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USING OF MODERN ENERGY MANAGEMENT SYSTEMS IN ELECTRICITY SUPPLY

N.N. Sadullayev
Doctor of technical sciences, professor, Bukhara engineering technological institute
Sh.N. Nematov
Docent, Bukhara engineering technological institute
Mizomov Y.S.
Postgraduate student, Bukhara engineering technological institute

Abstract: An energy management system (EMS) is a system of computer-aided tools used by operators of electric utility grids to monitor, control, and optimize the performance of the generation or transmission system. Electricity management is a vast topic in environmental science that deals with the control, monitoring, and conservation of energy consumption. This not only includes efficiency in consumption but also the creation and distribution of electric power. Energy management systems are mainly focused on providing functionalities such as energy monitoring, conservation measures, demand management, and energy efficiency analysis. It is also used to optimize energy consumption and reduce costs in buildings, industrial facilities, and other energy-intensive operations. In an era where energy conservation and efficient use are paramount, the electricity sector stands on the brink of a significant transformation.
Key words:energy consumption, transmission system, industrial facilities, energy-intensive operations, optimizing energy usage, reducing costs.

Introduction: Modern energy management systems are ushering in a new age of electricity supply, optimizing energy usage, reducing costs, and contributing to a more sustainable world. This article delves into the role of these innovative systems in revolutionizing the way electricity is supplied and managed. Energy management promotes energy conservation and responsible resource management. By adopting energy-saving practices, reducing waste, and encouraging sustainable behaviors, businesses actively contribute to preserving natural resources and minimizing their ecological footprint. A good example of a very basic EMS is the thermostat in your house. The thermostat has an interface where you can set a heating or cooling schedule, a sensor that measures the temperature in the room, a controller that tells the heater to turn on or off, and the actual heating or cooling element itself [1]. Energy management systems analyses a company's current energy consumption and show companies where they can use less energy, thereby helping them to continuously improve energy efficiency and reduce their costs without compromising their performance.

At their core, modern energy management systems leverage cutting-edge technology to monitor, control, and optimize the generation, distribution, and consumption of electrical energy. They employ a suite of sophisticated tools that include real-time data analytics, Internet of Things (IoT) devices, machine learning algorithms, and artificial intelligence. These technologies work in tandem to make electricity supply more efficient, reliable, and green.

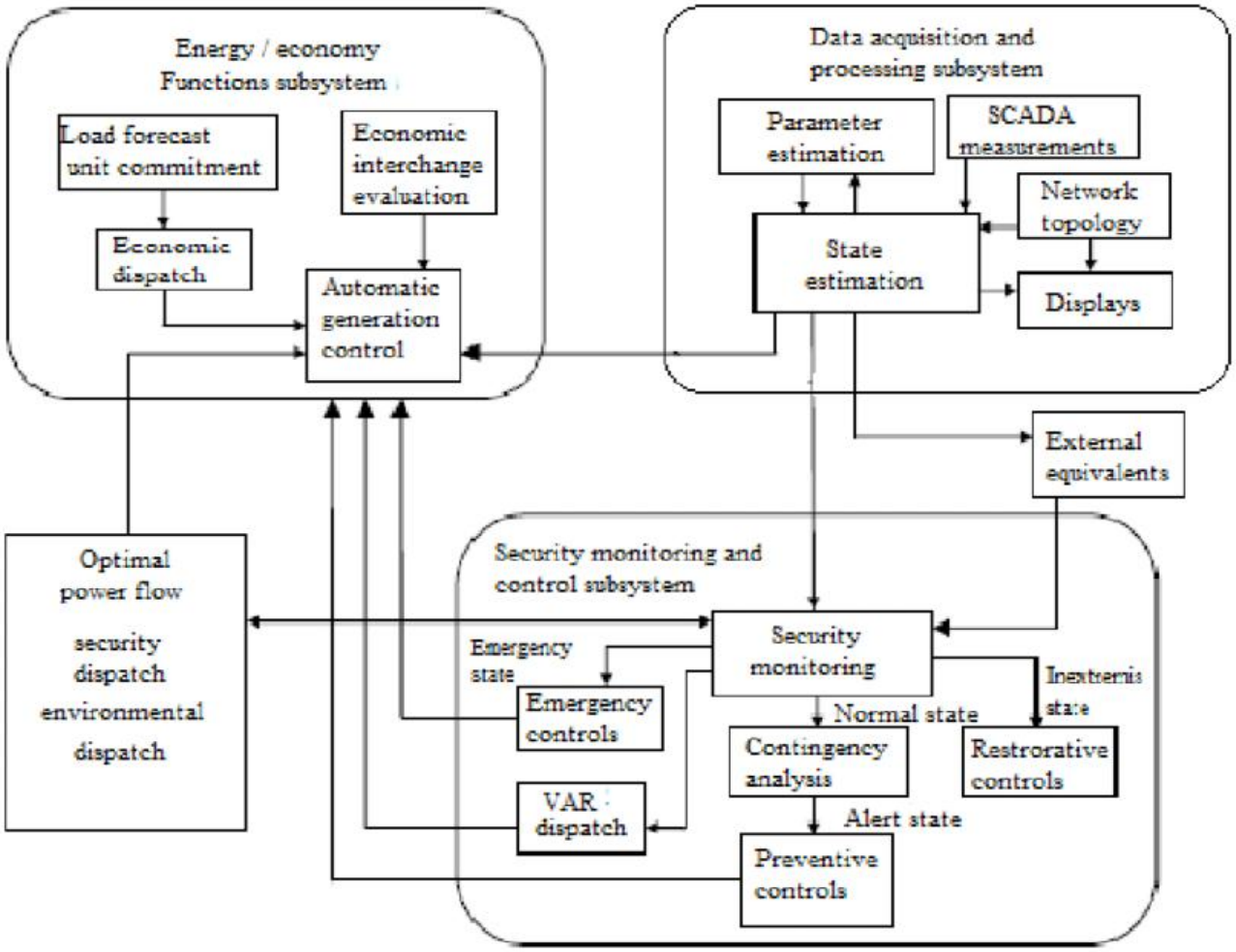

Figure 1. Functional Diagram of Modern Energy Management System

One of the key benefits of EMS is their ability to optimize power generation. By analyzing data from a variety of sources, these systems can forecast demand patterns, adjust generation in real-time, and reduce wastage. For instance, during periods of low demand, the EMS can decrease output from power plants, thus conserving fuel and reducing emissions [2].

Similarly, on the distribution side, EMS help in identifying and mitigating losses. They can pinpoint inefficiencies in the grid, such as leaks or theft, and suggest corrective measures. Moreover, they enable a more dynamic response to changing load demands, ensuring that electricity is delivered where it is needed most efficiently.

As the world moves towards a more sustainable energy future, the role of renewables becomes increasingly critical. However, integrating renewable sources into the existing grid is not without its challenges, primarily due to their intermittent nature. Here, modern energy management systems shine by smoothing out the variability associated with renewable energy [3].

Through advanced forecasting tools, EMS can predict solar and wind energy production, allowing grid operators to adjust conventional power generation accordingly. Additionally, they support the use of battery storage systems, enabling energy to be stored when generation exceeds demand and released back into the grid when needed.

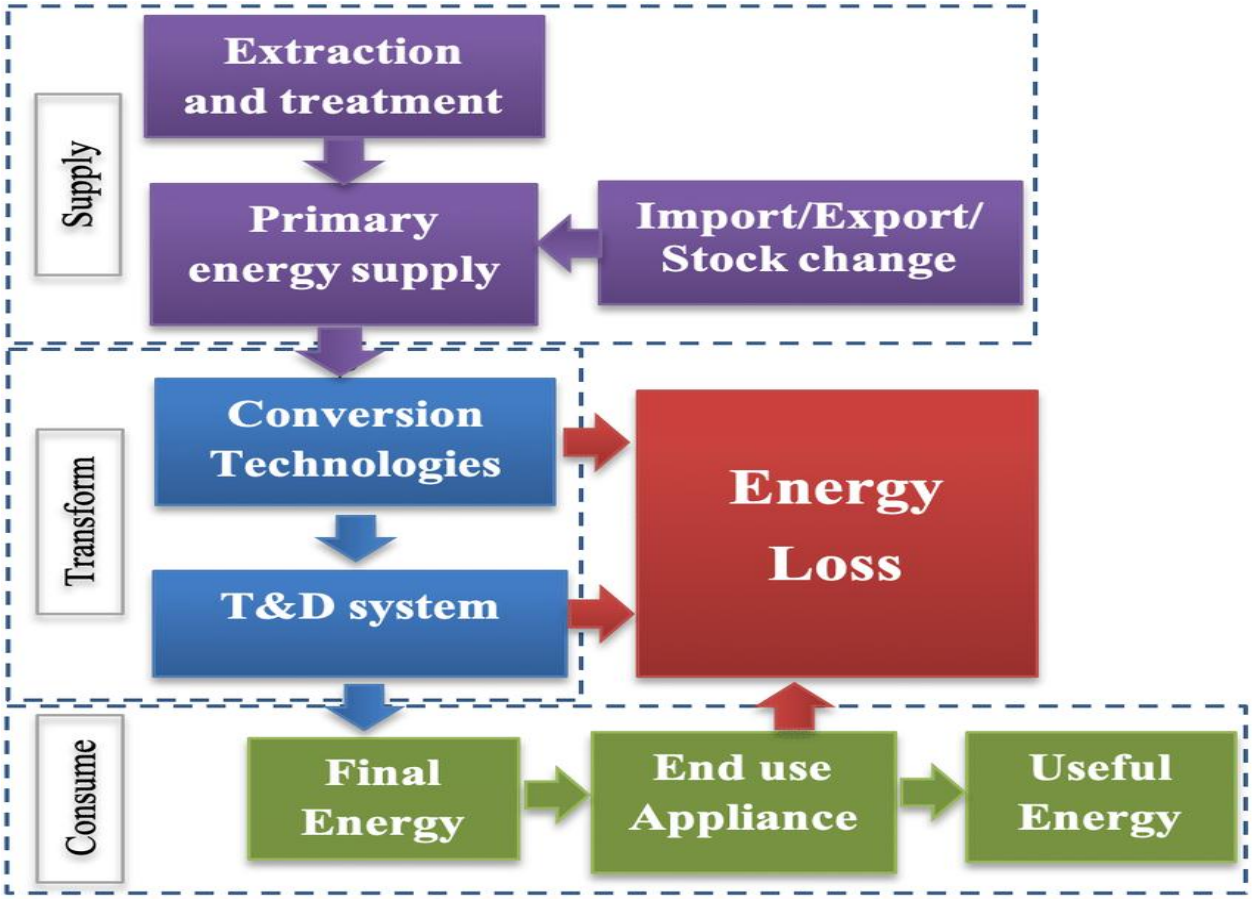

Figure 2. Energy supply chain

Modern EMS also play a crucial role in empowering consumers. Through smart meters and home energy management systems, consumers can monitor their energy consumption in real-time, identify inefficiencies, and adjust their usage patterns to save costs. These systems can also automate the operation of appliances, turning them on during off-peak hours when electricity rates are lower, further optimizing energy use and costs.

The potential of modern energy management systems in transforming the electricity supply is immense. By making the grid more flexible, efficient, and resilient, they pave the way for a more sustainable energy future. However, the deployment of these systems is not without challenges. Issues such as data security, privacy, and the need for significant investment in infrastructure must be addressed.

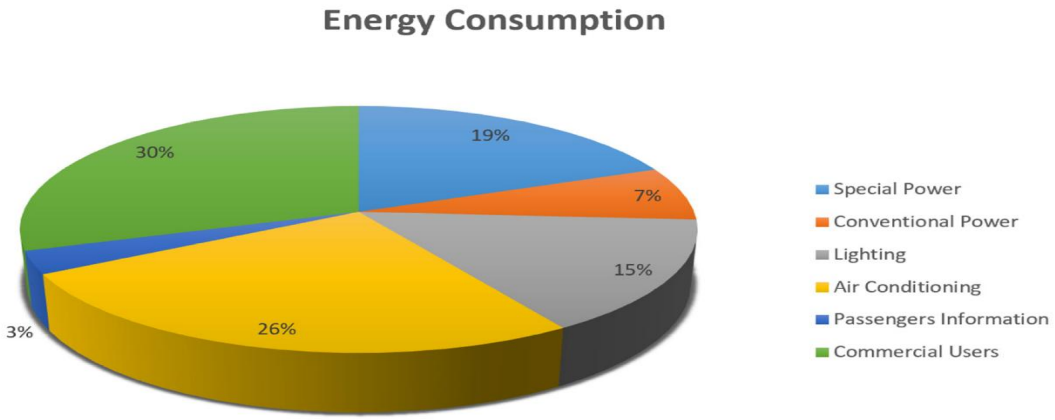

Figure 3. Statistics on the categorization of energy consumption at high-speed railway stations

Moreover, there is a need for regulatory frameworks that support the adoption of these technologies and encourage innovation. Policymakers, utilities, and consumers must work together to overcome these hurdles and fully realize the benefits of modern energy management systems. Energy management systems can efficiently increase the balance between supply and demand while reducing peak load during unscheduled periods. The energy management system can handle distributing or exchanging energy among the many energy resources available and economically supplying loads in a stable, safe, and effective manner under all power grid operating situations [4]. This article examines the energy control system's structure, goals, benefits, and challenges through an in-depth investigation of the various stakeholders and participants involved in this system. This review provides a detailed essential analysis of the operation of several programs used inside the power management system, such as demand response, demand management, and energy quality management. It also includes a summary of the smart grid's functionalities, features, and related techniques and has discovered research gaps, challenges, and issues. Furthermore, in this article, the authors review the literature on the enabling technologies of smart grid and investigate the energy management system, which is among one of the major emerging technologies and quantifications of the various uncertainty techniques [5]. In this regard, a novel prosumer energy management system is urgently needed to take full advantage of prosumers' flexibility while taking the interests of other parties into account. Research into prosumer energy management involves a wide range of disciplines, including power engineering, computer science, (micro) economics, thermal and control engineering. This session will bring together researchers and practitioners to introduce and discuss emerging technologies covering monitoring, operation, planning, marketing and control architectures related to the prosumer energy management [6]. In recent years, some prosumer energy management strategies have been proposed in literature, such as the peer-to-peer approach, coordinated scheduling-based scheme and centralized control method. However, the current energy management system needs to be rigorously re-engineered into an integrated and intelligent system that manages not only the smart grid but also the multi-energy system with couplings of electricity, thermal and natural gas networks. To this end, a large number of prosumers will actively participate in system-wide and local coordination tasks. Therefore, the modeling methods and related emerging technologies are still hot topics that require substantial scientific research.

Conclusion: Modern energy management systems represent a leap forward in the way electricity is supplied and managed. By harnessing the power of technology, they offer a solution to many of the challenges facing the energy sector today. As we continue to grapple with the dual imperatives of meeting rising energy demand and reducing our carbon footprint, the role of EMS in creating a more efficient, reliable, and sustainable electricity supply cannot be overstated. The journey to a smarter energy future is well underway, and modern energy management systems are leading the charge.

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