Development of a Practical Site Specific Cost Optimization Model for Renewable Energy Technologies and Electrolyser for Green Hydrogen Production

Renewable Energy Technologies | Green Hydrogen & Ammonia | Mathematical Tool for Cost Optimization |Life Cycle Assessment

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Hydrogen production is likely to be an economic reality due to the significant growth of onshore and offshore wind and solar energy. This research will focus on evaluating a combination of a ***Renewable Energy Technologies and Integrated Electrolyser*** scenario (Figure 1). This hydrogen plant will include a proton-exchange membrane (PEM) or another type combined with a water treatment plant. To evaluate this quantitatively, a mathematical model will be developed. This simulation tool will combine techno-economic and life cycle assessment models based on process engineering principles and methodologies. The output of the research is expected to develop a dashboard based on scientific and engineering principles to evaluate and to optimize the cost of green molecules using various technology combinations at a specific geographic location based on a capital cost to determine operating cost, primary embodied energy, carbon, water, and waste footprints of ***the levelized unit of hydrogen, ammonia, and green urea*** from renewable electricity.

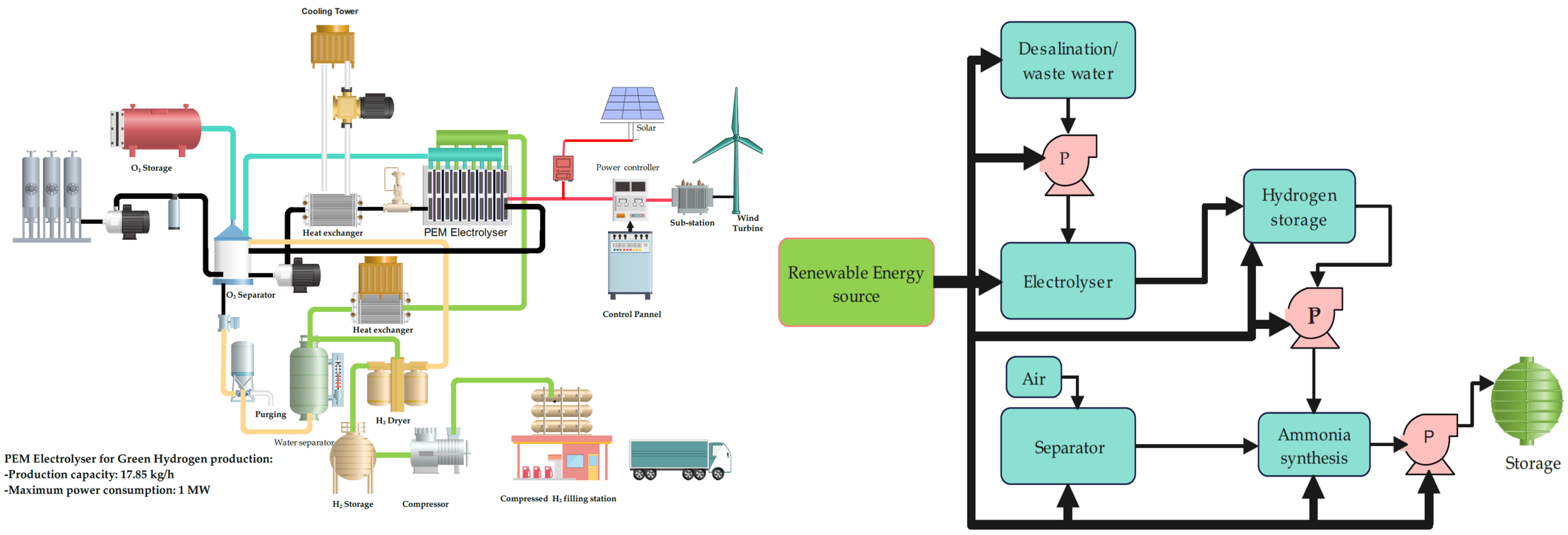

Figure 1: (a) Schematic diagram of green hydrogen production (b) Process flow diagram of green ammonia production.

Methodology

- Development of a comprehensive mathematical model, based on process Engineering principles and a process flow diagram with dynamic interactions among the energy balance, equipment sizing, feed stock input at different scenario to find out CAPEX, OPEX and levelized cost of green hydrogen.
- Validation of the of the mathematical tool using real feed stock data at various load conditions and different times throughout the year to capture the lowest possible cost of the feed stock.
- Development of a user-friendly dashboard for specific geographical location allowing stakeholders to evaluate and optimize green hydrogen and ammonia production cost with a suggested combination of current and future technologies to produce green hydrogen in range of AU$1 – $3 per kg H_2.

Project Milestones

- By the end of 2023, a practical mathematical model will be developed based on with dynamic interactions amongst the key variables and equipment sizing parameters.
- By 2024, validation of the model using actual renewable energy technologies data in various scenarios and load conditions with a combination of current and upcoming technologies.
- By 2025–2026, a dashboard will be developed for quick project assessment and prefeasibility of the project. This evaluation tool can be applied to different case-studies to demonstrate the indicative project viability with optimised hydrogen and green molecules production cost.

Expected Outcomes: To answer questions such as what configurations of specific technologies are required for a particular location to produce green hydrogen at desired price range.

FOR FURTHER INFORMATION
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