

**Techno-Economic Assessment of Solar-Powered Green Hydrogen Production in West
Java Using TMY Data**

By

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STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.

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ABSTRACT

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This study evaluates the techno-economic feasibility of producing zero-carbon green hydrogen from a grid-tied solar photovoltaic and battery storage system in Tangerang, West Java, Indonesia, using Typical Meteorological Year data sourced from the Joint Research Centre of the European Commission covering the period 2005 to 2023. The system comprises a 150 kW bipolar alkaline electrolyzer with a Zirfon Perl UTP 500 membrane and 30 wt.% potassium hydroxide electrolyte, a 1,200-module LONGi Hi-MO 5 LR4-72HPH-450M monocrystalline photovoltaic array totaling 540 kWp with a footprint of 2,608 m², and a 250-unit battery bank providing 2,250 kWh total capacity and 1,800 kWh usable storage. The system is connected to the PLN Golongan I-3 grid for site auxiliary loads only; the energy management control logic prevents grid electricity from reaching the electrolyzer at all 8,760 hourly simulation timesteps to maintain the zero-carbon integrity of the hydrogen produced. The hourly simulation, implemented in MATLAB/Simulink R2023b using the Simscape Electrical toolbox, applies Nominal Operating Cell Temperature thermal derating and Maximum Power Point Tracking correction at each timestep to account for tropical climate performance losses. The Tangerang site receives an annual Global Horizontal Irradiance of 1,872.7 kWh/m², yielding an annual hydrogen output of 7,760 kg with the electrolyzer operating 4,500 hours per year at a utilization rate of 51.4%. Solar energy supplies 80.4% of

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total electrolyzer demand and battery storage supplies the remaining 19.6%, with zero grid electricity reaching the electrolyzer. Total capital expenditure is Rp 11,761,838,550, with the battery bank comprising 40.7% of total capital cost. Applying a Capital Recovery Factor of 0.1019 at an 8% discount rate over a 20-year project life, the baseline Levelized Cost of Hydrogen is Rp 204,964/kg (\$12.09/kg), which is 5 to 8 times higher than Indonesian grey hydrogen at \$1.5 to \$2.3/kg. Sensitivity analysis identifies solar irradiance as the most influential parameter, followed by battery capital cost as the most actionable near-term lever for cost reduction.

Keywords: green hydrogen, levelized cost of hydrogen, solar photovoltaic, alkaline electrolyzer, West Java



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DEDICATION

I dedicate this thesis to my family, without whose love and support I would not have been able to complete this project. In every difficult moment of this thesis, my family has continued to believe in me and support me in my endeavors.

To my friends who have stood by me throughout the challenges of completing this project, thank you for your friendship. I could not ask for a more precious friendship in my life.

Finally, to all the people who believed in me and who thought that I was capable of completing this thesis: thank you for your belief in me and for your support throughout my education.



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A special and personal thank you goes to my friend Steven Kurniawan, without whose help the simulation component of this thesis would have taken far longer to complete. Steven generously gave his time to help me understand MATLAB and Simulink from the ground up, patiently working through coding problems with me and explaining concepts that I struggled to grasp from documentation alone. The hourly simulation that forms the technical heart of this thesis would not have been built as rigorously or as efficiently without his support. His willingness to sit down and work through lines of code with me, often outside of his own study commitments, reflects a quality of friendship that I do not take for granted and will not forget.

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