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Government of India
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Smart Grid – Journey and Global Regulatory Insight

11th March 2019

Agenda

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1. Smart Grid Vision and Overview
2. Brief of NSGM, Objectives, Support and Progress
3. Smart Grid Projects, Progress so far
4. Learnings and insights from SG project/Pilot implementation
5. EV and AC load growth, Opportunities for DISCOMs
6. Need for Smart Grid Regulations & Role of Regulators
7. Global Key Regulatory Considerations
8. Electricity Act 2003, DSM & DR
9. Background/Expectations from Regulatory Conference

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

Traditional vs Smart Grid

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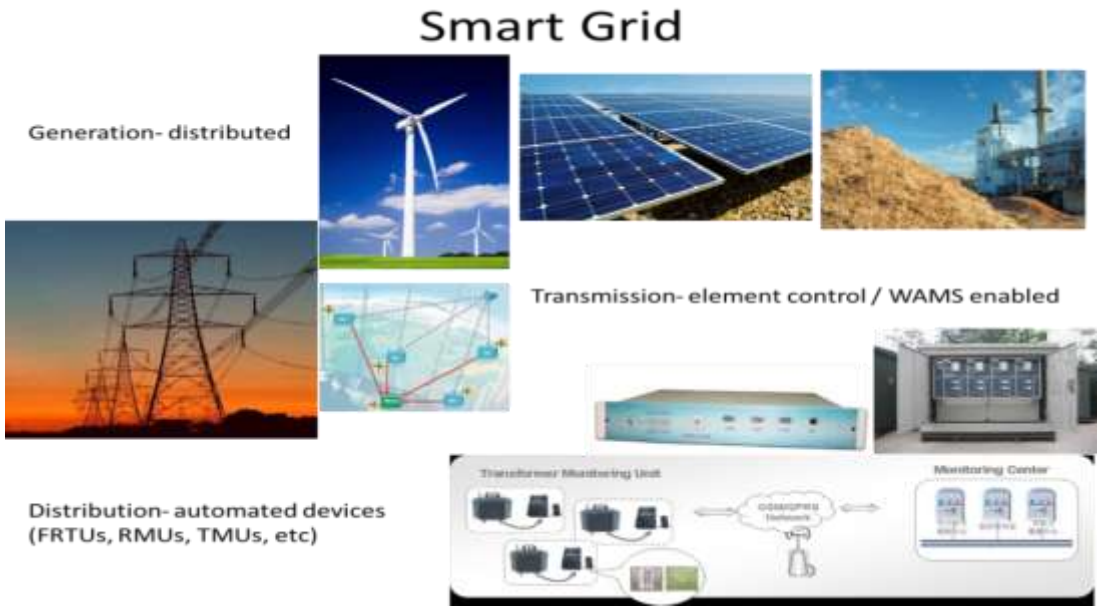
- Efficient, Near Energy Source (**Coal Mine, River Basin**) Generation;
- Consumer at Receiving End
- Grid Connects the Two
- Challenges of Quality at Customer end, Aging Infrastructure and Load Growth



- Near Consumption and Green Energy Source (**Solar, Wind, Bio-Mass, Nega Watt**) Generation;
- Consumer can generate power and Bank with/ Sell to grid
- Two way communication with the Grid
- Grid Transformed to Energy Exchange Infrastructure of Economy

Grid Operation

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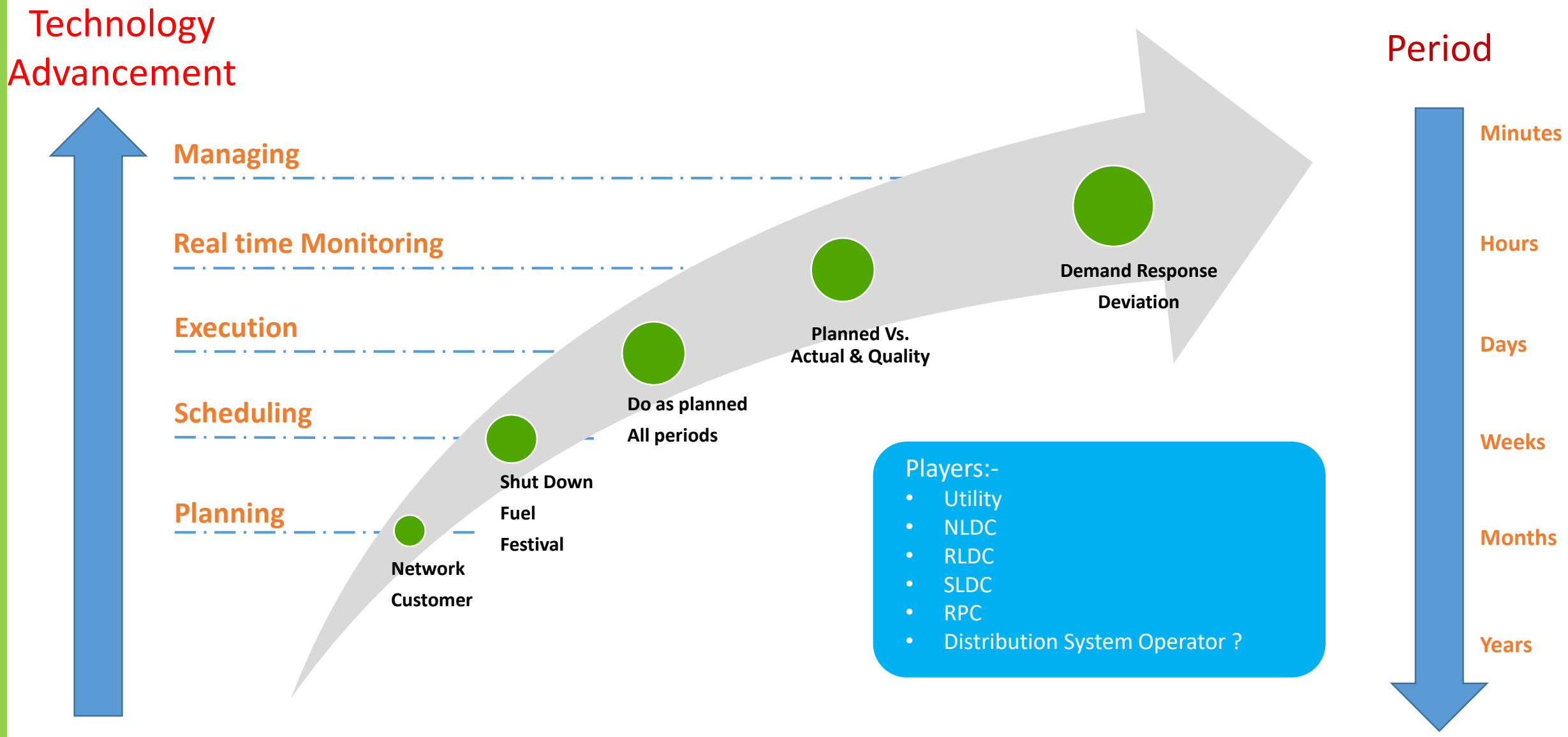

NSGM Institutional Framework

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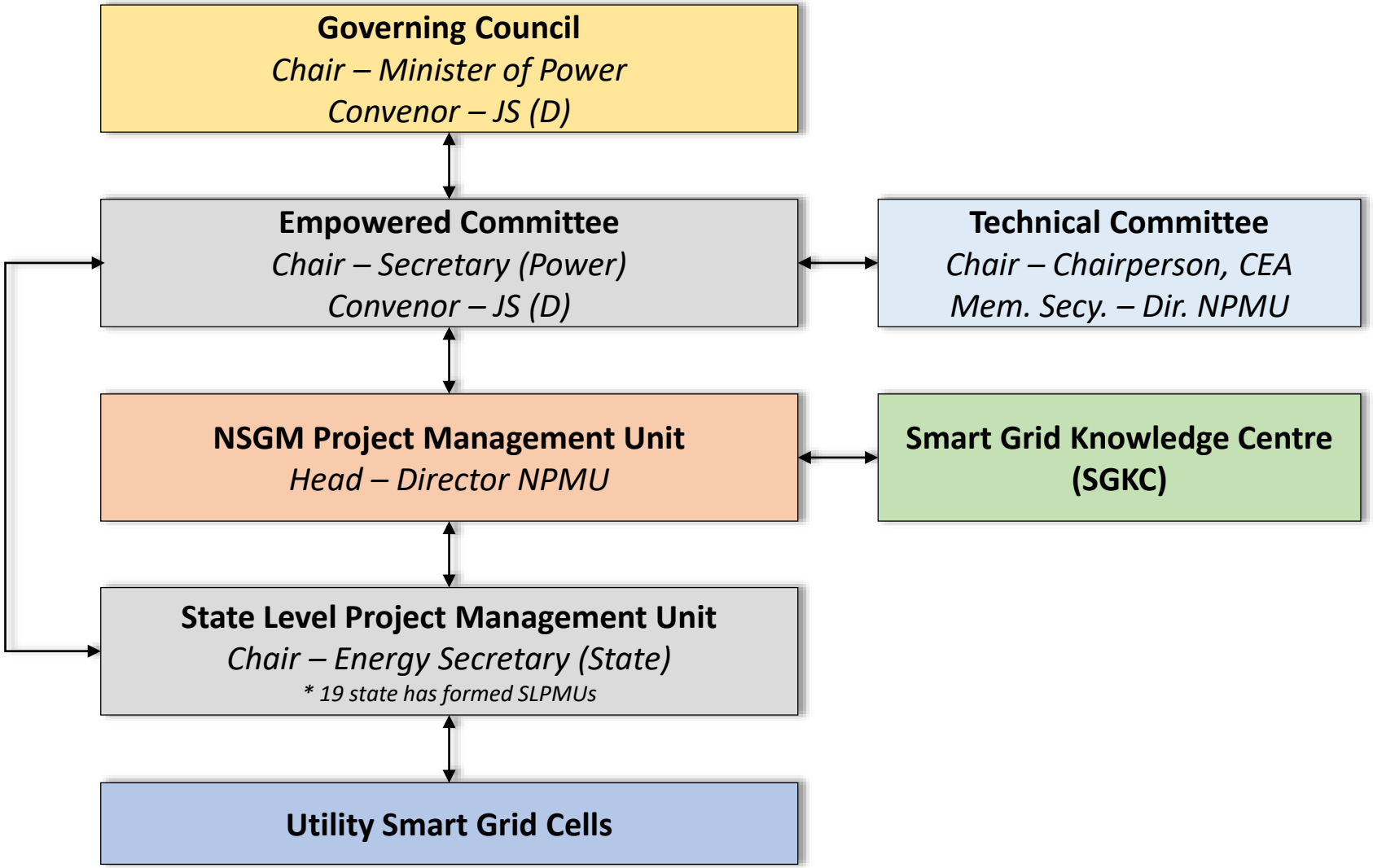

Achievements

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Five projects worth Rs.686.6 Cr. sanctioned for ~7.50 lakh consumers with 30% funding

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

- 5 training programs for utilities
- 6 national and 3 international workshops
- SG training course developed
- 2 brainstorming sessions

- NSGM Framework, Model RfP & Model DPR released
- Draft smart meter rollout plan submitted

IS 16444 (Part 1 & 2) and IS 15959 (Part 2 & 3)

AMI functional requirements

Model Smart Grid Regulations adopted by 5 states

19 State Level PMUs formed

Smart Grid Projects

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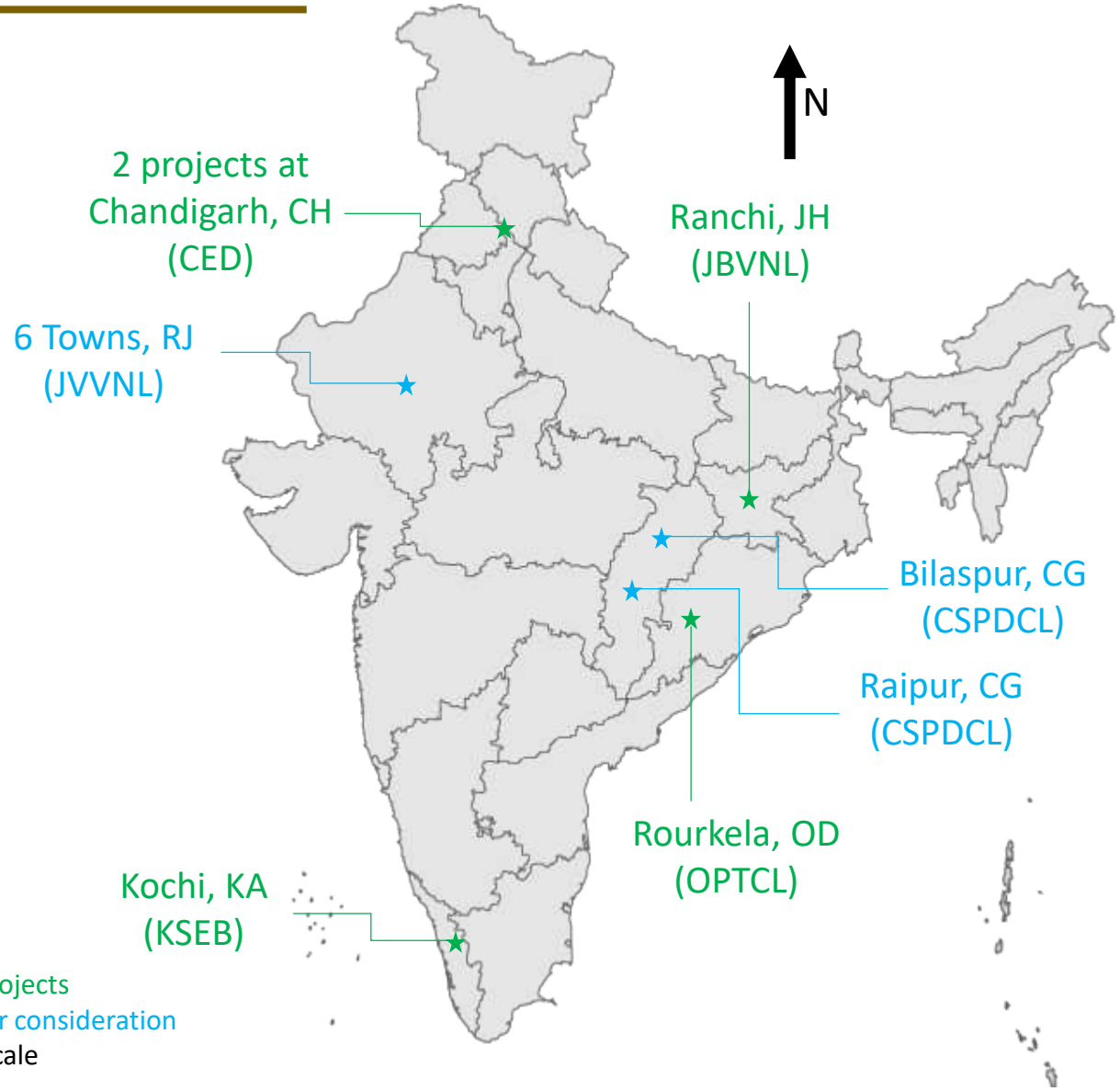
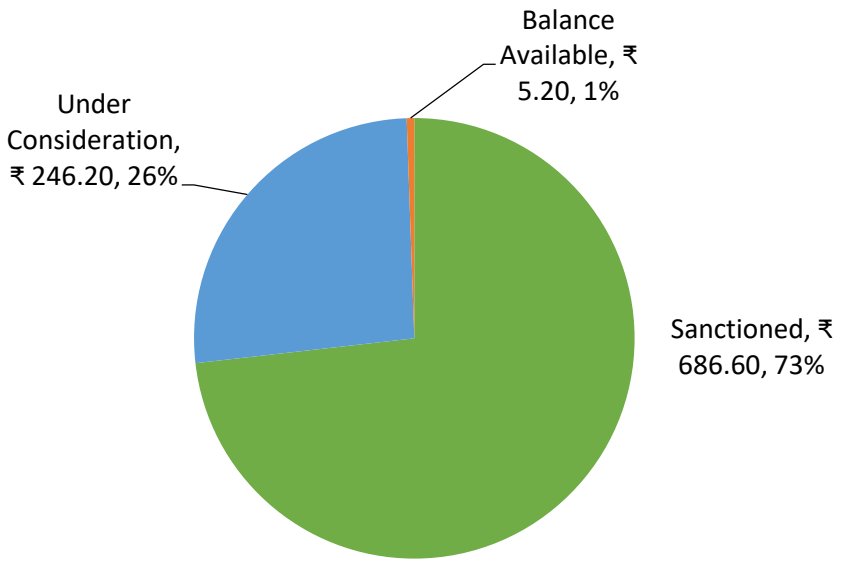


Sanctioned Projects
Projects under consideration
Map not-to-scale

NSGM Budget for Smart Grid Projects



Smart Grid Pilot Projects

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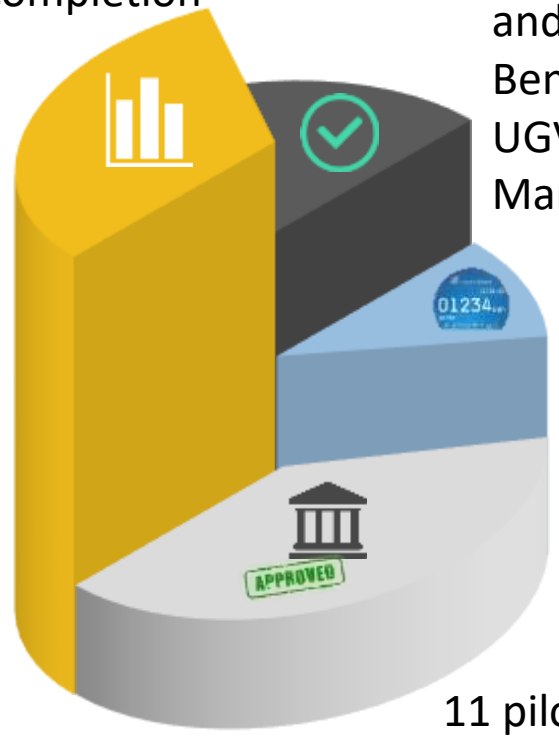
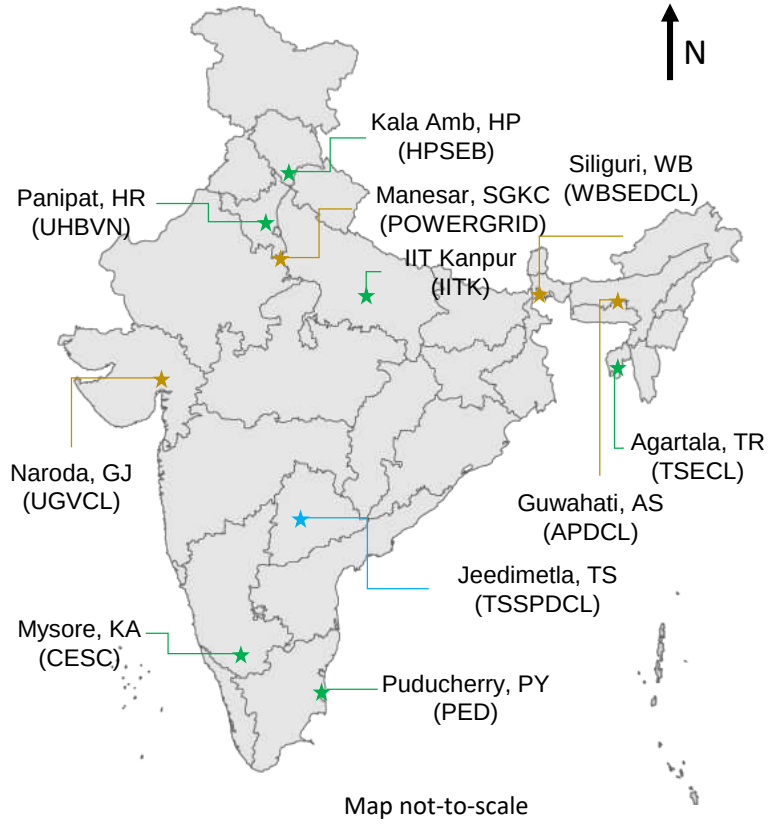
Remaining pilots nearing completion



6 pilots at CESC (Mysore), IIT Kanpur, PED (Puducherry), UHBVN (Haryana) and TSECL (Tripura), WBSEDCL (West Bengal) completed
UGVCL (Gujrat) pilot & SGKC at Manesar inaugurated

~1.5 lakh Smart Meters installed out of 1.7 lakh envisaged

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 Discom infrastructure w.r.t. PLC technology was negated - performed well in Tripura SG Pilot
- Two new product (Smart Meter) developed & deployed

Draft India Cooling Action Plan (ICAP)

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The draft India Cooling Action Plan (ICAP) was recently released by Ministry of Environment, GoI

- India's present per capita cooling energy consumption - 69 KWh
- Average global cooling energy consumption- 272 KWh per person

India's aggregate cooling requirement to ↑ 8 times in next 20 Years.

- Building sector (space cooling) to ↑ approx. 11 times
- Transport cooling to ↑ 5 time and 4 times ↑ in cold chain and refrigeration sector.
- All these sectors together ↑ 4.5 times energy in next 20 years.

➢ **Business opportunity for DISCOM's ?**

➢ **Infrastructure Capacity challenge?**

➢ **Customized DSM programs for cost effective operations ?**

Source:http://timesofindia.indiatimes.com/articleshow/65849491.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

EVs and ACs Growth in India

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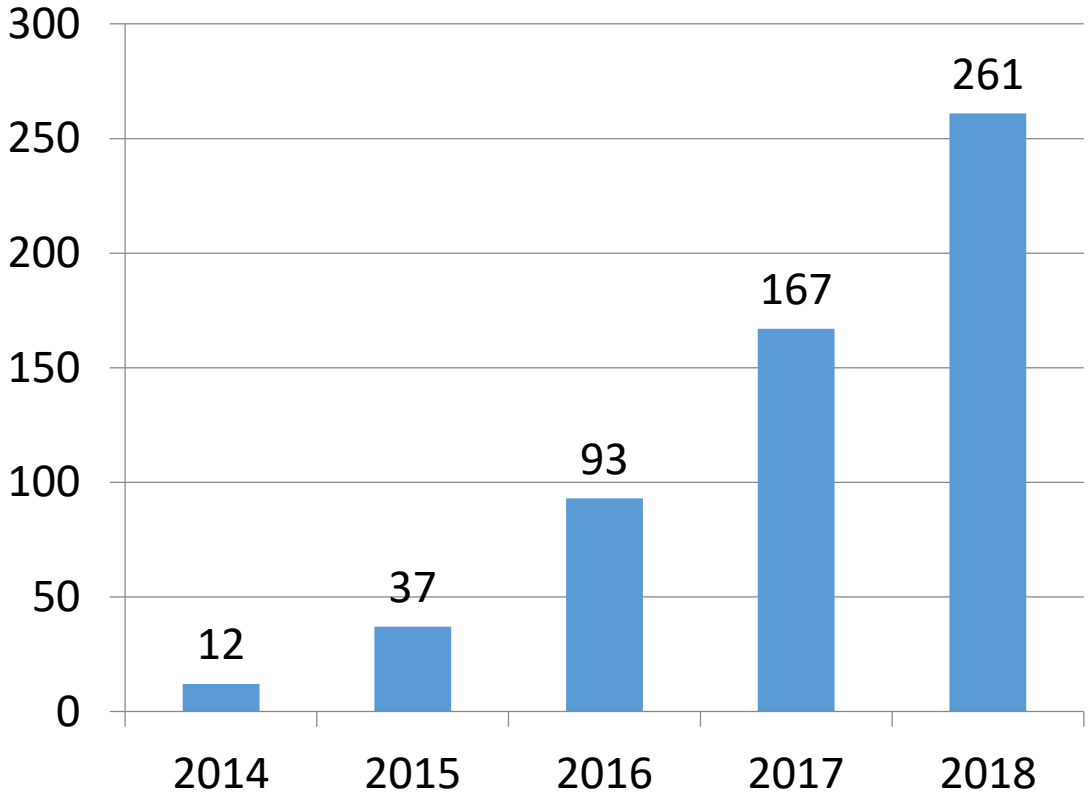
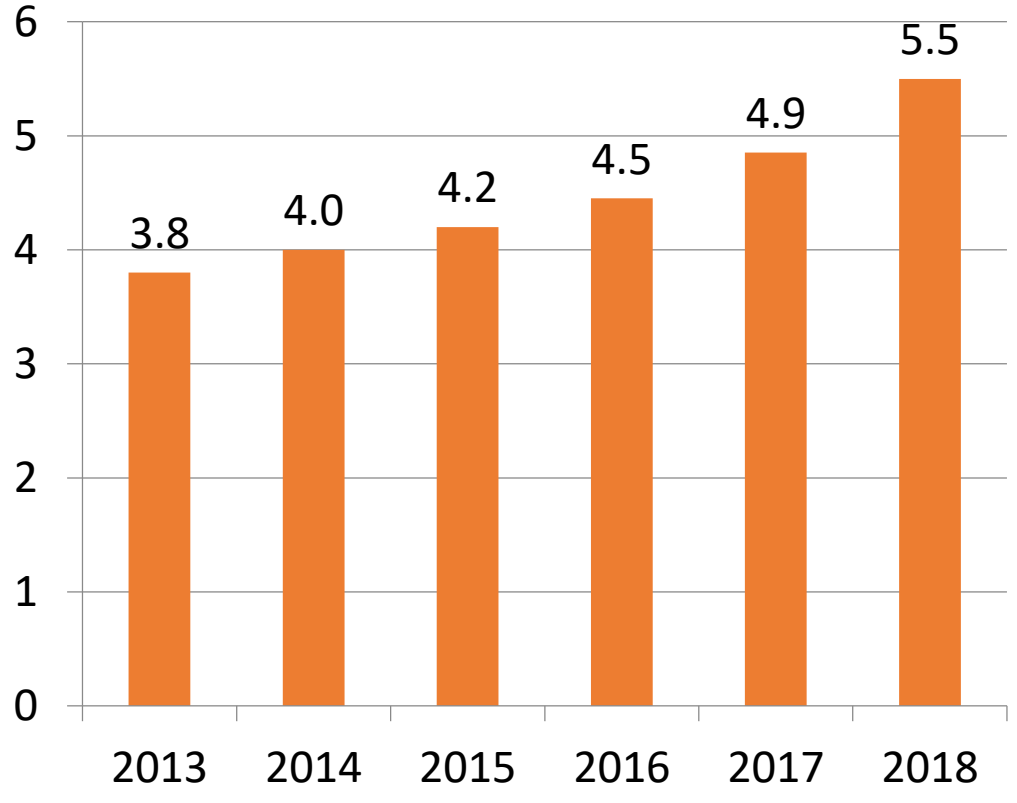
Electric Vehicles in thousands



Y-o-Y Growth of EVs in India: 80-100%^
EV30@30: 30% of market share shall be EVs by 2030 – CEM

^ Sources: https://bit.ly/2I9ONIK, https://bit.ly/2Fz5lfe, https://www.fame-india.gov.in

Air Conditioners (AC) in millions



Y-o-Y Growth of ACs in India: 5-7%
Estimated Growth by 2024: 12-15%*

* Sources: https://bit.ly/2QU7szq, https://bit.ly/2SI0Fpy, https://bit.ly/2Eslqm4

Future Scenario

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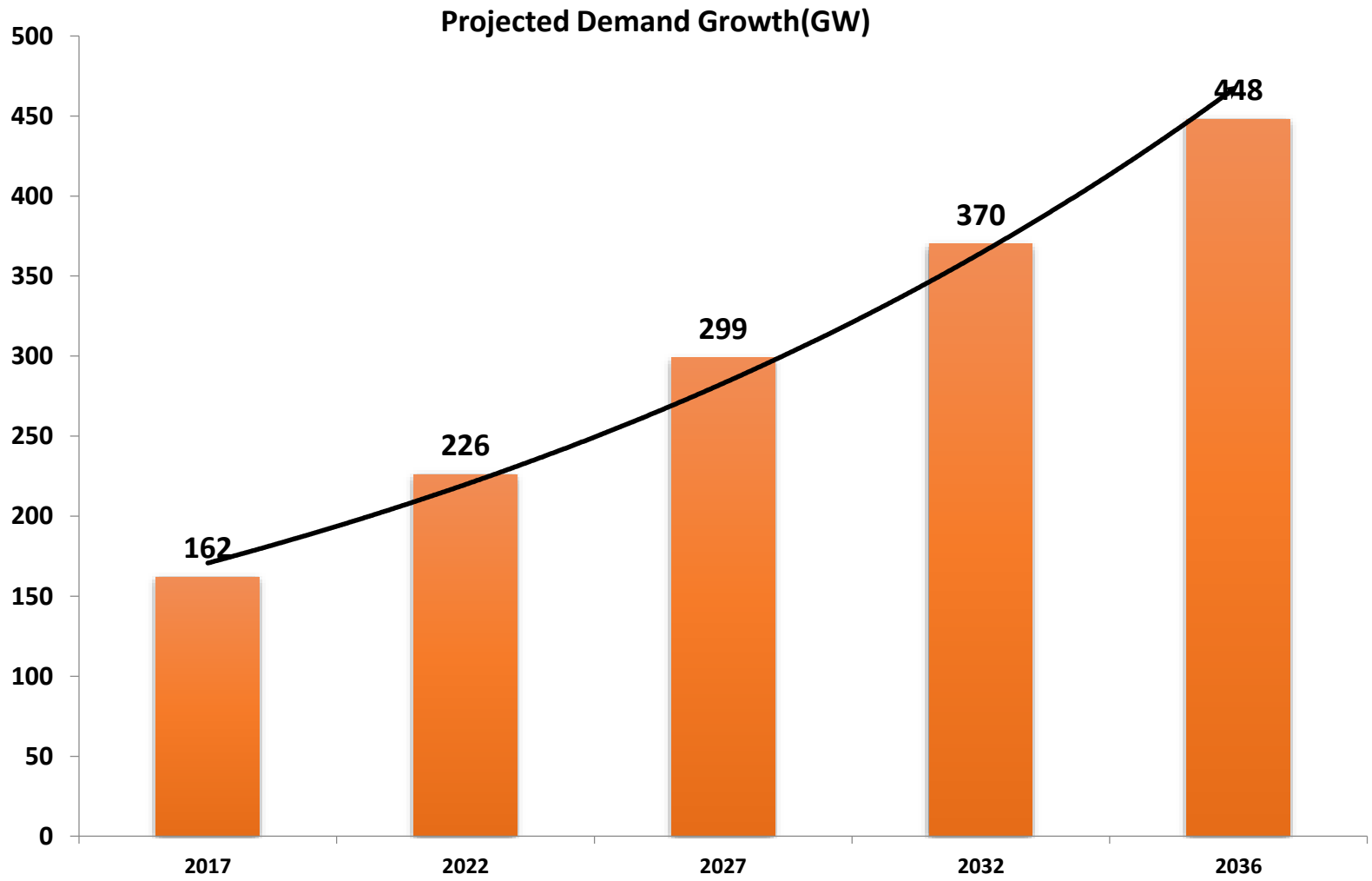

Source- CEA 19th EPS

Latent demand : reality with electrification

Opportunities for DISCOMs

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- Availability of improved IT solutions
- Redesigning business process by digitalization
- Timely and proactive services
- Data analytics and automation of routine activities
- Discover sweet spot on EV, storage and DR/DSM as well as DER
- Reducing rate of RE
- Solar agri pumps
- Decentralized generation to reduce T&D losses and increase availability
- Real time monitoring and energy accounting.
- GoI intends to double the R&D expenditure for smart grid technologies.

Need for Smart Grid Regulations

Transition of roles and actors in prosumer based power system

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Today

1 Consumer	2 Supplier	3 Grid Operator	4 Wholesale Market
▪ Energy Consumption	▪ Energy Supplier ▪ End-user customer care and billing ▪ Energy forecasting and planning ▪ Bulk Energy generation ▪ Energy trade ▪ Balance Management ▪ Wholesale settlement	▪ Grid capacity forecasting and planning ▪ Energy transport ▪ Balance management ▪ Allocation ▪ Reconciliation ▪ Asset management	▪ Energy Trade ▪ Wholesale settlement

Tomorrow

1 Prosumer	2 Prosumer Community	3 ESCO, CVPP	4 TVPP
▪ Energy consumption ▪ Energy production ▪ Energy storage ▪ Energy management ▪ Prosumer asset management	▪ Intra end-user settlement ▪ Energy forecasting and planning ▪ Energy buy/sell ▪ Community energy management ▪ Wholesale settlement	▪ End-user customer care and billing ▪ Energy forecasting and planning ▪ Aggregator ▪ Energy Trade ▪ Balance management ▪ Wholesale settlement	▪ Asset management ▪ Aggregator ▪ Operation parameters

Source: A Prosumer Oriented Energy Market - Developments and future outlooks for Smart Grid oriented energy markets, IMPROSUME Publication Series #3, NCE Smart Energy Markets, Halden, 2012

Legend: CVPP - Commercial Virtual Power Plant (commercial aggregator); TVPP - Technical Virtual Power Plant; ESCO - Energy Service Company

Smart Grid - Role of Regulators

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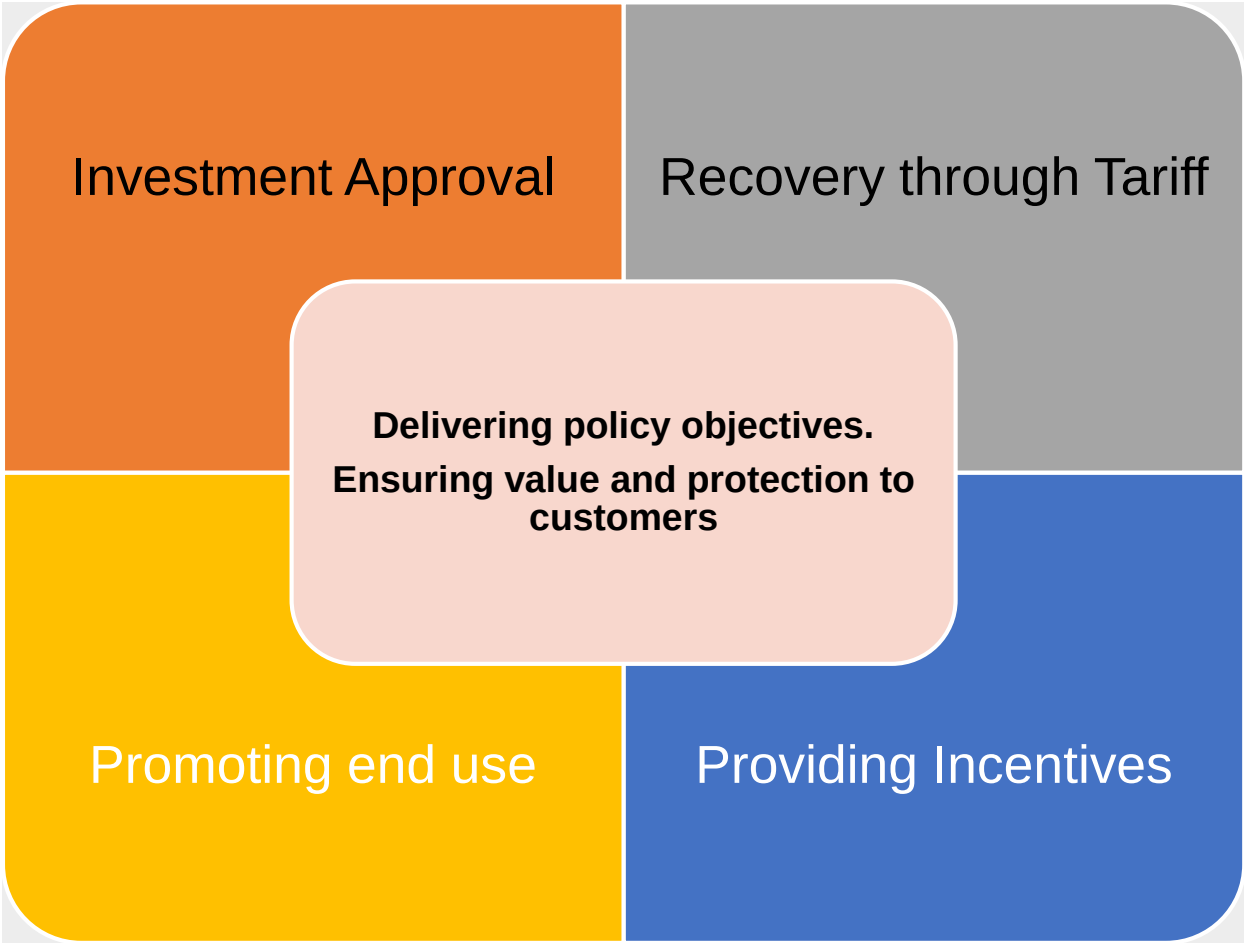
- Smart Grids cannot evolve without dynamic, flexible regulation (“Enabling”)
- Regulator will be a facilitator to smart grids business (“Catalyst”)
- Discoms need to demonstrate clear positive benefits to consumers (“Business Case”)
- Regulators more than ever need to protect the interests of the consumers (“Avoid Tariff Shocks”) and (“Data and Privacy Protection”)



Key Regulatory Considerations for Smart Grid Projects

Investment Cost Recovery – Through ARR Process

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- ***Recovery of investments through the regular ARR process***
- ***Socialization of expenses wherein the incremental expenditure is spread over a wider consumer base***
- ***The impact of large investment is minimized with entire consumer base sharing the burden of investments***

Higher Depreciation Periods

Illinois Commission approved a 10-year amortization for smart meters in a Commonwealth Edison case. The Texas PUC approved a seven-year depreciation period for both Oncor Electric Delivery and CenterPoint Energy. US smart grid tax provisions have reduced the depreciation rate for smart grid technologies from 20 years to 10 years, bringing smart grid tax treatment in line with other high-technology systems

Recovery from Tariffs

To promote demonstration projects, the regulatory model in Finland (applies from 2012 to 2015) includes an innovation incentive allowing a proportion of research and development (R&D) costs (that covers pilot schemes) to be passed through to consumers. This is currently the position in Great Britain where up to 90% of the cost of certain projects can be funded from network tariffs. However, the network company still has to consider the balance between costs, benefits and risks before initiating a project

Source: "State Regulatory Update: Smart Grid Cost Recovery", Edison Electric Institute, 2016

Key Regulatory Considerations for Smart Grid Projects

Investment Cost Recovery – Specific Tariff Schemes and Designs

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This recovery method involves introduction of specific schemes to incentivize users for promoting a particular application that is likely to benefit the stakeholders

Specific Tariff Scheme: CPP	System operators such as PJM Interconnector USA publish Critical Peak Pricing (CPP) rates, (normally during times of stress for a period of 2 weeks and related to summer cooling load) that encourage downstream connected entities to reduce consumption during this time
Specific Tariff Scheme: RTP	RTP programs are offered by Ameren Illinois and ComEd in Illinois, USA where consumers pay electricity supply rates that vary by the hour. With Ameren's residential real-time pricing program, hourly prices for the next day are set the night before and can be communicated to consumers so they can determine the best time of day to use major appliances
EnerNoc Incentive Scheme	Though a 3rd party service provider (EnerNoc), Midwest Energy in the US targets consumers with peak summer demand > 30kW. For accounts having 40hp motors at pumping sites there is no charge for participation and sites with a 25hp motor can participate by paying a $500 installation fee. For participation, Midwest Energy pays $20 per kW of interrupted capacity

Source: http://www.enernoc.com/our-resources/case-studies/547-midwest-energy-grows-new-energy-supply-with-enernoc-agricultural-demand-response

Key Regulatory Considerations for Smart Grid Projects

Investment Cost Recovery – Design of Surcharges

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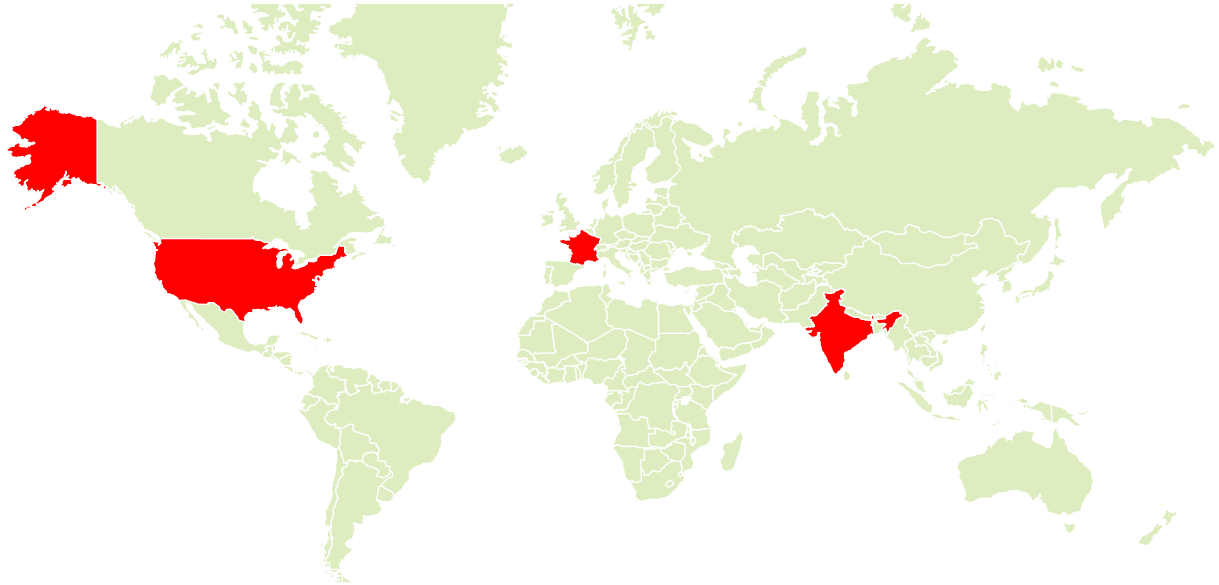
- System improvement surcharges are designed to provide consumers with improved service quality; greater rate stability; fewer service interruptions; increased safety; and lower levels of unaccounted for energy
- A system improvement charge would normally appear as a surcharge on consumers' bills

Benefits

- Accelerate investment in new plant to replace aging infrastructure
- Recover fixed costs of certain non-revenue producing, non-expense reducing infrastructure improvement
- Better absorb increases in other costs during times of relatively low interest rates
- Facilitate compliance with evolving regulatory requirements

Examples of surcharges for cost recovery



- Delhi Electricity Regulatory Commission (DERC) by 3rd Amendment of Principal Regulations introduced Compensation for power supply failure
- The Maharashtra Electricity Regulatory Commission (MERC) introduced reliability surcharge for withdrawal of load shedding for specific Instances of application of surcharges
- In Germany all domestic consumers pay a green surcharge to cover the costs of investing and integrating renewable energy
- In the US, the Pennsylvania Public Utility Commission (PUC) recently approved the use of system improvement charges to allow electric companies to use a surcharge on consumers' bills

Compensation for power supply failure, standard for restoration and compensation payable for a consumer : DERC 3rd Amendment of Principal Regulations 18th Dec'18

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Sl. No.	Service Area	Standard for restoration of power supply	Computation of period of default	Compensation payable to the consumer for the period of default in case of violation of standard
1	Unscheduled power failure for any reason whatsoever, for a single time during an entire day, except the exemption as mentioned at Regulation 83	Within One Hour	After lapse of 1 hour for a day from the time 1st complaint has made	Rs. 50/hour/consumer for the first two hours of default. Thereafter, Rs. 100/hour/consumer.
2	Re-occurrence of Unscheduled power failure for any reason whatsoever, to same consumer on same day, except the exemption as mentioned at Regulation 83	Immediate	Immediately after 1st complaint made.	Rs. 50/hour/consumer for the first two hours of default. Thereafter, Rs.100/hour/consumer.
3	Scheduled power outages	Within 12 hours or restoration by 6PM in a day	From the lapse of 12 hours from the scheduled start of maintenance or after 6PM of the day whichever is earlier	Rs. 50/hour/consumer for the first two hours of default. Thereafter, Rs. 100/hour/consumer.
4	Replacement of burnt meter or stolen meter	Restoration within 3 hours by bypassing/installing temporary meter.	After lapse of 3 hours from the time of complaint	Rs. 50/hour/consumer for the first two hours of default. Thereafter, Rs. 100/hour/consumer
5		Meter to be replaced within three days	After lapse of 3 days from the time of complaint	Rs.50 /day of default

Key Regulatory Considerations for Smart Grid Projects

Investment Cost Recovery – Pricing of new services

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- **New services provided through smart grids can be recovered through specific pricing of such services**
- **Regular alerts to consumers for load management may come as specific service provided through utility designated third parties. In such cases, the SERCs may permit recovery of charges through different modes**

Pennsylvania Public Utility Commission-System Improvement Charges

1. PUC urges the use of system improvement charges

2. Allows electric companies to use a surcharge on consumers' bills to accelerate the replacement of existing aging facilities

3. Without surcharge, replacement would only occur if the utility waits until the completion of a rate case so as to begin receiving a return on its investment.

4. System improvement charges reduce the frequency and the associated costs of base rate cases while maintaining a high level of consumer protection through better reliability and service

Key Regulatory Considerations for Smart Grid Projects

Safety and Standards Related to Smart Grid

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Examples of Regulatory Approaches

NIST

- Initiated the Smart Grid Interoperability Panel (SGIP) to coordinate standards development for the Smart Grid
- NIST has already released, NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 3.0
- The documents describe the reference model, standards, gaps, and action plans for developing a secure and interoperable Smart Grid

European and USA regulators

- Regulators have demanded accurate performance data from utilities related to service to consumers
- Integration of business processes and analytics of applications to automatically provide information on levels of service to consumers

UK Energy Watchdog

- Monitors performance of all of the UK utilities and issues fines to utilities according to the inconvenience to the consumer
- Compensation mechanism provides an incentive for utilities to ensure power to consumers

Singapore Power Regulator's Perspective

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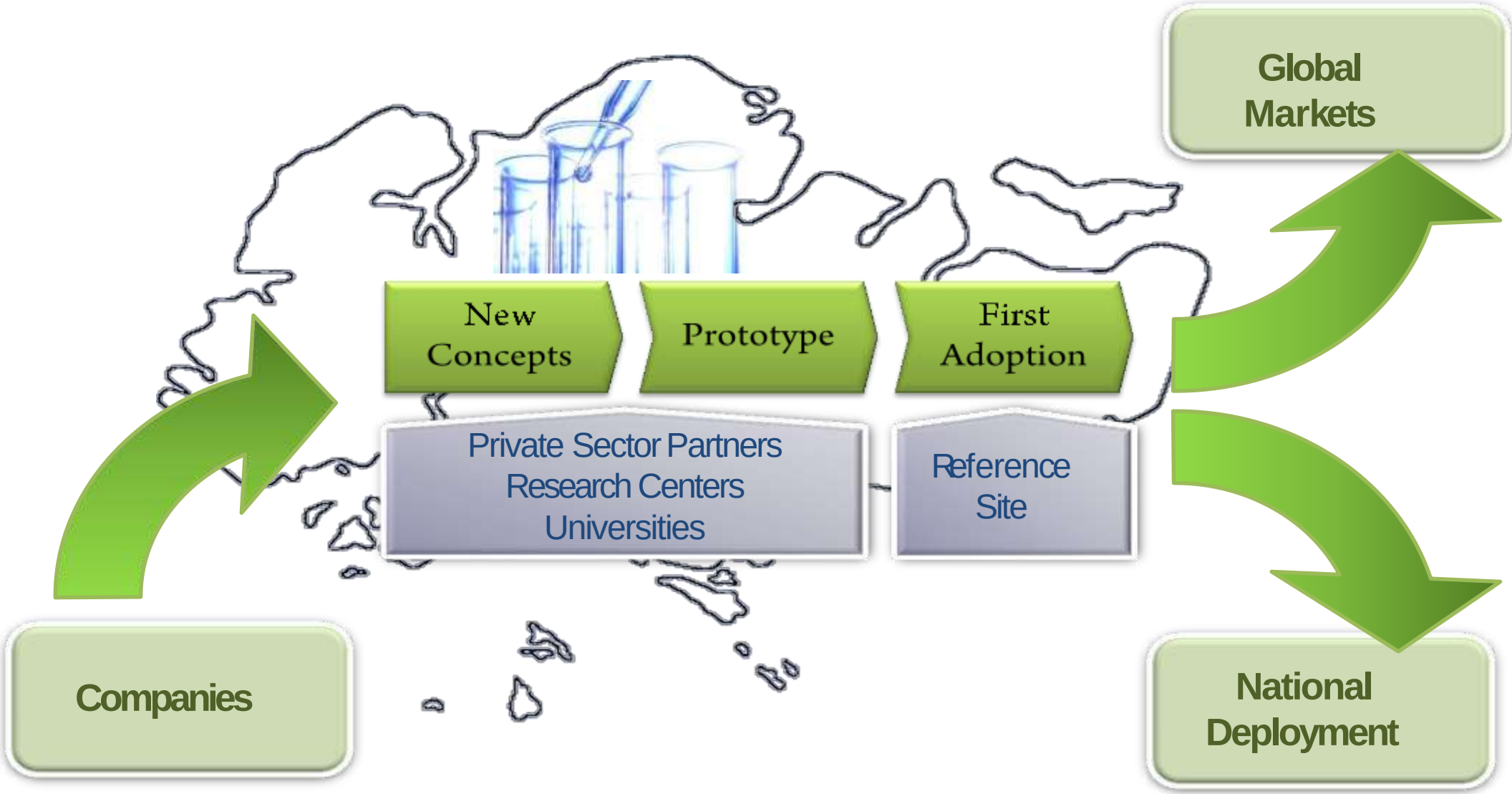

Singapore Open Electricity Market Roll out

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The roll-out to include 1.4 million consumers across the rest of Singapore will be done in batches according to postal codes.

Zone	Postal Codes Starting With...	To be launched from*
1	58 – 78	1 November 2018
2	53 – 57, 79 – 80, 82 – 83	1 January 2019
3	34 – 52, 81	1 March 2019
4	01 – 33	1 May 2019

The Open Electricity Market will be rolled out across Singapore in batches
(Graphic: Energy Market Authority)

Singapore Open Electricity Market

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Open Market Insight

- Pilot test of the Open Electricity Market began in Jurong on 1st Apr'18- Homeowners were given an option for the first time for switching supplier.
- For five months, more than 30% of consumers switched to different provider, with savings of about 20%
- Energy Market Authority (EMA) announced nationwide roll-out of the Open Electricity Market in Sep'18
- The agency surveyed 400 people that have switched retailers; about 80% agreed that the initiative has its benefits such as competitive pricing and innovative offers.

Inherent Features

- Singapore Power Group (SPG) continues to operate and maintain the power grid, while providing market support services such as billing and meter reading
- SP Group is paid for these network costs and market support services that are reviewed annually and regulated by the EMA
- Opting for a different provider will not affect supply reliability
- Even as retailers leave the Open Electricity Market, there will be no power disruptions
- Provision for comparison website that will be updated with the latest price plans
- Retailers are required to safeguard each household's security deposits, and are banned from making unsolicited calls, messages or door-to-door visits.

Key regulations, legislation & guidelines

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Electricity Act 2003

- Section 62(3) guides SERCs to incorporate ToD tariff:
  - *"The Appropriate Commission shall not, while determining the tariff under this Act, show undue preference to any consumer of electricity but may differentiate according to the consumer's load factor, power factor, voltage, total consumption of electricity during any specified period or the time at which the supply is required or the geographical position of any area, the nature of supply and the purpose for which the supply is required." (Electricity Act, 2003, p.49)*

DR and DSM

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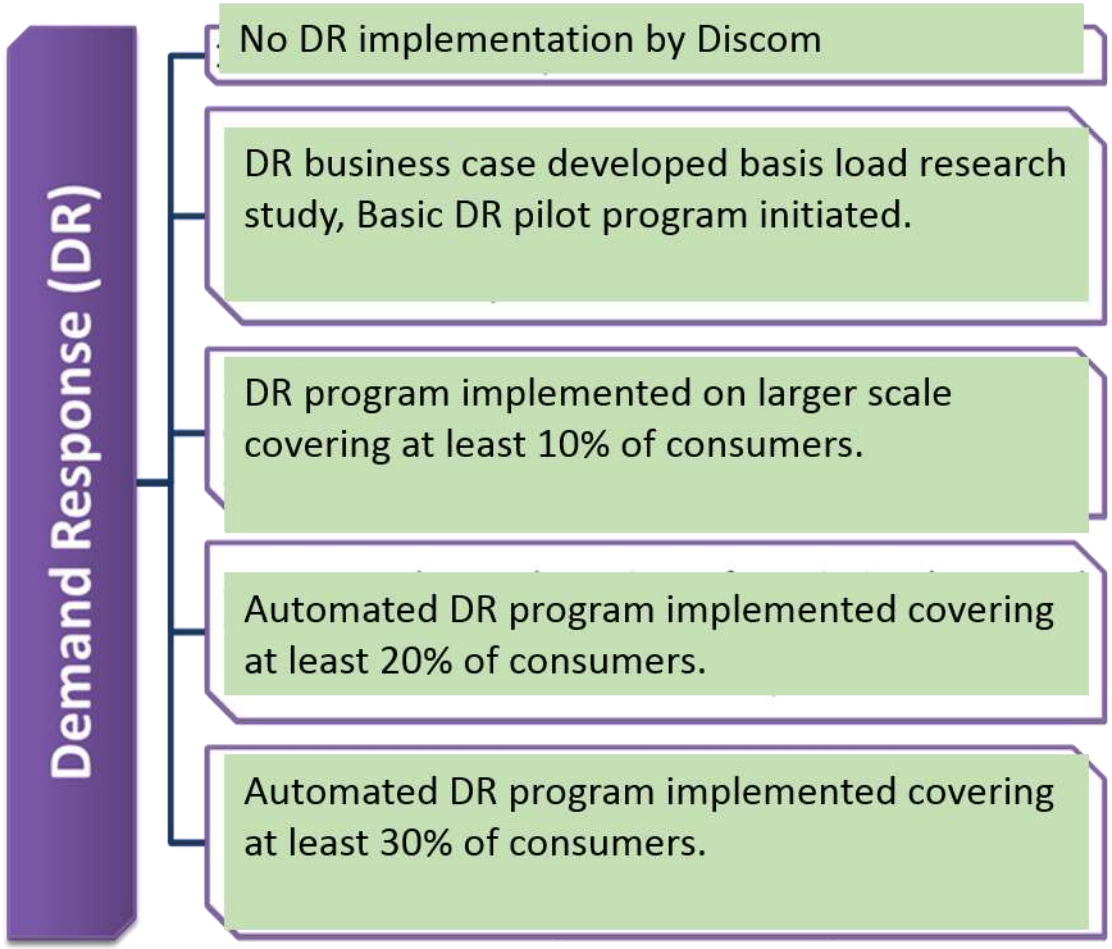

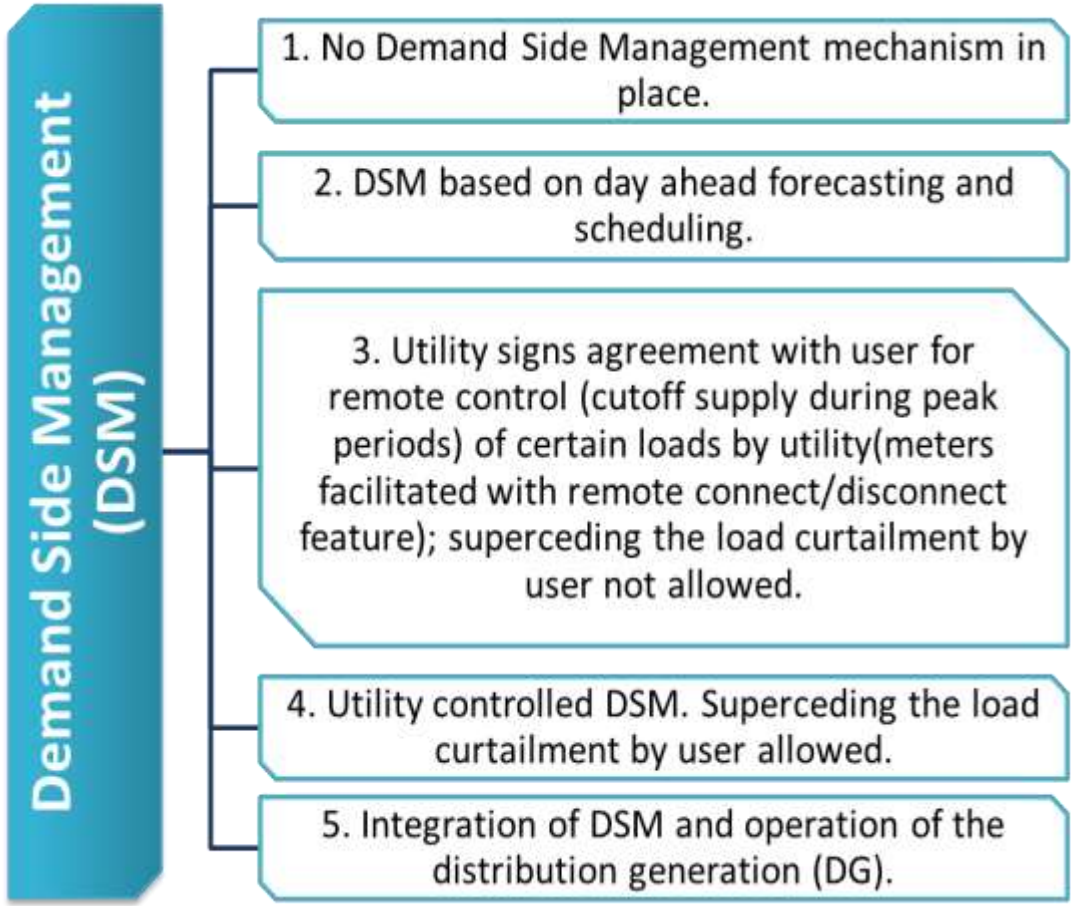

Dynamic Tariff Option for DR

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- ✓ The current pricing mechanism does not provide appropriate signal to end consumer for judicious use of electricity.
- ✓ If we add some price component to existing tariff that could reflect the real time imbalances, the end consumers may shift their load to get some incentive or to avoid disincentives.
- ✓ This necessitates design of Dynamic tariff that will not always remain same to encourage participation of end consumers in DR/DSM programs.
- ✓ In various pilot smart grid projects in the United States, participating customers were guaranteed a neutral bill impact from participation,
- ✓ As supported by survey data, there is probability that consumers will shift/reduce their loads when ToU tariff is high during the day (and/or if there is a discount at night).

Dynamic Tariff Option for DR

Components considered for tariff design

Components of ARR

- Cost of generation and transmission
- Service cost of DISCOM
- Reactive power consumption
- Voltage level
- Sanctioned/contracted load
- Subsidy
- Unscheduled Interchange charges for deviation from agreed drawal and generation schedule

Proposed

- ToD or pre-announced prices based on a forecast for peak load hours
- ToU/CPP that can be linked to Cost of purchase to an average of daily maximum demand
- Power supply quality- based on voltage fluctuations, reliability and harmonics

Whitepaper on Dynamic Tariffs - http://indiasmartgrid.org/en/knowledge-center/Reports/Dynamic%20Tariffs%20White%20Paper.pdf

Key Regulatory Framework

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Investment

- Review & Approval of Investments
- Recovery of Costs
- Role of Smart Grid Consultation Committee (SG-CC)
- Evaluation, Measurement & Verification

Tariff Design

- Implement specific Tariff Structure to promote deployment
- Process of tariff setting

Safety and Standards

- Product Standards
- System Standards
- Performance Standards
- Network and Comm. Standards
- Customer Data Protection Standards

Customer Engagement

- Awareness and Capacity Building
- Customer Participation and Incentives
- Consumer or Prosumer Dispute Redressal Process

Smart Grid Cell & Nodal Officer

- Constitution of Smart Grid Cell
- Appointment of Nodal Officer

Model Smart Grid Regulations were issued by Forum of Regulators (FoR) in August 2015

Background: Regulatory Conference

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- The power tariff in India has undergone series of improvements initiated by the Electricity Act 2003 and National Tariff Policy 2006.
- Schemes such as APDRP, R-ARDRP, IPDS have infused funds for deployment of IT and Automation as well as system strengthening.
- There has been considerable improvement in efficiency of operation of DISCOMs however issues such as undue burden of cross-subsidies, absence of cost reflective tariffs and the collection of past arrears have constantly challenged their financials.
- India is now moving towards making the Distribution infrastructure Smart by deployment of cutting edge Smart Grid technologies
- Government has also clearly spelt out its intention of moving towards a pre-paid regime for energy metering.

Thank You

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