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EXPLORING THE POTENTIAL OF RENEWABLE ENERGY TO ENABLE GREEN HYDROGEN PRODUCTION FOR A SUSTAINABLE FUTURE

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Abstract – Amidst intensifying concerns about greenhouse gas emissions, the imperative to transition towards sustainable energy solutions is paramount. Renewable energy sources (RES) provide a promising avenue, especially in hydrogen production. In this context, the emergence of ‘green hydrogen’ is pivotal. Green hydrogen is a concept produced using RES like solar and wind energy to power the hydrogen production process. Unlike conventional methods emitting carbon dioxide, green hydrogen is generated through water electrolysis using clean energy. India relies on coal for around 70 % of its energy needs, leading to a 29 % rise in carbon emissions from 2015 to 2022. Green hydrogen is a potential alternative solution to address the increasing energy demand and the depletion of fossil fuels. Using wind energy for water electrolysis emerges as a suitable method for green hydrogen production. Therefore, the present study assesses the potential of hydrogen production using the wind energy resources in five selected locations in India using ERA5 hourly wind data. The investigation further explored the characteristics of wind speeds at these locations using average wind speed, Weibull parameters and wind rose analysis. Using the SUZLON S95 wind turbine, power output and annual energy generation at each location were estimated. Further, the annual hydrogen production and required storage capacity at each location were estimated. The results showed a power generation of 891 kW in location Una and 895 kW in Mandvi. Finally, the amount of carbon emissions mitigated due to the use of wind energy sources instead of conventional sources for H₂ production is calculated.

Keywords – CO₂; electrolysis; green hydrogen; hydrogen storage; mitigation; wind energy