TECHNO-ECONOMIC ANALYSIS OF THE GREEN HYDROGEN PRODUCTION FROM PV PLANT

Pokhrel, Basanta Raj[1]; Litleskare, Mira Elise[1]; Oleinikova, Irina[1]; Adams II, Thomas Alan[2]
[1]Department of Electric Energy, Norwegian University of Science and Technology, Trondheim, Norway
[2]Department of Energy and Process Engineering, Norwegian University of Science and Technology, Trondheim, Norway

Corresponding author's e-mail address: basanta.r.pokhrel@ntnu.no

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ABSTRACT

Due to environmental concerns with the need of decarbonization, the drive of dynamic changes in the global energy landscape and the demand for innovative technologies is pressing. To overcome the challenges to the stability of energy supply due to increasing penetration of intermittent renewable energy sources (RESs), such as solar photovoltaic (PV), innovative solution such as alternative way of energy storage might be needed. In order to address this challenge, hydrogen as energy storage (ES) option can be an attractive choice. Hydrogen production through renewable sources offers a sustainable approach as well as positions itself as a possible central player in shaping low-carbon stable energy system in future.

Therefore, this research explores into the possible challenges of integrating PV systems with water electrolysis to generate green hydrogen. It will present both technical and economic aspects to consider for the green hydrogen production with this set up. Enhancing the efficiency and development status of Electrolysers as well as storage technologies are the key technical challenge, especially when considering grid integrated set up for hydrogen production from PV plant. At the same time, the economic feasibility requires a thorough understanding of the financial landscape, including costs needed for the electrolysis and hydrogen storage equipment. This multiple challenge emphasizes the significance of adopting a holistic approach in this study.

This investigation narrows its focus on key considerations for selecting water electrolysis technology, identifying an efficient hydrogen storage method. Three paramount recommendations surface for optimal green hydrogen production from a PV plant have been identified. Firstly, proton exchange membrane (PEM) electrolysis emerges as a favorable technology, offering high efficiency and flexibility. When considering high-temperature compressed gas storage proves a viable hydrogen storage solution, especially concerning storage size and technology maturity. Lastly, a grid-connected system stands out as advantageous, recognizing its potential to efficiently balance demand and supply as well as stabilizing the electricity grid from challenges effected by the increasing integration of renewable energy, such as flexibility, inertia, and grid congestion. Together, these suggestions provide an outline for the development of green hydrogen generation.

To advance the field of green hydrogen production from PV, this work provides a foundation for the future work and can be used as a guide to conduct an actual techno-economic analysis. It is essential to check if using PEM Electrolysers, high-pressure gas storage, and grid connections really works well for large-scale green hydrogen projects by doing a detailed techno-economic analysis. A case study with real field data from the PV installation site for the company Golyan Group in Nepal has been carried out. It was investigated if it is feasible for the PV plant owner to use the generated electricity from the PV plant to produce green hydrogen. A techno-economic analysis has been conducted to find out if green hydrogen production can be feasible for such set up.

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