

White Paper on
**NEW REVENUE
OPPORTUNITIES
FOR UTILITIES**



April 2021

In 2020, India has moved up from 76th to 74th positions on a Global 'Energy Transition Index (ETI)' with improvements on all key parameters of economic growth, energy security and environmental sustainability. With solar panels getting cheaper and its efficiency getting higher, renewable energy is playing a major role in energy transition. Alongside renewable energy, battery technologies are showing tremendous growth in terms of higher efficiency, longer life and cheaper price with compact form factor. This would accelerate the transition and also opens a window for introduction of vehicle to grid technology to play a vital role, where electric vehicle's batteries would act as virtual power plants.

With constantly declining prices and increasing efficiencies of solar panels and batteries, a large section of customers could generate, store and consume their own electricity. Today, the primary revenue for electric utilities is from the sale of energy (kWh) to their customers which is going to be seriously impacted in the near future. Since these changes are already on the horizon, it is important for utilities to consider **New Revenue Streams** for growth and sustainability. This White Paper suggests various opportunities for revenue generation for utilities from the **Digitalization of the Power Sector** and **Unlocking Existing Infrastructure and Services**.

A. New Revenue Opportunities Enabled by Digitalization of the Power Sector

During the lockdown in 2020, electric utilities, like all other organizations, quickly adopted to *paper-less* and *contact-less* operations. This alone has pushed forward the digitalization process in utilities. The level of automation and digitalization that would have taken another decade in power utilities would now happen in next 2-3 years. Most processes have become paper-less. The culture of remote working and use of third-party owned digital platforms for meetings and collaborations have instilled confidence in utilities to adopt cloud technologies and applications hosted on the cloud. So, many systems that utilities used to buy earlier will now move to the services model for a monthly or quarterly fee. Availability of digital data of all assets, processes and operations in near real-time will enable utilities with better visibility and control; and they can now deploy analytical tools to optimize their operations. This is a quantum leap from their paper-based operations in the pre-Covid era. Covid-19 has presented never before opportunities for innovation and transformation with profound implications that are gainful in the long term. We are building data driven smart utilities which will open up new business opportunities for organizations providing tools and services to host and manage the enormous amounts of data utilities are expected to generate in the coming days.

While the typical physical assets of utilities depreciate, the digital assets will constantly

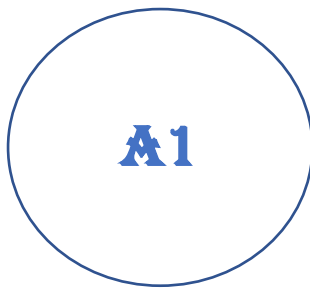
appreciate. Here, we are presenting few ideas on how these digital assets can be monetized through appropriate business models.

Physical Assets Depreciate

- Power Plants
- Transmission and Distribution Network Equipment
- Offices, Buildings, etc.
- Computer and Communication Hardware

Digital Assets Appreciate

1. Customer Data
2. Billing and Collection Systems
3. AMI Data and Energy Consumption Profile
4. GIS Maps indexing electrical network and customers covering all buildings and roads in a city
5. Automation Systems - SCADA/DMS, DA and SA, DR, DERMS
6. Outage Management System and Mobile Workforce Management System
7. Call Centers and Call Data Archives



Customer Data

All the homes, business establishments and industries in cities, towns and villages are electricity customers. The electricity distribution utility has the full data of all their customers. They also know the size of the house or building, connected load, power consumption and their contact information. This is a very valuable data for other infrastructure and services providers, product marketing companies and a host of other businesses.

The customer information can be monetized by utilities by sharing that with responsible organizations under agreements. For example, a new agency that won the license for city gas distribution (CGD) in a town require customer data of all residents in the town to approach them. The electric utilities can share the customer data with the CGD company helping them kick start their operations in their new territory.

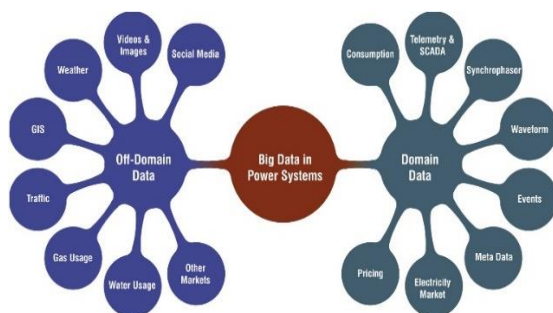


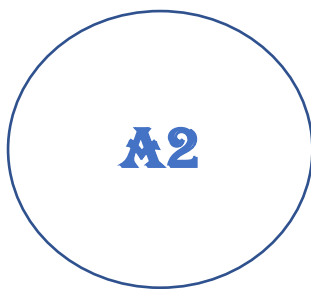
Fig 1: Types of Big Data in Power Sector [1]

Key Findings

- Digital data can be shared easily: removes spatial and inter-domain barriers
- Cross-pollination over several sectors

The market opportunities

- Share with Service Providers in other Domains: Water and City Gas Distribution, Municipal Agencies, Renewable Energy Development Agencies
- Large aggregation allows for better and more integration of renewables into the grid on the supply side and more effective Demand Response tools on the demand side
- Big data analytics can use power system data for various cross sectoral themes - environment, lifestyles, wealth, health, etc.
- Analytics both real-time and stored/archived data from equipment, systems and operations could yield valuable insights
- The use of AI and M2M communications to determine optimal energy use, lifestyle, comfort, energy efficiency etc.



Billing and Collection System

Most electric utilities now a days have state of the art Billing and Customer Relationship Management (CRM) systems and the customers have multiple options to make their payments. There are also Customers Care Centers at strategic locations and interactive customer portals. Utilities have regular interactions with their customers for meter reading, bill distribution, payment collection, attending to complaints, sharing information on planned outages etc. Large number of customers regularly use the customer portals.

All water and gas consumers are electricity consumers also. The Billing and CRM systems of electric utilities can be used for collection of water and gas bills, house taxes and other municipal dues. At certain places it 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 terms of timely payment. Similarly, it can also cover multiple Government to Citizen (G2C) payments like monetary awards, senior citizens benefit, subsidies, and scholarships.

Moving billing and payment collection of different domains like electricity, gas, water, tv, internet, house tax and other municipal fees to common platform with a one bill would considerably reduce the cost of business operation for all domains. The customers would love the combined bills as they can pay for all utilities in one bill on one payment platform or location.

This could be an additional revenue opportunity for the electric utilities.

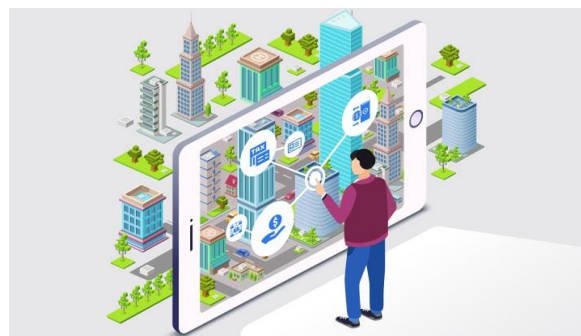


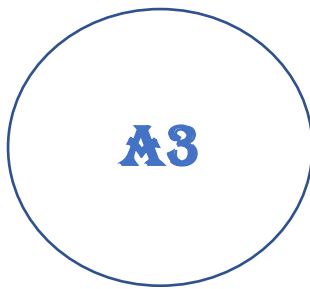
Fig 2: Digital Payment and Collection Platforms [2]

Key Findings

- State of the art Billing and Collection Systems deployed in utilities cover all customers (residents in their service area) and are capable of extending to other domains in a city

The market opportunities

- Extension of the billing and collection system to water and city gas distribution, house tax collection, other municipal/city taxes
- Can even be extended to other service providers such as cable TV, internet, telephone, etc. in semi-urban and rural areas
- Considerable savings in cost of doing business to other domain owners
- Additional revenue stream for electric utilities



Smart Meter Data and Energy Consumption Profile

Smart metering or Advanced Metering Infrastructure (AMI) enables two-way communication between the customer and the control center of the electric utility. AMI facilitates remote monitoring and control of energy consumption as well as other electrical parameters in real time. Through analysis, data from the smart meters can be utilized by utilities to learn, predict and forecast the energy consumption of a customer. AMI system is capable of

- Meter data validation
- Extracting tamper and missing information due to communication failure, meter fault etc.
- Energy audit and accounting of all customers on a feeder or connected to a distribution transformer in near real time
- Peak demand estimation
- Consumer profile analysis for demand estimation and energy usage
- Forecast and build predictive models for demand management or demand response program planning

AMI data of millions of customers is a gold mine for data analytics applications. Advanced analytical tools could yield new insights on the distribution network planning. The data will be valuable for several other domain owners.

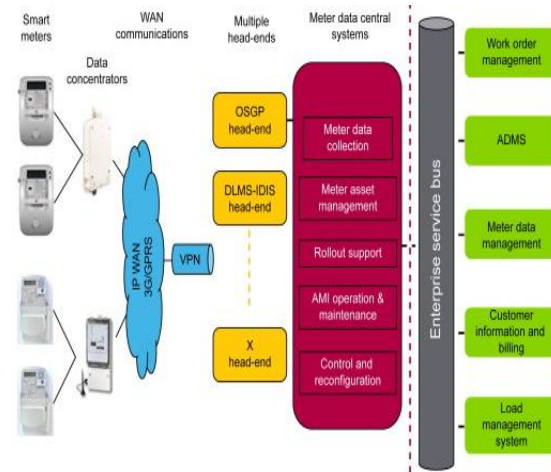


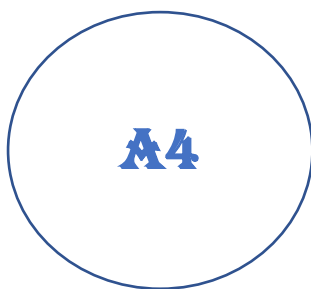
Fig 3: Ease of Analysis from AMI data for Utilities [3]

Key Findings

- AMI data is a very valuable resource depicting energy consumption profile of millions of customers
- Could help better estimation of demand leading to savings in power purchase cost

The market opportunities

- Sharing of AMI data with a variety of industry players for development of innovative applications and services
- Authentic load research for many stakeholders in the sector
- New revenue stream for electric utilities



GIS Maps

R-APDRP and IPDS programs in India facilitated creation of GIS maps in distribution utilities in India. During the past ten years, distribution utilities created GIS maps of their electrical network and indexed all their customers on the maps in 1900 towns. These digital maps depict all the buildings and roads in a city; and are periodically updated.

Other infrastructure and services providers in a city could leverage these digital maps to plan their operations. The Digital Door Number (DDN) framework can be created on these maps and that can be linked for all services. Further it can be leveraged to interlink the built-up area information obtained from the geotagging exercise with the utility bills. This will result in the creation of a property wise database for electricity bills, gas bills, built-up area, etc. and enable estimation of energy performance indicators (EPI) at the building and city levels.

The simplest example of how a good GIS system can help beyond a single domain is avoiding damages to each other's assets. If one knows the routing of underground power cables, then the same can be synergized by other utilities that would need to dig up roads (like water, sewage, telecom, etc. – thus one should, in the future, never interrupt other services for adding new connections/ lines/ pipes).

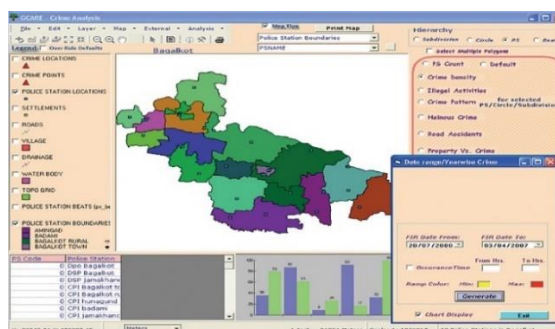


Fig 4: Karnataka state GIS Map [4]

Use Case

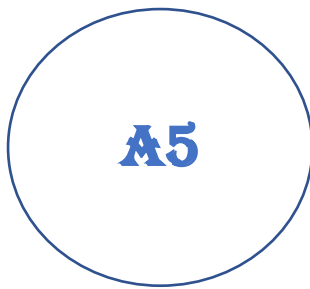
The Karnataka state police department has been using shared GIS data for pilot project for crime analytics and real-time monitoring as shown in figure below. [Source – India: A Vision for National GIS]

Key Findings

- All electrical assets (medium voltage and low voltage lines, substations) and customers 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 customers/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 networks

The market opportunities

- Share the maps with other stakeholders in a city for a mutually agreed fee



Automation Systems - SCADA/DMS, DA and SA, DERMS

Under the R-APDR/IPDS programs of the Ministry of Power, Supervisory Control and Data Acquisition System (SCADA) and Distribution Management System (DMS) were implemented in about 78 towns in India with population of 400,000 and above. In the coming days all major towns will implement advanced SCADA/DMS and Distribution Automation (DA) and Substation Automation (SA) systems. Utilities with larger share of renewable resources will have to go for Distributed Energy Resources Management Systems (DERMS). The field infrastructure and dedicated communication bandwidth for these automation systems of the electric utility can be shared with the water and gas distribution utilities to automate their networks at marginal cost.

The automation systems have Remote Terminal Units (RTU) installed on the electrical network in the field with dedicated communication bandwidth to the control center. The same communication bandwidth can be shared by the automation system of water and gas distribution networks. It can also be leveraged for security and traffic cameras and other sensors monitoring noise, pollution etc.

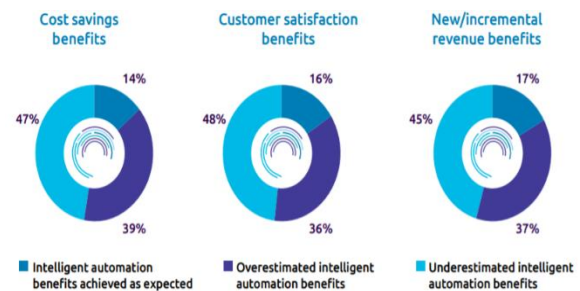


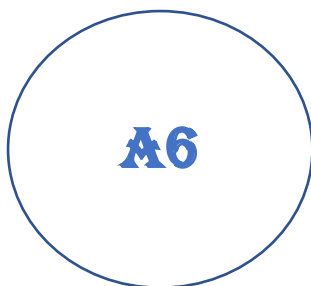
Fig 5: Benefits of Automated Systems [5]

Key Findings

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

The market opportunities

- **Common SCADA** with water and gas distribution utilities
- Sharing the **communication infrastructure** for security cameras, traffic cameras and other smart city applications
- Communication network (spare fibers) can be leased to telecom operators



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

Utilities recognize that, when it comes to service outages, the bar has been raised. Customers, regulators, media and the public have significantly higher expectations from the utilities regarding the reliability of their service, the speed of outage restoration, and the quality of information and communication they receive from their utility.

A next-generation Mobile Workforce Management (MWFM) solution unifies the field and the office on a single, mobile platform to manage utility crews and all types of work they perform on the field. MWFM provides the ability to create, receive, schedule, dispatch, and execute work orders. It is also integrated with the Customer Information (CIS) & Billing Systems, Outage Management Systems (OMS), Work and Asset Management (WAM) systems and Geographic Information Systems (GIS), as well as extensions to AMI systems and hardware devices, when needed.

Use Case

According to Tata Power DDL, the total AT&C losses stand at 7.79% as of April 2020 which is an unprecedented reduction of around 85% from an opening loss level of 53% in July 2002. To ensure reliable power supply Tata Power-DDL has implemented technologies like Advance Distribution Management System (ADMS) and real-time Outage Management System (OMS) integrated with Geographical

Information System (GIS) for instant services, Advanced Metering Infrastructure (AMI), Automated Demand Response (ADR), Smart Street light Management System to manage the grid more efficiently and convert it to an intelligent network

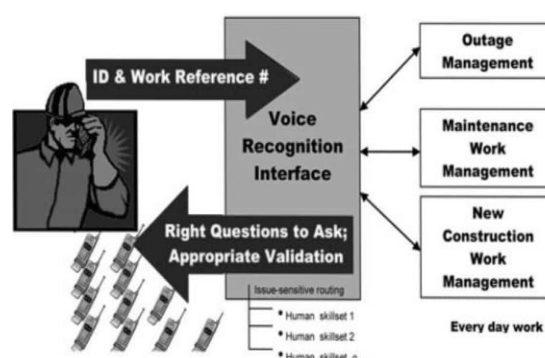


Fig 6: Voice Response Technology for Customer Satisfaction [6]

Key Findings

- OMS and MWFM are very powerful platforms that can be shared with other infrastructure and services providers in a city

The market opportunities

- Revenue from sharing the OMS and MWFM with water and gas distribution agencies, white goods services agencies, other city service providers



Call Centers and Call Data Archives

A common command and control center that can handle the complaints from customers for all their grievances related to electricity, water, gas, internet etc. can be created. Now, there is a common 4-digit number (1912) all across India for electricity complaints. Electricity distribution utilities have setup state of the art Customer Care Centers in about 1900 towns in the country. These same call centers can be upgraded as common city command centers. The incoming calls can be diverted to the respective teams responsible for each domain and their crew. The IT and communication infrastructure and cost can be optimized significantly. It will also boost customer satisfaction to a great extent as they do not have to knock at different doors for each service. A state-of-the-art call center in the electricity distribution companies have data of all their customer calls which can be analyzed with advanced tools to identify recurring complaints and rectify them. Chatbots and Voicebots are today deployed in call centers that further optimizes the operations and cost while improving customer experience.

Use case

Offset Solar, a US-based solar company, generated \$1.2 million revenue within six months using a simple homepage messenger chatbot.

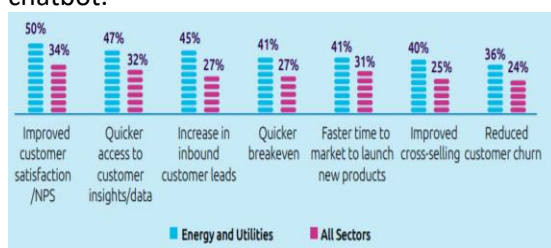


Fig 7: Additional revenue by automated call centers [5]

Key Findings

- Customer Care Centers, Call Centers, Chatbots and Voice Bots of electric utilities are very valuable assets in a city/country
- India has 4-digit common number (1912) all across the country for electricity complaints/enquiries which can be extended to water, gas and other city services
- The incoming calls on 1912 can be diverted through IVR to the respective teams responsible for each domain
- The IT and communication infrastructure and cost can be optimized significantly

The 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 information for different stakeholders to optimize their business operations
- Call Centers of electric utilities can be made City Command and Control Centers at marginal cost

B. New Services and Revenue Opportunities from Unlocking Existing Infrastructure and Services

A set of paradigm shifts is forcing electric utilities to rethink their approach to services businesses and services policies to generate more revenue streams, and promote growth and operational efficiency

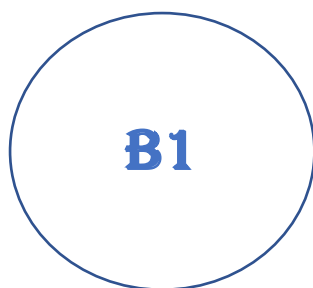
Growing customer expectations mean electric utilities must actively manage customer participation, such as demand side management programs, and provide network access to prosumers (consumers who are also energy producers). Mass adoption of electric vehicles (EVs) is poised to alter demand growth and put pressure on grid stability. Today, technology is being built into every asset, operation and interaction, transforming businesses into smart enterprises.

Based on the energy consumption of the existing customer base, utilities can enhance the customer experience by introducing new technologies at the same time increasing their revenue.

By ensuring various schemes and policies of the government, utilities can identify new streams of serving the customer and collaborating with new technologies to generate additional revenues.

New Business Areas

1. Selling Rooftop PV (RTPV) Systems and promoting “Prosumers”
2. Selling Energy Efficient (star-rated) and “Smart” Appliances
3. Promotion of Electric Cooking and sale of Cooking Appliances
4. Selling Electric Vehicle Chargers
5. Selling Batteries for Energy Storage and other Applications
6. Sharing of Communication Bandwidth
7. Smart Home: Grid Interactive Buildings and Appliances
8. Maintenance Services to Large Buildings and Complexes
9. Unlocking the Value of Substation Land: Commercialization of Surplus Land by Conversion of existing Substations to Gas Insulated Substations (GIS)
10. Unlocking the Value of Lamp Poles and Transmission Towers
11. Cooling as a Service – District Cooling Systems



Selling Rooftop PV (RTPV) Systems

During 2013 to 2016 all the state electricity regulatory commissions in India had issued net metering policies that allowed the consumers to be prosumers.

Today, the payback time for RTPV systems in most parts of India is 3-4 years. Presently 1 kW PV system cost is around Rs 35000 to 40000 and is expected to go down to Rs 20000-25000 by 2025. This would further reduce the payback period and could create a RTPV revolution which utilities can benefit if driven correctly.

Utilities can also generate additional income by selling and installing RTPV systems for their customers. They could also sign up for annual maintenance contracts for RTPV systems. This would create job opportunities and additional revenues.

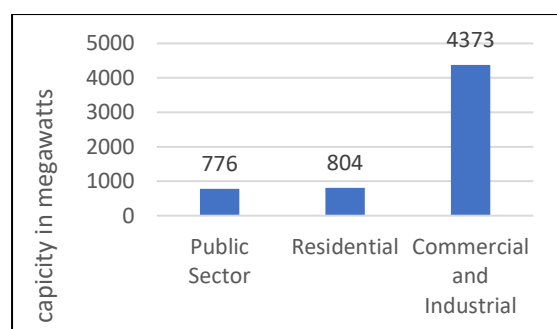
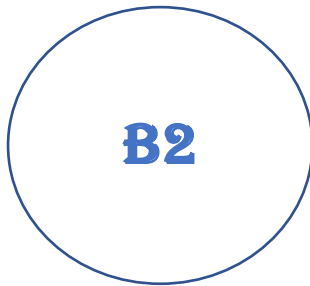


Fig 8: Total installed solar rooftop capacity in India as of June 2020 [7]

Key Findings

- RTPV has become economically attractive to most categories of customers
- Customers are not familiar with RTPV systems and models available in the market; neither aware of the formalities to avail net-metering/gross metering benefits
- Utilities should TEST and CERTIFY good quality RTPV Systems and offer services to their customers for procurement and installation of RTPV systems as well as its annual maintenance
- A study by BRPL-CEEW in 2019 estimated a net benefit to the utility to the tune of Rs 0.22 per kWh of RTPV power generated in Delhi
- Time has come to unleash a RTPV revolution in the country and utilities can benefit from this huge opportunity – being part of this revolution and leading it is the way forward rather than being a “Kodak of Tomorrow”



Selling Energy Efficient (star-rated) and Smart Appliances

Energy efficiency measures are the foundation of a smart and efficient buildings and homes. The building automation and IT solutions can reduce the baseline load of a building and lower the overall electricity use. Use of smart appliance enabled by WiFi can support the utilities through demand response (DR) programs.

Currently, the efficiency standards of the Department of Energy (DoE), USA cover more than 60 categories of products, from dishwashers to vending machines to lighting technologies. Implementing these standards reduced the national energy bill by about \$80 billion in 2015. The benefits of efficiency standards are significant and widespread, including product innovation, billions of dollars in energy savings for consumers, and significant reductions in carbon emissions as well as reduction in emissions of mercury and nitrogen oxide from power plants.

Star Labelling Program in India: Bureau of Energy Efficiency (BEE) has 10 mandatory and 13 voluntary labeled appliances. Total electricity savings from energy efficiency programs in 2017-18 was estimated at 86 Billion Units (BU) which was 7.14% of total electricity consumption in the country. This helped save US\$ 7.5 billion and a reduction in CO₂ emissions of around 108 MTOE annually.

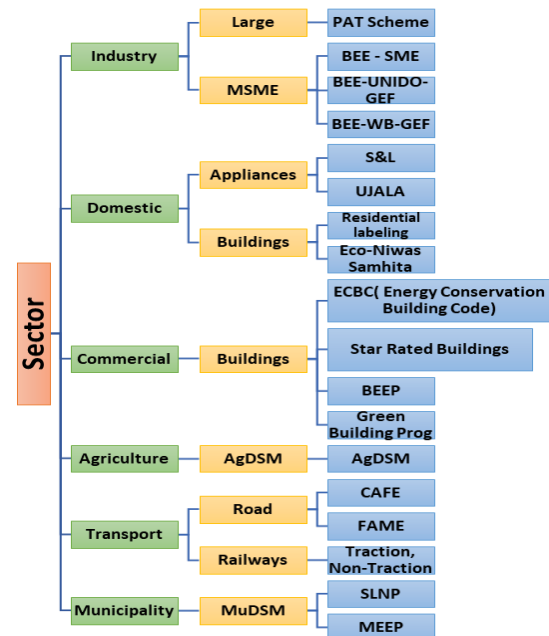
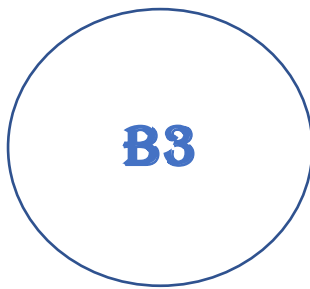


Fig 9: Energy Efficiency Schemes in India

Key Findings

- Many utilities are already promoting replacement of old Air-Conditioners and Refrigerators with new star-rated appliances
- Should promote “*smart*” appliances which can be connected to the WiFi network and remotely controlled
- The range should cover geysers, washing machines and electric cooktops
- This can be clubbed with energy efficiency programs and incentives
- Promote innovative and sustainable business models that will be WIN-WIN for both the Utility and the Customers



Promotion of Electric Cooking

Government of India (GoI) has undertaken several targeted programs in the recent past to provide access to clean cooking energy to urban and rural households as well as to electrify all the households in the country. Pradhan Mantri Ujjwala Yojana launched in 2016 provided credit-linked subsidized LPG connections to over 100 million households making the total LPG connections to over 200 million households. While DDUGJY program completed electrification of all the 619,000 villages by April 2018, another very successful program SAUBHAGYA has electrified almost all (>99%) households by March 2019.

Electricity being the cleanest fuel at user-end and with surplus electricity generation capacity and having electrified all households, it is prudent to promote electric cooking. In February 2021, Government of India launched GO ELECTRIC program which will promote electric vehicles and electric cooking.

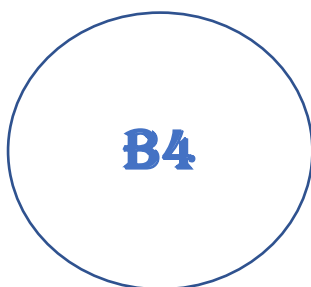
Today a variety of electrical appliances are available for cooking almost all items in any cuisine. Cost-wise also electric cooking will be cheaper for customers. With smart plugs that can be remotely controlled, customers can avail subsidized tariff for cooking when power is surplus on the grid.

Emissions from cooking is a significant contributor to CO₂; Electric Cooking will help achieve NDC targets.

Utilities should uprate the electricity connections to minimum 3 to 5kW for all households and promote electric cooking that will improve the load factor and income of the utilities.

Key Findings

- Electricity is the cleanest fuel at the user end and increasing share of electricity is being generated from clean resources
- Millions of women and children in rural areas in developing countries use firewood/biomass and cow dung for cooking leading to pollution and serious health issues
- Electric cooking leads to economic efficiency in myriad ways:
 - a. Houses are already connected to the grid - no additional infrastructure is required to electrify the kitchens
 - b. Huge amount of energy (and money) being wasted in transporting gas cylinders to households – 1500 million LPG cylinders were handled in 2019-2020
 - c. Billions of dollars spent every year in subsidy for cooking gas and kerosene
 - d. Healthcare expenses to treat respiratory diseases in millions can be avoided
- Electric pressure cooker, oven, hot plate, kettle, induction cooktop and air fryer – the combination of these appliances can cook almost every item in all cuisines
- Electric cooking can also help the grid in load balancing – there is surplus electricity on the grid during many timeslots in a day and can offer cheap electricity to millions of cooking appliances that will improve the load on the grid. With Time of Use (ToU) Tariff and Smart Plugs, most cooking load can be shifted to non-peak hours at lower tariffs
- Electricity connection capacity to all households should be enhanced to 3-5kW so that cooking and cooling load can be met efficiently
- Electric Cooking is an Idea whose time has come!



Selling Electric Vehicle Chargers

The utilities can collaborate with Electric Vehicle (EV) manufacturers in order to provide charging solutions to their customers. Promotion of EV and home charging stations by utilities would allow them to generate new revenue streams.

The electric vehicle charging stations market is projected to reach USD 27.7 billion by 2027 from an estimated USD 2.5 billion in 2019, at a CAGR of 34.7%. Increasing investments made by governments across the globe to develop charging infrastructure creates opportunities for utilities to expand their revenue streams

Use Cases

Jaguar Land Rover (JLR) has recently entered into a partnership with Tata Power to set up and provide EV charging solutions at 27 outlets of JLR and also at customers' residence in India.

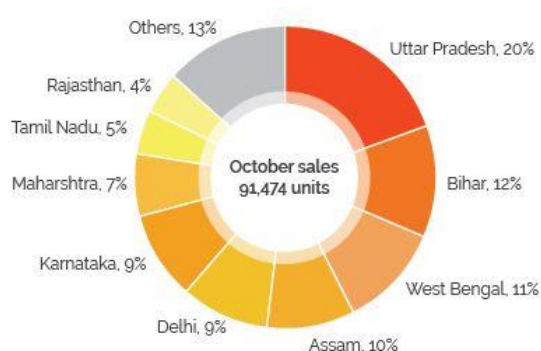
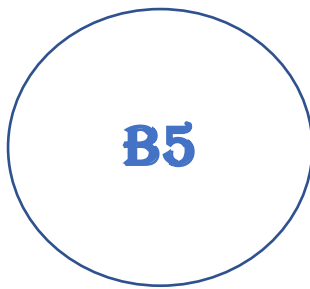


Fig 10: Cumulative EV Sales [8]

Key Findings

- Most EV owners likely to buy EV Chargers for home charging
- Utilities could partner with EV manufacturers and set-up home charging facilities (mostly AC Slow Chargers)
- AC Chargers with Vehicle-to-Grid (V2G) functionality would help load balancing on the grid
- Large number of EVs connected to the grid could be aggregated as virtual power plants (VPP) and support the grid in many ways
- Selling EV chargers and giving new electricity connections for EV charging to customers is new revenue opportunity for utilities



Selling Batteries for Energy Storage and Other Applications

Lithium-ion batteries (LiBs) have emerged as the best choice for grid-level energy storage systems because of their rapid response, modularization, and flexible installation. It can also be shifted from location to location easily. LiB's performance related to energy density, energy efficiency and cycle life has significantly improved in the recent past while the cost came down by over 90% in the last ten years.

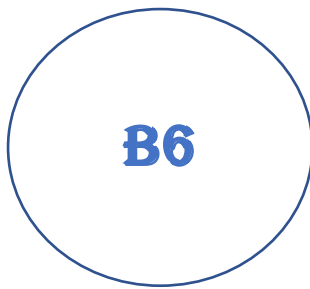
In India there are about 100 GW of Diesel Generator (DG) sets for backup power supply in buildings, data centers and other emergency requirements. Due to the high levels of carbon emission many states have banned the use of DG sets. With the present cost of diesel, the electricity from DG sets is above Rs 30/kWh. The cost of electricity from a LiB based battery energy storage system (BESS) can be much cheaper, particularly if the batteries are charged when cheap electricity is available on the grid. Typical DG sets are used for few hours in a month whereas the BESS can be leveraged for multiple grid services.

BESS can offer voltage and frequency support as well as peak load shaving, load shifting and deferral of distribution system upgrades. Energy storage is becoming cost competitive with peaking power plants partially due to the ability to offer flexible grid services. The need for flexible grid services is increasing as the renewable penetration is increasing. BESS will also help RTPV integration with distribution grid.

Selling and maintaining of BESS is a very attractive business opportunity for utilities.

Key Findings

- Energy Storage System (ESS), particularly Lithium-ion Batteries (LiB) is fast becoming popular for several applications at customer end:
 - a. DG Set Replacement
 - b. Solar and Wind Power Applications
 - c. EV Charging
 - d. Data Centers
 - e. Stand-by Power for all new Infrastructure – lifts, emergency lights, computers and WiFi routers
- Utilities can offer LiBs to Customers and lease it back for grid support (large batteries):
 - a. Ancillary Services
 - b. Network Upgrade Deferrals
 - c. Smoothing of Power from Solar PV
 - d. Other Emergency Situations
- Smaller batteries at customer premises can be aggregated through battery aggregation systems and run as Virtual Power Plants (VPP)



Communication Bandwidth

Traditionally utilities created their own communication infrastructure for the power system operations. In the old days they had power line carrier communication (PLCC) systems on high voltage lines which they upgraded to digital PLC and also laid fiber optic cables as part of the ground wire (OPGW). Now the latest trend is to lay fiber along with power cables to create utility owned and controlled communication systems. Power cables are now available with fiber optic cables integrated inside at marginal cost.

Installing fiber optic cables is relatively economical for power utilities since they already own rights-of-way (ROW) and power poles or cable trenches. This gives the utility company the ability to install fiber optic cables alongside their existing power lines. Having own telecom network enable the utility to automate the electrical network and offer smart metering and other services to customers. Fiber optic cables along with power lines can connect all the distribution transformers, capacitor banks, EV charging stations, RTUs and FRTUs of SCADA/DMS and distribution automation systems etc and help remotely monitor and control them.

The spare band width and spare fibers can be leased to other users or telecom operators.

Key Findings

- The latest trend in utilities is to build own telecom network by utilities
 - a. Electric cables with in-built fiber optic cables are now available at marginally higher cost – no additional right of way required; laying cost also saved; only fiber termination cost is extra
 - b. PLC/RF Mesh may be used for last mile connectivity
- Utilities own communication network for smart metering and network automation
- The spare fibers can be leased to third parties and telecom service providers
- Utilities could offer internet and cable TV services in underserved-communities



Smart Homes: Grid Interactive Buildings and Appliances

Countries are trying to decarbonize the electricity sector by increasing renewable generation and other significant changes are underway with the penetration of DERs, electric vehicles, smart grid-interactive appliances and demand management solutions in buildings. The grid is evolving from the linear system with a uni-directional energy flow to an increasingly complex and interconnected system through which energy and data flow to and from various entities (buildings, utilities, third-party service providers).

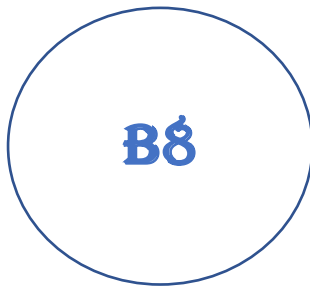
Globally about 40% of total energy generated is consumed in buildings. As the electric grid transforms into a more distributed two-way power system, and buildings incorporate new technology, including electric cars and smart appliances that can be remotely controlled, big opportunity is emerging to integrate homes and grid connected resources behind the meter to offer flexibility services to the grid. Technologies that transform a building into a grid-interactive smart building are becoming affordable and by making buildings a dynamic grid asset that can generate and/or store and use energy efficiently.

Utilities should offer the service of making the buildings and campuses grid interactive.

According to IEA's projections the Indian power system is likely to quadruple to 1600 GW by 2040 and the power system would require up to 85% flexibility.

Key Findings

- Globally buildings consume 40% electricity generated
- Buildings are becoming smart and can be made grid interactive
- Large buildings and campuses with Rooftop/in-premise Solar PV, Electric Vehicles and Battery Energy Storage Systems can be made Grid-Connected Smart Microgrids that could
 - a. Island from the grid during peak hours
 - b. Buy electricity from the grid when prices are low and store it in the BESS/charge EVs and sell back to the grid during peak hours
 - c. Provide Ancillary Services (voltage and frequency support) to the grid
- Smart Homes/Buildings with Smart Appliances could provide Demand Response (or load relief) to the grid when required
- Utilities can evaluate appropriate equipment, smart appliances and systems to facilitate this transformation to smart homes/grid interactive buildings for mutual benefit
- Utilities could offer this as a new business to large buildings and campuses



Unlocking the Value of Substation Land: Commercialization of surplus Land by conversion of existing Substations to Gas Insulated Substations (GIS)

Economic growth will propel demand for electricity as well as cost of land. Land availability and high cost of land as well as the right of way to construct high voltage transmission lines to urban areas are major constraints in capacity expansion of transmission and distribution networks. Old substations built 30-40 years ago outside the cities have now become prime commercial properties. Those substations require refurbishment and capacity enhancement which can be achieved by converting them to Gas Insulated Substations (GIS). By converting the Air Insulated Substations (AIS) to GIS, 70-80% of the land can be made available for commercial purposes.

Railway stations, metro stations, airports, sea ports and bus stations are commercializing the surplus land around them and utilizing the money generated for improving the existing facilities. Same way, electric utilities should be allowed to commercialize their land assets and utilize the money generated to improve and expand their networks.

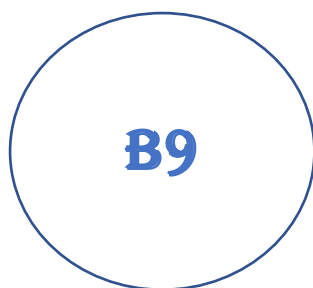
Use Cases

Gurgaon Palwal Transmission Ltd is a 130 km long inter-state transmission line built in the urban landscape of Gurugram and its

neighborhood. A vertical substation was developed as a compact, multi-storied structure. This futuristic substation houses the 400 kV GIS equipment on the ground floor, the 220 kV GIS on the first floor and the open 220 kV switchyard on the roof. This entire 400/220kV GIS substation occupies just 3.8 acres, thus, reducing the land required by as much as 75 percent. The project built multi-circuit monopole towers across the transmission path, using micro piling to create the foundations. In addition to space-saving, another remarkable advantage of these vertical substations is the reduced carbon footprint.

Key Findings

- Large substations built 30-40 years ago outside the cities are now prime commercial properties
- Old substations require urgent refurbishments and capacity enhancement
- Conversion of these substation to Gas Insulated Substations (GIS) could release up to 80% of the land that could be commercialized
- Only a portion of the price of the land commercialized is required for the conversion to GIS and to enhance the capacity



Unlocking the Value of Lamp Poles and Towers

Utilities own millions of lamp poles and towers of different sizes which is today largely under-utilized. This is a gold mine that can be unlocked to create additional revenues. Since the lamp poles already have electricity, they can be leveraged for installation of WiFi routers, security cameras, EV charging points, sensors for pollution and noise monitoring, navigation systems for drones etc.

Latest trend is to go for smart poles that are multifunctional light poles equipped with electronic components, software controls and smart sensors that can receive and transmit data. Smart pole comprises LED lights with advanced controls to remotely control lighting; and built-in sensors and communication units. They have the potential to incorporate numerous add-on capabilities and functions, and can be easily upgraded with new and evolving technologies and devices.

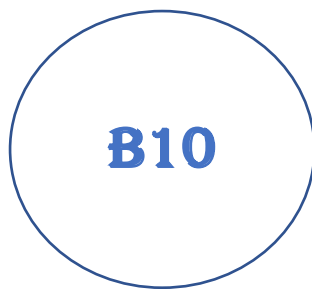
Smart poles could also act as nodes for capturing traffic data, weather and pollution levels.

Use Cases

In March 2018, Tata Communications announced its plan to install 15,000 smart street lights in Jamshedpur. Wipro Lighting partnered with Schröder Lighting to market “smart city products and beyond” in India and meet premium lighting requirements. It will leverage the latter’s expertise in IoT-based smart street lights and smart poles.

Key Findings

- Millions of lamp poles that utilities own is an undervalued asset which can be deployed for:
 - a. Installation of EV Charging Points
 - b. Installation of 4G/5G/WiFi Antennas
 - c. Installation of Navigation Systems for Drones – Passenger Drones and Delivery Drones
 - d. Installation of Pollution and Noise Monitoring Sensors
 - e. Installation of Security Cameras
 - f. Advertisements
- Lamps can be converted to solar powered lamps with integrated sensors and cameras for the above - lot of innovation is going on in this domain
- Above possibilities offers additional revenues to utilities



Maintenance Services

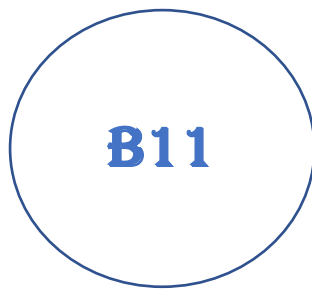
Outsourcing maintenance services is becoming an increasingly prevalent method for companies to maintain their assets in numerous industries, from aviation to IT and manufacturing as carrying out such functions in-house is expensive.

Utilities have skilled technicians who could undertake complete maintenance of large buildings and campuses with the help of contract employees for miscellaneous tasks. Utilities would be able to efficiently do the service and maintain the reliability and trust of their customers.

This could generate huge revenues for utilities.

Key Findings

- All large buildings outsource electrical maintenance services to third parties
- Utilities have skilled employees and better access to supply chain for undertaking such services efficiently
- Customers will have more trust with utilities taking over the responsibility to maintain their buildings and campuses – particularly in case of Schools, Colleges, Hospitals, IT Parks etc.



Cooling as a Service – District Cooling Systems

Electricity, water and gas are supplied to buildings as a service against monthly payments. Same way, cooling can also be provided as a service to buildings and homes.

Chilled water produced at a central chiller can be supplied to buildings through insulated pipes where air handling units will cool the air passing over chilled water pipes for air conditioning the buildings/rooms. This is called District Cooling Systems (DCS) which are successfully implemented in several cities around the world including GIFT City in Gujarat. Nationally only 5% people have room air-conditioners (ACs) while urban India has room ACs in 10% households. The traditional model of more efficient equipment and appliances for space cooling is not going to help as the demand is expected to surge exponentially in the coming years. The 2050 scenarios show that space cooling could reach 28% of India's electricity demand and 44% of peak load. The way forward is DCS and providing cooling as a service. DCS is highly energy efficient and will significantly reduce electricity consumption in buildings, reduce heat in the street/neighborhood as well as avoid the capex by each building/flat owner to buy window air-conditioners.

DCS is normally built with large chilled water storage tanks that could provide cooling service to the buildings for several hours. This thermal storage system is a good flexibility resource for the electric grid as well. During off-peak hours the chiller plant can produce chilled water and store it and give load relief to the grid during peak hours.

Use Case

Gujarat International Finance Tec- City (GIFT City) has the country's first public DCS which is successfully operating for last 7 years. With much

higher energy efficiency, DCS has fundamental cost and space saving benefits, including load variety, streamlined processes, advanced technology and better employee economies. It reduces the capital investment needed for the additional infrastructure for power generation, transmission and distribution and would create additional revenue streams through the service provided.

Key Findings

- Summer temperature in North India is constantly on the rise - during the past 3-decade maximum temperature in Delhi has gone up from 42°C to 48°C; at this rate by 2030, temperature in most parts of North India will be above 50° C making it impossible for people to live, work and commute. Nationally only 5% people have room air-conditioners; Urban India has 10% (over 30% in Delhi)
- Room air conditioners spew out heat and create heat islands – making it further difficult to for those without access to cooling. Incremental improvement in efficiency of room air conditioners and other appliances will be over shadowed by the sheer increase in the number of new units added every year
- District Cooling Systems (DCS) is successfully implemented in several cities around the world including GIFT City in Gujarat where cooling is provided as a service against monthly bills.
- DCS is highly energy efficient and economical; reduces the electrical load of individual buildings; it also can be combined with thermal storage.
- Electric Utilities should seriously consider Cooling Service with DCS as a new business opportunity

Conclusion

ISGF had the opportunity to discuss the ideas presented in this paper with regulators and utility CEOs in different forums in the recent past. All of them were interested in taking up few of the ideas on pilot basis in 2021 itself. It is recommended that regulators may accord approvals to utilities to try some of these ideas on pilot basis and depending on the success factor and customer acceptability may scale up the same.

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About ISGF

India Smart Grid Forum (ISGF) is a non-profit think tank established by the Ministry of Power (MoP), Government of India in 2011. ISGF closely works with central ministries of Renewable Energy, Urban Development, Heavy Industries, Dept of Telecom, NITI Aayog, state governments, electric utilities, central and state regulatory commissions. ISGF is responsible for accelerated development of smart grid technologies and has the mandate to advise government on policies and programs for promotion of Smart Grids and e-mobility in India, work with national and international agencies in standards development and to help utilities, regulators and the industry in strategy development, technology selection, training and capacity building. With 170+ members comprising of ministries, utilities, technology providers, academia and research, ISGF has evolved as a

Think-Tank of global repute on Smart Grids and Smart Cities. Since inception, ISGF has been actively involved in various consulting and research activities in smart grid, energy storage, electric vehicle renewable energy, energy efficiency etc. and provided advisory services including capacity building and training programs to policy makers, regulators and utilities.



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