SAARC Energy Centre, Islamabad

Pakistan

THE REPORT

Webinar On "Energy Planning for Cities of SAARC in Future"

12th May, 2020

Organized by
SAARC Energy Centre Islamabad

May 12, 2020

SAARC Energy Centre
697, Street 43, Sector E-11/4 (NPF),
Islamabad, Pakistan
www.saarcenergy.org

Introduction

1. SAARC Energy Centre (SEC), Islamabad under its approved Programmes for the year 2020 successfully conducted a Webinar on "Energy Planning for Cities of SAARC in Future" on Tuesday, 12th May 2020. Webinar Agenda is available at Annexure -I.

2. Focus of the webinar was to share the information on energy planning for cities of South Asian countries to the participants and sensitize the policy/decision makers, investors and project developer. Areas discussed during the webinar were, Smart Cities in India: Opportunities and Challenges; Solutions and Strategies; Leveraging Smart Grid Assets for Smarter Cities; Sustainable Mobility Solutions for Smart Cities of the Future; and Future of Power & Utilities Companies.

Participation

3. The webinar was attended by 69 professionals representing public sector organizations, academia, private sector, and other stakeholders within and outside SAARC region. The experts from M/s India Smart Grid Forum and M/s "Price-water-house" Cooper Ltd India shared the experience of energy planning for cities and appraised the participants about the importance of such planning in SAARC countries. The list of participants is available at Annexure-II.

Description

4. The webinar was started with welcome remarks by Program Coordinator, Mr. Bhaskar Pradhan, Program Leader (Energy Trade) of SAARC Energy Centre. The technical session comprised of presentations by the expert speakers. Each presentation was followed by a brief Q & A session. Towards the end the Program Coordinator read out conclusions, which were gathered during the webinar session. Before closing the webinar, the Program Coordinator from SAARC Energy Centre offered remarks of appreciation to all the participants and presenters.

Technical Proceedings

5. Three resource persons from M/s India Smart Grid Forum and one resource person from M/s Price-water-house Cooper India shared their knowledge in the webinar. All the presentations delivered during the webinar are available at SEC's website https://www.saarcenergy.org/webinar-on-energy-planning-for-cities-of-saarc-in-future/. Details of Resource Persons are available at Annexure-III and their Presentations at Annexure-IV. A brief information on the content of the delivered presentations is as follows:

Reji Kumar Pillai	President	India Smart Grid Forum
Reena Suri,	Executive Director	India Smart Grid Forum
Suddhasatta Kundu	Senior Manager	India Smart Grid Forum
Sandeep Kumar Mohanty	Director	Power & Utilities, PwC, India

Presentation 1 – Energy Planning for Cities and Smart Cities in India

Mr. Suddhasatta Kundu, Senior Manager (Technical), India Smart Grid Forum, India.

6. Mr. Suddhasatta Kundu is currently working as Senior Manager – Technical Advisory in India Smart Grid Forum (ISGF) and has an experience of more than 10 years in the energy sector. He has worked with various power and transport utilities, multilateral and bilateral agencies across South and South East Asia on development of smart grid roadmap, policy and regulatory assessment etc.

7. Mr. Suddhasatta talked about the energy planning for cities and smart cities in India. He highlighted the energy scenario and population growth scenario in SAARC countries and briefed the participants on the smart city mission in India where 100 smart cities were identified in 2008. This smart city mission in India is presently said to have completed 25% of the projects however completed share of work is just 11% of the total amount. Various areas of smart city solutions were also been discussed in the area of waste management, water management, E-Governance and citizen services, energy management, urban mobility and others. Further the barrier toward the smart city development were also highlighted.

Presentation 2 – Leveraging Smart Grid Assets for Smarter Cities

Ms. Reena Suri, Executive Director, India Smart Grid Forum, India.

8. Ms. Reena Suri is currently the Executive Director of ISGF. She brings over 20 years of experience in the Energy Sector. Reena has contributed to the various advisory services, whitepapers and research reports of ISGF on key Smart Grid domains.

9. Ms. Suri talked on the topic leveraging smart grid assets for smarter cities. Smart grid can be an anchor infrastructure of smart cities to accelerate the development of liveable, workable and sustainable ecosystem in SAARC cities. She explained that renewable energy is the key to build sustainable future which would promote carbon neutral smart cities.

Standard framework for smart cities will help in understanding the interdependencies of various domains and better planning. Smart city maturity model will map and benchmark various domains in the city and offer a framework to develop the roadmap for transformation from AS-IS state to TO-BE state in a phased manner.

Presentation 3 – Planning Smart Cities in SAARC Countries

Mr. Reji Kumar Pillai, President, India Smart Grid Forum, India.

10. Mr. Reji is the President of ISGF and is also the Chairman of Global Smart Grid Federation since November 2016. He is an internationally renowned expert with over three decades of experience in the electricity sector in diverse functions covering the entire value chain and across continents.

11. Mr. Pillai presented on the Planning of smart cities in SAARC Countries. He explained about the key features of infrastructure like communication, energy efficiency, emission, mobility, wastage minimization, sustainability etc. On Energy efficiency, he spoke about the consumption patter in new buildings, large campuses and commercial buildings. He highlighted the need for certified buildings and towns and shared the ideas about the EV charging infrastructures, clean energy, smart grid, energy storage system and others. On Smart mobility, he presented on the requirement for minimum commute for daily needs, electric vehicle friendly infrastructure and delivery drone. He also talked on various communications system that would be required for intelligent planning of cities.

Presentation 4 – Global Energy Transformation, Challenges and Solution for Power Sector

Mr. Sandeep Kumar Mohanty, Director, Power and Utilities, PwC, India.

12. Mr. Sandeep Kumar Mohanty has over 10 years of professional experience in management consulting. He has supported several state and central government entities, investors and others on financing strategy, market research, financial modelling, commercial and technical due diligence. He has expertise across various sectors such as Power and utilities, mining, urban transport and agriculture.

13. During the presentation Mr. Sandeep first highlighted on the impact of megatrends on all sector across the globe and explained the disruptive dynamics impacting the power sector. His presentation also advised companies to adapt to remain competitive in this new world and be mindful of the transformational change in power market. He highlighted the importance of competition in the transformational markets. Various business model for market participation were presented with some examples. He also reckoned that utilities should select their business models based on the future market opportunities and capabilities required and determine how to leverage their strengths to enhance their competitive positioning.

Wrap up and Conclusion

Mr. Bhaskar Pradhan, Program Leader (Energy Trade), SAARC Energy Centre

14. Mr. Bhaskar Pradhan thanked everyone for attending the event. He informed the participants that it was very important for SAARC countries to understand the need of proper planning for cities in South Asian countries. Following are the main conclusions:

a. Proper energy planning for cities offers multiple benefits. Some of them are listed below:

   i. Timely identification of sources of clean energy for cities
   ii. Identification of methodologies for implementation
   iii. Ways to improve energy efficiency
   iv. Increase renewable energy share
   v. Creation of sustainable energy and climate plans for cities
   vi. Reduction of greenhouse gases
   vii. Overcoming energy shortage
   viii. Planning, implementation and evaluations

b. It is important that all SAARC Member States take timely actions towards the energy planning for the future cities. SAARC Energy Centre has always played its role to facilitate and encourage South Asian countries on energy initiatives and will continue to do so by arranging events to allow deliberation on crucial aspects for the benefit of the region.

Closing of Webinar

Mr. Bhaskar Pradhan, Program Leader (Energy Trade), SAARC Energy Centre

15. Mr. Bhaskar Pradhan, informed all the participants that the presentations and recording of the webinar proceedings will be available on SAARC Energy Centre's website (www.saarcenergy.org). He requested the participants to submit suggestions/comments for any further improvement of these webinars and suggest topics that they would like SEC to conduct webinar on. He closed the webinar with a thank you note to everyone attending the Webinar.

Annexures

Annexure-I

Webinar Agenda

Webinar on
"Energy Planning for Cities of SAARC in Future"
Tuesday, 12th May 2020

1100 – 1110	Introduction
1110 – 1130	**Smart Cities in India: Opportunities and Challenges, Solutions and Strategies** *Mr. Reji Kumar Pillai, President and Suddhasatta Kundu, Senior Manager, India Smart Grid Forum*
1130 – 1140	**Leveraging Smart Grid Assets for Smarter Cities** *Ms. Reena Suri, Executive Director, India Smart Grid Forum)*
1140 – 1200	**Sustainable Mobility Solutions for Smart Cities of the Future** *Mr. Reji Kumar Pillai, President, India Smart Grid Forum*
1200 – 1210	Q & A session
1210 – 1230	**Future of Power Industry** *Mr. Sandeep Kumar Mohanty, Director PwC, India*
1230 – 1240	Q & A session
1310 – 1320	Conclusion and Recommendations
1320 – 1330	Closing of Webinar

Information for the participants:

1. All times mentioned in agenda are according to Pakistan Standard Time (PKT). The participants from other Member States may attend this Webinar by following their own local time. The time conversion for all Member States is given below for reference:

Country	Afghanistan	Bangladesh	Bhutan	India	Maldives	Nepal	Sri Lanka
Local time	(PKT-00:30)	(PKT+01:00)	(PKT+01:00)	(PKT+00:30)	PKT	(PKT+00:45)	(PKT+00:30)

2. The participants can ask questions to presenters by typing questions or clicking the "raised hand" option in the Attendees pane of the main window of GotoWebinar application. You may send in your questions at any time during the presentations; we will collect these and address them during the Q&A session at the end of each presentation.

3. All participants can also submit comments/views and/or observations on the draft study report to SAARC Energy Centre through email to Mr. Bhaskar Pradhan, Program Leader (ET) (plet@saarcenergy.org) before 20th May, 2020.

List of Participants

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Annexure-II

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Annexure-III

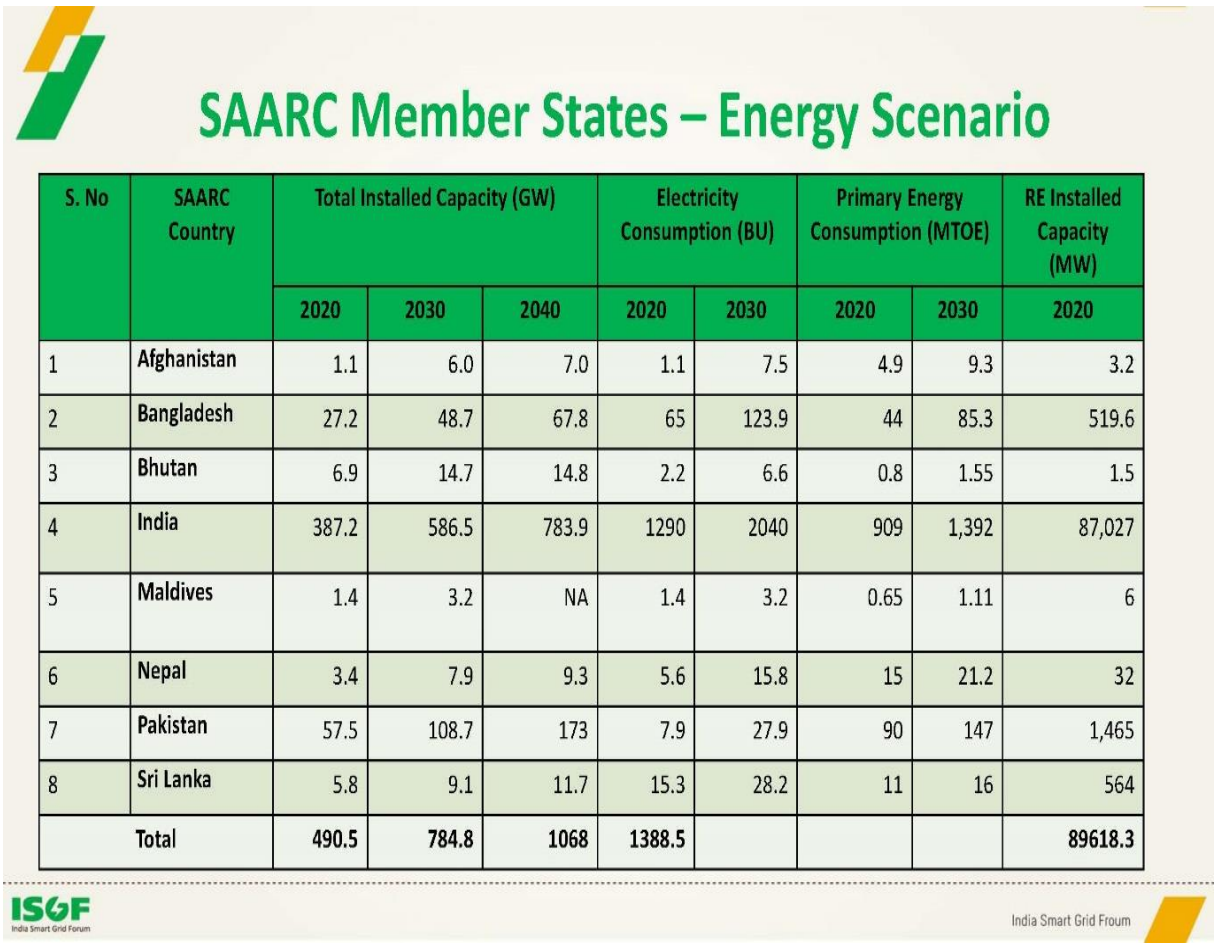
List of Presenters/Resource Persons

S. No.	Name	Designation	Organization	Email address
1.	Mr. Reji Kumar Pillai	President	India Smart Grid Forum	reji@rejikumar.com
2.	Ms. Reena Suri,	Executive Director	India Smart Grid Forum	reena.suri@indiasmartgrid.org
3.	Mr. Suddhasatta Kundu	Senior Manager,	India Smart Grid Forum	s.kundu@indiasmartgrid.org
4.	Mr. Sandeep Kumar Mohanty	Director	Power & Utilities, PwC, India	sandeep.kumar.mohanty@pwc.com

Presentations Delivered During the Webinar

1. "Smart Cities in India: Opportunities and Challenges; Solutions and Strategies" by Mr. Suddhasatta Kundu,

Senior Manager, India Smart Grid Forum, India.



S. No	SAARC Country	Total Installed Capacity (GW)			Electricity Consumption (BU)		Primary Energy Consumption (MTOE)		RE Installed Capacity (MW)
		2020	2030	2040	2020	2030	2020	2030	2020
1	Afghanistan	1.1	6.0	7.0	1.1	7.5	4.9	9.3	3.2
2	Bangladesh	27.2	48.7	67.8	65	123.9	44	85.3	519.6
3	Bhutan	6.9	14.7	14.8	2.2	6.6	0.8	1.55	1.5
4	India	387.2	586.5	783.9	1290	2040	909	1,392	87,027
5	Maldives	1.4	3.2	NA	1.4	3.2	0.65	1.11	6
6	Nepal	3.4	7.9	9.3	5.6	15.8	15	21.2	32
7	Pakistan	57.5	108.7	173	7.9	27.9	90	147	1,465
8	Sri Lanka	5.8	9.1	11.7	15.3	28.2	11	16	564
	Total	**490.5**	**784.8**	**1068**	**1388.5**				**89618.3**

SAARC Member States – Population Growth

S. No	SAARC Country	Population (Crores)			%Urban Area			% Rural Area		
		2020	2030	2050	2020	2030	2050	2020	2030	2050
1	Afghanistan	3.72	4.8	6.46	25.4	28.7	39.4	76.3	71.3	60.6
2	Bangladesh	16.44	17.89	19.25	39.4	47.3	61.2	63.4	52.7	38.8
3	Bhutan	0.075	0.084	0.09	45.8	52.7	63.4	59.1	47.3	36.6
4	India	135.26	150.36	163.9	35	40.4	53.5	66	59.6	46.5
5	Maldives	0.051	0.059	0.058	34.5	44.4	53	60.2	55.6	47
6	Nepal	2.81	3.33	3.53	21.4	25.2	38.2	80.3	74.8	61.8
7	Pakistan	21.22	26.29	33.80	35.1	37.8	47.4	63.3	62.2	52.6
8	Sri Lanka	2.17	2.2	2.22	18.4	20.6	30.1	81.5	79.4	69.9
	Total	**181.75**	**205**	**229.3**						

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Energy Savings in India (2018-19)

Name of the Scheme	Energy Savings		Total Savings (MTOE)	Monetary Savings (INR Crore)
	Thermal (MTOE)	Electrical (BU)		
PAT	11.093	30.279	13.698	34405
MSME	0.022		0.022	40
Standards and Labeling		55.693	4.790	27,846
UJALA		44.645	3.839	22,323
ECBC – Commercial Buildings Programme		0.040	0.003	20
BEE Star Rating Buildings		0.083	0.007	41
Building Energy Efficiency		0.110	0.009	55
Other Green Building Programmes		0.070	0.006	35
Street Lighting		5.647	0.486	2,824
Star Rated Pumps		0.18	0.015	90
Corporate Average Fuel Economy	0.848		0.848	1,560
FAME-I Scheme	0.038		0.038	70
Total	12	136.374	151.741	89,122

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Smart City Mission - India

Total Smart Cities: 100

Total Urban Population Impacted: 9,96,30,069

Total Cost of Projects (Rs. Cr): 2,05,018

Total Area Based Development Cost (Rs. Cr): 1,64,204

Total Pan-City Solution Cost (Rs. Cr): 38,914

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List of Smart Cities

S. No	State/UT	No. of Cities Allocated	S. No	State/UT	No. of Cities Allocated	S. No	State/UT	No. of Cities Allocated
1	Andaman & Nicobar Islands	1	13	Haryana	2	25	Nagaland	1
2	Andhra Pradesh	3	14	Himachal Pradesh	1	26	Odisha	2
3	Arunachal Pradesh	1	15	Jammu & Kashmir		27	Puducherry	1
4	Assam	1	16	Jharkhand	1	28	Punjab	3
5	Bihar	3	17	Karnataka	6	29	Rajasthan	4
6	Chandigarh	1	18	Kerala	1	30	Sikkim	1
7	Chhattisgarh	2	19	Lakshadweep	1	31	Tamil Nadu	12
8	Daman & Diu	1	20	Madhya Pradesh	7	32	Telangana	2
9	Dadra & Nagar Haveli	1	21	Maharashtra	10	33	Tripura	1
10	Delhi	1	22	Manipur	1	34	Uttar Pradesh	13
11	Goa	1	23	Meghalaya	1	35	Uttarakhand	1
12	Gujarat	6	24	Mizoram	1	36	West Bengal	4
Total								**100**

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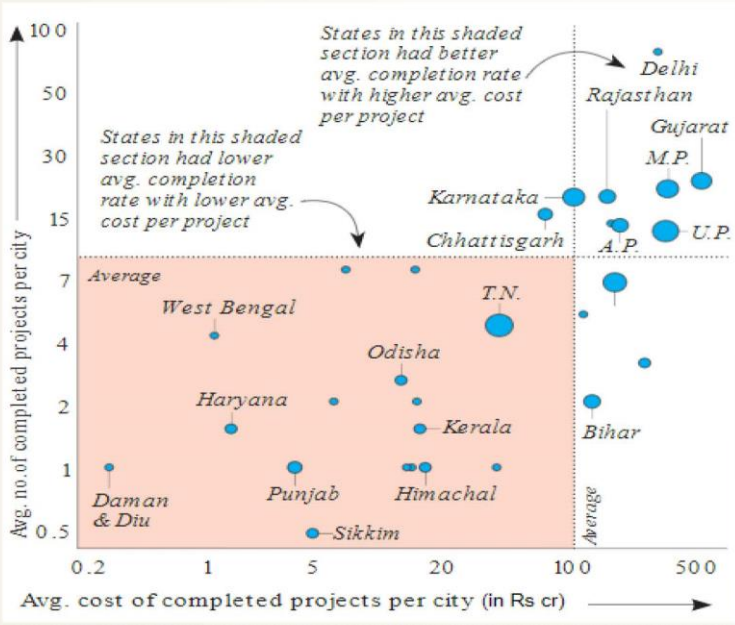
Smart City Progress - India

Of the 5,151 projects initially proposed, only 3,629 have been actively pursued. Of these, about 25% of the projects have been completed. But in value terms, the share of work completed amounts to just 11% of the total amount



- *5,151 projects worth more than 30.76 billion USD at different stage of implementation in 100 cities*
- *4,154 Smart City Mission (SCM) Projects worth 22.92 billion USD tendered (72% of total)*
- *1,290 SCM Projects worth 3.53 billion USD completed and operational*

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Smart City - Solutions

Waste Management

1. Waste to Energy Audit
2. Waste to Compost
3. Waste water treatment
4. Recycling and Reduction of C&D Waste

Water Management

1. Smart Meters & Management
2. Leakage Identification, Preventive Management
3. Water Quality Monitoring

Others

1. Tele-medicine & tele-Education
2. Incubation/Training Facilitation Centres
3. Skill Development Centres

E-Governance and Citizen Services

1. Public Information, Grievance Redressal
2. Electronic Service Delivery
3. Citizen Engagement
4. Video Crime Monitoring

Energy Management

1. Smart Meters & Management
2. Renewable Sources of Energy
3. Energy Efficient & Green Buildings

Urban Mobility

1. Smart Parking
2. Intelligent Traffic Management
3. Integrated Multi-Modal Transport

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Smart Solutions in Use

Centralised Command and Control Centre	Transit Operations System	Smart Parking System	Common Card (Payment & Operations)
Smart Metering – Water, Gas & Electricity	Data Analytics Centre	LED Street Lighting	E-Healthcare
Air Quality Monitoring Sensors	CCTV Surveillance	Public Information System	Emergency Response

Smart City Development - Barriers

Governance

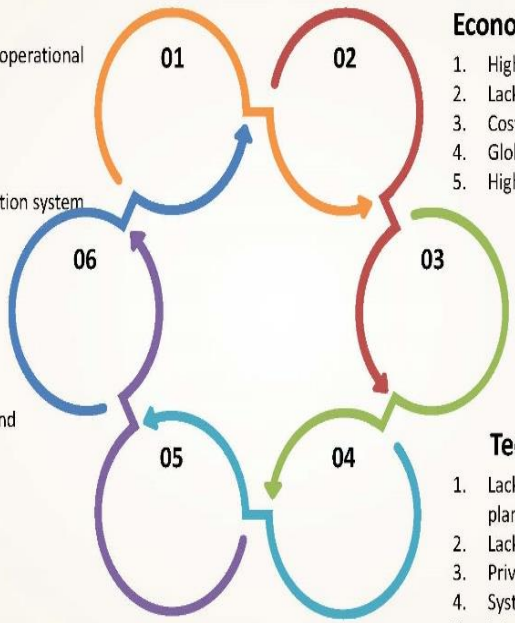
1. Lack of Coordination between city's operational networks
2. Unclear IT management vision
3. Political Instability
4. Poor private-public participation
5. Lack of developing a common information system model

Legal & Ethical

1. Cultural Issues
2. Lack of Standardization
3. Issues of Openness of Data
4. Lack of Transparency and Liability
5. Lack of Regulatory norms, policies and directions

Environmental

1. Lacking ecological view in behaviour
2. Growing Population problems
3. Lack of sustainability considerations
4. Carbon Emissions Effect
5. Degradation of Resources



Economic

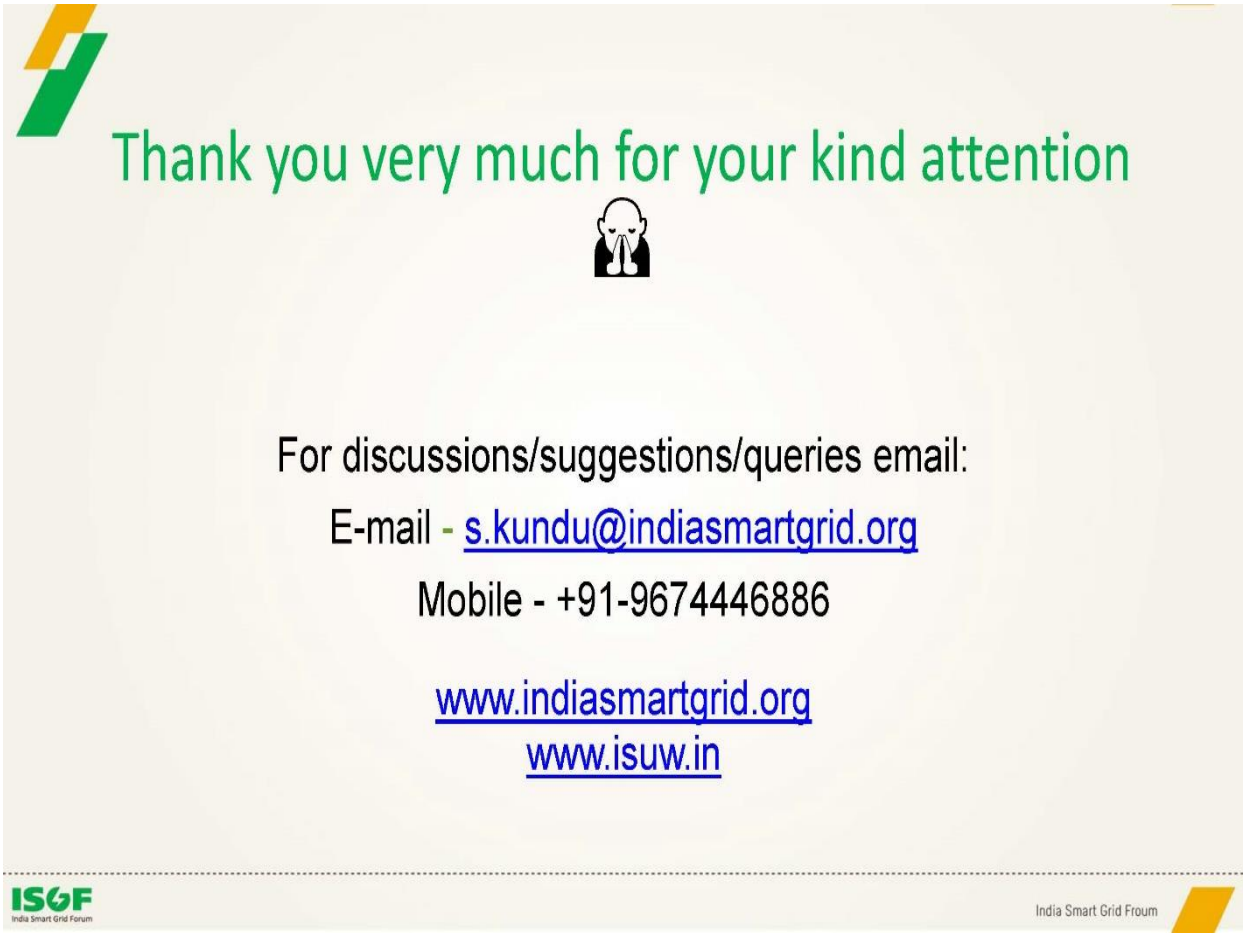
1. High IT infrastructure and intelligence deficit
2. Lack of Competitiveness
3. Cost of IT training and skills development
4. Global economy volatility
5. Higher operational and maintenance cost

Social

1. Lack of involvement of citizens
2. Low awareness level of community
3. Geographical diversification problems
4. Degree of inequality

Technology

1. Lacking technological knowledge among the planners
2. Lack of access to technology
3. Privacy and security issues
4. System failures issues
5. Integration and convergence
6. Issues across IT networks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ISGF
India Smart Grid Forum
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2. "Leveraging Smart Grid Assets for Smarter Cities" by M. Reena Suri,
Executive Director, India Smart Grid Forum, India

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India Smart Grid Forum

Leveraging Smart Grid Assets for Smarter Cities

Presented by

Reena Suri, Executive Director

India Smart Grid Forum

ELECTRICITY GRID: A PARADIGM SHIFT

ISGF
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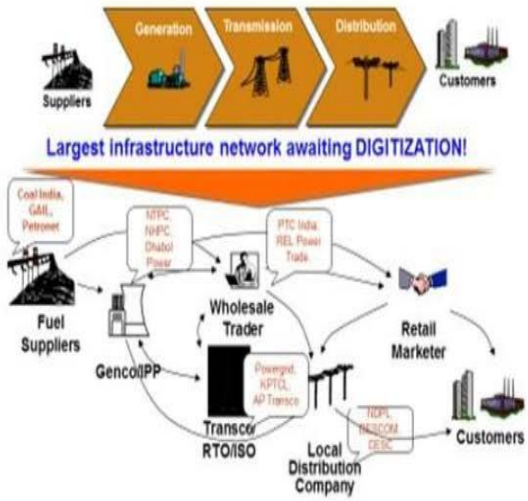
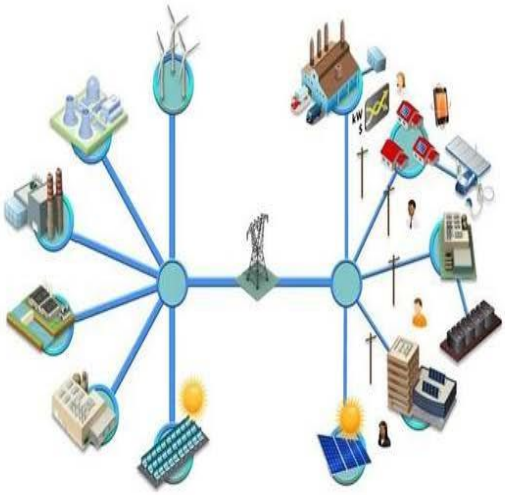
Traditional Grid



Emerging Integrated Grid



Source: EPRI

SMART GRID

An electricity grid with Communication, Automation and IT Systems that enable Real Time Monitoring and Control of Power Flows from points of generation to points of consumption at the appliances level

TYPICAL COMPONENTS OF SMART GRIDS

1. Electrical Network Strengthening at 33kV/11kV/0.415kV levels
2. SCADA/ DMS and Distribution Automation Systems
3. Moving Overhead Lines to underground cables at select locations
4. Distributed/Renewable Generation and its integration with electrical grid; Smart Microgrid that can island from main grids in times of emergencies
5. Conversion of Air Insulated Substations to Gas Insulated Substations
6. Communication systems connecting all substations and DTs on fibre optic network
7. Smart Metering or Advanced Metering Infrastructure (AMI)
8. Billing, CRM and Consumer Portal
9. Mapping electrical assets and consumers (all buildings) on digital maps (GIS)
10. IT Network (LAN, WAN), Data Centre, Asset Management and other Enterprise IT Systems
11. Enterprise Resource Planning (ERP)
12. Outage Management Systems and Mobile Crew Management Systems
13. Enterprise Applications Integration and Analytics

DESIRED FEATURES OF SMART CITIES

ISGF India Smart Grid Forum

1. Ensure 24x7 stable electricity to all citizens
2. Building GIS data of all infrastructure and services in an integrated fashion
3. High levels of Renewable Energy mix that is integrated with the power grid
4. EV Charging Infrastructure; Grid-connected EVs as virtual power plants (VPPs)
5. Efficient Water Distribution Network with leakage detection systems and safe Gas Distribution Networks
6. Integrated Billing Systems for a variety of services; Common Consumer Care Centers and user friendly Payment Platforms
7. Intelligent Transportation Systems – Traffic lights; Congestion Alerts; Common Toll Payments etc.
8. Digital Security Systems Integrated with emergency services (police, fire, ambulance, municipality etc.)
9. Intelligent buildings with rooftop PV and EV Charging facilities integrated with automation systems of the electric utility participating in the demand response
10. Sharing of data between various domains and building smart analytical tools

BUSINESS CASE - SMART CITIES WITH SMART GRIDS

ISGF India Smart Grid Forum

Business Case for Smart Cities:

- **Two categories Cities in India**: Existing cities and New Cities
- **No Single Ownership** for all their services in a City - Herculean task to bring all services on a Common Platform
- Projects Complex and justifying ROI even more difficult

Business Case for Smart Grids:

- Electricity Distribution Companies (Discoms) in several states report very high AT&C losses (>30% in many large states); Smart Grid projects can bring losses down to below 10% and the payback period is 3-4 years
- Possible to **extend the Digital Platform** of one domain - say Electricity - to offer services in other domains - say Water, Gas, Internet, Security, Traffic etc

BUSINESS CASES FOR DIGITALIZATION OF POWER SECTOR - GIS MAPS

ISGF India Smart Grid Forum

A. GIS Maps

- All electrical assets (medium voltage and low voltage lines, substations) and consumers are mapped on a digital map and the Utilities update this system on regular basis to capture changes/addition to the electrical network as well as new consumers/buildings
- This digital map can be effectively used by other infrastructure services providers for planning as well as operation and maintenance of their systems
- Very useful for planning the laying of water supply and sewerage lines, telecom cables, gas pipe lines etc; also useful for planning of road network

Market Opportunities

✓Share the maps with other stakeholders in a city for a modest fee

BUSINESS CASES FOR DIGITALIZATION OF POWER SECTOR - AUTOMATION SYSTEMS

ISGF India Smart Grid Forum

B. Automation Systems - SCADA/DMS, DA and SA, DR, DERMS

- Field infrastructure and dedicated communication bandwidth of automation systems can be shared with other infrastructure domains
- Latest trend is utilities building their own communication networks

Market Opportunities

- ✓ Common SCADA with Water and Gas Distribution Utilities
- ✓ Sharing the Communication Infrastructure for Security and Traffic cameras and other Smart City Applications
- ✓ Communication Network can be leased to Telecom Operators

BUSINESS CASES FOR DIGITALIZATION OF POWER SECTOR – BILLING AND CRM

ISGF India Smart Grid Forum

C. Billing and Customer Relationship Management (CRM)

- Billing and CRM systems have been implemented in most towns and the consumers have multiple options to make their payments
- There are also Consumer Care Centers at strategic locations and interactive Consumer Portals
- DISCOMs have regular interactions with their customers on – Meter Reading, Bill Distribution, Payment Collection, Attending to Complaints, Information on Planned Outages etc

Market Opportunities

- ✓ These Systems can be used for collection of Water and Gas Bills, House Taxes and other Municipal Dues
- ✓ Can even be extended to private utilities such as Cable TV, internet, telephone, etc
- ✓ This not only reduces the overall collection cost, but also facilitates higher compliance in timely payment. If the consumer wishes, he/she could even opt for a consolidated bill across all such services

BUSINESS CASES FOR DIGITALIZATION OF POWER SECTOR – CALL CENTERS

ISGF India Smart Grid Forum

D. Call Centers and Call Data Archives

- Customer Care Centers, Call Centers, Chatbots and Voice Bots of electric utilities are very valuable assets in a city/country
- The incoming calls (on single number) can be diverted to the respective teams responsible for each domain and their crew
- The IT and communication infrastructure and cost can be optimized to a great extent

Market Opportunities

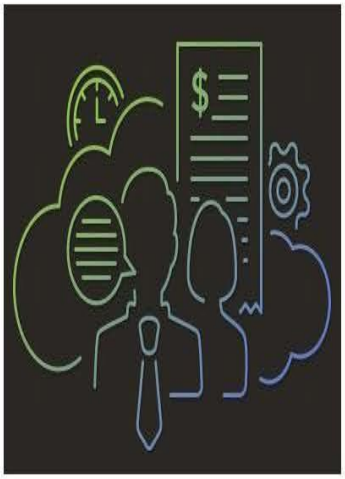
- Revenue from sharing the Customer Care Centers, Call Centers, Chatbots and Voice Bots with other stakeholders
- **Analytics of data** from the customer calls and interactions with Chatbots and Voice Bots can be useful tools for different stakeholders to optimize their business operations
- Call Centers of electric utilities can be made **City Command and Control Centers** at marginal cost

BUSINESS CASES FOR DIGITALIZATION OF POWER SECTOR – MANAGEMENT SYSTEMS

ISGF India Smart Grid Forum

E. Outage Management System (OMS) and Mobile Workforce Management System (MWFM)

- OMS and MWFM platforms can be can be shared with other infrastructure and services providers



Market Opportunities

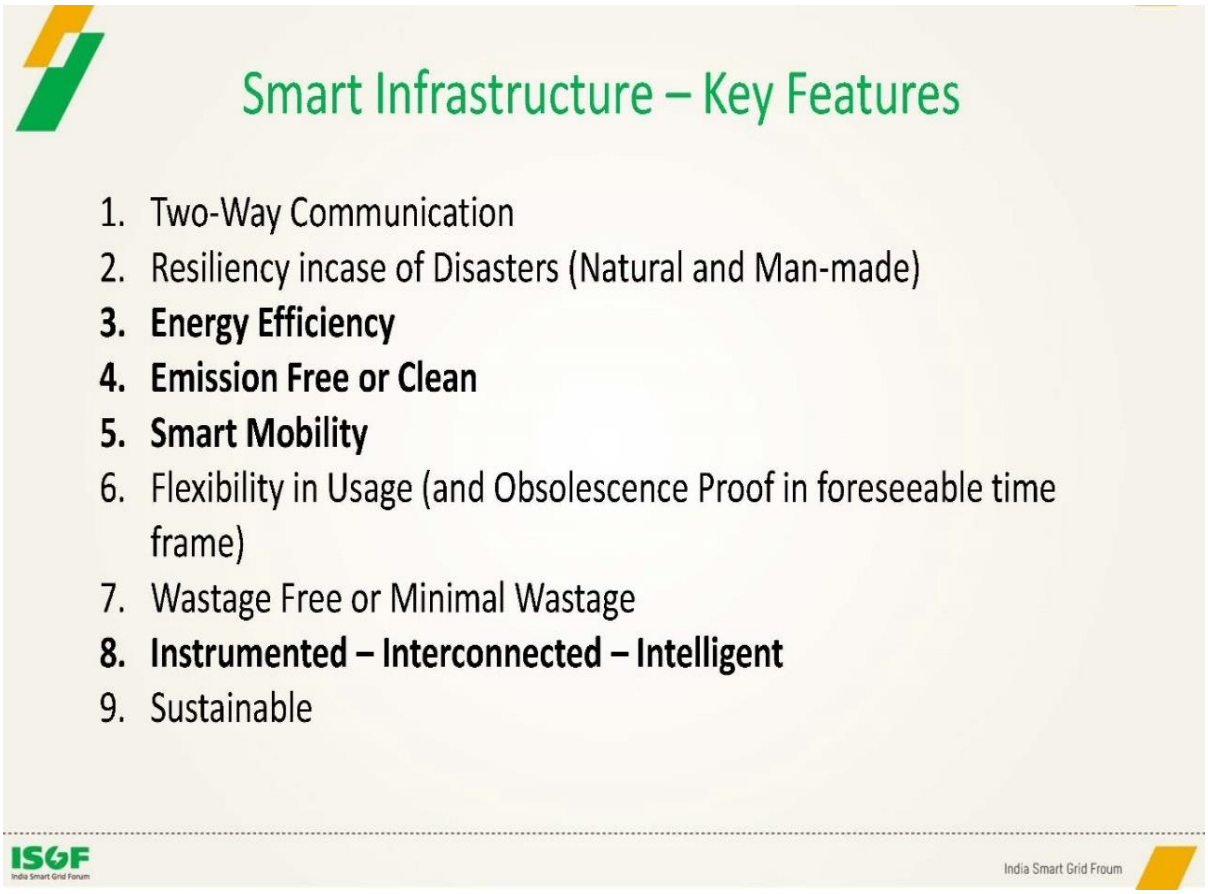
✓Revenue from sharing the OMS and MWFM with Water and Gas Distribution agencies, White Goods Services agencies, other city service providers

Summary

ISGF India Smart Grid Forum

- **Smart Grid** can be an anchor infrastructure of Smart Cities to accelerate the development of liveable, workable and sustainable ecosystem in SAARC Cities
- **Renewable Energy** is the key to build sustainable future which will promote carbon neutral Smart Cities
- **Standard Framework for Smart Cities** would help in understanding the interdependencies of various domains and better planning
- **Smart City Maturity Model** would map and benchmark various domains in the City and offer a framework to develop the roadmap for transformation from AS-IS state to TO-BE state in a phased manner

3. "Planning Smart Cities in SAARC Countries" by Mr. Reji Kumar Pillai,
President, India Smart Grid Forum, India.



Smart Infrastructure – Lasting Centuries

- How to design buildings, roads and other public infrastructure that last several centuries – if not millenniums
- What is serving the needs of today may not serve good after few decades or centuries
- Some of the ancient monuments do survive natural disasters where as our modern buildings collapse
- What planning tools are available for designing the infrastructure that can support the needs – jobs, mobility, trade, health, education, recreation.....

3. Energy Efficiency

- Commercial buildings in most countries consume >200 kWh/SqM per Year
- Present technologies and materials can bring this down to below 50 kWh/SqM per Year
- All new buildings should be mandated to have energy consumption below 100 kWh/SqM/Year
- Large Campuses to be smart microgrids that can island from the main grid when required
- DC (48 volt) distribution system in parallel with AC distribution system
- Regenerative Lifts

Energy Efficient Buildings

Commercial Building

Net Zero Emission Building

4. Emission Free

- Zero Emission Buildings (ZEB) and Zero Emission Campuses
- LEED/GRIHA certified buildings
- PEER certified campuses and towns
- E-Vehicles ONLY Zones
- Walk-to-Work neighborhoods
- Dust free constructions – no open earth between roads and buildings
- EV charging infrastructure in buildings and campuses
- Clean Energy
  - Solar, Wind, Wave, Geothermal, OTEC
  - Waste-to-Energy plants
- Smart Grids, Microgrids, Energy Storage Systems

Date: 18th December 2018

Coal Power Plant to Solar and Wind Farms

Coal Power Plant
3-5 years to build

Solar and Wind Farm
12-18 months to build

Smart Microgrids, Grid Interactive Buildings and Campuses

- Microgrids
  - Self Generation – solar PV, wind, fuel cells, gas turbines, DG sets
  - Energy storage systems (ESS)
  - Load control – demand response
  - Vehicle-Grid Integration (VGI) – car batteries as virtual power plants (VPP) offering V2G services
  - Islanding feature - peak hours (price arbitrage), major grid faults, cyber attacks, weather events
- Grid Interactive Buildings and Campuses
  - Building Management System (BMS) integration with Distribution Management System (DMS) of the electric utility
  - Rooftop PV and EV charging infrastructure integration
  - Buying and selling electricity from the market (or P2P sellers) in real-time
- Smart Appliances – Grid Interactive
  - Grid interactive smart appliances could buy electricity from cheapest sources in real-time through smart contracts executed on Blockchain and schedule its consumption accordingly

5. Smart Mobility

- Minimum commute for daily needs
  - Walk (or Bike) to work/school/shopping/recreation
  - Long escalators, ropeways where cost-effective
- Electric Vehicles friendly infrastructure
- Autonomous Vehicles friendly infrastructure
- Promoting Shared Mobility – electric buses and shared taxis and 3Wheelers
  - Shenzhen Example
- Delivery Drones and Passenger Drones friendly infrastructure
  - Drone Pads for landing of drones
  - Future navigation systems for drones (similar to ATCs for planes)
  - Charging Infra for drones
- Vertical Takeoff Vehicles (flying cars) friendly infrastructure

Glimpses of the evolving Future of Transport

Future of Transport

Transit Elevated Bus

Hybrid Flying Car

Velocopter

Passenger Drone

Delivery Drone

Future of Transport

Hyperloop

Autonomous Car

Future of Transportation: https://youtu.be/ETpXydVmSfo

Future of Transport – the Evolving Revolution

- Electric Vehicles
  - No fuel, no lubricants – warranty for unlimited mileage
  - Less than 20 moving parts (compared to >2000 in ICE vehicles), no need for regular servicing - automobile servicing stations and repair shops will disappear
- Autonomous Vehicles and Self Owned Vehicles
  - Millions of drivers redundant
  - Accidents almost NIL
  - Ten times more vehicle utilization: >20 hours per day driven compared to 2 hours driving average
  - Total vehicles on the road will be reduced by 50-70%
  - Parking space requirement will be much less
  - Lower insurance premium
  - Self-owned Vehicles: owned by themselves, paying mortgage, insurance, charging fee, management software license fee and toll charges from the vehicle's e-Wallet which earns money from the service it provides
- Ariel Transportation – Drones, Flying Cars
  - Drone Pads instead of parking slots in buildings and apartment complexes
  - Highways and roads (flyways) designed for flying cars

8. Instrumented – Interconnected – Intelligent

- Automation Systems for Key Infrastructure and Services
  - Electricity, Gas and Water Distribution
  - Traffic and Security Cameras
  - Mobile Crew Management Systems
- GIS Maps
- Utility Corridors - all cables (electricity, communication) and gas and water pipes in separate underground ducts
- Common Billing and CRM systems for multiple services
- Broadband Internet in all Buildings and Public Places
- Cloud Strategy
- Master System Integration
- Common Command and Control Centers
- Advanced Analytics
- Robotics

Thank you very much for your kind attention

For discussions/suggestions/queries email:

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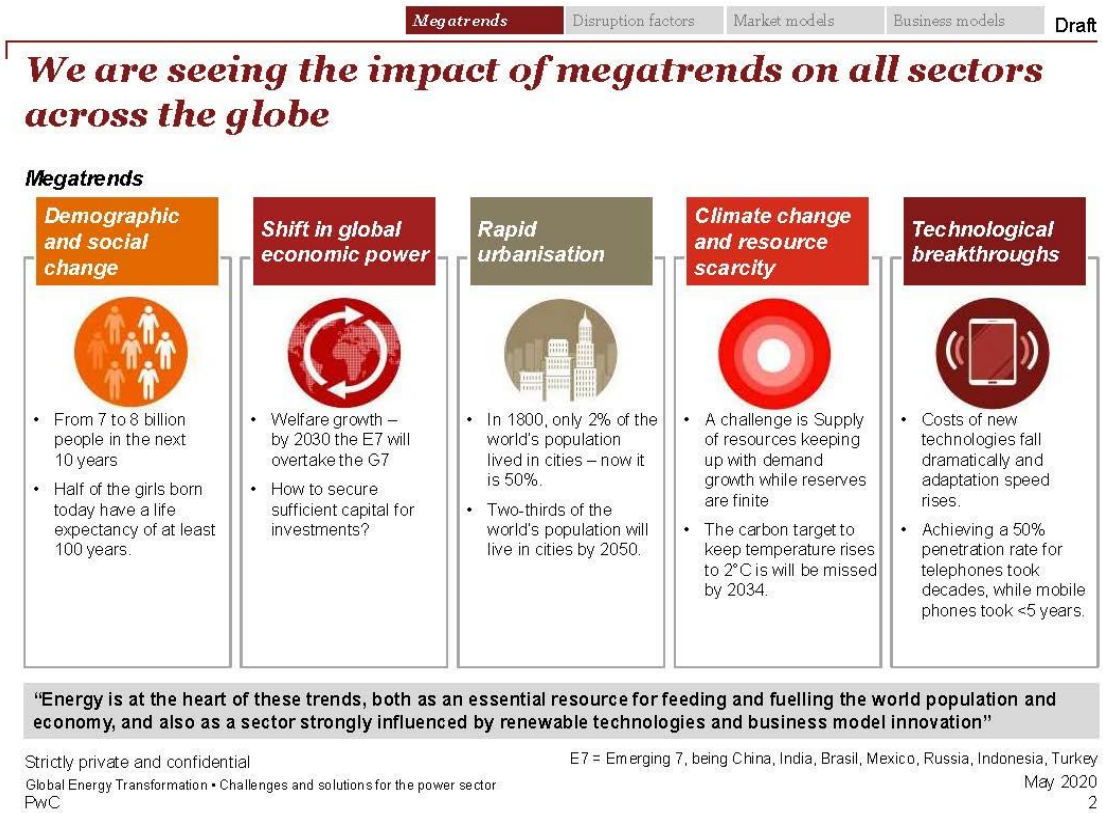
www.indiasmartgrid.org
www.isuw.in

4. "Global Energy Transformation, Challenges and Solution for Power Sector" by Mr. Sandeep Kumar Mohanty,

Director, Power & Utilities, PwC, India



These megatrends are leading to disruptive dynamics impacting the power sector

Disruptive dynamics

Customer behaviour

Grid provides back up

Less need for utilities, consumers produce and store energy themselves

Competition

Outflanked & outpaced

More nimble and able competitors seize key revenue segments

Production service model

Outdated or stranded

Outdated or out-of-market assets leads to stranded investments

Distribution channels

Digitalised intervention

Innovative digital plat-forms matching demand and supply become dominant

Government and regulation

Caught in the crossfire

Shifting policy goals and regulatory risk undermine business decisions

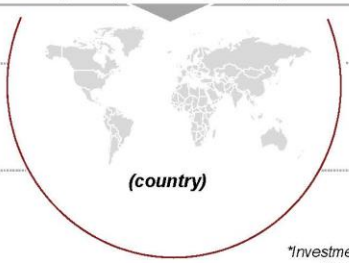
Disruption profiles differ by region

European utilities value reduced by **~60%** between 2008 and 2014

~$20B+ in cleantech venture capital funding between 2008 and 2014

Europe

North America



Asia

Black outs hinder economic development : **$6.2 trillion** needs to be invested in the power sector by 2035*

Africa

Technology supports policy aims – 160m new grid connections are required to be supplied by micro-grid and off-grid systems

*Investments in China, India and Southeast Asia (2014 - 2035); Source: MSCI index. IEA (2014) World investment outlook 2014 (new policies scenario), IEA (2011) Energy for all.

European example – Market demand will remain, however value pools will shift "downstream" towards behind-the-meter segments

Evolving Energy Value Chain

	Centralised generation	Transmission & distribution	Trading & retail	Metering	Behind-the-meter (BTM)
Value (growth/ decline)	▼ ▲	▼ ▼	▼	▲	▲ ▲ ▲ ▲
Drivers of value shift	• From power provider to power guarantor • Falling demand as result of economic crisis, manufacturing declines and energy efficiency • Significant overcapacity in fossil-fuel-fired gen. • Low plant utilization • Growth in higher-priority renewables	• Due to multi-directional and volatile energy flows, 50% more network capacity is required to meet similar demand • Reducing demand for grid power • Emerging role of the complex system operator	• Falling demand • Fierce price competition • Increasing customer churn • Expanding into energy services • Increasing pressure from trading regulation	• Growth in advanced metering (infra) to optimize demand patterns • New data-driven services, e. g. energy advisory, demand response	• Higher competition upstream – more power to consumers • Maturing DG, storage and EV technologies – new growing market for installation, leasing and service • Increasing level and volatility of power prices increases value of energy management services • Demand for usage insights and control solutions • Demand for holistic home services • Emergence of local island grids • Residual demand visible for upstream player – exposed to risk of surges in demand or supply

Value is shifting towards behind the meter segments

Sources: Expert interviews, PwC/Strategy& analysis

Megatrends | *Disruption factors* | Market models | Business models — Draft

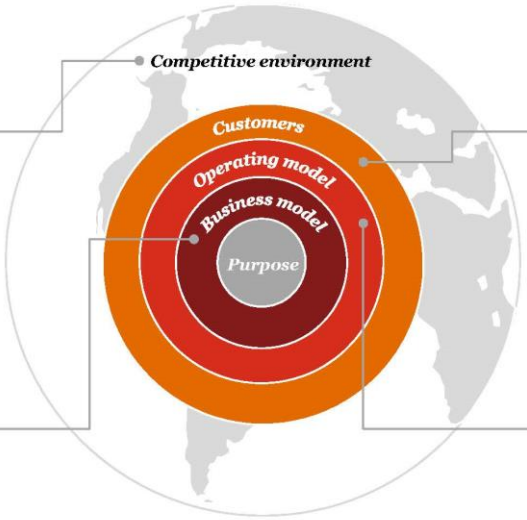
Companies must adapt to remain competitive in this new world

Competitive environment

- How quickly will my market change?
- Who are my new competitors?
- What is the government doing in order to achieve policy goals?

Business model

- What are the new value pools in the market and what should be my focus?
- How should I adapt my current business model?
- How can I enter the market?



Customers

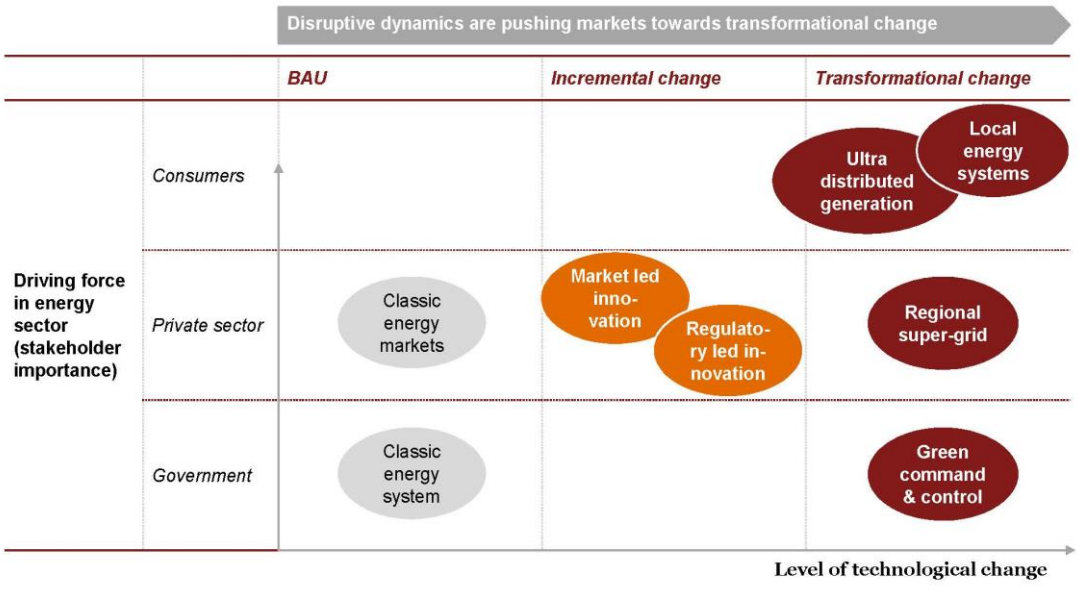
- How are my customers changing?
- Which customer segments and geographies do I want to serve and how?
- What are customers willing to pay for new services?

Operating model

- How do I align my operating model and culture?
- How do I finance this path of change?
- How can I put technology at the forefront of my operations?

Megatrends | Disruption factors | *Market models* | Business models — Draft

We believe that the disruptive dynamics are causing transformational change in power markets



Megatrends | Disruption factors | **Market models** | Business models — Draft

New transformational market models will emerge as markets shift away from incremental change

Market models	Regional super-grid	Green command and control	Ultra distributed generation	Local energy systems
				
Characteristics	**low — high**	**low — high**	**low — high**	**low — high**
Ave generator size				
Consumer role				
Government intervention				
Service delivery digitalisation				
New entrant opportunities				
Local factors	• Mature national infrastructures • Limited indigenous fuel sources • Clear cost benefits of market integration • Political stability	• Limited private sector involvement • Government direction on capital investment • Reliability and price stability are valued over cost	• Mature infrastructure • Strong customer engagement in micro-generation • Interest from private capital • Average/peak demand differential	• Sufficient private funding • Rural electrification policy • Interest from private capital • Local communities taking control

Strictly private and confidential
Global Energy Transformation • Challenges and solutions for the power sector
PwC

May 2020
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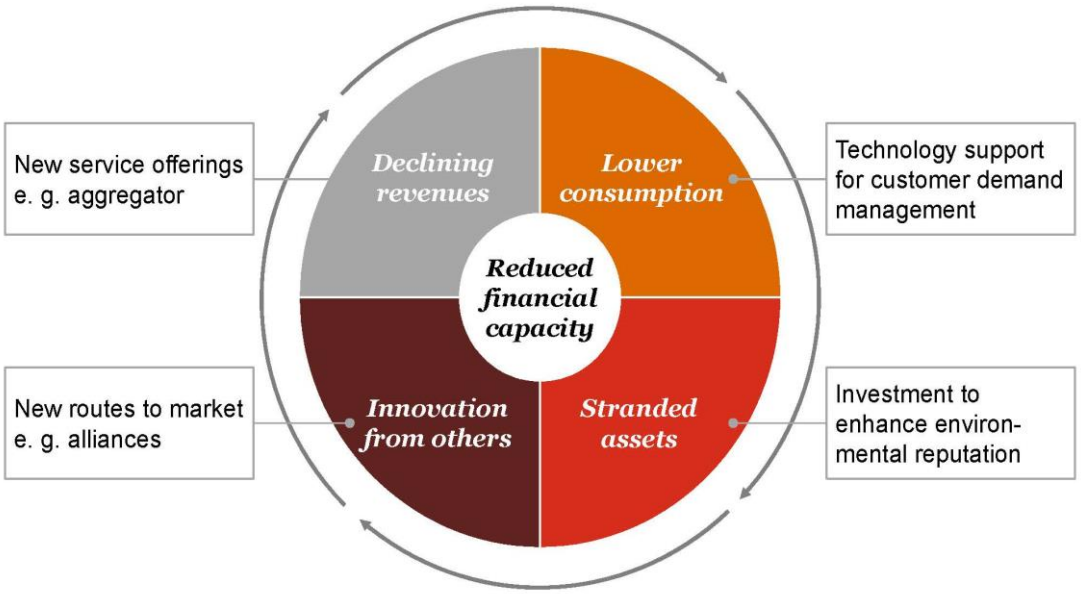
Megatrends | Disruption factors | **Market models** | Business models — Draft

Utilities need to break out from traditional business models to be competitive in transformational markets



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In defining a future business model(s), companies need to first align on several fundamentals …

Foundation strategy factors

Where do we play? — Determine our ***"purpose"*** and desired outcomes, e. g. "end-to-end" participation or selected parts of the value chain

How do we play? — Establish the ***"positioning"*** we wish to achieve, e. g. full offering portfolio or highest value products

How do we win? — Define the ***"role"*** we would like to perform, e. g. go it along or strategic partnering

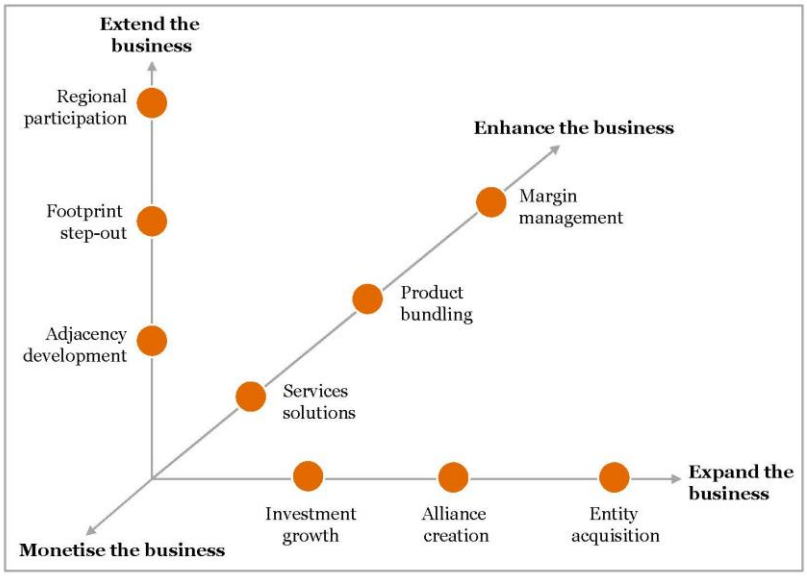
Future strategy

How competitors choose to play impacts our choice of business model?

… and then determine the dimensions of its available options

	Future role evolution			
Emergent roles	***Energy supplier*** → "Asset focused"	***Integrator*** → "System focused"	***Enabler*** → "Value focused"	***Optimizer*** "Insight focused"
Primary segment focus	***Generation*** "Have to do" to if asset heavy or 'short' in supply	***Transmission/ distribution*** "Will do" regardless of new area participation	***Distribution/ customer*** "Should" migrate into depending on role	***Customer*** "Could" evolve into as new business models mature
Key focus areas	• Focus will be directed at ensuring **assets are optimized** in the market to match price signals • Focus will move toward **achieving the right balance** of asset-based and notional transactions within risk parameters	• Focus will address facilitating **grid interconnection** with other transmission developers • Focus will also extend to the **deployment of technologies** or equipment into the distribution network	• Focus will be on enhancing the **'value of the grid'** to all stakeholders • Focus will also address how to **leverage technology** to enhance system performance and customer engagement	• Focus will be on enabling customers to better leverage **behind-the-meter** technology • Focus will also extend to **broader engagement** with the customer by providing value through advanced data analytics

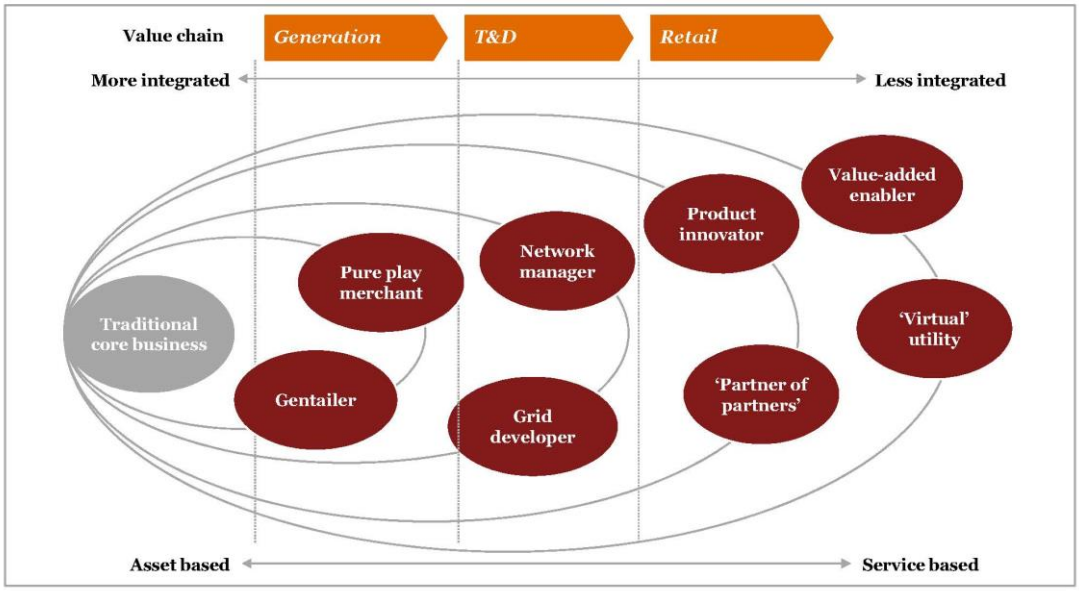
Market participants have a range of strategic options to choose from when determining the business model



Description

- **Extend the business (Where to play)** Growing outside of the core footprint requires enhancing regional market knowledge and more flexible participation models
- **Enhance the business (How to play)** Developing attractive customer solutions and improved margins will require broader offerings and tailored prices
- **Expand the business (How to win)** Growing the current business will require alliances and/or partnerships with providers and market participants

Players may choose to operate in one or multiple business models across the value chain



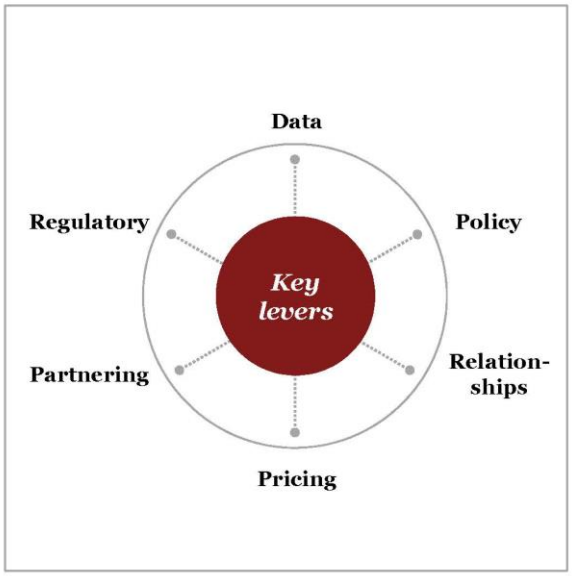
Business model options vary based on scope, basis of competition, and source of earnings

Business models	Traditional core business	Gentailer	Pure play merchant	Grid developer	Network manager	Product innovator	"Partner of partners"	Value-added enabler	"Virtual" utility
Business focus	Assets – customers	Assets – customers	Assets	Assets	Assets	Customers	Customers	Customers	Customers
Business alignment	Generation – T&D, retail	Generation – retail	Generation	Trans-mission	Trans-mission – distribution	Retail	Retail	Retail	Distribution – retail
Profit-ability basis	ROIC	Com-petitive margin	Com-petitive margin	Regulated ROIC	Regulated ROIC	Com-petitive margin	Com-petitive margin	Com-petitive margin	Com-petitive margin

Utilities should select their business model(s) based on future market opportunities and capabilities required …

	Description	*Capabilities req'd*		*Description*	*Capabilities req'd*
Gentailer	Own generation assets and sell retail energy to customers in a competitive market	• Market insights • Project development • Energy trading/hedging • Origination, product development & pricing • Customer management	**Product innovator**	Offers electricity and behind-the-meter products such as solar, fuel cells, EV chargers, and smart devices	• Customer acquisition, retention, cross selling • Pricing and bundling • Energy sourcing • Customer service
Pure play merchant	Owns generation assets and sells power into competitive wholesale markets or through bilateral contracts	• Market insights • Project development and finance • Origination • Energy trading/hedging • Risk management	**"Partner of Partners"**	Offers standard power and gas plus a range of energy services using high quality, branded partnerships	• Customer acquisition, retention, cross selling • Partner management and service delivery • Innovative financing • Customer service
Grid developer	Acquires/develops, owns and maintains transmission assets connecting generators to distribution systems	• High voltage line design and operation expertise • Real-time electricity supply/load mgmt. • Stakeholder mgmt. • Investor relationships	**Value-added enabler**	Uses core "big data" capabilities to provide enhanced energy services to customers not wanting to actively manage their energy use	• Big data management, analytics, and security • Customer acquisition • Ability to educate and guide customers, and deliver value
Network manager	Operates transmission and distribution assets and provides network access to generators and retail service providers	• T&D line design and operation expertise • Real-time supply/load mgmt. and central/DG resource integration • System data analytics	**"Virtual" utility**	Aggregates generation from distributed systems and acts as intermediary between/with energy markets without owning generation/T&D assets	• Energy sourcing and real-time balancing • Customer management • Partner development and management • Demand management

... and determine how to leverage their strengths to enhance their future competitive positioning



Business Model Levers

- **Data:** Ownership of grid and customer information can provide a knowledge platform that enhances the value proposition
- **Policy:** Mandates and legislation can shape the playing field and enhance the incumbent's ability to compete
- **Relationships:** The natural interfaces of the incumbent with customers, suppliers, stakeholders and other providers creates a natural platform
- **Pricing:** Shifts in traditional cost recognition models can provide greater certainty to cost recovery and additional flexibility to rate design
- **Partnering:** Enhanced creative and delivery capabilities can extend the incumbent's existing platforms and market "reach"
- **Regulatory:** Decisions can provide both offensive (exploit) and defensive (preserve) mechanisms to enhance market competitiveness

Our four step approach can help you with your strategic decision making

1. ***What markets will emerge***
   - Identify most likely emerging markets
   - Analyse the likely impact of emerging market models and value pools
2. ***Where do we play?***
   - Identify future business models
   - Estimate size of future value pools
   - Develop scenarios for different roles and play vectors
3. ***How do we play?***
   - Analyse strategic business model dimensions
   - Enable strategic business model decisions
4. ***How do we win?***
   - Capability development
   - Operating model design
   - M&A activity and development partnerships
   - Invest in regulatory debate
   - Develop financing plan and analyse impact on credit rating
   - Plan culture change management programme

PwC as your partner in realising change

- We can support in driving the strategy process and conduct in depth analysis.
- We can help you achieve optimal implementation of strategic decisions and clear measurement of success.

pwc

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Thank you!!