Global Smart Energy Federation

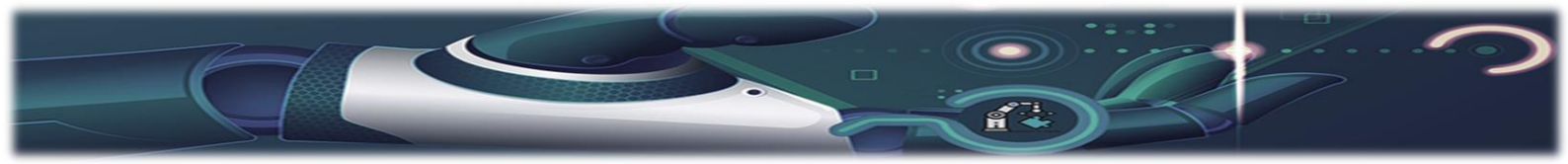
WHITE PAPER ON

ARTIFICIAL INTELLIGENCE & ROBOTICS FOR UTILITIES

February 2022

Global Smart Energy Federation

www.globalsmartenergy.org

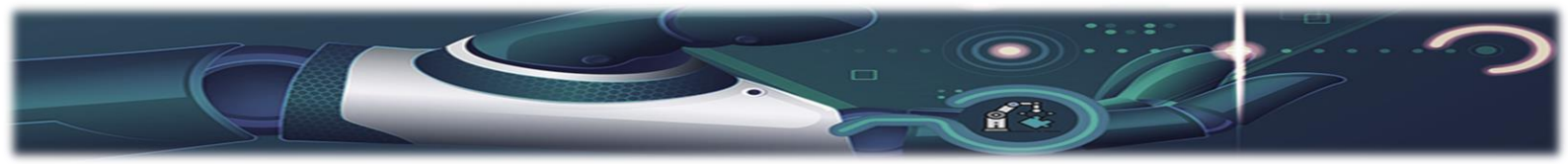


Executive Summary

AI as solution is transforming the global ecosystem of information and knowledge. Robotics as service is paving ways for better physical interaction with the world. The resulting technology combining AI and Robotics is one of the greatest technological revolutions of 21st century, which has huge potentials in various pillars of smart world, including utilities. For example, in Inspection & Monitoring, Analysis & Reporting, Repairing & Cleaning, Optimization & Efficiency, Predication & Prevention, Personalization & Adaptation, Search & Rescue.

Artificial intelligence and robotics will change the nature of work in the energy sector. It has an important role in the planning, operational and monitoring functions in utilities. These technologies can be deployed for smart cities, smart homes, smart appliances, power system security, load estimations and management, virtual power plants, electricity trading; and training of personnel etc. To optimize assets and operations of utilities, AI and Robotics Process Automation (RPA) can be deployed effectively. Utilities have started implementation of AI technologies around Big Data Automation, Predictive Analysis and Machine Learning (ML).

The series of lockdowns owing to COVID-19 around the world have dramatically changed the way we live and work within a short span of time. The operations and work style of governments, city/local administrations, businesses and utilities (electricity, water and gas) have changed drastically in the past one year. There is a greater need for governments, city managers and local authorities as well as all utilities to deploy advanced automation, remote working, remote monitoring, robotics and artificial intelligence to handle day-today operations. Electric Grids are at the Heart of Sustainability. In order to meet the evolving demands of the future generations, we must embrace innovation and digitization across all infrastructure domains. If we make our grids greener, it automatically makes the world it powers. Artificial Intelligence (AI), Data Science (DS), Machine Learning (ML), Virtual Reality (VR), Augmented Reality (AR), Drones and other types of Robots could play crucial roles in various infrastructure and services in city management including utility operations. These new technologies and tools could make the operations more efficient, faster, reliable and economical. For example, AI tools will be able to balance electricity grids, manage demand, negotiate actions, enable self-healing functions and facilitate a host of new products and services leading to the energy transition. It will also enable more efficient and effective utility operations by helping to analyze the massive amounts of data gathered from the digital devices. AI and Robotics enabled tools could automate all measurable, repeatable and predictable transactions in all domains of city management and utility operations.



In the aftermath of COVID-19, the digital platforms have become the coveted assets for utilities in their business continuity and resiliency; and this movement towards digitalization is irreversible. Emerging technologies like Artificial Intelligence, Machine Learning, Data Science and Advanced Analytics, Virtual Reality, Augmented Reality and Robotics, will radically revolutionize the city management and utility operations and overall governance in every domain in the near future.

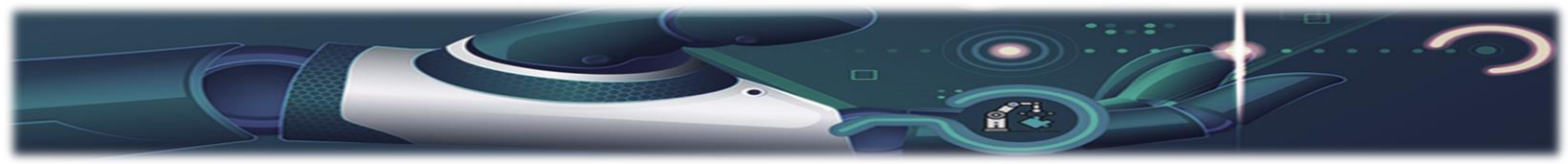
This white paper will focus on various contemporary uses of AI and Robotics, and surrounding technologies, as well as outline future potentials. The paper will also provide guidelines on the policy, ethical, legal, social aspects of such technologies and outline some of the barriers, which should be addressed and share the vast details on Artificial Intelligence and Machine Learning Technologies as Next Gen Solution. The whitepaper has following chapters:

Next Gen Solution: Advanced AI technologies, while blended with in-intensity expertise of the commercial enterprise and the IT landscape, can deliver corporations the brink of automation. The chapter has the Insights on Robots, AI and IoT - the new Body, Mind and Senses, Modes of operation for robots, AI and other technologies and AI and sensors. The Complementary Technologies of AI/ML such as Blockchain, Digital Twin and AR/VR Metaverse are also elaborated.

Applications and Case Studies: This whitepaper covers some of the prodigious global case studies for AI/ML and Robotics technologies which Energy & Utilities Industry is deploying AI in lots of ways, on the way to help them in coming across new strength projections.

Initiatives, Policies and Stakeholders: Various global initiatives and policies from USA, South Africa, Europe, South Korea, Thailand and India are covered. The mentioned initiatives are recognized procedures/policies that are implemented to help the implementation of useful AI-based solutions and boost up progress in the sector

Conclusion: Energy companies are looking for ways to leverage and expanding of data to improve their operations. The increased investment in AI is being done to provide the details to the critical issues or queries that they have. The chapters will shed light on the value proposition including the Benefits, Barriers and Challenges with the recommendations to the organizations.



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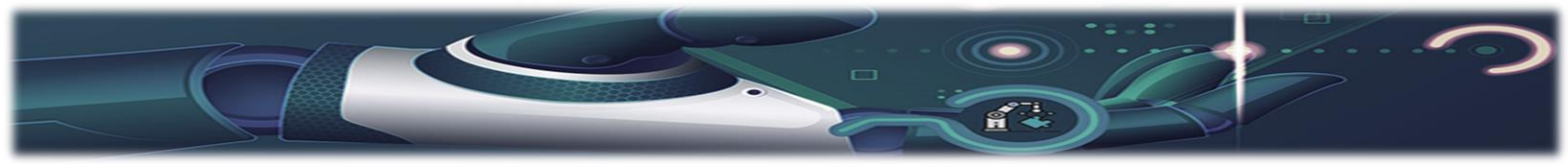


1 Introduction

Artificial Intelligence has emerged as a first-rate enabler for the improvement of a develop and green atmosphere of electricity sector, because it affects all of the stakeholders along with Utilities, Industries and Consumers. Artificial Intelligence and different rising technologies, inclusive of virtual communications, excessive velocity bandwidth (5G), blockchain, Data technology and develop analytics, in aggregate have emerge as a completely sturdy gear for green and optimized operations and services. With numerous possibilities and the unheard-of nexus of those technologies, there also are large demanding situations for the electricity sector.[1]

There is a greater need for energy utilities to use advanced automation, remote monitoring, robotics and artificial intelligence to handle day-today operations. Artificial Intelligence (AI), Data Science, Machine Learning, Virtual Reality, Augmented Reality, Drones and other types of Robots could play crucial role in the energy utilities which are more efficient, faster, reliable and economical. Intelligence backed by data science will be able to balance grids, manage demand, negotiate actions, enable self-healing and facilitate a host of new products and services. AI, will not just accelerate the journey to the energy transition, it will also enable more efficient and effective utility operations.

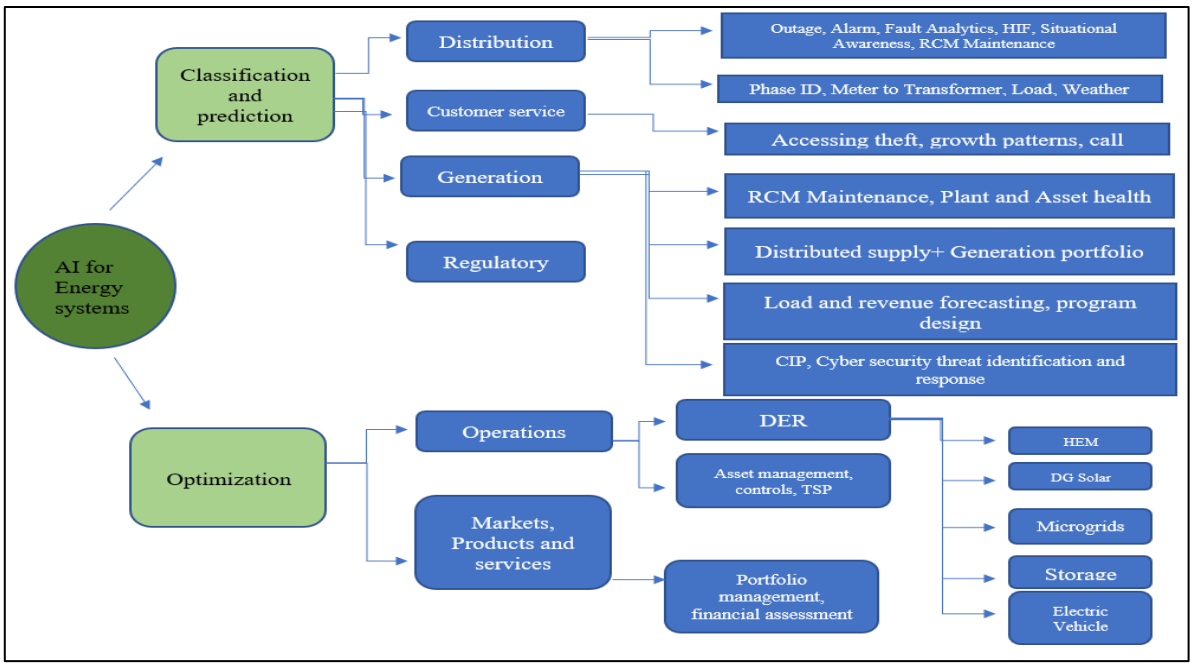
According to Bloomberg New Energy Finance (BNEF), by 2050, nearly 50% of the world's electricity will come from renewable energy sources, such as wind and solar. Technologies such as artificial intelligence (AI) provide new solutions to manage and prepare for these changes.

We can divide the AI and Robotics for Energy Systems based on Classification & Prediction and Solutions for Optimization. In distribution, there are some interesting and very recent advances in AI for doing phase identification, meter to transformer mapping also determining whether (Weather forecasting also applies down in distributed supply and generation portfolio). The high impedance fault identification, outage identification, prediction ahead of time, alarm classification and situational awareness for distribution and transmission operations are presently the key for utilizing an operator-based approach rather than a technology-centric approach for situational awareness which is open for new solutions backed by AI and Robotics. Another area is reliability maintenance.

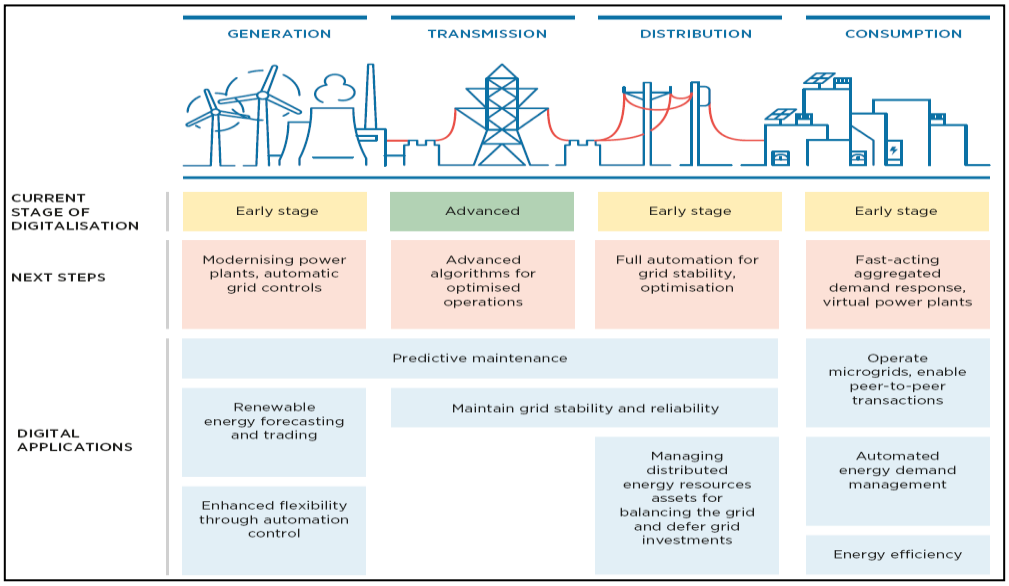
[1] https://www.eurelectric.org/media/5016/ai-insights-final-report-26112020.pdf

In customer services, we can use AI for growth pattern and call routing in IVR (Interactive voice responses) systems.

In generation, RCM (Remote Control Monitoring) maintenance, plant and asset management and understanding the asset health inside of a Plant are the key areas for the use of AI.



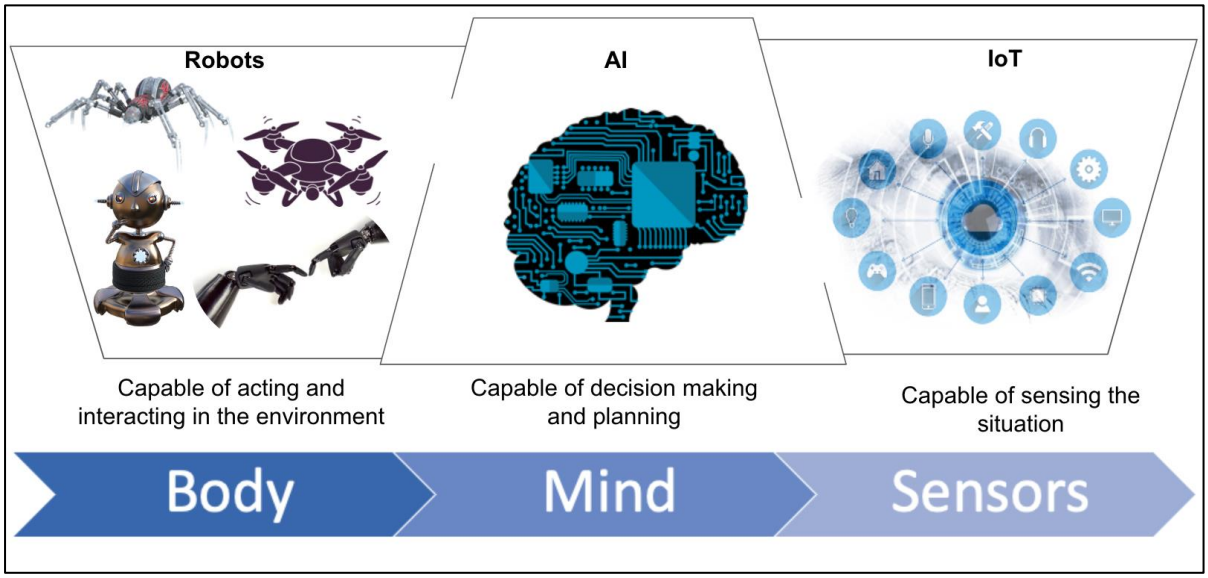
Source: Infocast Inc. Market Insights



Source: IRENA

2 Next Gen Solution

a. Robots, AI and IoT - the new Body, Mind and Senses



Robots are coming in different shapes, sizes and functionalities, and their design is inspired by various requirements. Such robots can be seen as media to act and interact in the real environment. On the other hand, AI is providing unprecedented abilities for decision making and planning, hence, can be seen as the mind of the robots. Obviously, there is a need to sense the environment, collect information and have a better understanding of the situation. Connected Internet of Things (IoT) can be seen as those sensors (e.g., camera, microphone, thermal sensor).

b. Modes of Operation for Robots

Autonomous
Robots can be fully autonomous, and capable of working without any human operator, for a particular situation or task.

Semi-autonomous
They can be semi-autonomous, needing human intervention in the task and partial control of the robot by the human, where a part of the task is done by the robot.

Avatar

Robots can also be simply an avatar for a human operator, for example to facilitate tele-presence.

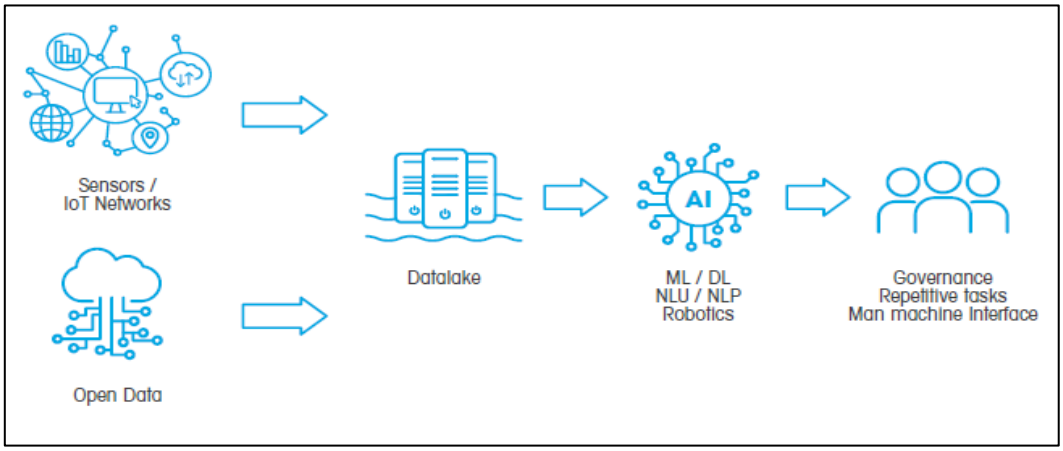
Further, such robots can be working alone or in presence of a human collaborator.

c. AI Technologies

Machine learning / deep learning (ML / DL) are artificial intelligence (AI) technologies capable of enabling systems to make sense out of a large amount of data, facilitating better decision making. Also, AI powered Customer service chatbots and virtual assistants can help in better customer experience.

In Energy Sector it can help in:

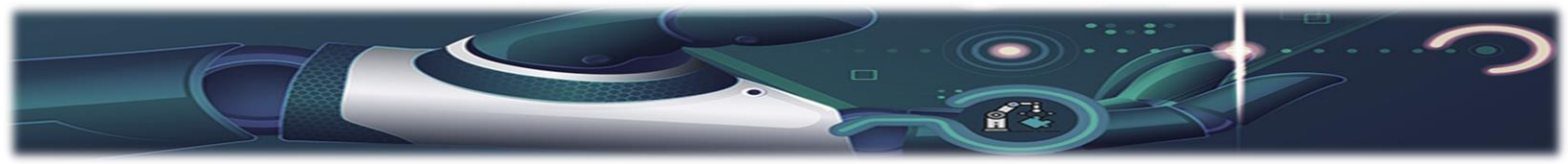
- Device and Sensors Analytics
- Microgrids Analytics
- Safety & Reliability Analytics
- Storage Analytics
- Simulation Analytics
- Advanced Solar Analytics
- Images Analytics
- Video Analytics
- Asset Management
- Automation



Source: ThinkSmartgrids

The Benefits include:

- Optimization of energy storage and production and the related costs
- Better forecast and prediction of supply and demand
- Reduction of energy consumption through optimization
- Leveraging chatbots and conversational agents to for customer support 24x7
- Reducing the maintenance costs through predicting equipment failure
- Supporting better grid resiliency and reliability
- Facilitating fraud detection and mitigating energy theft, signal irregular



patterns or consumer behaviors
- Asset management and Asset use rate optimization
- Energy management / micro grid optimization
- Consumer management
- Battery charging optimization
- Supply chain optimization

d. AI and Sensors

Sensors are becoming diverse, more connected, less expensive, with greater robustness, accuracy and durability. Also, shape and size of sensors are getting customized and optimized. All these are enabling mass deployment of sensors in different scenarios, for various applications and under almost all weather conditions.

The use of AI strategies has rushed in the electricity marketplace with a doubtlessly sensible option to make green use of allotted electricity resources, assist real-time and short call for reaction. The grid operators are looking for the correct choices to be made in the electricity grid starting from the switching of relays to big turbines controls in order to remove any undesirable harmonics in the gadget mitigated via a mesh of sensors embedded throughout all of the structures to ensure complete performance of the electricity gadget.[2]

Fault prediction has been one amongst the most important applications of AI within the energy sector, alongside real-time maintenance and identification of ideal maintenance schedules. In a business in which equipment breakdown is common, with doubtless important consequences, AI combined with applicable sensors will be helpful to watch instrumentality and notice failures before they happen, therefore saving resources, money, time, and lives.

e. Complementary Technologies

The entire ecosystem and the end-to-end pipeline from production to consumer, requires a set of solutions, which can be facilitated by set of technologies. For example, the integration of blockchain technology, conversational artificial agents, 5G.

Blockchain Technology

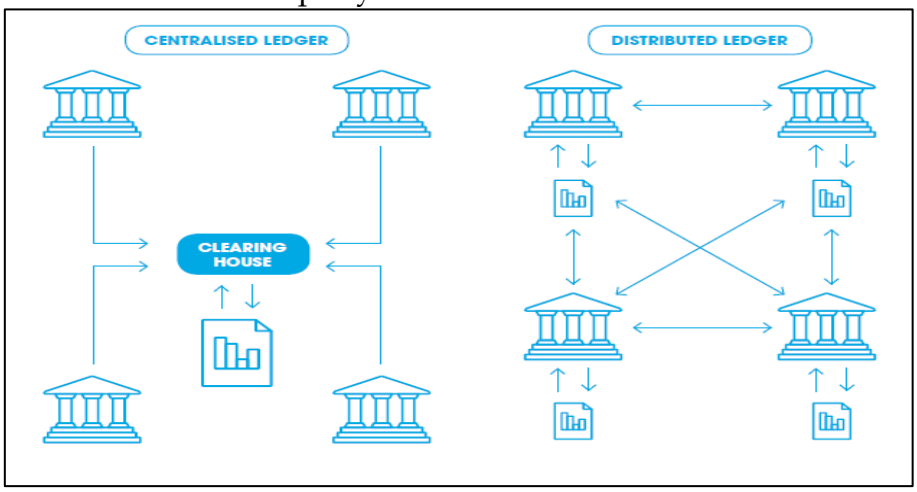
With expansion of the grid, and advancement in distribution due to involvement of diversified stakeholders, a distributed ledger technology built on a shared network infrastructure and public key encryption, is the solution to a trustworthy and secure platform. [3]

AI combined with Blockchain in energy sector can enable a better integrated business process implementation, Trust, Security and IT infrastructure overhead. By enabling direct transactions among organizations and ensuring security for transactions

[2] State-of-the-Art Artificial Intelligence Techniques for Distributed Smart Grids

[3] https://www.thinksmartgrids.fr/wp-content/uploads/2019/11/ThinkSmartgrids_livret-data_11.05-vdef-web.pdf

compared to traditional IT security mechanisms, such as firewalls, encryption, intrusion detection systems and packet filters. This also ensure a meter-to-cash business process without third party intervention.[4]

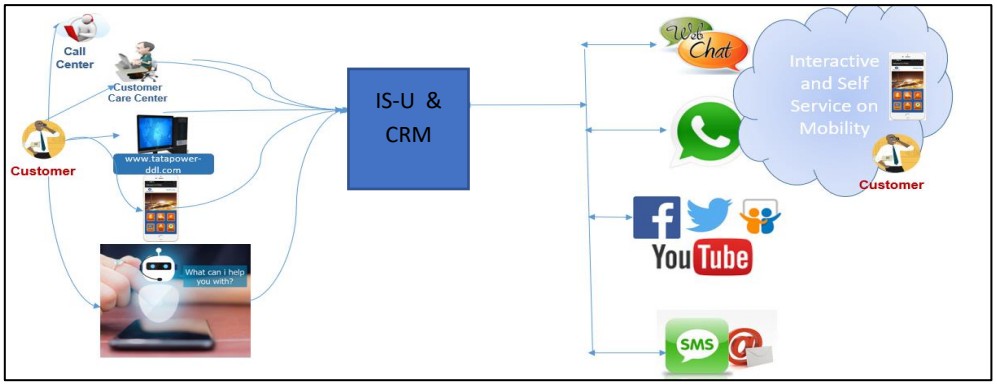


Source: ThinkSmartgrids

Some of the Applications of Blockchain Technology are:

- Origin guarantees of electricity produced from renewable energy sources
- Charging of electric vehicles
- Ledgers in energy trading platforms

The Blockchain technology is also enabling new method of collecting data that can be a new "digital ledger" for economic transactions, agreements, and contracts. Informational data is stored on thousands of computers around the world.



Source: Tata Power-DDL

Digital Twin

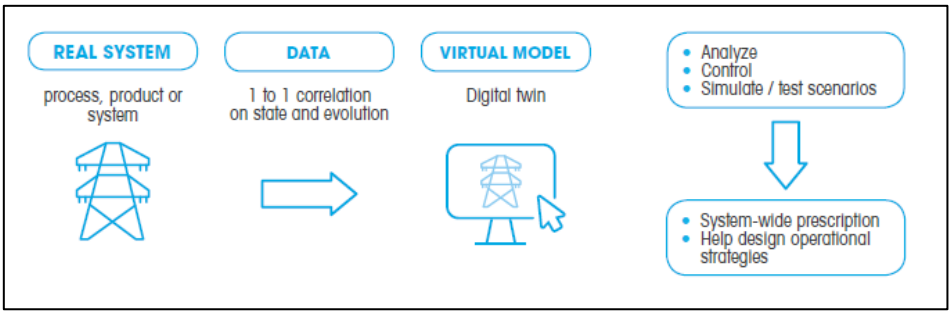
A digital twin is a digital replica of a physical asset, process, product or system, as well as the engineering information for understanding and modeling its performance.

[4] https://www.thinksmartgrids.fr/wp-content/uploads/2019/11/ThinkSmartgrids_livret-data_11.05-vdef-web.pdf

The digital twin can be continuously updated through various sources of information, including IoT devices and sensors. Used for continuous surveying, therefore it can show almost real-time status, working condition, and position. It can enable users to predict and optimize asset performance and status check of the modules and components through real-time visualization, performance analysis, and help in generating insights.

The first generation of digital twins aimed at a physical and offline representation of products. The development of telecommunications brought digital twins (such as SCADA for network control) real-time / real-state functions as a second step, which thanks to IoT has now been extended to many objects.[5]

With digital twins, users can use predictive analytics (AI, simulations) to evaluate system behavior in the short and long term by applying different scenarios.



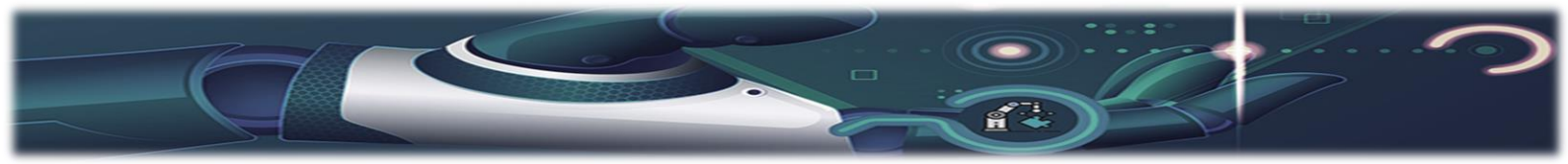
Source: ThinkSmartgrids

The Benefits of a Digital Twin include **Faster decisions for** leveraging near real time visibility on the system, **End-to-end decisions as** extensive data provides more granular, accurate, robust and transparent performance indicators And **Reduced costs of testing** new scenarios (virtual experimentation vs on field experimentation).
The Applications of Digital Twin include Network management, Predictive Maintenance (physical sensors + modeling) to detect problematic behavior before failure and plan appropriate action, Asset management, Supply chain and Infrastructure management.

AR/VR and Metaverse

With advancement of AR/VR technologies, the affordability of the hardware, and recent bigger interest in metaverse, is enabling many other opportunities, including training of staffs. The technology can facilitate virtual visits to a substation, move around in the environment and practice operations and control. It can help in accelerating the training cycle, reducing the travel cost and combined with the digital twin based simulation, can facilitate to tarin in various potential situations, which might occur in the real world.

[5] https://www.gartner.com/doc/3881989/market-guide-technologies-supporting-dto



3 Applications and Case Studies

AI and ML Applications for Utilities

AI leverage various applications for utilities such as, Forecasting Solutions, Monitoring Solutions, Optimization Solutions and Advanced Analytics and helps utilities use all relevant data sources that underpin machine learning models applicable for enhancement of grid asset management and forecasting systems. It will also boost energy-efficiency initiatives, and enrich customer service offerings and engagement, with real-time predictive insights.

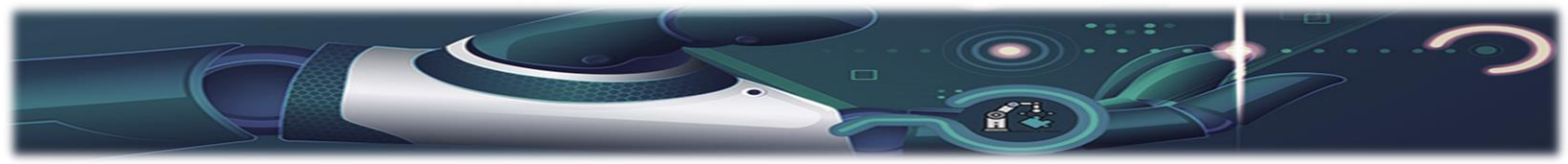
Robotics for Utilities

Robotics solutions for Utilities are available for Cleaning and Maintenance, Inspection and Monitoring, Predication and Optimization, Remote Sensing and Acting and Collaborative Robots. Robotics is increasingly being used to handle the inspection of risky, time-consuming, and hard to reach assets, as well as maintaining those assets and improving their operations in Power Utilities. With use of Robots and drones for inspection utilities are leading to savings on O&M costs.

Some of the applications of Robots include:

- Drone for remote sensing and monitoring, for example for vegetation management for power lines.
- Cleaning and Maintenance Robots, for example for solar panel, for pipelines.
- Mobile robots for inspection and monitoring.
- Suspension Robots for High Voltage Transmission Line Inspection.
- Scanning robot for Maintenance and Optimise casting moulds, for example for wind turbine blades.
- Manipulator Robots for repairing and physical interaction with environment.
- Tele-operated robots for remote operation. For example, to perform manipulation tasks in dangerous environments like nuclear plants, powerline repairing.

Overall, these robots can achieve high efficiency, can be available anytime, can access otherwise difficult to reach locations, have good precision, can reduce safety risks and optimize cost.



Case Studies on AI and Robotics Application for Utilities

Case Study 1

Bentley Systems- Brownfield Substation Projects Reap Design, Collaboration, and Construction Benefits from BIM and Reality Modeling

Technologies: Monitoring and Optimization Solutions

Pacific Gas & Electric Company (PG&E) owns and operates more than 1,000 transmission and distribution substations, spanning two-thirds of California. The substation engineering department has struggled to handle the volume of projects, given the push to modernize the electric grid. With 95 percent of its USD 1 billion substation budget spent on brownfield locations, PG&E had been manually converting existing 2D drawings to 3D models for use on retrofit projects.

A key component of the digital twin is the digital context, which includes reality meshes, point clouds, terrain models, imagery, and GIS sources. It enables multiple cost-saving workflows including online collaboration, remote inspection, virtual operations, in-context design and mixed reality applications. With Bentley's reality modeling solution, easily capture, manage, analyze and share terabytes of reality data of any size, from any system, into one single source of truth that provides 4D digital context to solve infrastructure challenges.

PG&E replaced the traditional design process with reality modeling by deploying a combination of photographic techniques using unmanned aerial vehicles, man lifts, and on-ground equipment. Using Bentley's Context Capture software, the team generated highly accurate reality meshes that were integrated into Bentley's OpenUtilities Substation for intelligent 3D design of upgrades, then shared among design teams through ProjectWise, which is used as the central repository.

Using drone imagery, Context Capture generated a 3D engineering-ready reality mesh that was then consumed in Bentley's OpenUtilities Substation, enabling 3D intelligent designs. PG&E also uses Context Capture to generate a reality mesh of the terrain, producing a quick and low-cost digital terrain model without a full land survey. It can also process images of substation assets, which can be categorized, inventoried, and used to plan condition-based maintenance. Project Wise helps keep all content in one place and allows effective collaboration among different groups or disciplines

Using reality modeling with Context Capture instead of manually converting 2D drawings, PG&E expects to reduce 3D modeling costs by 50 percent. The automatically generated reality meshes are accurate within inches and eliminate the need to take field measurements. As a result, personnel travel to and from the substation facilities half as often. With the adoption of OpenUtilities Substation, PG&E reduced project design time by 40 percent and saved an estimated USD 5.7 million across about 120 substation projects each year.

Source: Bentley Systems

Case Study 2

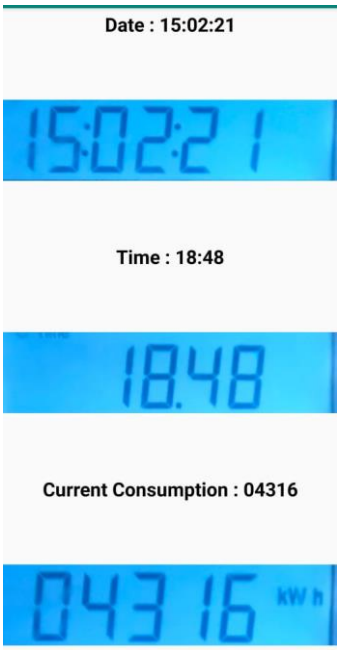
Assetplus Consulting- Applying Artificial Intelligence for Metering, Billing and Collection

Technologies: Advance Analytics and Optimization Solutions

The Utilities Revenue was hard hit as meter reader were not allowed inside premises for capturing meter reading and self-billing application had its own challenges in

delayed billing & payment. CLK2PAY innovated during the covid times is an Advanced AI intervention to enable (a) quickly pull meter reading on the already clicked images (b) Metering, Billing, Collection in less than a minute. The innovation has been adopted to solve pain areas of utilities. The company used data science expertise and applied Deep Learning technology to solve this problem. CLK2PAY not only enhanced the efficiency towards the revenue recognition for utilities, but also enabled the process efficiency. APC team conducted an online survey during covid time, wherein the inputs on delay in existing process were encouraging to create CLK2PAY. The solution has two phases: Phase1: To pull information from images captured by meter reader or customer through self-billing existing utility application as Photo Audit which was earlier a manual or time-consuming progress. Delay of 4-7 days has been brought down to less than one day. Phase2: To provide mobile solution to customer to capture meter reading in real time and process to billing and payment. The aim is to not only improve the revenue recognition process, but also add to the operation efficacy and reduction to the cost in serving the customer. The normal cost of the entire process: (a) meter reading, (b) sending bill, (c) follow up on payment, (d) defaulter or debtors' pursuit, is Rs 15 to 20 per person per month. CLK2PAY, facilitates this in almost one fourth of the cost.

On the technological module side, a mobile device based "apk" uses Deep Learning Deep Learning based OCR as AI engine. The Deep leaning framework "YOLO" has been customized along with RCNN/CNN model to get the meter reading.



Case Study 3

Dominion Energy – Monitoring of Transmission lines, Storm response, asset management, methane emission detection, solar panel examination, land and facility surveys and boiler inspections through Drones

Technologies: Optimization and Inspection & Monitoring

Virginia-based Dominion Energy first deployed drones in 2014, with the focus on linear inspection, which primarily meant identifying defects on electrical transmission lines. Since those early days, Dominion has discovered many other applications and has expanded its drone program to reach various operational business segments, including power generation facilities, gas infrastructure and solar farms.

Storm response, asset management, methane emission detection, solar panel examination, land and facility surveys and boiler inspections are among the many drone use cases that are improving safety and efficiencies for the company.

Highly skilled UAS (Unmanned Aerial Systems) operators are dispatched to the field and they fly a UAS remotely within line of sight. They use the UAS to take high-definition video and photos to identify any equipment that may need repair or maintenance. Flying and hovering around the high-voltage electric transmission system enables inspectors to clearly see any defects that could affect safety or service reliability. Specifically, the inspector surveys the transmission system for structural issues, damaged wire and hardware problems. Additionally, they use UASs to assess storm damage after major events, saving time and resources during the restoration effort.

In 2019, Dominion Energy became the only energy companies in the country to gain approval from the Federal Aviation Administration (FAA) for "beyond visual line of sight" (BVLOS) drone flights under the federal UAS Integration Pilot Program in collaboration with the Virginia Tech Mid Atlantic Aviation Partnership.

Source: Dominion Energy

Dominion Energy was always looking at new technologies that enables the utility to provide reliable service to their customers. The older methods of facility inspection such as flying helicopters and climbing power line structure were considered less safe, and they have a bigger carbon footprint. Drones have a limited environmental impact compared to traditional methods such as helicopters or manned aircraft, and have the

capability to reduce the carbon footprint of inspections process. Dominion Energy planned to use UASs to improve the speed, efficiency, and safety of completing routine and emergency inspections. UASs can be quickly dispatched to conduct preliminary inspections rather than dispatching helicopters, linemen or other field technicians to climb structures or maneuver through hazardous terrain.

Case Study 4

RTE (Réseau de Transport d'Électricité) -France's Transmission System Operator

Technologies: Data Analytics and Predictive Analytics

RTE has chosen simulation to determine their asset management strategies. Indeed, due to the many couplings at work in asset management, such as asset degradation and failures, business processes, operational (intervention grouping, HR), financial (budget, asset financial depreciation), and network constraints (outage, redundancies), it is now necessary to have a global understanding. Accordingly, the considered system may become too complex for straightforward optimization.

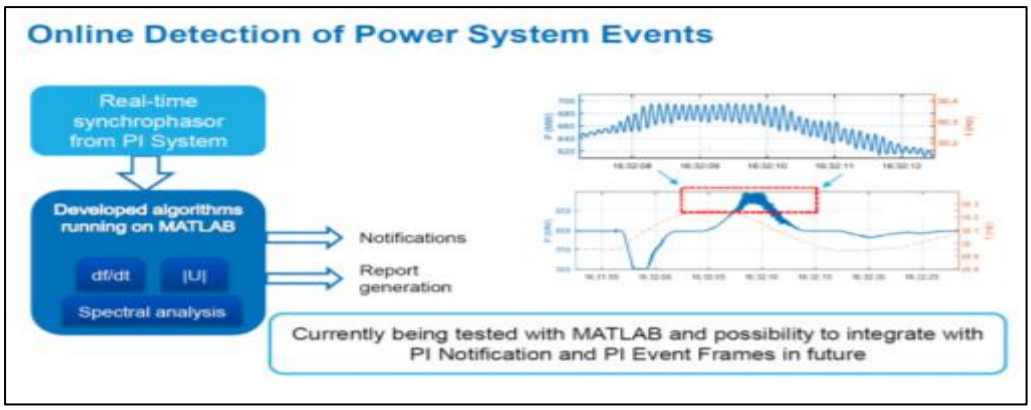
RTE has therefore acquired a digital twin of their electricity transmission network oriented towards "asset management", MONA, based on Cosmo Tech's asset management application. MONA is able to simulate the application of asset management strategies at whole system scale, over the short, medium and long term. It represents each asset in the network with its aging dynamics, the maintenance and renewal operations as well as the resources required to deliver the plan.

Case Study 5

MathWorks - Using Machine Learning and Deep Learning for Energy Forecasting

Technologies: Data Analytics, Predictive Analytics, Monitoring Solutions

Grid Analytics can cover wide varieties of data. MathWorks is using Grid Analytics for monitoring assets and Power System Events. For Asset Management Signal Processing and AI techniques to monitor asset health is being used with the development of Predictive Maintenance and RUL (Remaining Useful Life) Algorithms.



Source: MathWorks

Grid Stability can also be assessed with OSIsoft PI + MATLAB by:

- Integrate with OSI PI to access system data and perform analytics using MATLAB
- Combine visualization and online analysis

Energy Price Forecasting can be achieved by:

- Use AI to forecast Load, Generation and Prices at multiple nodes
- Integrate forecast models with grid simulation to improve system reliability

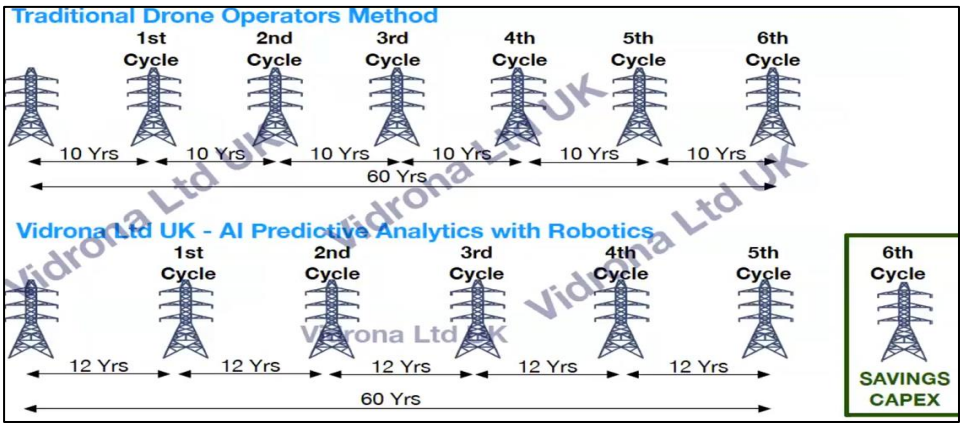
Case Study 6

Vidrona Limited

Technologies: Data Analytics, Predictive Analytics, Inspection & Monitoring Solutions

1. Increased Asset life and improved return on investment

Utilities need to make sure that despite of regulations it should be giving the best power quality to the end user customer at the same time the business should also be making some profit. The quality has to be maintained because the end user should have the un-interrupted supply throughout the period of time.



Source: Vidrona Ltd.

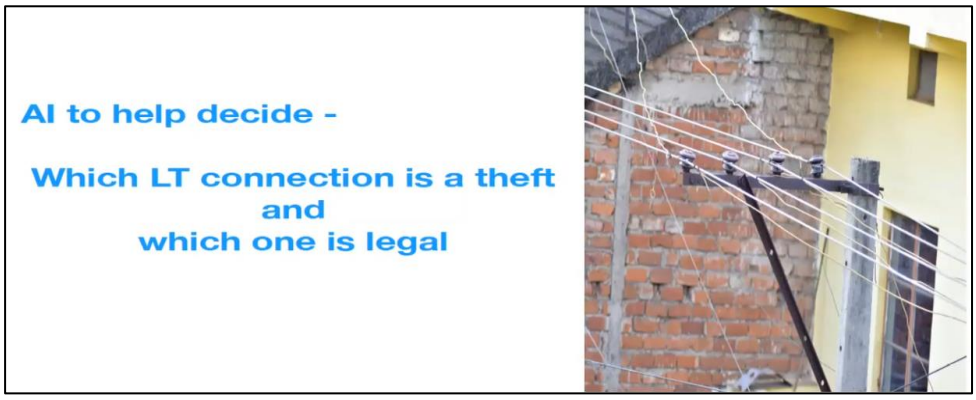
In the above image, through the traditional method of operations and maintenance whether its drone or patrolling, utilities have to spend 60 years and six cycles but by utilizing predictive analytics they are increasing the gap two years with five cycles i.e., utilities have managed to save one complete cycle switch is savings of the capex. A huge revenue is created from the asset since they have 10 years of additional revenue. It is achieved by increasing asset life and which is increasing the revenue and it is also improving the return on investment.

2. Quality Assurance

As a utility company they cannot send a human or engineer to verify each and every aspect of the asset hence, they need to rely on the data. Utilizing AI inspired precision predictive analytical platform will help to see that they have to quantify the quality assurance i.e., if it is a poor-quality work done by contractor then they can immediately send it as an anomaly saying it as a outlier. AI and ML can help in making the decision so there is no need to go and spend time looking for the fault.

3. AI & ML based Analytics for Theft

As a Discom, it is very important to identify the legal and illegal connections. Through AI and ML, they can identify the types of annexures that will be provided as a legal connection and those which will not and are extras. It is a big cost and time saving method as there is no need to spend time by looking manually for the illegal connection. By AI it will identify to provide the exact point for legal or illegal connections.



Source: Vidrona Ltd.

Case Study 7

Eskom Holdings SOC – Enhancing Environmental threat Management through the use of Artificial Intelligence

Technologies: Data Analytics, Monitoring Solutions

Artificial Intelligence and A.I. is used to classify the severity and likelihood of environmental factors such as lightning and fire causing disruptions op a Transmission line. Environmental factors have a significant impact on a Transmission Grid's stability and availability. Recent technological breakthroughs have given rise to technology that is able to track an locate events such as fire and lightning anywhere along a transmission line that has little to no human interaction in Real-time. The volume and rate at which these risks are identified can cause controllers to disregard key information if the risks aren't categorized. Implement Machine Learning algorithms that are able to classify whether a threat such as lightning or fire has the capability to incur a line outage.

Two models were produced that are able to successfully classify the risk of a lightning or fire related disruption with an overall geometric mean score of 70% and 74.5% respectively. Testing on unseen Fire data yielded the confusion matrix from its classifications as in picture below.

	MODEL_O	MODEL_NO
O	819	52
NO	391	652

Source: Eskom Holdings SOC

Case Study 8

Assetplus Consulting- Defaulter Prediction Model and Applying Campaign Management for CASH FLOW improvement /Early Revenue Recognition for Discom

Technologies: Advance Analytics and Optimization & Monitoring Solutions

Utilities tend to realize only 60-70% of the revenue before or on the due date. With atleast 2-5% consumers being chronic in nature for the remaining consumers revenue collection has DSO spread over a month. Any solution in this regard is a welcomed as the Billing collection is always a pain for utility. The AI based solution is helping Delhi based utility to predict the customer payment behavior and apply the business decision to target the customer in phased manner to get the revenue earlier.

Cash Flow Improvement & Revenue Recognition Application platform

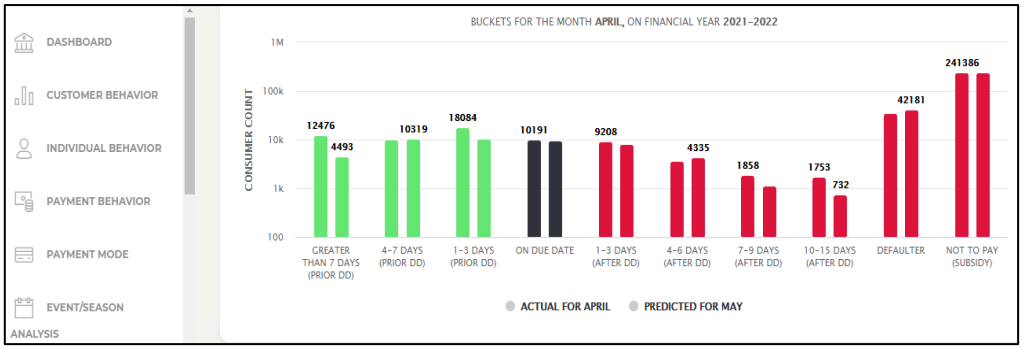


Fig. Defaulter prediction AI Application in use at Delhi & NCR& Ahmedabad Utilities

Also, utility can plan for better mechanism to reduce the burden to decrease the operation cost like reducing the no of cash collection center by shifting customer from cash to online mode. Utility also interested to know the seasonal and event impact to manage the defaulter in a better way. The solution uses defaulter prediction along with consumption forecasting model and then applying ML model to cluster into "Critical", "Severe" and "Mild" category

Problems Areas are Defaulter Prediction Model, Seasonal/Event Analysis and Payment Mode Prediction Model and Campaign Management Solution. Advance ML model has been applied viz. Logistic regression, Bayesian Algorithm, xGboot, and Ensemble modeling for defaulter prediction for next months based on historical data [at-least 12 months data]

Actual_Default_Oct	31554
Predicted_Default_Oct	23175
Accuracy	~73%
Total Value(Actual)	~11 Cr
Total Value (Predicted)	~9 Cr (~81%)
Actual_Default_Nov	**33915**
Predicted_Default_Nov	20280
Accuracy	~60%
Total Value(Actual)	~12 Cr
Total Value (Predicted)	~7.5 Cr (~61%)

Cluster Modeling has been applied on top of defaulter model outcome along with consumption data to get the category of customer as "Critical", "Severe" and "Mild".

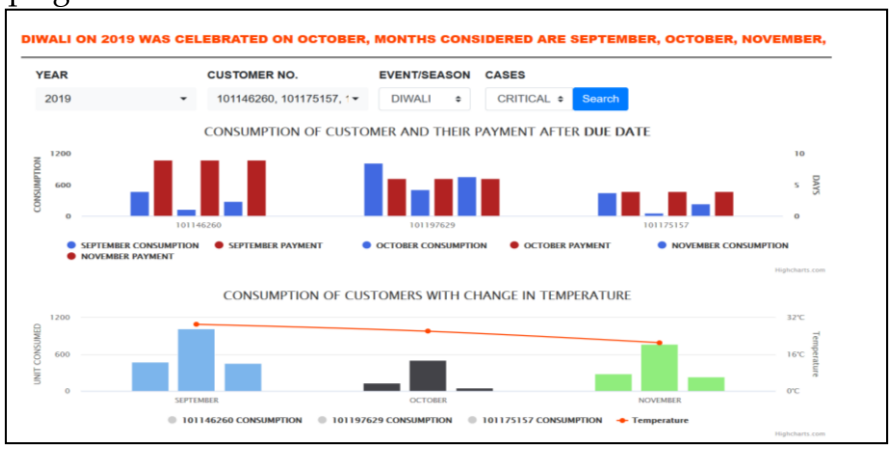
Campaign Solution is applied at two level:

- Level 1:- To target defaulter model outcome to get early revenue using email, SMS, WhatsApp campaign along with IVR. For defaulter field can connect with customer based on amount and history of the customer directly
- Level 2:- To target "Critical", "Severe" and "Mild" customer using email, SMS, WhatsApp campaign along with IVR.

Below data points have been used in the technology:

- Payment Data
- Subsidy Data
- Consumption Data

- MRD Files
- Campaign Data



Case Study 9

Eskom Holdings SOC – Enhancing Transformer Condition Monitoring through the use of Artificial Intelligence

Technologies: Data Analytics, Monitoring Solutions

Dissolved gas analysis and Neural Networks are used to classify the severity and likelihood of agitated internal faults causing transformer failure on Eskoms Transmission network. Transformer failures have a significant impact on a Transmission Grid's stability and availability. Dissolved Gas Analysis (DGA) is a proven solution to prevent premature transformer failure from agitated internal faults. Existing models don't take into account the historic DGA measurements for Eskom transformer failures or the unique characteristics of how they operate on Eskoms transmission network.

Implement Machine Learning algorithms that are able to predict the time to failure of a transformer by taking into account historic DGA data.

Looking at the number of failed transformers versus non-failed transformers, the classifier has a precision of 81.0%, selectivity of 67.5% with a geometric mean score of 74.0%. Testing on unseen transformer data yielded the confusion matrix from its classifications below.

	MODEL_F	MODEL_NF
F	34	8
NF	6303	13070

Source: Eskom Holdings SOC

Case Study 10

Tata Power Delhi Distribution Limited (Tata Power-DDL) – Outage Management Digitalization and Inventory Optimization

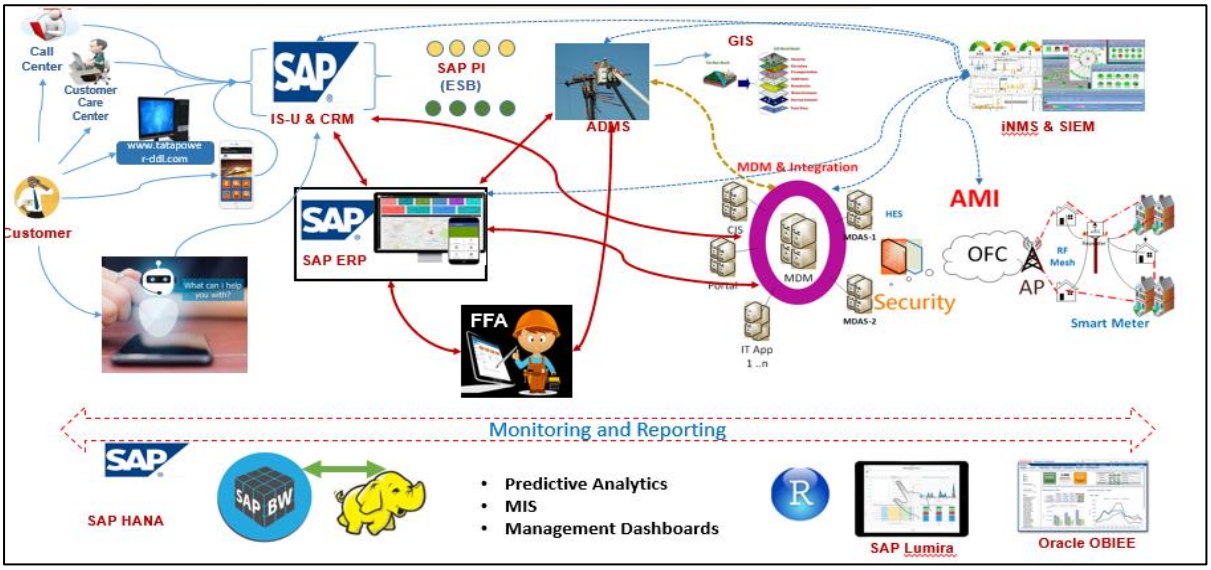
Technologies: Data Analytics, Prediction Monitoring

At the utility TPDDL had identified few basic problems, which need resolution:

- What will be demand of electricity at different hours of the day?
- What is feeder level and Distribution Transformer Load Growth estimation?
- Identify which Consumer is likely to default this month
- How Many Customers will come to the Customer Care today?
- How Many Customers may call at the Call Centre at certain hour?
- Which 11 kV Feeder is likely to trip this month?
- Which employee may resign?
- Can we project cash flow on different days to handle operating cash flow better?
- Can we reduce or optimize the cost of inventory?

TPDDL could create models for all the above and with acceptable level of accuracy, sensitivity. They are working on increasing the sensitivity of prediction of Customer Theft model which is highly skewed data by nature. The business needed the next level i.e., what to do with these predictions, what action to be taken. Like segregation of customers for different type of follow up actions to get the payment. Creation of service order depending upon the Load Growth or Feeder tripping likelihood. Optimizing Cash Collection Agent or Call Centre Agent and in which way.

Outage Management Digitalization



They have reached very high level of accuracy for **load matching, Inventory Optimization, commercial meter forecast, cash flow prediction as well as defaulters predictions.**

Case Study 11

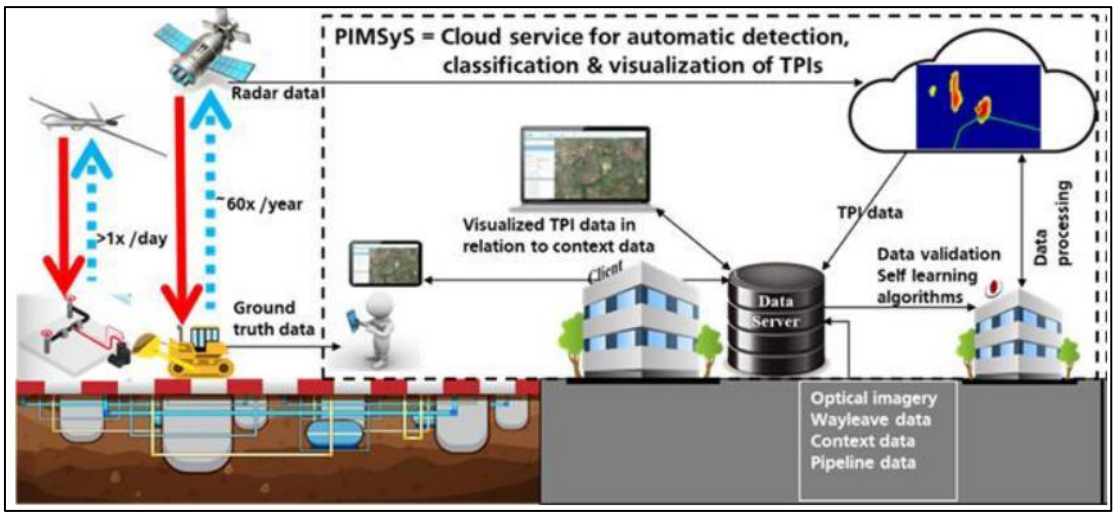
European Space Agency (ESA)

Technologies: Monitoring and Optimization

1. High Altitude Pseudo Satellites (HAPS)

Over the past twenty years, the satellite applications market has grown and propelled the development of space technologies. The number of satellites devoted to Earth observation. Geophysical and geographical observations of the earth from earth orbit have increased continuously in recent years and reached 19% of the 1,459 operational satellites at the end of 2016. HAPS (High Altitude Pseudo Satellite) is considered to be high-in addition to the use of satellite systems, a platform that evolves in the stratosphere could provide significant added value for applications that require great versatility, availability and capacity, real-time information or radio frequency verification of the target.

In the context of pipeline monitoring applications, an important part of the technical solution that enables a robust operational service is a software platform with which the end user can recognize, classify and identify relevant changes / anomalies in his areas of interest as per the image below.[6]

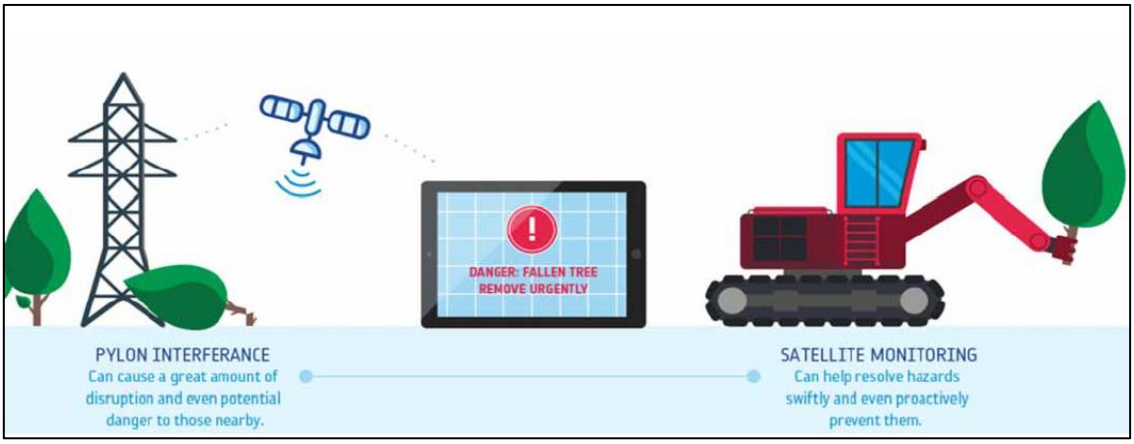


Source: European Space Agency

[6] https://business.esa.int/projects/services-enabled-haps

2. Vegetation Monitoring

Earth Observation Optical and Earth Observation SAR data provide information on tree species & height estimation, determination of the position of trees with respect to power lines. With support of AI solutions for knowing the tree species and environmental condition (including weather), a prediction of vegetation growth can be modelled. Proba-V's Vegetation instrument will provide a continuous daily picture of the state of vegetation across the majority of Earth. It will give a complete coverage of high latitudes each day, with 90% of equatorial regions also acquired. This will provide data imagined for complete land in just two days.[7]



Source: European Space Agency

Case Study 12

Serbot Swiss Innovations – Mobile Cleaning Robot for PV Installations on Roof Tops

Technologies: Cleaning and Maintenance

According to the Serbot Swiss Innovation's website, the robot GEKKO Solar is designed to clean Solar PV panels on roof tops and solar farms, which are difficult to access. The robot cleaning efficiency reaches maximum up to 1040 square meter per hour and average cleaning efficiency reaches up to 670 square meter per hour. It's a good choice for extended roof top installations, where cleaning by hand is hardly feasible. The GEKKO Solar is typically used together with a mobile work platform: from here, the operator can lift the robot comfortably to the roof and control it by radio using a joystick. There is a little trolley for water an energy supply with a hose of about 100 m in length. It has a high cleaning efficiency i.e., 4 times faster than manually. It can be used for steep rooftops included up to 45 °. It has an easy handling; it can be operated by joystick and radio control.[8]

[7] https://www.esa.int/Enabling_Support/Space_Engineering_Technology/Proba_Missions/V_for_Vegetation

8 https://www.serbot.ch/en/solar-panels-cleaning/gekko-solar-robot

Source: Serbot Swiss Innovations

Case Study 13

DroneDeploy– Standardizing Solar Site Assessments with Sunrun

Technologies: Inspection and Monitoring

As published on the website, DroneDeploy generates 3D models for site planning and energy estimates, improve safety to workers, by leveraging APIs to automatically send roof reports to design teams Through 3D models and aerial maps, DroneDeploy automates evaluation and reporting fasten up the survey process, standardize the deliverables, lessen the risks to workers engaging in inspections, and enhance collaboration with stakeholders.[9]

Source: DroneDeploy

[9] https://www.dronedeploy.com/solutions/renewable-energy/

Case Study 14

Jo-Carroll Energy- VR Training for long distance locations

Technologies: Virtual Training

JCE has used VR training program to scan 18 of their 34 substations. Since the scans provide highly detailed, accurate dimensions can be pulled directly from them and eliminates the need to re-create missing engineering drawings. Engineering staff can view and measure substations' equipment and layout remotely and easily. The footage required to develop the VR training, JCE and DMI used Matterport and Leica digital cameras to create highly-accurate, 3D digital scans of the substation's interior and exterior, including the building structure as well as controls and displays. This type of scan is highly precise and can be described as a "digital twin" of the real-life object. Viewers can also see different views of the space, like Google's Street View panoramas.

Jo-Carroll Energy (JCE) performs the following:

- Enable staff to virtually visit a substation
- Move around in the environment
- Practice operations and control

Return of investment in two years

- From reduced drive time of the more than 30 staff who have used VR.[10]

Source: Jo-Carroll Energy

[10] *https://www.cooperative.com/programs-services/bts/Documents/Advisories/Advisory-AR-VR-Case-Study-Jo-Carroll-January-2020.pdf

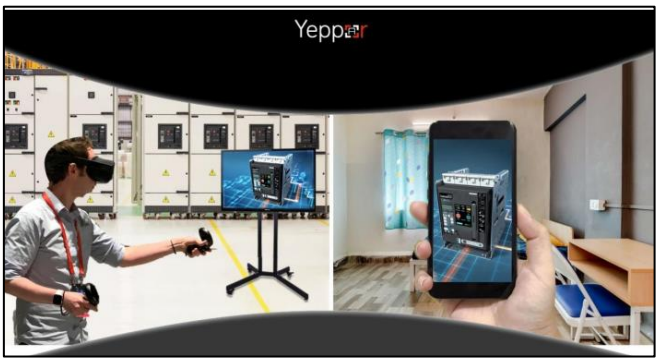
Case Study 15

Yeppar: Virtual Reality Immersive Interactive Experiential Training

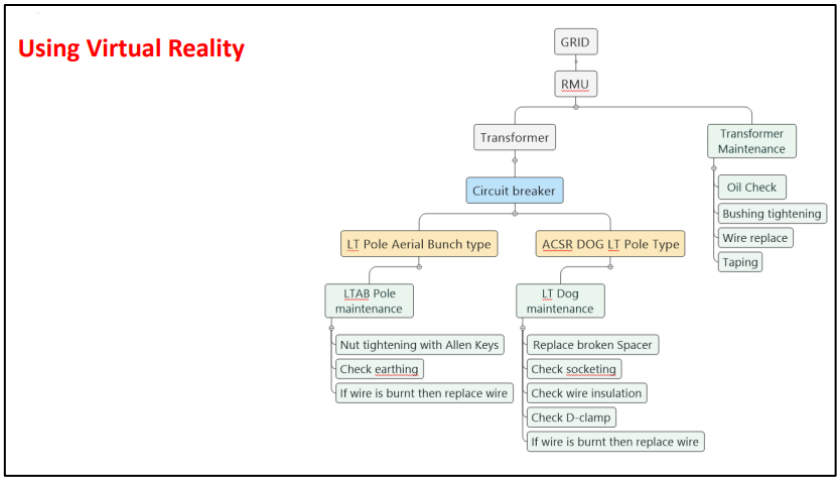
Technologies: AR/VR Training

Yeppar has provided Virtual Reality Solution for BSES, Delhi. The process was performed to utilize Virtual Reality for Training & Guidance for Operators. Operator can get the Training & Guidance to work on the Process Learning using Standalone Virtual Reality HMDs

Modules used were:
- General Safety
- Process (SOPs) Related



Source: Yeppar



Source: Yeppar

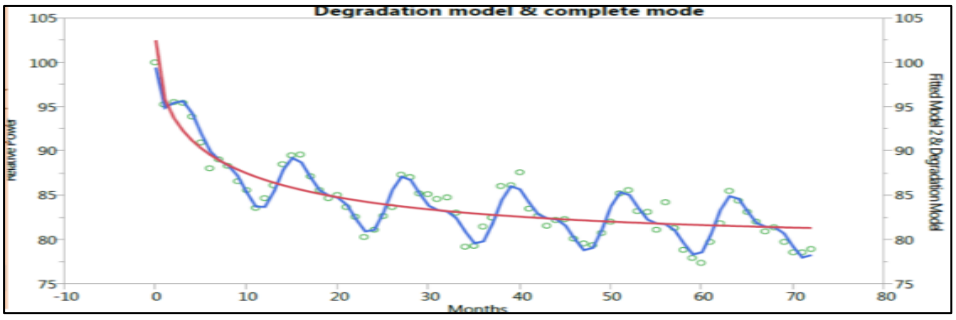
Source: Yeppar

Case Study 16

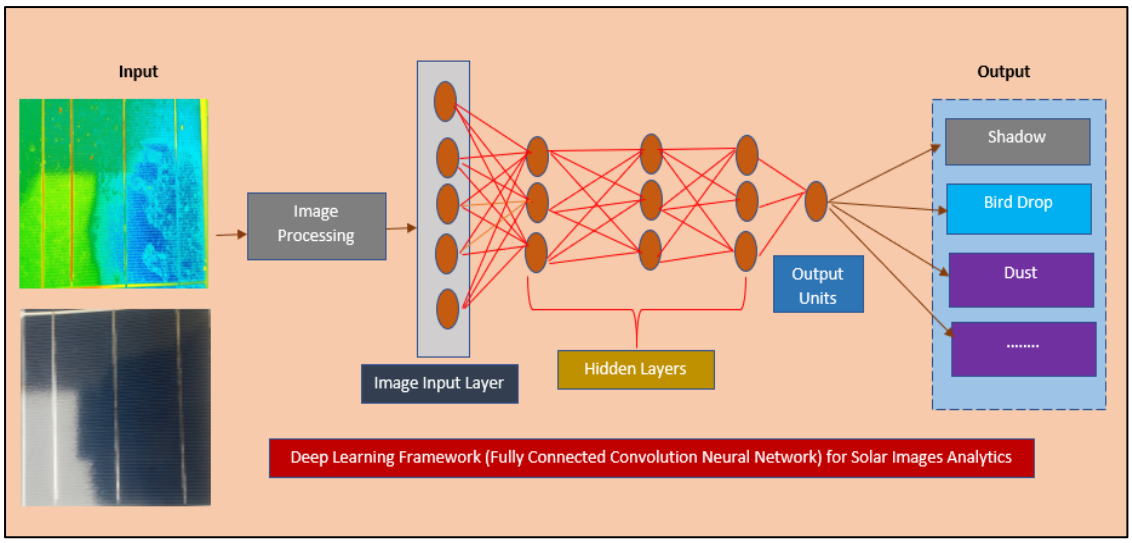
Assetplus Consulting- Analyzing the solar module images using Deep learning and Thermal Image Conversion and establish the degradation equation

Technologies: Data Analytics, Deep Learning

Analyzing the solar plant life is very crucial aspect for successful operation of any solar plant. Even through the panel looks fine but to get the optimal energy generation panel to be analyzed critically and corrective measures must be taken time to time. Current technological advancement provides cost effective and robust solution which must be explored by Solar Developer. The capturing images using drone or IoT based camera can be replaced by traditional image capturing by mobile camera by the persons who are doing operational activity at solar site. The images to be analyzed and all hidden and important parameters to be extract using feature engineering and fed into AI based system for analysis and establishing degradation equation.



Establishing Solar Module Degradation Equation



Identification of Solar Module Degradation Causes

4 Initiatives, Policies and Stakeholders

Initiatives

Globally there are several initiatives.

- **Adra - European Partnership on AI, Data and Robotics**

An initiative to foster European Partnership on Artificial Intelligence, Data and Robotics. It has produced Joint Strategic Research Innovation and Deployment Agenda (SRIDA), with the vision to "boost European competitiveness, societal wellbeing and environmental aspects for value-driven trustworthy AI, Data and Robotics based on fundamental European rights, principles and values." More Details at: https://ai-data-robotics-partnership.eu/

- **AI Committee**

A select committee on AI under the National Science and Technology Council, USA., composed of the most senior R&D officials in the federal government. More Details at: https://indiaai.gov.in/country/usa

- **AIRAWAT (AI Research, Analytics and Knowledge Assimilation Platform)**

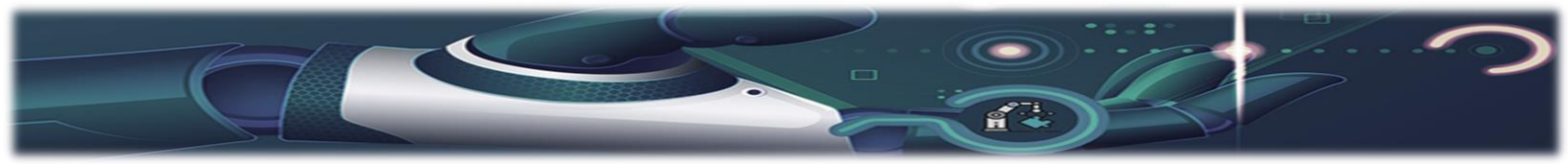
In June 2018, NITI Aayog announced a cloud platform called AIRAWAT for the analysis and assimilation of big data with a large performance-optimized artificial intelligence computer infrastructure that uses advanced processing for artificial intelligence.
More Details at: https://indiaai.gov.in/ministries/niti-aayog?initiative=atl-ai-step-up-module

- **American AI Initiative**

A high-level strategy that guides the development of artificial intelligence in the United States. The initiative will redirect federal funding and resources to research into AI, as well as a call for the creation of US-led international standards for AI and new research to retrain American workers.
More Details at: https://indiaai.gov.in/country/usa

- **Andhra Pradesh Transmission Corporation Electricity Forecasting Model**

Andhra Pradesh Transmission Corporation (APTransco) launched for the first time in India the electricity forecasting model to forecast electricity consumption for the next



day. The development will enable officials at the AP State Load Dispatch Center (SLDC) to minimize decisions about power supply and demand, network management, and purchasing power costs.[11]
More Details at: https://indiaai.gov.in/news/andhra-pradesh-forecasts-energy-needs-using-ai

- **Artificial Intelligence Committees by Ministry of Electronics and Information Technology (MeitY)**

In view of the possible impact of AI on the economy and society and to come out with policy framework on AI, MeitY constituted committees on AI for platforms and data, identifying national missions in key sectors, mapping technological capabilities, key policy enablers required across sectors, skilling, reskill and on cyber security, safety, legal and ethical issues.
More Details at: https://www.meity.gov.in/artificial-intelligence-committees-reports

- **ARTPark, India**

AI and Robotics technology park, based on public-private collaborative model, aims to bring innovation through its various support mechanisms, in several sectors, in which Robotics and AI can be applied.
More Details at: https://www.artpark.in/

- **ASR initiative by CSIR, South Africa**

The Council for Scientific and Industrial Research (CSIR) is working on the use of automatic speech recognition (ASR) to support language learning and translation.
More Details at: https://bit.ly/3GKXSEB

- **euRobotics – the European Union Robotics Community**

euRobotics aisbl, is a collaboration of various stakeholders in Europe. It has produced the Multi-annual Roadmap (MAR) and the Strategic Research Agenda (SRA) for robotics in Europe in collaborated with the European Commission through SPARC, a Public-Private Partnership under EU Horizon2020, and among the largest civilian funded robotics innovation program in the world (https://www.eu-robotics.net/sparc). It is supported by a set of topic groups representing various technologies and applications sectors, through networks of experts.

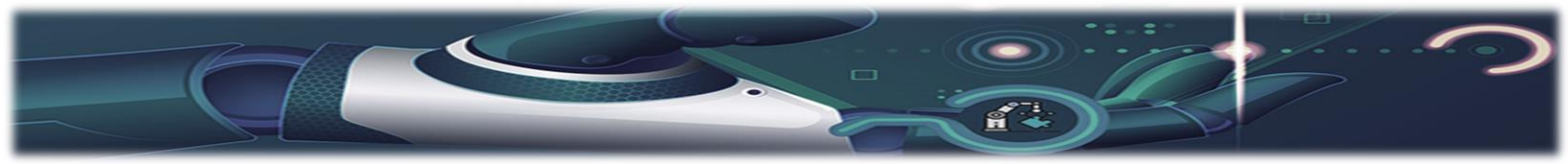
More Details at: https://www.eu-robotics.net/

- **Global Partnership on Artificial Intelligence (GPAI)**

GPAI is an international and multi-stakeholder initiative to guide the responsible development and use of AI, grounded in human rights, inclusion, diversity, innovation, and economic growth.
More Details at: https://pib.gov.in/PressReleasePage.aspx?PRID=1631676

- **India Smart Utility Week by ISGF**

[11] https://indiaai.gov.in/ministries/government-of-andhra-pradesh?initiative=forecasting-energy-needs



Aa flagship annual event, since 2015. Serving as a single platform for discussion on the new technologies and integration in the utility ecosystem. More Details at: https://www.isgw.in/conference-themes/

- **NITRD Task Force, USA**

Network and Information Technology Research and Development Subcommittee (NITRD) - AI working group in USA defines the federal government's strategic priorities for AI R&D, with an emphasis on areas the industry is unlikely to address. More Details at: https://indiaai.gov.in/country/usa

- **Responsible AI for Social Empowerment**

The virtual summit (RAISE 2020) was a global summit for artificial intelligence organized by the Indian government in cooperation with industry and science. More Details at: https://raise2020.indiaai.gov.in/#overview

Efforts on Policies, Regulations and Standards

- **AI working group by the Ministry of Trade and Industry, India**

An AI working group set up by the Ministry of Trade and Industry, India, prescribes principles that developed AI systems should follow, including transparency and explainability of the AI systems, data protection, security and protection. More Details at: https://indiaai.gov.in/country/india

- **AI-Powered Enterprise Asset Management Solution**

The Electricity Generating Authority of Thailand (EGAT), Thailand's largest power producer under the Ministry of Energy has selected IBM's AI-powered enterprise asset management solutions to help manage the high-value assets of its electric power plants.
More Details at: https://ibm.co/3HVKEGA

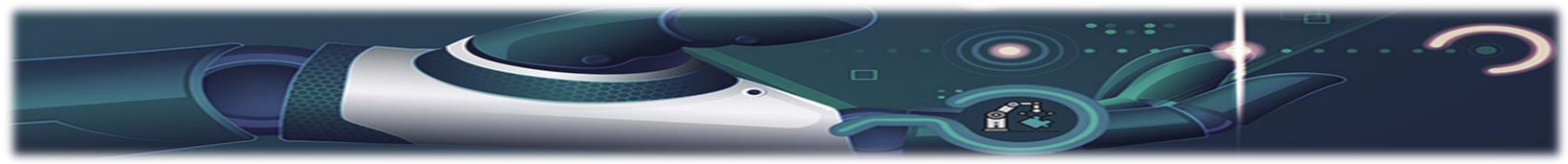
- **Executive Order on Maintaining American Leadership in AI**

Executive Order on Maintaining American Leadership in Artificial Intelligence provides for identification of data and models for consideration for increased public access. It further acknowledges the need for data documentation, formatting, interoperable and machine-readable data formats. More Details at: https://indiaai.gov.in/country/usa

- **FUTURE of AI Act 2017**

The FUTURE of AI Act 2017 was introduced in December 2017 in both the House and Senate, in USA. The resulting committee would consider US competitiveness, workforce and technological change, education, ethics, data sharing, international cooperation, accountability and legal rights, cultural and social norms, impacts on rural communities, and government effectiveness. More Details at: https://indiaai.gov.in/country/usa

- **India-South Korea collaboration in AI**



In July 2018, India and South Korea signed five memorandums of understanding (MoUs) in the field of new tech. The collaboration focuses on Internet of Things focused on agriculture, energy, water and transportation
More Details at: https://indiaai.gov.in/country/south-korea?standard=interoperability

- **MEITY'S Experts Committee**

Union's Department of Electronics and Information Technology (MEITY) set up a Committee of Experts to study, identify and recommend methods of addressing key privacy issues. The report made several recommendations on protecting data protection in connection with emerging applications of artificial intelligence and big data.
More Details at: https://indiaai.gov.in/country/india

- **National Science and Technology Council**

The National Privacy Research Strategy (NPRS) established by the National Science and Technology Council, USA aims to respond to privacy issues arising from the large-scale use of information technology and big data systems.
More Details at: https://indiaai.gov.in/country/usa

- **NIST (National Institute of Standards and Technology)**

NIST (National Institute of Standards and Technology) is participating in the creation of international standards that ensure innovation, public trust and confidence in systems that use AI technologies, and security and protection to improve the reliability of AI systems for users. Also, to set technical standards that provide a clear framework for designing artificial intelligence systems that can be easily integrated with other technologies.
More Details at: https://indiaai.gov.in/country/usa

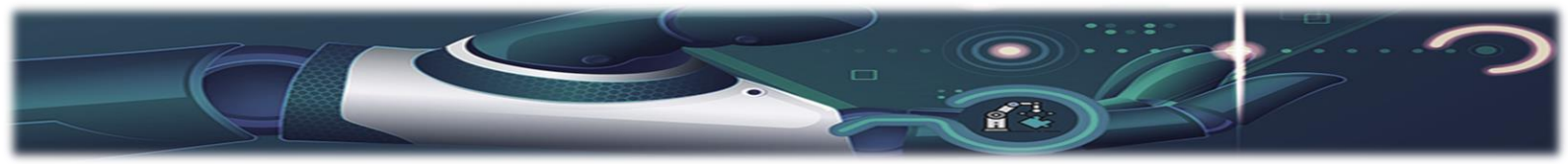
- **Public Discussion Conference**

The USPTO (US Patent and Trademark Office) hosted a public discussion conference with IP specialists on topics such as economic frameworks and implications, how to protect inventions related to AI and international ones discuss perspectives in this regard. The US Copyright Office's Compendium of Practice provides some basic guidelines that prevent works made by a machine without creative input or human intervention.
More Details at: https://indiaai.gov.in/country/usa

- **Report on Liability for AI Systems**

The US National Science and Technology Council's technology committee published a report on liability for AI systems and recommended extensive testing of AI systems with an emphasis on boxing algorithms.
More Details at: https://indiaai.gov.in/country/usa

- **SPD rules**



The SPD rules (Adequate Security Practices and Procedures and Sensitive Personal Data or Information), India, outlines the liabilities aspects for indemnification for negligence in the implementation and maintenance of Reasonable Security Practices. More Details at: https://indiaai.gov.in/country/india

- **The National Strategy on AI**

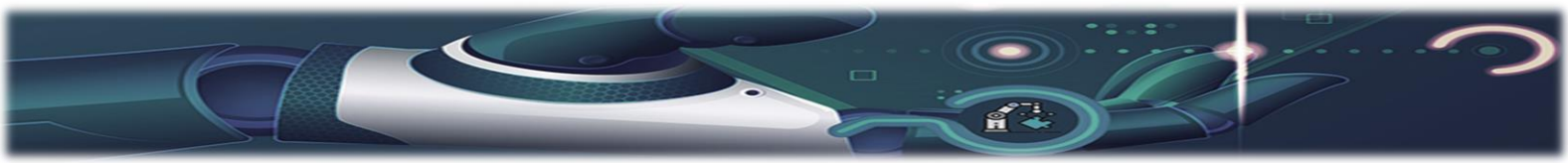
The National Strategy on AI, India has policies formulated for the following:

- Civil Liability of Artificial Intelligence: the issue of liability by drawing parallels with the airline industry wherein every accident is meticulously investigated to eliminate loopholes in security thereby making the industry safer and service providers more accountable.
- Interoperability: Of big data in specific sectors to ensure that data provided is operable in common AI platforms and frameworks used by AI researchers.
- AI and Network Security: recommendations of strategies to develop a better and more secure cyber network.
- AI and Intellectual Property Rights: Issuing appropriate changes to the IP regulatory system related to AI.
- Transparency: Developing a FAT (Fairness, Accountability and Transparency) framework with the aim of following standard practices in the development of AI tools and products.

More Details at: https://www.niti.gov.in/sites/default/files/2021-02/Responsible-AI-22022021.pdf

- **The N-CAIR Initiative**

The N-CAIR is also an initiative created to encourage tech giants like Google, Amazon, and Facebook to invest their AI research and development in the country, which in turn is expected to empower workers and provide opportunities. In line with this initiative, the Philippines' Department of Science and Technology's council for Industry, Energy and Emerging Technology Research and Development (DOST PCIEERD), opened programs that would support the development of AI technologies in the country.
More Details at: https://ai4da.com/ai-readiness-in-the-philippines/



5 Conclusion

The Value Propositions

Benefits

1. Supply and Demand: Today's AI delivery is largely data-driven. Utilities are adopting AI technologies for big data automation, predictive or prescriptive analytics, and machine learning. The IT department is the primary user of AI technologies, followed by operations and data that are exploited in an advanced manner through AI technologies is a critical driver for a future sustainable energy ecosystem that includes an adequate mix of fossil fuels and renewable energy. The demand management problem of the grid is resolved by AI through using predictive algorithms solutions to help in deciding to store and releasing energy and help balance the grids. The predictive algorithms also accurately estimate the production and consumption of small-scale producers and consumers.

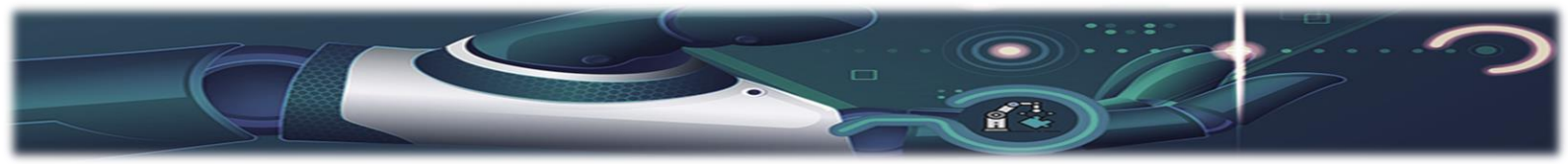
2. Efficiency and Reliability: AI also helps improve the profitability of energy, another crucial element of sustainability. AI makes the home energy efficient. AI technologies like predictive analytics and machine learning can monitor various parameters to detect anomalies and repair systems automatically. AI is used for predictive maintenance, which uses weather, sensor and temperature data, among other things, to detect and prevent errors in your infrastructure.

3. Optimizing Production: AI solutions are also changing the scenarios for traditional energy production. AI can take data, such as flow rate, pressure, and vibration, and combine that with environmental information to optimize operations.

4. Consumer Engagement: While current AI implementations are primarily intended to improve production and sales processes, AI can also have the greatest impact on business and consumer engagement. [12]

5. Data Analysis: AI ensures optimal efficiency by implementing changes based on the analysis of energy consumption trends. AI enables utilities to respond

[12] https://www.infosys.com/smart-automation/documents/energy-utilities-ai-perspective.pdf



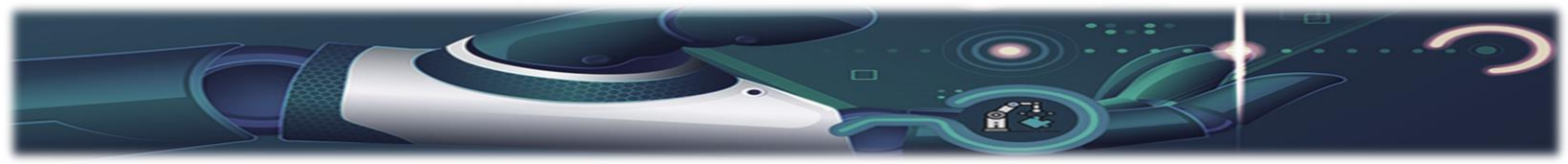
instantly to ways to respond to demand without interfering with them. Through AI, distributed energy storage systems can be used effectively and optimal storage can be ensured at all times. AI can determine peak times for electricity generation from renewable sources based on the analysis of weather patterns. I can also study complex market trends and analyze data to create power purchase plans that kill market volatilities.

- Using real-time and batch processing tools, big data can be used to evaluate current green strategies and assess whether these strategies are actually working.
- Monitoring device power usage patterns and comparing them to similar devices and locations can help prevent unexpected device, device, and system failures.
- Big Data solutions allow you to monitor device performance pressures in real time. For example, if a particular part failure causes a machine to consume excess energy, such patterns can be identified using big data.
- Providing detailed, real-time energy data for every device and system as part of encouraging changes in human operating patterns and rewarding their design can result in permanent behavioral changes.
- Enables a detailed analysis of the energy demand and the energy load as well as the effects of distributed generation resources.

6. Better Communication: With AI and IoT, efficiency can be achieved by activating intelligent lighting based on presence detection or meeting confirmation. We can control heating and cooling in a building based on presence detection. OT can communicate with external devices such as a smart grid to control energy consumption and minimize system stress. It also supports the scalable integration of clean and efficient technologies like photovoltaic and electric chargers. Through AI and IoT integration and coordination with connected devices (load / generator / storage) for energy and financial efficiency.

7. Cloud and AI: The cloud and artificial intelligence help reduce the carbon footprint of companies by giving them remote access to their computing resources. Improves performance for more operational flexibility at a lower cost to deal with competition, regulations, and market conditions. Enhance supercomputing capabilities and support intensive analytical activities such as Geospatial Seismology and 4D. Modeling artificial intelligence and the cloud also helps build deeper customer relationships and brand value using cloud-enabled customer relationship management and social media tools.[13]

[13] Sustainable Energy Management with Artificial Intelligence (PDF)



Barriers and Challenges

1. Regulation for Sensitive Data: Many end users are critical of artificial intelligence, especially with regard to smart home technologies. because data is collected from the most private area that reveals a lot about its users. Studies have shown that the biggest barrier to smart meter adoption is the fear of divulging private information without knowing exactly how it is being used. These fears are justified as there are as yet no regulations in place for handling this sensitive information, which is important for the electrical system of the future.

2. Power Consumption: Processing large amounts of data consumes a lot of electricity. When using AI to transform energy systems, it is important to also consider the design of the data center. Possible solutions to this dilemma include physical proximity to data centers and power plants for generating renewable energy, postponing energy-intensive computing processes to times when a lot of electricity is available, more efficient IT hardware in the energy sector, or programming that requires the least amount of computing power.[14]

3. Inaccuracies in the results: Data limits the functionalities of AI as it is developed only through the given data. There is no other way to incorporate knowledge means that inaccuracies will be shown in the results and additional forecasting, or analysis layers must be added separately.

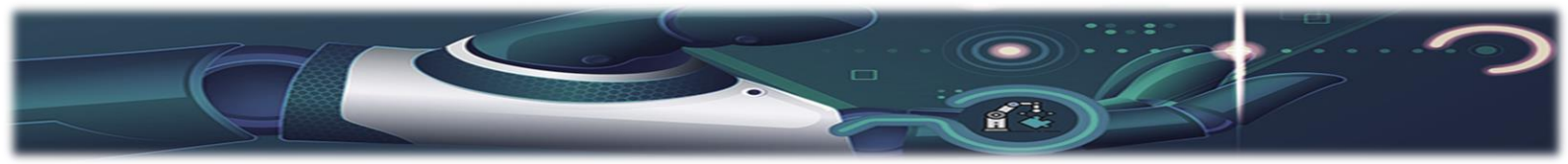
4. Emotional Intelligence: AI lacks emotional intelligence because it cannot divide human feelings and ways of thinking into clear data points or profiles.[15]

5. Safety, Security, Privacy: The power supply and the entire energy system are part of this critical infrastructure, which is why cybersecurity is becoming increasingly important today and in the future in order to protect the highly networked power grid from external attacks and data theft. Data protection and security has strict requirements for the participants in the electricity markets.

Electricity ecosystem stakeholders face challenges regarding the maintenance of resilience which is a significant priority for critical infrastructure.

With all the digital technology being used for the modernization of the grid, there is a raising concern that this growth increases exposure to cyber-attacks leading to the vulnerabilities of the power supply. As utilities increasingly adopt business models that connect power generation, transmission, and distribution assets to Information Technology (IT) systems, critical infrastructure is more vulnerable to cyber-attacks.

[14] https://www.next-kraftwerke.com/knowledge/artificial-intelligence
[15] https://www.analyticsinsight.net/top-5-limitations-artificial-intelligence/



Use of drones or robots for the inspection and maintenance of energy infrastructure also poses a major cyber threat. The GPS navigation systems in latest drones have evolved towards accuracy enabled it to be auto-piloted using pre-programmed directions. There are vulnerabilities present within all navigation systems that would allow a cyber hacker access to the drone's data stream or telemetry link connection, or they could even spoof the connection to the pilot's ground station, allowing complete control of the interface. Both scenarios are cause for concern from the perspective of potential threats.

Also, drones capture detailed data about power & utilities infrastructure, there is a growing risk that confidential information could be hacked. This concern requires the implementation of data security systems to ensure effective protection. Data gathered by drones are usually transmitted to the cloud via Wi-Fi or Bluetooth, which increases exposure to cyber-attacks. As a result, drones are extremely vulnerable to cyber threats both on controlling it and on the data communication.

Applying AI and big-data analytics for monitoring and detecting cyber threats in the operating environment helps defenders create a unified picture of anomalous behavior and draw out actionable insights for defenders to stop attacks.

Recommendations

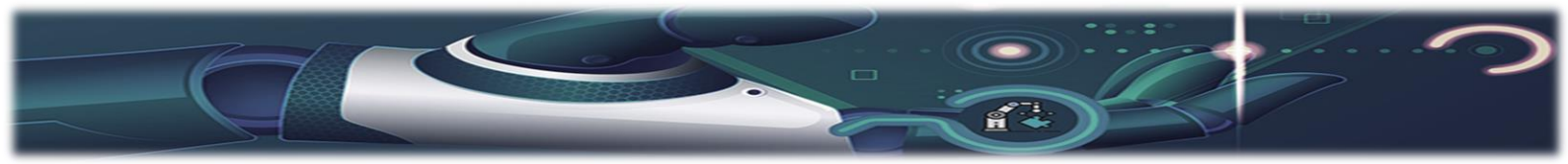
Integration of Robotics and AI in utility sector is unavoidable and happing with unprecedented manner.

Policy-makers, regulators, utilities and solution providers should collaborate to create a collaborative alignment for cybersecurity regulations for the power sector y across countries and regions, while retaining the flexibility to tailor their regulations to reflect their unique needs and national interests.

Following are the findings of The Systems of Cyber Resilience in Electricity (A World Economic Forum (WEF) community):

- Development of principle-based global cybersecurity regulatory guidance, enabling utilities to align their cybersecurity practices across regions, enhancing flexibility.
- A common product certification approach, with limited and specific use cases, to assist utilities in securing their supply chains.
- Enhanced collaboration across government, industry, academia and supply chains, leading to more flexible, effective and targeted regulatory and information- sharing practices.

The above findings are based on the analysis of the gaps in current regulations, and opportunities which are identified for improvement in regulatory practices for public and private sector entities to further enhance cyber resilience in the ecosystem.



At the same time there is a great need of development of right skills and upskilling. The right kind of training and certifications programs should be developed and implemented.

The Way Forward

Robotics and AI, no doubt are changing the way the entire ecosystem operates, and with obvious benefits:

- Reduces human workload.
- Supplements human's abilities.
- Reduces safety risks and dangers for human.
- Mitigating human errors.
- Improves efficiency of the ecosystem.
    - Realtime integration of energy resources
    - Cost optimization
- Capable of handling large amount of data.
- Finding hidden and useful patterns.
- Predicting "situation" well in advance.
- More interactive, information rich, able to perceive environment, act intelligently.
- Facilitating remote sensing and monitoring.
- Creating better connected world.
- Facilitating to operate in harsh environment.
- Can help in search and rescue situations.

Also, they are able to take the load of Handling routine tasks, allowing people to focus more on critical tasks and be more creative.

With right kind of technology ecosystem integration, we will be able to address other environmental issues including global warming, pollution, and ensure unprecedented safety and comfort for the human involved.

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