

Comparative Life Cycle Assessment of Steam Methane Reforming and Dry Methane Reforming from Landfill Gas for Green Hydrogen Production

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Green hydrogen is a key component in the transition to a sustainable energy future, offering a low-carbon alternative to conventional hydrogen production. In this study, we focus on landfill gas as the source for hydrogen production and compare the environmental impacts of steam methane reforming (SMR) and dry methane reforming (DMR) using a comparative life cycle assessment (LCA) approach, following ISO 14040–14044 standards. The objective of the study is to understand the impact of the reforming process on various environmental impact categories, comparing the two possibilities, also with the conventional way of producing hydrogen.

A cradle-to-gate approach is used, with 1 kg of H₂ as the functional unit. The system boundaries include landfill gas utilization, the water-gas shift reaction, reforming processes, H₂ purification, and captured CO₂ storage. Life cycle inventory data were sourced from literature and previous process simulations, and the system was modelled using openLCA software, coupled with Ecoinvent database. The environmental impact categories analysed include global warming potential (GWP) emissions (CO₂-eq), acidification, and other key metrics. The findings provide insights into the comparative sustainability of SMR and DMR, supporting the adoption of landfill gas-derived hydrogen as a viable pathway for reducing the carbon footprint of hydrogen production.