Chemeca 2025 and Hazards Australasia
28 – 30 September, Adelaide, South Australia

Feasibility Assessment of Decentralized Photoreforming of Garden Organics for Sustainable Waste Management and H2 Production

Rehan Gunawan[1], Denny Gunawan[1], Rose Amal[1], Jason Scott[1]

[1]School of Chemical Engineering, University of New South Wales, Sydney, NSW 2052, Australia

rehan.gunawan@unsw.edu.au

ABSTRACT

The increasing accumulation of organic waste from industrial and household activities presents a significant environmental challenge. Conventional waste treatment methods, such as landfilling and composting, contribute to greenhouse gas emissions and fail to fully harness the potential value of organic waste. This study explores the integration of photocatalytic reforming as a sustainable approach to convert organic waste, including garden waste and other lignocellulose-based materials, into hydrogen and valuable chemicals. The process facilitates the breakdown of organic compounds under visible light irradiation, promoting hydrogen evolution while generating intermediates that can serve as chemical feedstocks.

A technoeconomic analysis (TEA) was conducted to evaluate the feasibility of this process in a small-scale or decentralized system in one remote area in NSW, Australia, considering both capital and operational expenditures. The findings indicate that this system is more viable from a waste treatment facility perspective rather than a commercial hydrogen production standpoint. The levelized cost of hydrogen (LCOH) is primarily influenced by photocatalyst efficiency, whereas organic waste treatment costs are more dependent on waste processing capacity. In additional, a simplified environmental impact assessment, including a life cycle analysis (LCA), reveals that the process can reduce CO_2 emissions by more than 50% compared to traditional waste management methods such as landfilling and composting, especially when integrated with solar energy. However, challenges remain in scaling up the technology, optimizing photocatalyst performance, and ensuring economic viability.

This study highlights photocatalysis as a sustainable alternative for waste valorization and clean energy production. The findings suggest that future research should focus on improving photocatalyst system design and stability, particularly in enhancing selectivity for value-added chemical production. This work contributes to the growing interest in circular economy strategies and sustainable hydrogen production pathways.

KEY WORDS

Sustainability, Photoreforming, Organic Waste, Lignocellulosic Biomass, Hydrogen

BIOGRAPHY

Rehan is a researcher in the Trailblazer Recycling and Clean Energy program at UNSW, focusing on waste processing with photocatalyst for hydrogen production. His work explores the integration of solid catalysts and renewable energy to develop sustainable solutions in waste utilization. He is also a part of the PartCat Group within the School of Chemical Engineering, UNSW, a research team dedicated to energy and solid catalysts for renewable applications. The group is led by Professor Rose Amal, who also serves as the Deputy Director of the ARC Centre of Excellence for Carbon Science & Innovation.

CONFERENCE PROGRAM

Please indicate which conference program your abstract relates to:

- ✓ Chemeca