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Abstract title

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ABSTRACT

Process Optimisation and Techno-Economic Modelling of Biomethane Production

As Australia intensifies its pursuit of net-zero emissions, the chemical process industries face the dual challenge of decarbonising thermal loads while maintaining process stability. Biomethane, derived through the anaerobic digestion of organic waste and subsequent gas upgrading, offers a drop-in replacement for natural gas. However, optimising the chemical pathway from heterogeneous feedstocks to grid-spec methane requires rigorous process integration and techno-economic validation.

This paper details a comprehensive techno-economic analysis (TEA) of biomethane production within the Australian context. The study employs process modelling to evaluate production pathways, specifically focusing on anaerobic digestion (AD) and the efficiency of upgrading technologies such as membrane separation, water scrubbing, and pressure swing adsorption (PSA).

The investigation centres on a multi-scale analysis of the production lifecycle, beginning with the quantification of feedstock-specific methane yields derived from diverse agricultural, industrial, and municipal organic waste streams. This is coupled with an assessment of the upgrading processes to ensure compliance with AS 4564 gas quality specifications.

The study aims to quantify the role of process intensification in reducing the levelised cost of energy (LCOE) for renewable gas. Through this analysis, the research will evaluate how feedstock logistics and the selection of upgrading technologies impact both carbon intensity and the overall thermodynamic efficiency of the plant. By aligning chemical engineering advancements with market-based carbon incentives, the investigation seeks to identify a viable pathway for scaling biomethane as a circular economy solution, potentially bridging the gap between waste management and industrial energy supply in Australia.

KEY WORDS

Techno-economic Analysis (TEA), Process Optimisation, Sustainability, Biogas Upgrading, Decarbonisation, Anaerobic Digestion, membrane separation, water scrubbing, pressure swing adsorption (PSA)

BIOGRAPHY

Jason has over 26 years of experience collaborating with Fortune 500 companies such as Petronas and Quanta Services. His areas of expertise encompass oil and gas, renewable energy, hydrogen and biomethane production, transportation, and storage, which have enabled him to develop and implement innovative and sustainable energy solutions. This extensive background has earned him a reputation as a respected specialist in the industry. Currently, Jason is working at Fyfe as a principal engineer, renewables and hydrogen. In this role, he is contributing to the renewables, hydrogen and biomethane projects, further advancing the field of sustainable energy.

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