made by the utilities)

Level 1	Level 2	Level 3	Level 4	Level 5
○ Load growth done on reactive basis; and no standard load forecasting/ model established	○ Standard process established for load forecasting ○ KPIs (like error margin) defined & are being monitored regularly	○ Dedicated forecasting software deployed which takes into account a number of factors to predict load ○ On-line grid scheduling system implemented with process in-place to vet day-ahead schedule exchanges with SLDC	○ Forecasting software integrated with smart metering data ○ Sub-transmission and distribution assets augmentation plans fully aligned with power flow analysis ○ All zones are covered	○ Forecasting software's logic integrated with Artificial Intelligence/ Machine Learning and other IT-OT smart grid systems to minimize the margin of error [1-2%]

Options to upload existing documents for review

Tool Snapshot – Sub-Domain View (2/2)

Domain:

5. Customer

Subdomain:

Customer Connection Mgt. | **Customer Care Infrastructure** | Customer Engagement | Net Metering

Maturity levels (Selection to be made by the utilities)

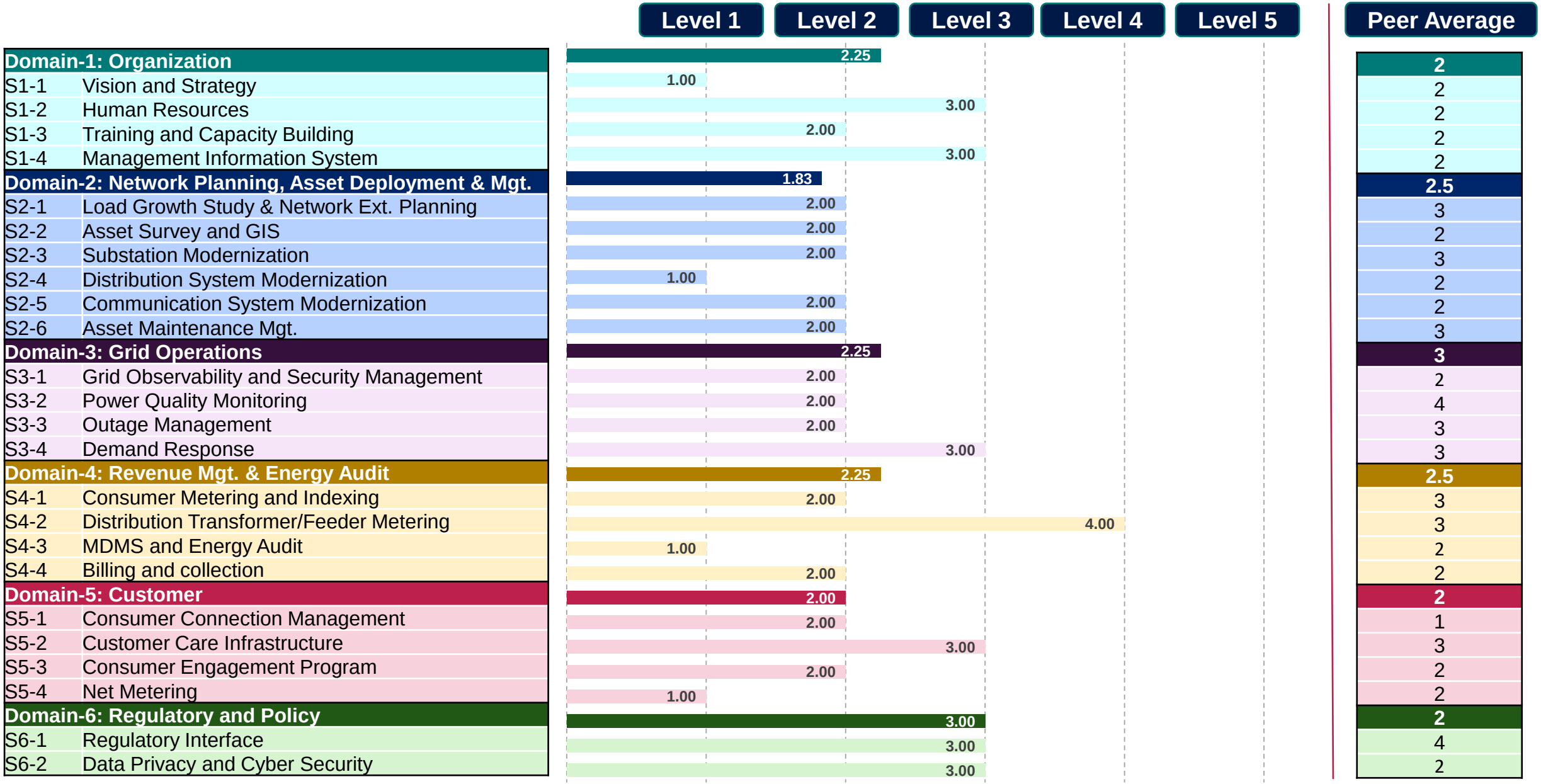
Level 1	Level 2	Level 3	Level 4	Level 5
○ Customer help-desk in customer care center established	○ Customer care centers are IT enabled with Customer Relationship Management implemented ○ KPIs defined (e.g.: Average complaint resolution time) & are monitored on monthly/quarterly basis	○ Interactive Voice Response, Computer Telephony Integration, automatic call distributor implemented for optimum routing of consumer calls ○ Improvement in KPIs due to automation in customer care infrastructure	○ Call center workforce management system implemented for optimal scheduling of customer care executives	○ Self-service options such as chat-bots are introduced

Options to upload existing documents for review

Usefulness

Tool Usefulness– Illustrative Example

Creating the As-Is Maturity View (Full-View)

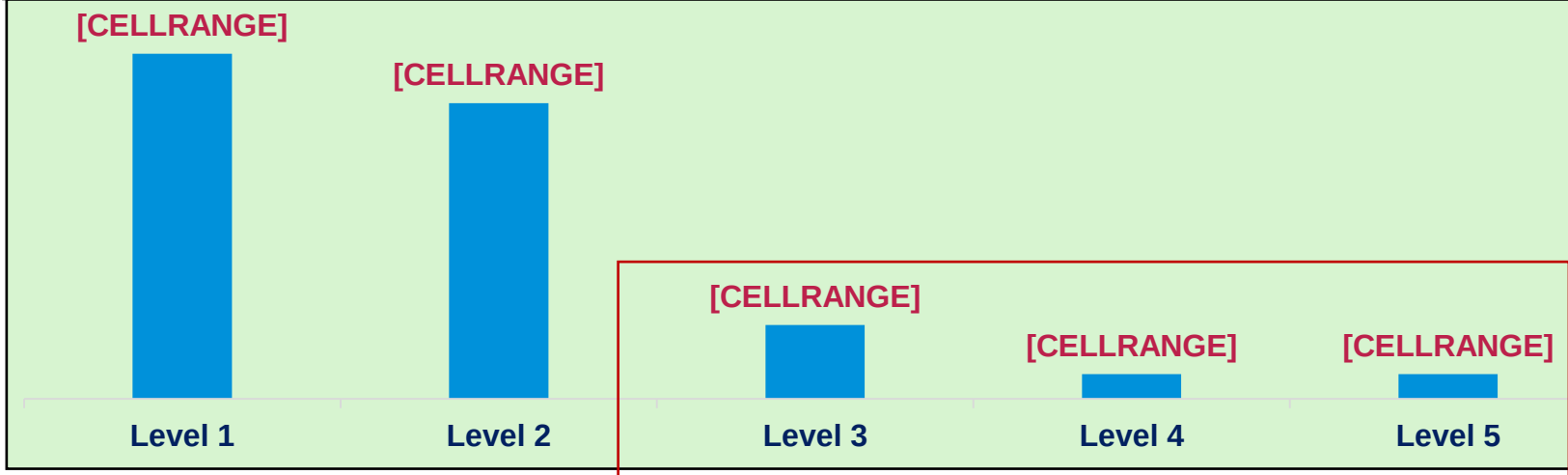


Tool Usefulness– Illustrative Example

Peer Learning

Your Sub-Domain Maturity

Peer Group Analysis



Learning Opportunities

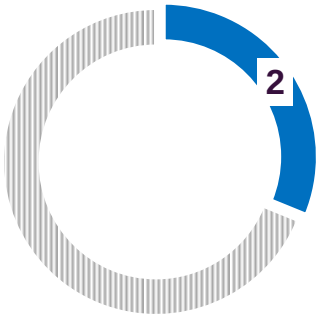
- Get insights on peer group maturity and possible areas of interventions for your utility
- Undertake visits/knowledge exchange with peers to understand good practices for the specific sub-domain, understand cost & benefits, business model, etc.

Tool Usefulness– Illustrative Example

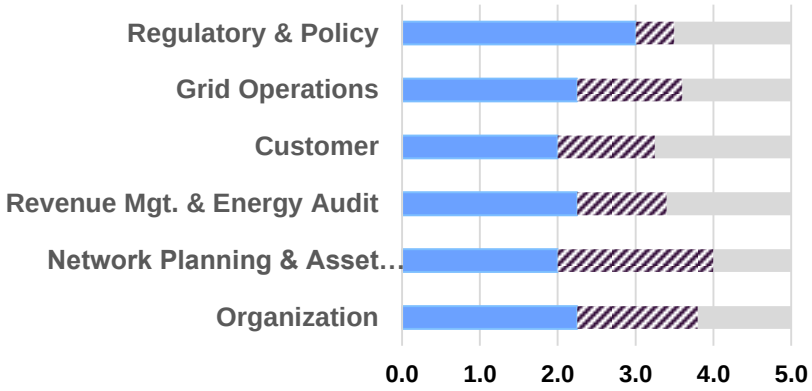
Create a To-Be States

Your Sub-Domain Current Maturity

Load Growth & Net. Exp. Planning Score



Overall Domain Targets are Defined

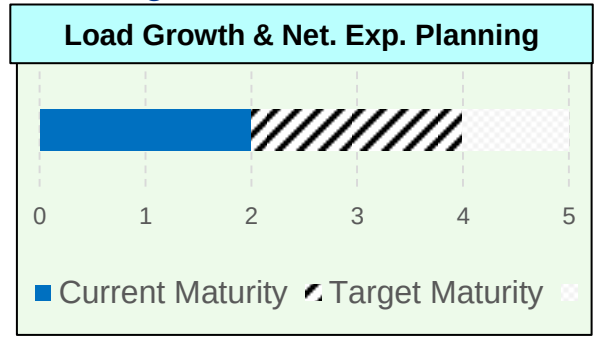


Undertake To-Be Assessment for Each Sub Domain

Analyze

- Peer group learnings
- Own business objective
- Demographic characteristics
- Operating Environment, etc.

Set Targets/Goals



Get Insights on Possible Interventions for Achieving Target

Key Intervention Areas

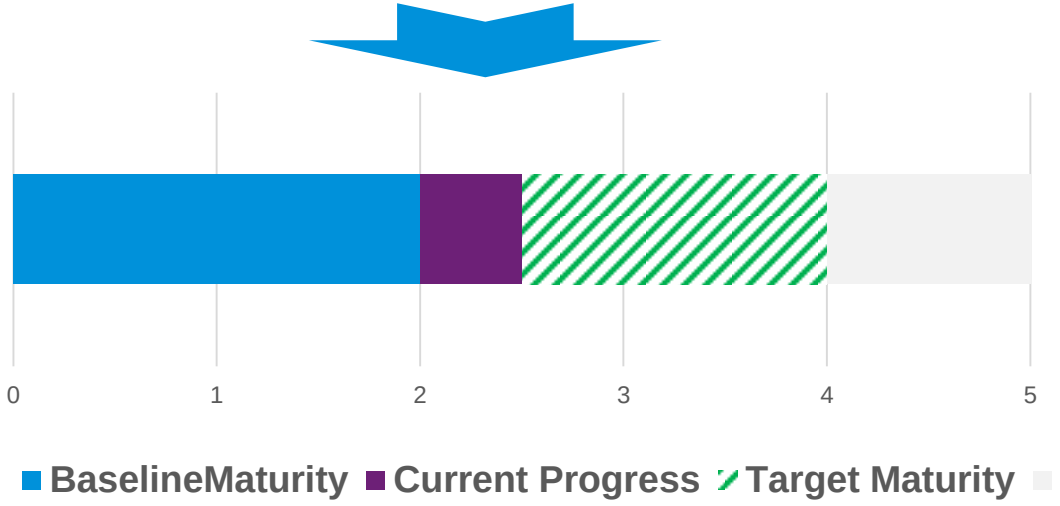
- Implement dedicated forecasting software which takes into account a number of factors to predict load
- Implement On-line grid scheduling system and define process to vet day-ahead schedule exchanges with SLDC
- Integrate forecasting software with smart metering data
- Align the sub-transmission and distribution assets augmentation with power flow analysis
- Cover all zones by protection schemes

Tool Usefulness– Illustrative Example

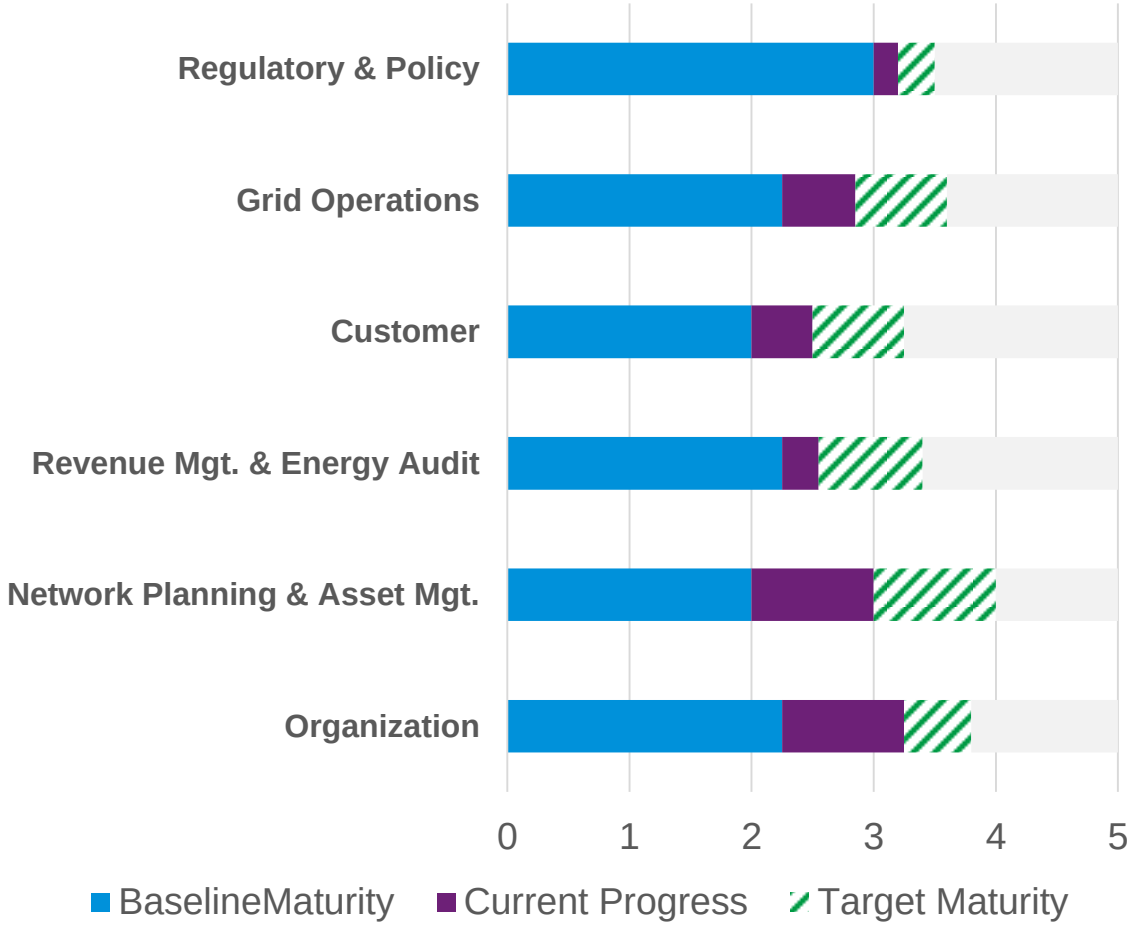
Undertake regular assessments to monitor progress and to re-calibrate targets if required

Sub-Domain Wise Progress

Level 1	Level 2	Level 3	Level 4	Level 5
Load growth done on ad-hoc basis and no standardized load forecasting/ modelling established	Standard process established for load forecasting KPIs (like error margin) defined & are being monitored regularly	Dedicated forecasting software deployed which takes into account a number of factors to predict load On-line grid scheduling system implemented with process in-place to vet day-ahead schedule exchanges with SLDC	Forecasting software integrated with smart metering data Sub-transmission and distribution assets augmentation plans fully aligned with power flow analysis All zones are covered by protection schemes	Forecasting software's logic integrated with Artificial Intelligence/ Machine Learning and other IT-OT smart grid systems to minimize the margin of error [1-2%]



Overall Domain Progress



Applicability & Way Forward

Applicability

- SGR-SAT has wide applicability for different areas, however, At **First Level** it is recommended to select areas with homogenous boundary condition.
- Areas/Towns under RAPDRP and IPDS schemes will be thus selected for assessment through SGR-SAT in the initial phase
- This would help in:
  - Creating a better benchmark
  - Understanding on how utilities have performed in these areas, and how they have built upon these measures

Some of the Key R-APDRP Initiatives

Part – A

- Consumer Indexing, Asset Mapping
- GIS Mapping of the entire distribution network
- Automatic Meter Reading (AMR) on Distribution Transformers & Feeders
- Automatic Data Logging for all Distribution Transformers and Feeders
- Supervisory Control and Data Acquisition (SCADA)/Distribution Management System (DMS) in big towns / cities (with population > 4 lakh & energy input > 350 MU)
- Feeder Segregation / Ring Fencing
- Establishment of Information Technology (IT) enabled customer service centres
- Establishment of the Base Line data System

Part – B

- Renovation, modernization and strengthening of 11 kV level Substations, Transformers/Transformer Centres
- Re-conductoring of lines at 11 kV level and below
- Load Bifurcation, Load Balancing
- HVDS (11kV)
- Installation of capacitor banks and mobile service centres etc.
- Aerial Bunched Conductors in populated areas
- Strengthening at 33 kV or 66 kV level.

Way forward

1. **Finalization of SGR-SAT tool basis stakeholder feedback and comments**
   - ❑ Draft Tool to be hosted on NSGM Website for inviting comments in a time bound manner
2. **Development of online version of the tool for easy use and access**
3. **Launch of the tool to the utilities**
4. **Continuous handholding by NSGM to facilitate use of the tool and create avenues for peer-to-peer learning**

Thank You

Annexure

Sub-Domain Characteristics and Maturity Implications (Organization Domain)

1.1 Vision & Strategy	**Definition/ Characteristic**	Well-developed utility goals/targets and investment plans incorporating smart grid/IT measures to help guide the management to achieve its business objectives
	Maturity Implication	The levels track the transition to increased organizational focus on sustainable smart grid/digitization measures and incorporation of new business cases/services
1.2 Human Resources	**Definition/ Characteristic**	Ensuring right skills and personal are identified and included in the utility for ensuring high productivity in an increasingly ICT driven smart grid operations
	Maturity Implication	The levels track the transition of workforce to one with increased competencies/skillsets/responsibilities related to overseeing implementation/integration of increased smart grid/IT measures in the organization
1.3 Training & Capacity Building	**Definition/ Characteristic**	Ensuring that all education and training to develop smart grid competencies across functions and levels are available for its personnel, so that they are ready to address any smart grid challenges
	Maturity Implication	The levels track the improvement in training practices in the organization to one which actively incorporates current and emerging needs of the sector
1.4 Management Information System (MIS)	**Definition/ Characteristic**	Enabling monitoring and tracking of key performance metrics and supplying requisite information to the senior management for making informed decisions

Sub-Domain Characteristics and Maturity Implications: (Network Planning, Asset Deployment and Management Domain) - (1/2)

2.1 Load Growth Study & Network Expansion Planning	***Definition/ Characteristic***	Incorporating techniques of load modelling and forecasting, and power flow analysis for accurate load growth study, basis which network extension planning is carried out. Historical Data from field devices/ metering, weather, usage pattern etc. is used for accurate load modelling and forecasting.
	Maturity Implication	The levels track increased sophistication, automation and accuracy in load forecasting techniques (including integration with various smart grid data sources)
2.2 Asset Survey and Geographic Information System (GIS)	***Definition/ Characteristic***	GIS applications allow the user to map, model, run a query and analyze large amount of spatial information within a single database. By enabling increased level of up-to date information mapping with GIS such as customer database and indexing; mapping of electrical distribution network, etc., the utility can provide a number of benefits such as efficiency improvement, loss reduction, improved planning and downtime reduction amongst others
	Maturity Implication	The levels track an increased adoption/integration of up-to-date GIS application for various utility functions
2.3 Substation Modernization	***Definition/ Characteristic***	It includes deployment of various components which aids substation automation such as: • Numerical relays- Network protection relays protect distribution assets in the event of faults which cause drop in voltage, unbalance and loss of stability of the system. By upgrading to IED based numerical relays, utilities can enable faster disturbance detection, and provide remote supervision & control of asset • On-load tap changer– The digital OLTC devices installed at power transformers enable adjusting of the feeder voltage at the substation, depending on the loading condition of the feeders • Substation gateway - they provide the communication interface between the electrical substation and the area dispatch centers (SCADA). The main functions of the Substation Gateway is to transmit substation indications and measurements to the dispatch center, and dispatch centers' commands to the substation control system. The SAS deployment may be aligned with IEC 61850 architecture, which is an international standard defining communication protocols for intelligent electronic devices at electrical substations.
	Maturity Implication	The levels track an increased penetration of substation automation devices in the grid and also its integration with SCADA/DMS for effective operations

Sub-Domain Characteristics and Maturity Implications: (Network Planning, Asset Deployment and Management Domain)- (2/2)

2.4 Distribution Modernization	***Definition/ Characteristic***	It includes deployment of various components which aids distribution automation such as: • Fault Passage Indicator's (FPI) are installed across distribution network to identify faults occurring in the downstream section from the point of its installation in the distribution system. With increased coverage of FPI, utility can acquire information regarding the section of the line having fault. This would help it in eliminating the patrolling of entire line for finding the fault, ultimately reducing restoration time and improving the efficiency of outage management system. • Recloser are distribution circuit protection devices that provide more accurate and more flexible coordination for faults than can be obtained from traditional fuses. By strategically adding reclosers to the design of distribution circuits, utility can divide the main feeder into a series of load blocks to limit outage effect. Further these devices, by enabling remote control and data acquisition, form a critical part of enabling automatic fault restoration function. • Sectionalizers are self-contained and circuit-opening devices used to isolate faulted sections of electrical distribution systems (Sectionalizer cannot interrupt fault current, an upstream breaker or recloser has to operate that). Therefore, by placing Sectionalizers strategically in co-ordination with reclosers, utility can provide the desired protection over a wide range of fault conditions. • Ring Main Unit (RMU) enables to protect transformers on the secondary distribution network. The remote terminal units (RTU) installed at RMUs sites allow for control of switching devices such as breaker, isolator switches etc. inside RMU panel from Master station(s). With real time analysis of RMU data through SCADA, it is possible to detect sudden feeder voltages and current changes, any abnormal load variations or physical conditions. This helps utility to reduce installation, maintenance, and operational costs while also reducing the instances of power disruption that result from the sudden malfunctioning of the power grid systems.
	Maturity Implication	The levels track an increased penetration of distribution automation devices in the grid and also its integration with SCADA/DMS for effective operations
2.5 Communication System Modernization	***Definition/ Characteristic***	Substation communication systems provide the backbone of the Smart Grid, facilitating real-time monitoring capabilities over feeder heads at substations, feeder distribution automation components and enabling utility to transition to a dual mode (centralized and de-centralized) control over grid operations.
	Maturity Implication	The levels track an increased penetration of substation fiber-optic communication establishing links with field distribution automation components
2.6 Asset Maintenance Management	***Definition/ Characteristic***	By evolving asset maintenance strategies to align with smart grid infrastructure, the utility can unlock the capability to link maintenance with asset condition thereby reducing unnecessary maintenance shutdown, track causes of failures, take near-real time corrective actions, more efficiently deploy workforce resources and improve capacity planning performance.
	Maturity Implication	The levels track a transition from manual, scheduled maintenance practice to one with increased automation and advanced analytics for enabling condition/predictive based maintenance practice

Sub-Domain Characteristics and Maturity Implications: (Grid Operations Domain)

3.1 Grid Observability & Security Management	***Definition/ Characteristic***	Observability represents the comprehensive visibility of electrical networks on operator screen though centralized control center Situational awareness relates to the adequate processing and presentation of the huge amount of real-time data from electrical networks so that the insights drawn are helpful to the operator.
	Maturity Implication	The levels track an increased integration of IT-OT applications for providing increased level of network visibility (real time data) and ability for real time remote control at the centralized main control center
3.2 Power Quality (PQ) Monitoring	***Definition/ Characteristic***	With traditional infrastructure management of power quality has to rely mostly relied on reactive measures. However, by increasingly adopting advanced communication, data collection, monitoring, and control infrastructure, utility power quality management process should evolve to use analytics based decision making to maintain power quality within the established thresholds. Evolving power quality & reliability management process by adopting advanced monitoring and control infrastructure, and using analytics based decision making to maintain power quality & reliability within thresholds.
	Maturity Implication	The levels track an increased adoption of field and IT devices for enabling real-time capturing and monitoring of power quality data, including increased adoption of automation for voltage management
3.3 Outage Management	***Definition/ Characteristic***	A centralized OMS utilizing field level IEDs to enable automatic fault identification, isolation and restoration mechanism with a view to minimizing outage time Although reliability thresholds have been defined, tracking and managing them has been a challenge with traditional infrastructure. As utilities transition to enabling real-time monitoring and control systems, power reliability management should involve into a dedicated function involving analytics based decision making and increased level of automation/ self-healing capability to minimize impact of outages on the grid the established thresholds.
	Maturity Implication	The levels track an increased adoption of field and IT devices for enabling real-time capturing and monitoring of power outage data, including increased adoption of automation for fault location, isolation and restoration
5.4 Demand Response	***Definition/ Characteristic***	DR programs can form a major component of utility's peak load management strategy. By employing DR programs, utility can benefit through more efficient use of available assets/resources, reducing cost of power purchase and facilitation of higher penetration of renewable energy resources Employing DR as a major component of peak load management strategy with a view to reducing un-scheduled imports, reduced load diversity and facilitating higher penetration of renewable energy resources
	Maturity Implication	The levels track an increased adoption of demand response program by consumers and also an increased level of automation in DR process

Sub-Domain Characteristics and Maturity Implications: (Revenue Mgt. & Energy Audit Domain)

4.1 Consumer Metering and Indexing	***Definition/ Characteristic***	With adoption of Advanced Metering Infrastructure (at consumer level), utility can unlock a range of applications including real-time remote meter reading, & billing etc. Combined with the practice of maintaining up-to date consumer indexing, AMI enables utility to have system wide visibility and enables key smart grid operations like outage management, accurate energy audit, load monitoring etc.
	Maturity Implication	The levels track an increased penetration of smart meters deployed at consumer level along with the practice of maintain update consumer indexing data
4.2 Distribution Transformer / Feeder Metering	***Definition/ Characteristic***	With adoption of Advanced Metering Infrastructure (at Distribution Transformer or DT and feeder level), utility can unlock a range of applications including real-time remote meter reading, automatic real time energy audit, power quality monitoring, load monitoring, etc.
	Maturity Implication	The levels track an increased penetration of smart meters deployed at DTs and Feeders
4.3 Meter Data Management System (MDMS) and Energy Audit	***Definition/ Characteristic***	A MDMS is a database with analytical tools that enable interaction of smart meter data with other information systems such CIS, billing systems, OMS, GIS, etc. By achieving higher level of software integration and greater penetration of smart meter, utility can enhance the analytics capability of MDMS to provide detailed analysis of losses, load, power quality, etc. at the consumer level. The energy audit tool helps utility in analyzing consumption level data for identifying losses and protecting utility revenues and improving its financial health.
	Maturity Implication	The levels track an increased integration of smart meter data with other utility systems and an increased level of adoption of smart meter analytics for reducing AT&C losses, improving DT utilization and improving customer satisfaction
4.4 Billing and collection	***Definition/ Characteristic***	Enabling automation of the entire billing and collection process to reduce errors in billing, collection cycle time and deliver high customer satisfaction/convenience with reduced operational costs
	Maturity Implication	The levels track an increased adoption of online mode for billing and collection by utility's consumers

Sub-Domain Characteristics and Maturity Implications: (Consumer Domain)

5.1 Consumer Connection Management	***Definition/ Characteristic***	Incorporating IT/online based processes in consumer connection management to help the utility in securing higher customer satisfaction levels, saving transaction costs and optimizing use of manpower resources.
	Maturity Implication	The levels track an increased adoption of online tools for reducing time and cost for managing applications for new/existing customer connections
5.2 Customer Care Infrastructure	***Definition/ Characteristic***	A centralize, state-of-the art IT-driven customer care platform to provide an efficient and user-friendly customer service. Some of the core applications include: • Customer Relationship Management (CRM) systems compile customer data across different channels -- or points of contact between the customer and the utility. CRM concentrates on service-oriented activities such as customer set-up; issue correction; servicing requests for information, etc. CRM systems can also give customer-facing staff detailed information on customers' personal information, bill history and concerns. • Interactive Voice Response Service (IVRS) is a telephony menu system that enables identification, segmentation and routing of callers. It is an effective tool to help significantly reduce costs and increase efficiency of customer care center • Automated call distributor – this is a an application/device which integrates with IVRS to efficiently distribute/routes inbound calls to most appropriate customer care agents • Computer Telephony Integration (CTI) allows interactions on a telephone and a computer to be integrated or coordinated. The most common application of CTI is a "screen-pop" that has the ability to populate the computer screen with caller information and history. • Chat-bots - A chat-bot is an artificial intelligence (AI) software that can simulate a conversation (or a chat) with a user in natural language through messaging applications, websites/mobile apps. Chat-bot applications streamline interactions and enhancing customer experience. At the same time, they offer utilities new opportunities to improve the customer engagement process and operational efficiency by reducing the typical cost of customer service.
	Maturity Implication	The levels track an increased integration of automation/IT tools in customer care operations for increasing customer satisfaction and operational efficiency
5.3 Consumer Engagement Program	***Definition/ Characteristic***	Incorporating customer engagement as a core part of utility operations for encouraging customers to adopt smart grid technologies actively and thus help unlock full range of smart grid benefits Smart grid requires active consumer participation to unlock full range of benefits. Therefore, as utility transitions to smart grid, incorporating customer engagement as a core part of utility operations becomes important for encouraging customers to leverage and adopt smart grid technologies actively (i.e. enabling them to become more informed, aware of energy usage and participate in utility programs for mutual benefits).
	Maturity Implication	The levels track an increased level of program focus including increased funding, use of online media, dedicated staff and customer data for delivering a higher level of consumer engagement and participation
5.4 Net Metering	***Definition/ Characteristic***	Enabling greater choice for customer-owned generation (e.g., solar rooftop) by providing a seamless and consumer-friendly IT based process for implementing net metering policy.
	Maturity Implication	The levels track an increased adoption of online tools for reducing time and cost of net metering applications and helping increasing consumer adoption

Sub-Domain Characteristics and Maturity Implications: (Regulatory & Policy Domain)

6.1 Regulatory Interface	*Definition/ Characteristic*	Pro-actively seeking regulatory approvals and buy-in required for enabling new services to unlock various smart grid functionalities Departure from traditional business models of smart grid deployment and exploration of new business models which are more efficient as well as financially viable
	Maturity Implication	The levels track a progress towards pro-active collaboration of utility and regulator to identify, develop and enable operationalization of new business/investment cases based on smart grid technologies
6.2 Data Privacy and Cyber Security	*Definition/ Characteristic*	Having in place formal guidelines/ processes and structures to promote information security measures and deal with potential vulnerabilities of IT systems, thus enabling confidentiality, integrity and availability of its critical IT infrastructure.
	Maturity Implication	The levels track an increased adoption of data privacy and cyber security measures by utility in its day-to-day operations

Utility smart grid maturity assessment survey with criteria – Organization Domain

Sub-Domains	Maturity Levels				
	L1	L2	L3	L4	L5
Vision & Strategy	○ Development of smart grid roadmap/plan under consideration	○ SG roadmap in-place ○ SLPMU established. ○ At least one pilot/POC in-progress ○ SG training for workforce	○ Pilot deployed and scale-up plan prepared ○ ROI of SG business cases measured, documented and shared.	○ Large scale implementation complete ○ ROI from SG activities sufficient to sustain future SG opportunities	○ Organization wide roll-out ○ New service/ product offerings explored /integrated
People/ Human Resources	○ Planned for a team of personnel for SG ○ SG nodal officer selected	○ SG cell or core team established. ○ Roles and responsibilities defined	○ IT team growth trajectory specified ○ Ongoing SG projects monitored by core team	○ Core team engaged in planning and creating larger business cases for SG implementation	○ SG core team oversees organization wide technology initiatives and takes up new business cases
Training & Capacity Building	○ Planning for smart grid training goals under-way ○ Employees nominated for external training	○ SG competencies identified ○ Annual training completed for SG team members/ nodal officers	○ Defined SG training plan ○ Training of SG trainers initiated	○ Initiated strategic tie-ups ○ Annual SG training program	○ Review and up gradation of training plans ○ E-learning programs
Mgt. Reporting & MIS	○ Manual processes for data management and reporting	○ Standalone computer based systems used for data management and reporting	○ MIS implemented as web-based application ○ Reporting structures are well-defined	○ Data collection is automated ○ MIS is integrated with IT-OT systems of SG ○ Generation of reports by MIS for MoP, CEA etc.	○ Addition of business intelligence tools ○ Management dashboards

Utility smart grid maturity assessment survey with criteria – Grid Operations Domain

Sub-Domains	Maturity Levels				
	L1	L2	L3	L4	L5
Grid Observability & Security Mgt.	○ Legacy SCADA systems not impactful ○ Manual switching at SS through telephonic commands from CC	○ Implemented modern SCADA and integrated with SAS ○ Disaster Recovery centre ○ Grid status observable at main CC	○ Grid switching operations supported by on-line network security analysis ○ Remote control of SS ○ Operator screens ○ RT data sharing - SLDC ○ Volt-VAR controls	○ Grid switching operations based on smart field sensors/DA ○ Automated Fault Analysis ○ Disaster Recovery centre upgraded to Backup CC	○ Grid Operator screens fortified with Situational Awareness techniques ○ Grid operations based on RT data using WAM ○ Semi-automated dynamic grid operations
Power Quality Monitoring	○ Ad-hoc/Manual monitoring of PQ parameters and reliability indicies	○ 5% DTs regularly monitored ○ KPIs defined and monitored	○ RT monitoring of PQ parameters at DTs and consumer level ○ PQ reports for 30% SS, feeders, DTs ○ Improvement in KPIs	○ RT monitoring & reporting of PQ at 60% SS, feeders, DTs ○ Voltage variations tracked ○ Marked improvement in KPIs	○ RT monitoring and reporting of PQ at 90% SS, feeders, DTs ○ Automatic tracking of variations
Outage Mgt.	○ Manual outage monitoring	○ OMS implemented. ○ KPIs defined and monitored	○ OMS integrated with DA ○ FLISR implemented ○ Reliability indices ○ OMS-crew mgmt. app ○ Improvement in KPIs	○ OMS is integrated with WFMS. ○ Marked improvement in grid reliability indices	○ Automated Crew Tracking system ○ Predictive intelligence
Demand Response	○ DR implementation strategy being formulated	○ Business case developed ○ Basic DR pilot for 2% of consumers ○ KPIs defined and monitored	○ Semi-automated DR for 10% of consumers ○ Improvement in KPIs	○ Automated DR for 5% consumers ○ Semi-automated DR for 20% consumers	○ Automated DR for 10% consumers ○ Semi-automated DR for 30% consumers

Utility smart grid maturity assessment survey with criteria – Revenue Management and Energy Audit

Sub-Domains	Maturity Levels				
	L1	L2	L3	L4	L5
Consumer Metering & Indexing	○ Static meters installed for consumers ○ Consumer indexing not yet complete	○ Consumer indexing complete and formal process defined ○ Pilot/POC of at least 1000 smart meters	○ Smart meters installed for 100% consumers under 20% of total DTs ○ Consumer indexing tool integrated with IT sys.	○ Smart meters installed for 100% consumers under 60% of total DTs ○ HAN automation pilot	○ Smart meters installed for 100% utility consumers ○ HAN automation rolled out for 15% of consumers
DT/Feeder Metering	○ AMR meters installed for at least 50% Feeders and DTs	○ Smart meters for at least 10% feeders and DTs (or AMR at 100% DTs) ○ Reports on missing data available	○ Smart meters for at least 30% feeders and DTs	○ Smart meters for at least 60% feeders and DTs	○ Smart meters for 100% feeder and DTs
MDMS and Energy Audit	○ Legacy MDMS not complying with requirements ((lack of integrated platform/analytics) ○ Billing system & energy audits are manually managed	○ MDAS-HES installed and integrated with MDM ○ Energy audit tool established and integrated with MDM	○ MDAS-HES/MDM integrated with billing system & SCADA ○ AT&C losses show improvement ○ Worst performing Circuit technical losses tracked ○ Tracking by EA tool of DT loading/voltage profile	○ MDMS integrated with Consumer Portal ○ Billing system integrated with customer care sys. ○ Major improvement in AT&C losses ○ DT loading well balanced & voltage profiles improve over baseline	○ Energy Audit tool augmented with consumer loss analytics capability
Billing and Collection	○ Manual bill distribution ○ Development of digital payment options under consideration	○ Online bills by Email ○ 10% bill collection through digital media	○ 30% bill collection through digital media ○ Kiosk mode payment collection/ pre-paid metering	○ 50% bill collection through digital media	○ 80% bill collection through digital media

Utility smart grid maturity assessment survey with criteria – Regulatory and Policy Domain

Sub-Domains	Maturity Levels				
	L1	L2	L3	L4	L5
Regulatory Interface	○ State specific SG regulations yet to be notified ○ Grant based funding of SG projects	○ SG regulations established ○ Identified other funding options	○ Regulatory buy-in for various SG measures	○ New business cases developed and submitted to regulator for approval	○ New business case operational leading to increase in revenue
Data Privacy and Cyber Security	○ Formulation of initial policy draft in-progress	○ Customer data privacy policy established ○ KPIs are defined and monitored	○ IT policy defined ○ Cyber threat vulnerability assessment complete ○ None or minimal instances of security breach	○ Dedicated team for implementing IT guidelines ○ Achieved ISO certification ○ Annual audits for data privacy and cyber security ○ Reports supporting decision making by senior management	○ IT/Cyber policy reviewed and updated annually basis risk assessment

Smart Grid Maturity Model (Software Engineering Institute at Carnegie Mellon University)

SGMM is a **management tool** that provides a **common framework** for defining key elements of **smart grid transformation** and helps utilities develop a **programmatic approach** and track their progress.

Global Intelligent Utility Network Coalition (GIUNC) developed SGMM and it is currently under the stewardship of the Software Engineering Institute at Carnegie Mellon University

SGMM Product Suite

Model	• Model Definition document • Matrix
Survey	• Compass survey yields maturity ratings and performance comparisons
Navigation Process	• Licensed process led by a trained and certified "SGMM Navigator"
Training	• Overview Seminar • SGMM Navigator Course
Licensing	• License organizations and certify individuals to deliver Navigation process

Source: SEI http://www.sei.cmu.edu/

SGMM Levels

5 Pioneering	Breaking new ground; industry-leading innovation
4 Optimizing	Optimizing smart grid to benefit entire organization
3 Integrating	Integrating smart grid deployments across the organization
2 Enabling	Investing based on clear strategy, implementing first projects to enable smart grid
1 Initiating	Taking the first steps, exploring options, conducting experiments, developing smart grid vision
0 Default	Default level (status quo)

SGMM would allow utilities to assess their current smart grid position and reach consensus on the direction and pace of their smart grid journey. SGMM provides a guiding framework to utilities in smart grid planning and implementation efforts

Smart Grid Maturity Model (Software Engineering Institute at Carnegie Mellon University)

SMR — Strategy, Mgmt & Regulatory

Vision, planning, governance, stakeholder collaboration

TECH — Technology

IT architecture, standards, infrastructure, integration, tools

OS — Organization and Structure

Culture, structure, training, communications, knowledge mgmt

CUST — Customer

Pricing, customer participation & experience, advanced services

GO — Grid Operations

Reliability, efficiency, security, safety, observability, control

VCI — Value Chain Integration

Demand & supply management, leveraging market opportunities

WAM — Work & Asset Management

Asset monitoring, tracking & maintenance, mobile workforce

SE — Societal & Environmental

Responsibility, sustainability, critical infrastructure, efficiency

Domains are logical groupings of smart-grid-related capabilities and characteristics for which the SGMM defines a maturity progression. Each level of maturity within a domain is fully described by a set of expected characteristics and a set of informative characteristics.

Smart Grid Maturity Model (Software Engineering Institute at Carnegie Mellon University)

6 Maturity Levels: Defined sets of characteristics and outcomes

5
4
3
2
1
0

175 Characteristics: Features you would expect to see at each stage of smart grid journey

SMR	OS	GO	WAM	TECH	CUST	VCI	SE
Strategy, Management & Regulatory	Organization & Structure	Grid Operations	Work & Asset Management	Technology	Customer	Value Chain Integration	Social & Environmental

8 Domains: Logical groupings of smart grid related capabilities and characteristics

Smart Grid Definition

Smart Grid Definition *(As per Proposed Amendment to Electricity Act, 2003)*

An electricity network that uses information and communication technology to gather information and act intelligently in automated fashion to improve the efficiency, reliability, economics, and sustainability of generation, transmission and distribution of electricity*

Key Smart Grid Building Blocks

01 Advanced Metering Infrastructure

02 Geographic Information System

03 Supervisory Control and Data Acquisition

04 Distribution Management and Automation System

05 Smart Grid Enterprise Integration