

THE IMPACT OF AUTOMATION ON THE POWER INDUSTRY

Growing at a brisk pace, India continues to emerge as a major economic power. However, it also remains among the leading global CO₂ emitters. According to the Global Carbon Budget-2022, India accounted for 7% of the global fossil CO₂ emissions in 2021. India's annual emissions are estimated to be about 2.6 gigatonnes, 1/3rd of which is contributed by the coal-based thermal power sector. While the growth of renewable power capacity has been the success story of India's clean energy transition, enhancing efficiency in the generation and transmission of power through increased automation holds the key to India reaching net zero by 2070.

Key to India's Energy Transition

As per the World Energy Outlook 2022, spurred by annual GDP growth of more than 7%, India's energy demand will continue to rise at over 3% per year between 2021 to 2030. It further says that despite India's rapid strides in renewables deployment, coal will continue to meet a third of its overall energy demand growth till 2030. With coal being the backbone of its electricity system, India remains among the leading consumers of coal. According to the International Energy Agency, India's coal consumption has doubled since 2007 at an annual growth rate of 6% and will continue to be the growth engine of global coal demand.

While India is aggressively working towards enhancing its renewable power capacity in pursuance of the Nationally Determined Contributions (NDCs), enhancing efficiency in thermal power generation and transmission is as much crucial for the sustainable development of the energy sector. Herein comes automation which is revolutionising the power sector globally.

Automation Transforming the Power Sector

The global utility sector is undergoing unprecedented change with decarbonisation and decentralisation having a significant impact. The sector is moving from its conservatively regulated past to a new future where innovation is the key. Emerging technologies such as the Internet of Things (IoT), Big Data Analytics, and Artificial Intelligence (AI) are playing an increasingly important role in the automation of the power sector.

Digitisation is playing a pivotal role in managing the balance between demand and supply, boosting efficiencies across the value chain, improving customer experience, and transforming business.

With the increasing demand for energy, the Government has been actively pursuing the implementation of automation technologies in the power sector to enhance efficiency, reduce losses, and improve the quality of power supply. This has led to the adoption of advanced automation systems such as Supervisory Control and Data Acquisition (SCADA), Advanced Metering Infrastructure (AMI), and Distribution Management System (DMS) across the power sector value chain.

Some of the key impacts of automation in the power sector are:

Increased Efficiency

Automation has led to increased efficiency in power generation, transmission, and distribution. Automation technologies such as Supervisory Control and Data Acquisition (SCADA), Programmable Logic Controllers (PLCs), and Distributed Control Systems (DCS) have helped power plants operate more efficiently and reduce downtime. Like robots and drones, the Internet of Things (IoT) devices are capable of amassing large amounts of data on the performance of individual components of electricity production and delivery systems. They can perform this task and respond to problems automatically, and they use their wireless connections to the internet to make operational information available to any utility employee who needs it and in real-time, too.

Reduction of Losses

A major impact of automation on the Indian power sector has been the reduction of power losses. With the implementation of smart grid systems, utilities have been able to monitor power consumption in real-time, identify inefficiencies in the power supply chain, and take corrective actions to reduce losses. Furthermore, automation has also enabled better load management and control, allowing utilities to balance the demand and supply of electricity more efficiently. This has led to increased reliability of power supply and a reduction in power outages, thereby benefiting both consumers and the overall economy.

According to the Ministry of Power statistics, Aggregate Technical and Commercial Loss (AT&C Loss) of the DISCOMs in the country has declined significantly to 17% in FY2022 from 22% in FY2021.

Adoption of Smart Grids

India has been promoting the adoption of smart grids, which involve the use of advanced automation technologies to manage power supply and demand more efficiently. Smart Grid is an Electrical Grid with Automation, Communication and IT systems that can monitor power flows from points of generation to points of consumption and control the power flow or curtail the load to match generation in real-time or near real-time.

Smart grid solutions can contribute to the reduction of transmission and distribution losses, peak load management, improved quality of service, increased reliability, better asset management, renewable integration and better accessibility to electricity.

The Government in 2015 launched the National Smart Grid Mission (NSGM) to monitor the implementation of policies and programmes related to Smart Grid activities in India. As part of

the Smart Grid programme over 10 crore smart meters are being installed across the country. connected to the internet, these smart meters record electricity consumption in real-time.

Predictive Maintenance

Artificial intelligence (AI) and machine learning (ML) are being extensively used to predict equipment failures and optimise maintenance schedules. By analysing data from sensors, AI and ML algorithms can identify patterns that indicate when equipment is likely to fail. This enables power companies to schedule maintenance before a failure occurs, reducing downtime and repair costs. Drones are being used with high-definition cameras to check the transmission lines parts which are commissioned at high altitude areas, mountains, rivers, etc where line patrolling is not possible.

Predictive maintenance algorithms can analyse sensor data to identify when equipment is likely to fail and schedule maintenance before a breakdown occurs. The Indian power sector too has been using the power of automation to perform maintenance activities proactively, avoiding unplanned downtime and reducing costs.

Improved Safety

Automation has made the power industry safer by reducing the need for manual intervention in dangerous tasks. For example, robots can perform tasks such as cleaning and inspecting boilers and turbines, which are dangerous and require workers to work at height or in confined spaces. By automating these tasks, power companies can reduce the risk of accidents and injuries.

Augmenting Renewables

Automation is also playing a significant role in the Indian renewable energy sector, helping to improve efficiency, reduce costs, and enhance safety.

Companies in the solar energy manufacturing space are using robotics and automation to streamline and optimise various production processes. By leveraging advanced technologies such as robotics, artificial intelligence, and machine learning, solar power manufacturers can improve the efficiency, accuracy, and speed of their operations. Some of the key areas in the solar power manufacturing process where automation is being used include silicon ingot growth, wafer slicing, cell processing, and module assembly. For example, robotic arms can be used to precisely cut and shape silicon ingots, while automated inspection systems can quickly and accurately detect defects in solar cells.

Automation is also being used extensively by the wind power manufacturing industry to bring in higher efficiency, lower costs, improved quality, and consistency.

From using robotics to precisely control the shape and dimensions of the wind turbine blades or applying layers of composite materials with consistent quality and thickness or using automated

testing systems to ensure the quality and functionality of the final product, companies have embraced automation in a big way across the renewable energy sector.

Coupled with the Government's increased focus and automation bringing in cost efficiency, India has been making big strides in enhancing renewable power capacity.

Currently, India stands 4th globally in Renewable Energy Installed Capacity as well as 4th in Wind Power capacity in Solar Power capacity. A total of 14.21 GW of Renewable Energy capacity was added, during January to October 2022 as compared to a capacity of 11.9 GW added during January to October, 2021.

Not just in terms of renewables, automation has also contributed to the rise of India's total installed capacity, which has grown at a brisk pace over the years. Currently, the total installed generation capacity including the government and private sectors, is 4,11,649 MW. Of this, the share of non-fossil fuel power is 1,75,180 MW accounting for 42.5%.

Enhanced Reliability

Automation technologies have increased the reliability of power systems by reducing the chance of human error. It can help to detect faults and failures in the power system more quickly and accurately than manual monitoring, thereby helping to prevent or minimise downtime and improve overall system reliability. Moreover, automation can facilitate better coordination and control of the power system, enabling faster response times to change in demand and supply, and better management of system stability.

Automation can also improve the accuracy and efficiency of power system operations, such as load balancing, voltage control, and fault isolation and restoration, which can reduce the likelihood of outages and improve system reliability. For example, a digital automated distributed control system (DCS) can detect abnormal operating conditions and automatically shut down equipment to prevent damage. This helps to prevent outages and reduces downtime.

Better Asset Management

Automation has enabled better asset management in the power industry. With automation technologies, power companies can monitor and track their assets in real time, enabling them to schedule maintenance and repairs more effectively. For example, predictive maintenance algorithms can analyse sensor data to identify when equipment is likely to fail and schedule maintenance before a breakdown occurs.

Reduced Costs

Automation has helped to reduce the operating costs of power plants. By automating tasks that were previously done manually, power companies have been able to reduce labour costs and increase efficiency. For example, robots can perform routine maintenance tasks, such as cleaning, without the need for human workers. This reduces labour costs and enables workers to focus on more complex tasks.

Load Forecasting

Load forecasting is a critical task for power system operators to ensure the stability and reliability of the power grid. Automation can greatly improve the accuracy and efficiency of load forecasting by utilising advanced algorithms and data analysis techniques. Machine learning techniques such as artificial neural networks, decision trees, and support vector machines can be used to analyse historical load data and predict future load demand. This helps power companies optimise their operations by ensuring that they generate and distribute the right amount of power at the right time.

Energy Trading

Energy trading is a complex process that involves buying and selling energy commodities such as electricity, natural gas, oil, and other energy products. With the increasing demand for energy and the need for efficient and cost-effective trading, automation has become an essential tool for energy traders. AI and ML algorithms can be used to optimise energy trading. By analysing market data, these algorithms can predict energy prices and help power companies make more informed trading decisions.

Grid Optimisation

AI and ML algorithms can be used to optimise the power grid. For example, these algorithms can analyse data from sensors to detect anomalies and automatically adjust power flows to prevent outages.

Energy Efficiency

AI and ML algorithms can be used to identify opportunities for energy efficiency. For example, these algorithms can analyse energy consumption data to identify areas where energy is being wasted and recommend changes to improve efficiency.

New Employment Opportunities

Notwithstanding its potential to improve efficiency and productivity, automation also tends to raise concerns about job loss. Contrary to the belief that automation tends to create job displacement, it has been a driving force behind economic growth for decades. By enabling enhanced efficiency and reduced costs, automation boosts economic activities which in turn leads to employment generation.

Thanks to India's ambitious renewable energy targets coupled with automation-induced efficiency accelerating the uptake of renewables, India's renewable energy sector is poised to emerge as a mega employment generator. According to a study by the Council on Energy, Environment and Water (CEEW), the Indian renewable energy sector could potentially employ

around one million people by 2030, which would be ten times more than the existing workforce of an estimated 1.1 lakh (110,000) employed by the sector.

As per the study, most of the new jobs would be generated by small-scale renewable energy projects such as rooftop solar and mini and micro-grid systems. The study provides that India can potentially create about 3.4 million jobs by installing 238 GW of solar and 101 GW of new wind capacity to achieve 500 GW of non-fossil electricity generation capacity by 2030 goal.

On the global front too, renewable energy jobs are predicted to reach 42 million by 2050. According to a study by the International Renewable Energy Agency titled Measuring the Socio-economics of Transition: Focus on Jobs, employment in the renewable energy sector could reach 42 million by 2050 with Asia estimated to account for 64% of the jobs followed by the Americas 15% and Europe 10%.

Revolutionising the Power Sector

Automation using emerging technologies such as IoT, Big Data Analytics, AI, blockchain, and robotics is playing an important role in the automation of the power sector. These technologies are enabling power companies to improve efficiency, reliability, and safety while reducing costs and improving customer satisfaction. As these technologies continue to evolve, we can expect to see even more innovative applications in the future. These benefits are likely to continue as automation technologies evolve and become more sophisticated.

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