Reimagining India's Electricity Value Network

CONTENTS

Introduction

Electricity Value Chain

Digital to Transform the Electricity Value Network

Challenges and Digital Solutions for EVN

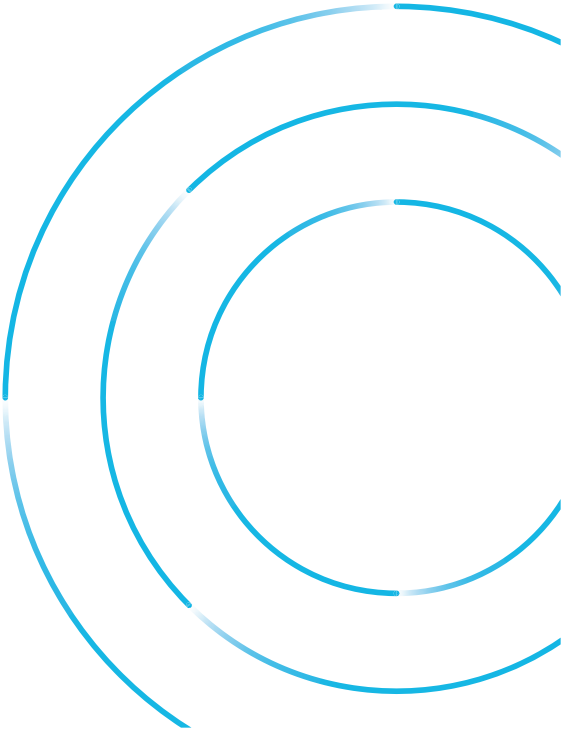
- Managing Multiple Energy Sources Together in the most Optimized way
- Optimizing the existing Assets (Power plants and T&D assets)
- Need for securing the Critical assets
- Evolving Technological Landscape and changing Customers preferences
- Increased regulations and Standards

Summary

Contributors

Appendix

References



INTRODUCTION

Power Industry which comprises of generation, transmission and finally consumption is what we call the "Electricity Value Network" (EVN). This industry has remained unchanged for years due to factors like stability, predictability and insulation from external macro-economic events. However today, they too face an array of challenges amid a rapidly evolving technology-driven environment coupled with environmental changes which is putting pressure on them to change and adapt. Companies need to find ways to reduce operating costs as well as come up with new business models to sustain in this changing market.

Traditionally this sector has worked on a 100+ year old linear model. Here the electrons travel in one direction only, from source to consumer via transmission mediums. Today it is about a "smart electron" that can flow in many ways and carry along with it even information. Currently the information is available but not being utilized. The idea is to use this data and help make better decisions and allow real time decision making.

As of today, electricity can't be stored on a large scale. Due to this, if demand is more than supply it results in cuts or blackouts. At the same time, for example a manufacturing organization pays around ~5% of their total operating costs on energy, which can go up to 30% in case of energy intensive industries. Hence there is enough incentive to be cost effective.[1]

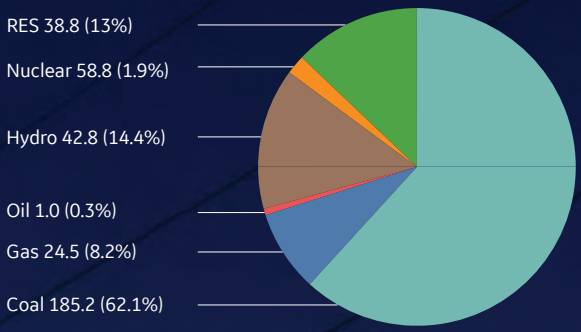
Navigating a changing industry requires an understanding across the entire value chain. No single technology will help solve the challenges. In fact, Barclays predicts that the entire value chain in developed electricity markets will be turned upside down within the next 10 to 20 years as distributed power and storage go mainstream.

By 2025, Barclays forecasts that "everybody will be able to produce and store power."

Regionally, India is home to 18% of world's population, uses 6% of the world's primary energy and has the fifth largest power generation capacity of 298 GW. Not only this the per capita consumption in India is way low compared to other countries and with the economic growth this is set on a path of growth. Coal is the largest contributor in thermal power with 185.2 GW of production.[2]

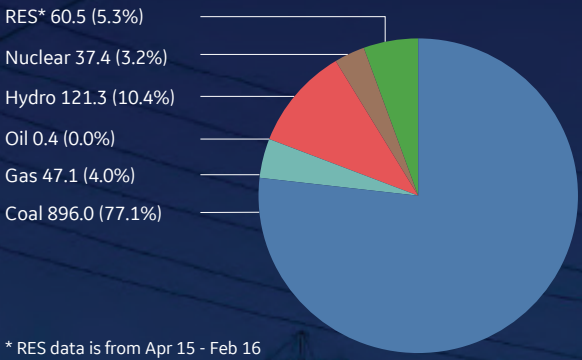
In terms of production, India is the third largest producer of electricity in the world. The production of electricity is growing at a CAGR of 6.3% over last 7-years and it is expected to grow at a rate of 4.7% till 2040 to reach 4124 TWh with a major share of 57% from coal alone.[3]

Given these challenges 'Digital technologies' work like an enabler for futuristic growth. It is no more about individual EVN components that worked in silos, but the entire value chain being reinvented through digital.



Total 298 GW

Fig: Installed Capacity in India - as of March 2016 (Source/ GW/ %)



* RES data is from Apr 15 - Feb 16

Total 1162.6 GW

Fig: Electricity Generation (India: FY 2015-2016)

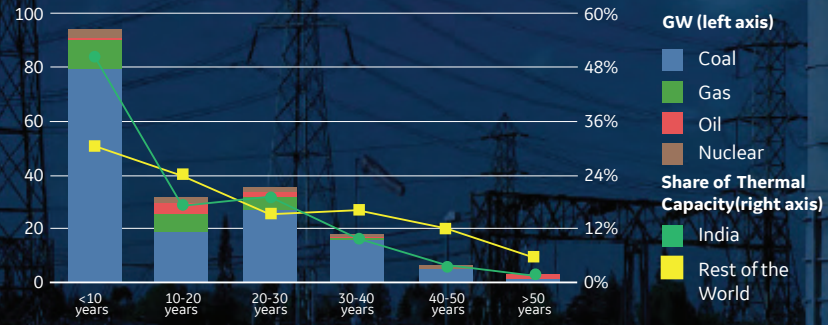


Fig: Age profile of Thermal capacity

ELECTRICITY VALUE CHAIN

Typically, the electricity generator system will have its own local control system. On the other hand, transmission and distribution is typically controlled by a real-time SCADA (Supervisory Control and Data Acquisition) system. Mostly today they work as independent systems.

"The Industrial Internet of Things (IIoT) is not a futuristic dream that will unfold in the years to come; it's happening right now, and it's happening very fast. Putting things in perspective – over the next five years, the energy industry will see more disruption than it has seen in the previous 125 years"

Steven Martin
Chief Digital Officer, GE Power

"The future of renewables is digital"

Sanjeev Addala
Chief Digital Officer, GE Renewables

DIGITAL TO TRANSFORM THE ELECTRICITY VALUE NETWORK

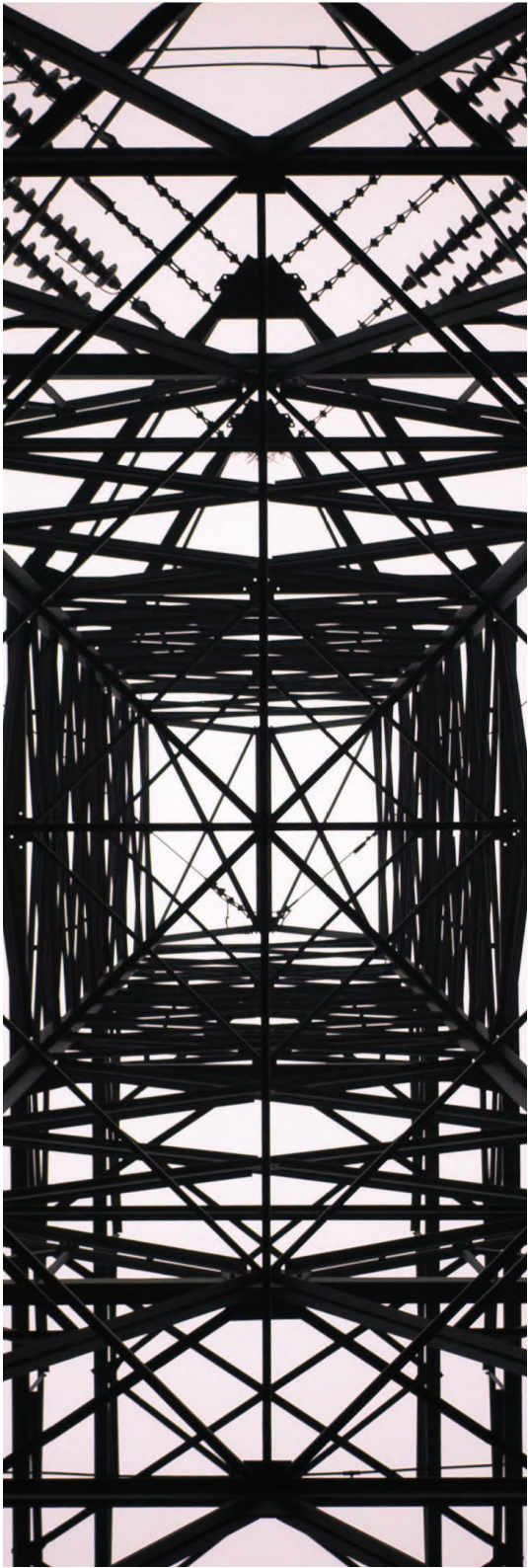
Digital solutions help aggregation of resources, connectivity of systems and collaboration across the network. EVN is a complex system comprising of many assets, which need to be optimized. But given the complexity optimization is not easy. The data generated is huge which then needs to be analyzed. To derive value across the entire EVN ecosystem means enabling both central and edge devices. Ability to combine and manage this data to derive insights is the first step towards optimization. The future is defined by digitally enabled intelligent solutions which will be aimed at generating higher quality power at reduced cost and at preventing unplanned downtime.

Digital touches each component of the value chain: from power generation with digitized assets, to transmission and distribution with optimized operations and cyber security, through the end consumer, enabling better trading, purchasing and portfolio decisions.

Deploying analytics and digital platforms can forecast usage and predict issues early. Cloud and Edge analytics together provide powerful mechanism over existing IT/OT infrastructures. Digital Platforms are a cornerstone element of the digital economy and will account for 25% of global GDP by 2020.[4]

Digital transformation helps achieve:

- Business Optimization: By looking at the insights generated through data with increased focus on profitability.
- Operations Optimization: By being able to make faster decisions with focus on improved productivity.
- Real Time Action: By monitoring the asset in real time.



1. MANAGING MULTIPLE ENERGY SOURCES TOGETHER IN THE MOST OPTIMIZED WAY

Renewables sources of power generation have been gathering pace. More wind and solar grids are reaching parity and their production is becoming more efficient. Yet coal and other traditional sources are still here to play an active part as the market is not yet fully mature to adopt renewable energy. There are challenges in network operation specifically to handle the load with renewable variability in the system and provide stability in the grid where fossil fuels need to flex to work alongside renewables.

- India too has set a plan to add 175 GW of renewable energy generation capacity by 2022.[5]

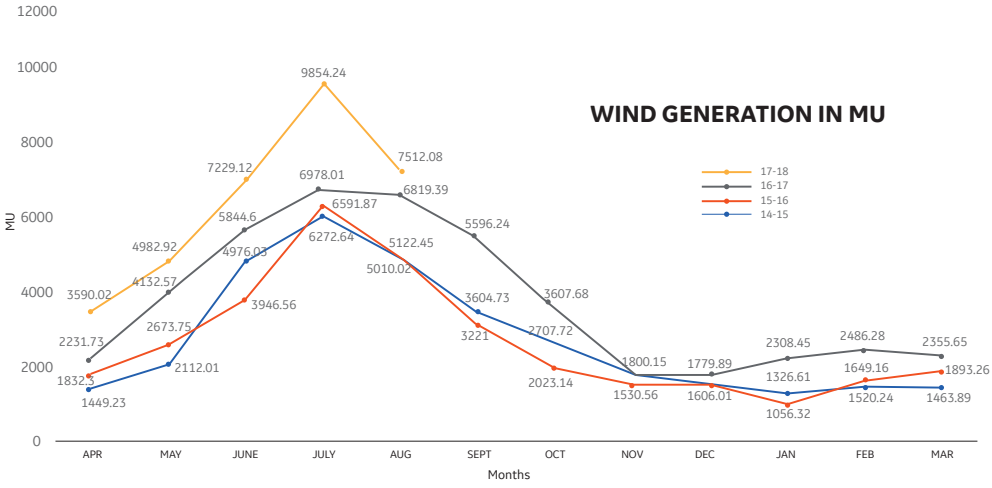
This interplay of traditional energy generation and renewables also brings the question of energy storage which has not been fully achieved today. Traditional sources provide 24X7 reliability whereas renewables are intermittent based on weather and geographical conditions. The critical link here is affordable storage between them. Harnessing that will help balancing flexible loads and peak demands which is a constant battle that the power generators, transmitters and distributors face.

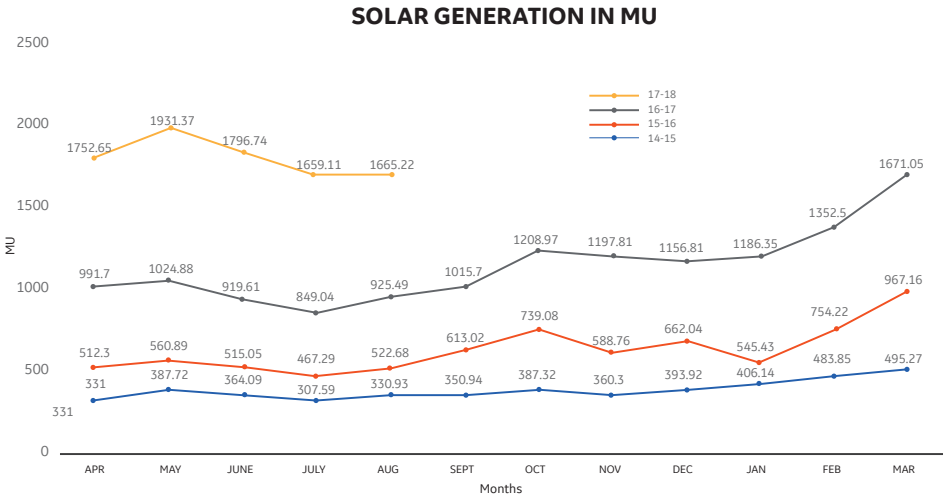
- According to PwC, more than 10,000 MW of electricity can be saved by avoiding T&D losses in 2022 alone if 40 GW rooftop Photovoltaic system is achieved.[6]

A typical future model of an EVN will be Distributed Energy Resources working together. Hence, power generators must deal with a combination of various distributed energy generation resources working together and then manage the grids in the most effective way.

The traditional grids are also being challenged with intelligent grid technology for higher quality power. Grids need to be stable and more reliable for providing smart transmission and reduce transmission losses.

Also enhanced situational awareness of the transmission and distribution networks is critical to manage the network effectively and ensure its reliable operation specially to take real time decisions.





USING DIGITAL TO MANAGE DISTRIBUTED SOURCES TOGETHER

Distributed sources need to work together in a form of a network to manage load effectively. By connecting the assets to digital solutions, one can get real time visibility to control and monitor these assets and networks. By having an overview of the entire network, assets can be managed better and issues if any can be handled pro actively. This also necessitates real time visibility into grid operations. The mix of distributed energy sources necessitates that traditional sources to be more efficient and complaint with environmental regulations. For example, micro-grids are electricity distribution systems containing loads and distributed energy resources, (such as distributed generators, storage devices, or controllable loads) that can be operated in a controlled, coordinated way either while connected to the main power network or while islanded.

They can also work independently of the mega grid or with it based on need. By working independently and taking inputs from physical conditions like weather forecast they can be controlled better and be optimized. It does this by interacting with the grid and the customer both in real time with help of digital solutions. It can also supplement the mega grid in case of overloads. Similarly, a multi directional intelligent grid can handle two-way power flows and can predict when customers want to send power to the grid. This connects the demand and supply better.

Transmission assets will also face challenges like variation in estimated load and in renewable generation.

Energy Management Systems (EMS) and Distribution Management Systems (DMS) are getting more “DER-Aware” (Distributed Energy resource) and helping the transmission and distribution system operators in making better and faster decisions to operate the power networks.

Digital substations are replacing conventional substations. The substations are getting more compact, safer for personnel with easier maintenance. Digital Instrument transformers, Merging Units, Intelligent sensors and controllers are improving the overall reliability and availability of power.

Technologies like Wide Area Monitoring Systems (WAMS) for transmission and Distribution Network Management (DMS) and Advanced Metering Infrastructure (AMI) for distribution are enhancing the reach to the edge of the distribution networks and providing better control to the utilities and more services to the consumer.

CASE STUDY

CUSTOMER AND GE DEVELOP SELF MANAGED SOLAR MICROGRID

An estimated 300 million people in India live in "energy poverty", having little or no access to electricity. In response to the Indian government's electrification plan, a partnership led by Customer which is India's leading power distribution company began developing a model for a self-managed solar microgrid.

The customer specifically required a cost-effective solution that could be deployed and managed in remote areas. Visiting far-flung installations for routine inspections and maintenance can be time consuming and costly. Also, microgrids must be maintained to keep them running.

GE provided a new hybrid power solution to supply high-efficiency, reliable power to Indian villagers. Solar panels will generate power to be used or stored in the batteries, and the diesel backup will take over during cloudy and nighttime hours. The plant is enabled for operational control and remote monitoring using a microgrid controller built on GE's Predix platform.

A key aspect is the unique integrated solar diesel battery technology that uses a variable speed engine to help reduce operational costs. Advanced controls automatically maximize solar power generation and minimize use of the diesel engine, significantly reducing the supervision of the microgrid. Also, the Industrial Internet platform connects the system to the cloud, enabling remote diagnostics and analytics.

However, this remote monitoring requires Internet connectivity. Reliable wi-fi isn't available in the rural villages. Hence communicating the data was another obstacle.

GE helped here by deploying Predix-based platform featuring Mini Field Agent technology. Data is securely communicated to and from the cloud via 3G mobile telecommunications technology.
This is also the first project where Field Agent data is communicated via wireless 3G technology. In this case data like power, voltage, battery charge, fuel levels and other key variables are sent to the cloud. The operator then analyzes this data to determine if there are issues that need to be addressed.

The Field Agent technology also enables a Digital Twin to improve performance and operation of the micro-grid. It also has built in security features.

LARGE AMERICAN INVESTOR OWNED UTILITY MANAGES DISTRIBUTED SOURCES BETTER

Customer experienced an increase of distributed generation in its grid. Due to the intermittent nature of renewables it experienced issues like reverse power flows, voltage swings etc. which harmed its equipment.

Customer partnered with GE and US Department of energy to solve this issue. First company used energy boxes and smart meters to integrate DER with DMS for optimal performance. Second it identified and mitigated challenges with distributed solar PV.

Through this the customer could manage and mitigate effects of growing distributed, renewable generation and storage capacity on the grid.

2. OPTIMIZING THE EXISTING ASSETS (POWER PLANT AND T&D ASSETS)

Traditional power plants are being challenged to be cost effective, productive and more reliable. As Per a Gartner report utility digital business focus continues to be operational where in more revenue is expected from better operations and cost reduction through digital.[7]

For example, GE increased the annual energy production (AEP) of a leading customer in the eastern US by 16% with virtual design modelling to Wind Farms, thereby generating more power and revenue.

In India, the key challenges that are faced by a coal-fired power plant are also similar: inefficiencies, high emissions, cyclic demand variations and high maintenance costs. The study by Center for Science and Environment (CSE), revealed that the average energy efficiency of 20 coal-fired power plants of 2000MW and above capacity is a mere 32.8%, lowest among the major coal-based power generating countries. The average CO2 emission was 14% higher than China and water consumption is 2 times higher than that of China. Today 85% of the coal plants are based on sub-critical technology.[8]

Studies conducted across India suggest the below as major reasons for inefficiencies:

- High gross heat rate due to lack of optimized boiler consumption, soot blowing, air leakage, obsolete instrumentation.
- High auxiliary power consumption
- Low plant load factor
- Poor quality of fuel
- Aging of sub critical fleet

According to a CSE study, over 20% of the thermal plants experienced average annual outage of more than 73 days against the desired level of 15 days.[9]

Considering the size of the current installed base and additional coal-fired capacity planned for India in future, it becomes imperative that even a marginal improvement of 1% in performance and efficiency will have a potential impact of $5B over the life span of 30 years.[9]
One of the most common issues that power generators face is unplanned downtime due to failure or unplanned outages or part failure causing the plant to go down, leading to reduced productivity and increased cost for the generators.

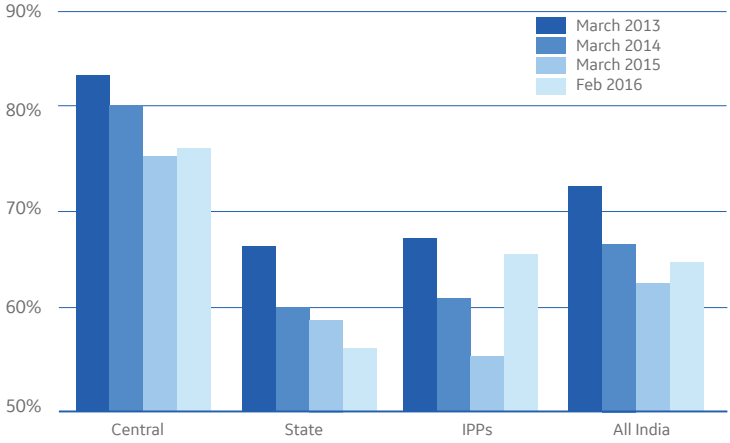
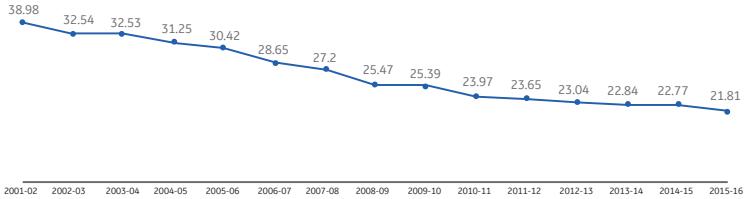
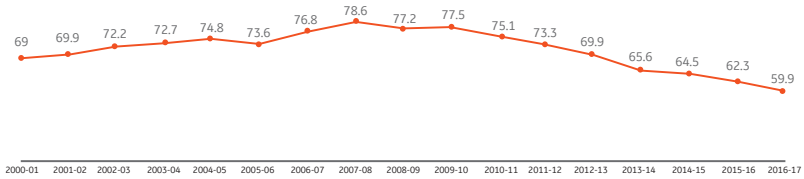


Fig: Trend of PLF for Coal & Lignite Plants

All India T & D losses



All India Thermal PLF



OPTIMIZING THE EXISTING ASSETS USING DIGITAL TECHNOLOGIES

Traditional power plants are being optimized using digital technologies. There is a need of integrating the physical plant with digital infrastructure for the industrial internet. All the new industrial assets need digital solutions that can monitor the assets and can drive operating efficiency by managing the overall asset life-cycle. One way to achieve this is through implementing a digital twin through which key health indicators of an asset can be monitored and predicted. This will help to improve measurement and forecast of current and future load, asset health, criticality and performance using data insights.

Analytics and Big data solution will play a huge role in inspecting and analyzing assets virtually or remotely to predict problems. This in turn can help prevent unplanned outages and have condition based maintenance.

CASE STUDY

FINA ENERJI INCREASES OPERATIONAL EFFICIENCY FOR WIND TURBINES

Company wanted smarter wind forecasts for managing the demand accordingly.

GE provided the solution that covered 150 GE Wind Turbines in 9 wind farms across the country where digital applications for data analytics will be used to enhance operations and hence revenue through APM and predix powered apps. (Cloud Connect, Wind Fleet Excellence, Enterprise e-SCADA, and Wind Power Forecasting)

"This type of agreement ensures that GE is not just a service provider, but an operational partner. They are incentivized to make our projects an even bigger success".

Volkan Başkaya
GM Operations Department, FINA

CASE STUDY

EXELON, A FORTUNE 100 COMPANY IMPROVES PERFORMANCE

The company which cuts across the value chain wanted to analyze and manage power plants in 48 states for achieving efficiency, power plant reliability and improved performance. They gathered massive amounts of data across their generation fleet, but they needed a single platform to look at these systems at a higher level to derive business insights from data.

Predix was implemented across the Enterprise and across the different energy sources like fossil, nuclear, wind and solar. In terms of solutions GE provided Digital Power Plant and Digital Wind Farm solution suites which helped the company to predict when its systems will need repairs so that maintenance can be scheduled and parts are available.

"All the operational data goes directly into Predix. By collecting all the data in the GE hosted Predix cloud — instead of spread across many systems — it can be brought together for analysis and machine learning."

Director of Innovation at the Company

3. NEED FOR SECURING THE CRITICAL ASSETS

In 2013, 91% of power generation organizations experienced a cyber-attack.[10] In fact, 40% of cyber-attacks are targeting the energy sector which can be a major reason for their downtime.[11]

As more and more assets in a power plant are connected to the cloud, so does the risk posed by connectivity increases. A Pew Research survey found that 61% of experts agreed that a major cyberattack would occur by 2025 that will cause widespread harm to the USA's security and capacity to defend itself. The costs of such an attack are tremendous. Lloyd's estimates that a blackout across 15 U.S. states would affect 93 million people and cost the economy between $243 billion and $1 trillion dollars. In Ukraine, 225K people lost power due to cyber-attack in December 2015 — and again in December 2016. Unplanned outages/trips cost ~$500K a day on average.[12]

One of the major reasons for the vulnerability is the fact that operational technologies and assets cannot easily be taken offline for upgrades. Along with them there are legacy systems too adding further complications.

Despite widely acknowledged concerns about the threats, a report says that 64% of power and utilities industries believe their security strategy is not aligned with today's risk environment.[13] The critical assets hence do need to be secured and monitored for threats.

SECURING ASSETS THROUGH CYBER SECURITY DIGITAL SOLUTIONS

Maintaining a continuously updated and secure perimeter for critical assets along with intrusion detection mechanism in place is a necessary step in securing the assets. In fact Organizations that implement just five Critical Security Controls CIS Controls can reduce their risk of cyber-attack by around 85%.[14]

CASE STUDY

LARGE UTILITY COMPANY IN US PROTECTS ITSELF FROM VULNERABILITIES

Company wanted to ensure that their operations are secure and can't be jeopardized in lieu of publicly disclosed BlackeEnergy malware. GE created a framework to protect them from vulnerabilities. GE provided OPShield solution at one plant to provide intrusion detection and prevention.

Through this the customer could have immediate visibility into their OT networks and classify normal traffic to establish rules and policies to govern. Customer was hence able to be NERC CIP complaint which was its major goal.

INVENERJY BECOMES NERC/CIP COMPLAINT

Customer identified cyber security as its top challenge on the grid. It has 10+ GW wind fleet. To meet this challenge, the legacy controls were upgraded and protected with Opshield.

This helped the customer not only be compliant but also avoid penalties/downtime due to Cyber-attack.

4. EVOLVING TECHNOLOGICAL LANDSCAPE AND CHANGING CUSTOMER PREFERENCES

Every customer today is a digitally enabled consumer who has more demands as they are more informed, have multiple choices, can generate their own power and expect high level of service. With the global shift of being closer to customers 'energy services', can be a new field altogether where customers expect services based on their choice and needs. Tracking consumption behavior for providing better services is what is expected.

Increased pressure to use cleaner sources are also increasing adoption of electric cars which are posed to grow to ~400 million by 2040.[15]

Transportation currently accounts for 20% global energy demand. As of today, only 1% is electrified. This presents a huge opportunity.[16]

CUSTOMERS SERVED BETTER THROUGH DIGITAL

Analytics draw insights on a consumer preferences, tastes and usage patterns that can help companies derive the most optimized usage of the power and load balance it better, especially in case of business and retail consumers.

CASE STUDY

LARGE SOUTH-EASTERN POWER UTILITY MANAGES TECHNICIANS BETTER

The challenge the company faced was to increase revenue through target of service jobs per day for business and household consumers. The current process of servicing was inefficient as technicians needed to call the dispatch multiple times to reschedule appointments or to make onsite sales.

Company used GE's module within ServiceMax with which technicians could now handle service requests better with effective scheduling and parts management tools.

5. INCREASED REGULATIONS AND STANDARDS

With the rise of environmental issues like climate change there is an increased focus on reducing environmental impact through reduced energy emissions and cleaner energy generation. 50% of the nation's electricity needs still relies on coal as fuel, hence the industry has a major role to play in the environmental discussion.

The environmental impact of thermal improvement for an average plant could result in a reduction of CO2 by 21 Mt per year for example.[17]

MANAGING INCREASED REGULATIONS AND STANDARDS

Managing emissions by regulating the output from a power plant helps industries track their emissions regularly. Most regions have various compliances by regulatory bodies which need to be followed. Digital solutions help achieve them in the most optimized way by visibility and tracking.

"Utilities' traditional business models are under attack, directly and indirectly. Utilities are racing to reinvent their roles and have started a profound transformation journey. The industry will be reborn in 3D: decentralized, divergent, and digital."

Roberta Bigliani, IDC Energy Insights

CASE STUDY

LARGEST MUNICIPAL ELECTRIC SYSTEM IN KENTUCKY REDUCES EMISSIONS

Customer wanted to reduce emissions. It adopted boiler optimization package part of GE's Operations Optimization software for this. By integrating the two components for combustion and soot-blowing optimization, the software works in real-time to reduce greenhouse gas (GHG) emissions. Additionally, it also improves heat rate and soot blowing by manipulating controls related to fuel and air mixing.

As a result, it has reduced emissions. For example, the NOx emissions are reduced by 10–17% and heat rate is reduced by 0.5%.

PANAMA MEETS RRF REGULATORY REQUIREMENTS FOR WIND FARMS

Customer wanted to forecast output better otherwise it would have resulted in them being penalized heavily ($126K per farm/year). The readily available wind forecasting solutions were not customized for the Indian conditions. The wind speed granular level data was not available. Even the internet connectivity was poor at the site.

GE helped by doing a pilot on 1 wind farm. It developed new wind power forecasting algorithm for 1-4 hours ahead and addressed network connectivity challenges with on-premise + cloud hybrid architecture. Post this the customer achieved 94% forecast accuracy which was 6% better than the industry best.

SUMMARY

The rate of change that the entire Electricity Value Network (EVN) is going through currently is accelerated due to digital. Future energy generation companies will be operating in a marketplace characterized by a network of connected machines, plants, end consumers on an industrial Internet platform. This convergence of digital and physical will deliver greater reliability and efficiency to reduce cost necessitating companies to adopt digital solutions and be early adopters.

APPENDIX

DIGITAL TWIN
A digital twin is a dynamic digital representation of an industrial asset, that enables companies to better understand and predict the performance of their machines and find new revenue streams, and change the way their business operates.

PREDIX
Industrial Cloud Based Platform developed by GE. It is specifically designed for the unique and complex challenges of industrial data

DISCLAIMER

REFFERENCES

1. https://www.eia.gov/outlooks/ieo/pdf/industrial.pdf

2. Powering India White Paper_Jun2016, GE

3. (a) http://www.cea.nic.in/reports/monthly/executivesummary/2016/exe_summary-03.pdf
(b) http://www.ibef.org/download/Power-January-2016.pdf

4. Industry Report by Accenture

5. future-of-energy-digital-for-coal-fired-plants white-paper

6. http://businessworld.in/article/2017-Touted-As-Landmark-Year-For-Solar-Energy-In-India-CleanMax-Solar/17-07-2017-122289/

7. Top-10-Digital-Trends-for-the-Electricity-Value-Network, GE

8. International Energy Outlook," U.S. Energy Information Administration, 2016.

9. Powering India White Paper_Jun2016

10. Cybersecurity in the power sector. Powering Engineering International, Vol. 22/#9

11. NERC CIP 2013 Reliability Report: http://www.nerc.com/pa/RAPA/PA/Performance %20Analysis%20DL/2013_SOR_May%2015.pdf.

12. EVN-Solutions-for-Power-and-Utilities-from-GE-Digital

13. Industry Report by Accenture

14. Baseline-Security-Center-Reduce-Your-Risk-of-Cyber-Attacks

15. BNEF global EV sales forecast by geography, 2015–2040, Bloomberg New Energy Finance, 02/25/16, GE Estimate

16. IEAf 2016

17. future-of-energy-digital-for-coal-fired-plants-white-paper

Per capita Consumption In regions.
https://goo.gl/id3mbw

Microgrids
https://building-microgrid.lbl.gov/about-microgrids

https://www.gtai.de/GTAI/Content/EN/Meta/Events/Invest/2016/Reviews/Hannover-messe/smart-grids-forum-2016-presentation-holger-kley.pdf?v=2

https://www.linkedin.com/pulse/machines-marketunlocking-electricity-value-network-jay-allardyce

https://www.linkedin.com/pulse/2017-top-digital-trends-electricity-value-network-maher-chebbo

http://sloanreview.mit.edu/article/value-networks-the-future-of-the-us-electric-utility-industry/

Top 10 tech trends GE paper
Gartner, 2016 CIO Agenda: A Utility Perspective, 19 February 2016

Cognizant paper 20 – 20 insights
Source Platform Economy: Technology-driven Business Model Change from the Outside In, Accenture 2016.

7 Global Platform Survey, The Center for Global Enterprises 2015.

http://www.cea.nic.in/reports/monthly/executive-summary/2016/exe_summary-03.pdf

http://www.ibef.org/download/Power-January-2016.pdf

Powering 2016 – The digital transformation of electricity

http://businessworld.in/article/India-May-Spend-1-Trillion-On-Power-By-2030-Piyush-Goyal/09-02-2016-90982/

http://shaktifoundation.in/wp-content/uploads/2014/02/Whitepaper-Thermal-Power-FINAL.pdf

http://cea.nic.in/reports/others/thermal/tpece/report_85_pul_coal.pdf

http://www.reuters.com/article/us-daimler-strategy-investors/mercedes-benz-to-offer-electric-option-for-every-car-by-2022-idUSKCN1BM0TL

http://www.ge.com/reports/internet-electricity-ge-exelon-crunching-data-generated-power-plants/

http://www.exeloncorp.com/newsroom/fortune-100-energy-company-exelon-chooses-ge-predix-to-accelerate-digital-transformation

GE Technology Powers Scalable Microgrid for Rural Electrification WhitePaper

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