

The impact of green hydrogen on the renewable energy sector

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Abstract: The global energy sector is undergoing a transformative shift from fossil fuels to renewable energy sources, with green hydrogen emerging as a cornerstone of decarbonization strategies. Produced exclusively from renewable energy such as solar, wind, and biomass, green hydrogen not only reduces greenhouse gas emissions but also offers a sustainable solution for addressing energy access challenges in remote and underserved regions. Beyond its environmental benefits, green hydrogen has the potential to revolutionize energy systems by enhancing energy storage, supporting industrial decarbonization, and enabling energy self-sufficiency in areas with limited grid infrastructure.

This study aims to investigate the integration of green hydrogen into localized microgrid systems, proposing a model that combines renewable energy generation, hydrogen production via water electrolysis, advanced storage solutions, and real-time energy applications such as hydrogen fuel cells. The research explores multi-objective optimization techniques to balance energy supply and demand, minimize costs, and reduce carbon footprints. Through detailed simulations and techno-economic analyses, the work evaluates the feasibility and scalability of hydrogen-integrated microgrids, offering practical solutions to renewable intermittency and energy equity. The findings underline green hydrogen's potential to drive sustainable development, facilitate global decarbonization goals, and pave the way for a resilient and inclusive energy future.

Keywords: Green Hydrogen, Renewable Energy Microgrids, Water Electrolysis, Hydrogen Storage, Fuel Cells, Decarbonization

References

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