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## Economic and Environmental Impact Assessment of Hydropower-Based Alkaline Electrolysis and Hydrogen Production in South Korea

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Alkaline electrolysis systems are gaining attention for large-scale hydrogen production, and energy storage systems (ESSs) have been introduced to address the intermittency issues associated with renewable energy sources. Small-scale hydropower, with its stable output and high utilization, presents a promising solution for overcoming these challenges. This study proposes the design of an optimized alkaline electrolysis system tailored for small-scale hydropower, analyzing the efficiency and cost of hydrogen production under various scenarios. It was found that the optimal selling price of hydrogen was USD 15.6 per kilogram, achievable only when the operational time exceeded 20 hours. Break-even point analysis under government subsidies and continuous operation revealed that a subsidy of USD 10/kgH2 or 24-hour continuous operation is essential for economic viability [1].

In addition, in the context of achieving carbon neutrality, this study evaluated greenhouse gas emissions associated with hydrogen production, from raw material extraction to production, across the entire lifecycle. An analysis of the carbon dioxide emissions from hydrogen production based on various renewable energy sources in South Korea revealed that hydropower had the lowest emissions, with 0.076 kg of CO2 per kilogram of hydrogen. The study found that alkaline water electrolysis (AWE) systems emit approximately 8434 kg of CO2, which is about 2.3 times more than proton exchange membrane (PEM) systems. These findings highlight the significant influence of the type of renewable energy and electrolysis system on the economic and environmental impact of hydrogen production, underscoring the need for government support and technological advancements to strengthen the economic viability of the green hydrogen market in South Korea [2].

References:

[1] Energies 2024, 17(1), 20; https://doi.org/10.3390/en17010020
[2] Energies 2024, 17(15), 3698; https://doi.org/10.3390/en17153698

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Born in 1986 in Seoul, Republic of Korea, Heena YANG graduated with Ph.D. Degree in Materials Chemistry and Engineering from Konkuk University in 2016. During this time, she worked as an undergraduate research assistant in the field of nanostructured materials for proton exchange membrane fuel cells (PEMFCs). From 02/2017, she moved to Ecole Polytechnique Federale de Lausanne(EPFL) Valais as a Postdoc and started her work on the hydrogen storage materials such as complex hydrides and carbon based porous materials. Currently she works as a senior research at Korea water resources corporation(K-water), her work is focused on green hydrogen production system and its application.