

ENHANCING THE ENERGY EFFICIENCY OF SOLAR POWER PLANTS WITH ARTIFICIAL INTELLIGENCE

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The global energy crisis and growing concerns about climate change underscore the urgent need to transition from fossil fuels to renewable energy sources. Among these, solar energy has emerged as a leading candidate due to its abundance and sustainability. However, the efficiency of solar plants remains a significant challenge, as it is influenced by factors such as weather conditions, system degradation, and suboptimal operation. Improving the energy efficiency of solar plants is critical to maximizing their potential and ensuring they contribute effectively to the global energy mix.

Artificial Intelligence (AI) offers a transformative approach to addressing this challenge. By leveraging AI algorithms, it is possible to optimize energy generation, predict maintenance needs, and adapt to varying environmental conditions in real-time. For instance, machine learning models can analyze historical and real-time data to optimize the angle of solar panels, predict shading patterns, and forecast energy output. Similarly, predictive maintenance powered by AI can significantly reduce downtime and operational costs, enhancing the overall efficiency of solar plants.

Furthermore, enhancing the efficiency of solar plants aligns with global sustainability goals, such as the United Nations’ Sustainable Development Goal 7, which aims to ensure access to affordable, reliable, sustainable, and modern energy for all. The adoption of AI in solar plants not only supports these objectives but also offers economic benefits by reducing energy losses and operational costs.

The rapid growth in renewable energy technologies, particularly solar power, has created an urgent need for optimization tools to maximize energy efficiency and minimize losses. Artificial intelligence (AI) has emerged as a transformative solution in this field, offering innovative approaches to enhance solar plant performance. This essay reviews ten recent scientific works, emphasizing the role of AI in improving the energy efficiency of solar plants.

Predictive maintenance is a crucial aspect of maximizing the operational efficiency of solar plants. Fouzi and Ying (2023) explore AI-driven fault detection mechanisms that rely on solar irradiance forecasting, ensuring timely interventions and sustained energy production [4].

Accurate energy forecasting is vital for balancing supply and demand in solar energy systems. Ashish and Sagar (2022) provide a comprehensive survey on AI-based forecasting models, emphasizing their accuracy in predicting solar irradiance and energy production. These models leverage large datasets to account

for variability in weather patterns, enhancing the reliability of solar energy systems [2]. Winlin and P. Chandrasekhar (2023) extend this concept by integrating IoT with AI for real-time energy predictions, thereby improving decision-making processes in energy management [1].

While the potential of AI in solar energy is undeniable, challenges remain. For instance, the deployment of AI models requires substantial computational resources and high-quality datasets. Hasan and Theyazn (2023) discuss these limitations, advocating for collaborative efforts between researchers and industry stakeholders to overcome technical and economic barriers [3].

Artificial intelligence has proven to be a game-changer in enhancing the energy efficiency of solar plants. By enabling predictive maintenance, optimizing energy outputs, improving forecasting accuracy, and facilitating real-time energy management, AI contributes significantly to the sustainability and reliability of solar energy systems. However, to fully realize its potential, ongoing research and collaboration are essential to address existing challenges. The reviewed studies provide valuable insights into the transformative role of AI, paving the way for a greener and more efficient energy future.

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THE TRANSPORT CORRIDOR FRAMEWORK: PRINCIPLES AND APPLICATIONS IN TRANSPORTATION PLANNING

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Corridors represent a versatile spatial organizing concept employed across diverse domains, including economics, conservation, agriculture, and