

Chapter 8

Harnessing Digitalization and Internet of Things for Sustainable Energy: A Comprehensive Study

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ABSTRACT

This chapter explores the relationship between digitalization, IoT, and sustainable energy, highlighting their potential in transforming the energy landscape, driving efficiency, and enabling smarter energy management. It discusses the role of data analytics, AI, and machine learning in optimizing energy systems, enhancing predictive maintenance, and enabling demand-side management. The chapter also addresses cybersecurity risks and data privacy concerns in implementing digital solutions. It

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calls for collaboration among stakeholders to foster innovation and accelerate sustainable energy solutions adoption. It also calls for policy frameworks to incentivize investment in digital infrastructure and IoT-enabled devices. The chapter concludes by offering recommendations for policymakers, industry leaders, and researchers to utilize digital technologies for a sustainable and equitable energy future.

INTRODUCTION

Digitalization and the IoT are revolutionizing the energy sector, enhancing efficiency, sustainability, and resilience. IoT enables real-time monitoring of energy infrastructure and seamless connectivity. The shift towards sustainable energy sources and reduced greenhouse gas emissions is driving digitalization in the sector. Governments worldwide are prioritizing technology to optimize energy systems and minimize environmental impact. Digitalization holds the promise of unlocking new pathways for renewable energy integration, grid modernization, and demand-side management, thereby promoting sustainable energy sources and reduced greenhouse gas emissions(Adekanbi, 2021).

The digital energy transformation is largely driven by the integration of IoT devices and sensors in energy infrastructure. These devices collect vast amounts of data on energy consumption patterns, equipment performance, and environmental conditions. By using advanced analytics and AI algorithms, utilities and energy companies can identify inefficiencies and optimize resource allocation. The benefits of digitalization and IoT in the energy sector include improving energy efficiency across the entire value chain. IoT-enabled devices offer real-time visibility into energy consumption patterns, enabling businesses and consumers to identify waste areas and implement targeted efficiency measures(Mishra et al., 2022).

Digital technologies enable energy companies to predict equipment failures and schedule maintenance proactively, minimizing downtime and operational disruptions. This optimizes asset performance and reduces maintenance costs, contributing to the economic viability of energy projects. Digitalization and IoT also enhance operational efficiency by integrating renewable energy sources into the grid. IoT sensors and advanced forecasting algorithms help anticipate fluctuations in renewable energy generation, optimizing grid operations. IoT-enabled smart grids facilitate bidirectional communication between utilities and distributed energy resources, enabling dynamic load balancing and grid optimization(Gupta et al., 2023).

The increasing use of distributed energy resources (DERs) has highlighted the importance of digitalization in the energy sector. IoT technologies enable efficient management of energy flows and grid congestion. As DER deployment grows, digitalization will play a crucial role in grid reliability and resilience. However,

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