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Unlocking Green Hydrogen Potential for Industrial Heat in New Zealand

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ABSTRACT

Green hydrogen, produced via renewable-powered electrolysis, is increasingly regarded as a pivotal component of deep decarbonisation in emissions-intensive industrial sectors. In New Zealand, industrial process heat accounts for over one-third of the country's total energy use and approximately 8% of gross greenhouse gas emissions. Decarbonising this sector is therefore essential for achieving the country's net-zero emissions target by 2050. This study evaluates the technoeconomic feasibility of using green hydrogen to support the decarbonisation of industrial process heat in New Zealand. A detailed bottom-up optimisation model is developed to integrate hydrogen production, storage, delivery infrastructure, and end use, alongside competing technologies including electrification and biomass. Using high-resolution industrial energy data, the model simulates multiple policy and cost scenarios through to 2050. Our analysis reveals that in most scenarios, electrification, particularly through electric boilers and heat pumps, offers the most cost-effective decarbonisation pathway for low to medium-temperature process heat. However, green hydrogen becomes a viable solution under specific conditions, especially for high-temperature applications in sectors such as metal manufacturing, where electrification remains technically constrained. Although cost competitiveness is currently limited, targeted policy measures, including capital subsidies, carbon pricing, and renewable energy incentives, could improve hydrogen adoption where it presents strategic benefits. The findings provide actionable insights for policymakers and industry leaders, highlighting the importance of a diversified strategy that combines electrification, hydrogen, and biomass to achieve cost-efficient emissions reductions.

Keywords: Decarbonisation; Green hydrogen; Industrial process heat; Scenario analysis; TIMES modelling