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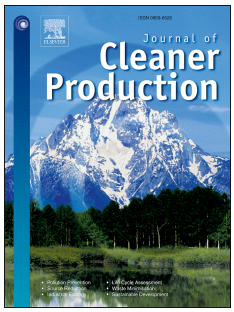

Remote, small-scale, 'greener' routes of ammonia production

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Remote, small-scale, 'greener' routes of ammonia production

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Abstract:

The techno-economic feasibility of low-carbon–based ammonia (NH_3) production has been explored in this study. Black coal and a eucalyptus-based biomass, available in the vicinity of a carbon dioxide (CO_2) sequestration site, have been chosen as the two carbon-based feedstocks. The scale of the production of NH_3 has been chosen to match the production of a bulk industrial Ammonium Nitrate/Fuel Oil (ANFO) explosives manufacturing facility. The production of NH_3 from any carbon-based feedstock implicitly involves a CO_2-removal step; therefore, only CO_2 pressurisation to the supercritical state is required before transporting it to the storage location. In order to gain a better understanding of the economic and environmental trade-offs, two representative flowsheets have been modelled in Aspen Plus® simulation software for the two feedstocks. A Natural Gas (NG)-based NH_3 process has also been modelled for comparison. Material and energy balance data from the Aspen Plus® simulation has been used to predict the economics and carbon footprint of NH_3 production from different feedstocks. A cradle-to-gate Life Cycle Assessment (LCA) has been performed to predict the environmental hotspots. Multi-Objective Optimisation (MOO), *via.* a genetic algorithm, has been performed to generate Pareto plots that represent the minimum cost of NH_3 production against different CO_2 footprints. For a similar CO_2 footprint, the coal-based NH_3 process has been found to be more economic than the biomass-based process. However, the biomass-based process has the potential to be carbon negative by capturing the biogenic CO_2, which is not possible in a coal-based process. The cost of carbon capture in coal-based NH_3 production has been estimated to be between 11-19 $US\ \$/t\ CO_2^{eq}$, which is