


Chapter 17


Harnessing Artificial Intelligence for a Greener Future in Solar, Wind, and Hydrogen

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ABSTRACT

Renewable energy sources have been the driver of innovation, with solar, wind, and the green hydrogen close to the top of the list. The addition of Artificial Intelligence (AI) to these systems enables faster development, improved scalability, and higher reliability for these systems. AI predicts weather patterns, optimizes panel orientation and allows for predictive maintenance of solar photovoltaic (PV) systems to maximize solar energy and minimize operational downtime and inefficiencies. AI optimizes the performance of wind turbines by optimizing accurate wind pattern forecasting and energy supply stabilization through intelligent grid integration via predictive analytics. Electrolysis processes are improved with AI, its energy efficiency is increased, and the green hydrogen is distributed and stored as well as possible. While barriers still exist in issues such as data privacy and computational demand, developments in edge computing and machine learning appear to bring about encouraging opportunities for moving past these barriers.

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INTRODUCTION

Overview of Renewable Energy and Sustainability Goals

Renewable energy is a must when looking for a sustainable future in energy. As the world community tackles the problems of climate change, energy security, and resource depletion, the answer in using energy from renewable sources such as solar, wind, and hydrogen becomes practical. This chapter aims to present a detailed analysis of various energy modes their significance in terms of achieving sustainability goals.

Solar energy includes solar thermal systems or photovoltaic cells to obtain the energy developed during the time of the sun. It's one the most abundant and simple to access sources of energy, but one of the biggest to reduce greenhouse gas emissions. A renewable technology like solar energy can help lessen a country's dependence of fossil fuels, overall energy independence, which will drive creation of jobs in the green technology field.

Wind energy, or wind generated energy, is the energy created when wind is converted into electrical power using wind turbines. It's a clean and renewable resource that in the last few years has seen tremendous growth. By helping to lower carbon footprints, wind energy also creates local jobs and builds local infrastructure to support local economies. Wind energy is solidifying itself as a key player in the world's energy future because technology breakthroughs are making it more cost effective and efficient.

Hydrogen is a form of energy that is now becoming quite popular, and can be generated from a number of renewable resources. As a fuel substitute vehicle or as fuel cells that can generate power, it can be used as a clean fuel. Hard to electrify sectors like long distance transportation and heavy manufacturing could be decarbonized by hydrogen.

Investing in hydrogen technologies can support countries in strengthening their energy resilience and energising their energy portfolios.

Renewable energy is important because it provides the answers to social, economic and environmental problems, helping us to achieve the Sustainable Development Goals (SDGs). Renewable energy sources such as solar, wind and hydrogen must replace fossil fuels for greenhouse gas emissions to be reduced and energy security improved. Along with supporting economic growth and generation of employment, it helps to fight the consequences of climate change. Renewable energy sources are much better than fossil fuels when it comes to lowering greenhouse gas emissions, thereby producing better air quality and reducing pollution. Essential to the preservation of biodiversity and natural resources as it relates to the SDGs for environmental protection, they are according to (Kumar et al., 2023). (Malik et al., 2023) For instance, investments in renewable energy technology raise employment and economic growth in countries where investments start, like in emerging countries. (Wang et al., 2024)

Solar, wind, and hydrogen are future solutions to sustainable energy. Energy produced from these resources is not taken out of the environment they are naturally regenerative produced, and do very little in the way of pollutants and greenhouse gases. Resources that come from solar and wind have experienced decreased pricing over the years due to decades of technological advancements, which makes these resources the best options for energy transitions over time. Solar and wind resources offer scalable and clean electricity that can be plugged into existing grids to prepare for future international energy supply and greatest demand (Saeedmanesh et al., 2018).

In addition, solar is versatile similar to wind which means it can fuel any transportation needs, work in manufacturing, or be a storage solution in itself. Thus, with both resources relying on solar and wind to electrolyze renewable energy, the production of hydrogen offers a zero emissions pathway toward

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