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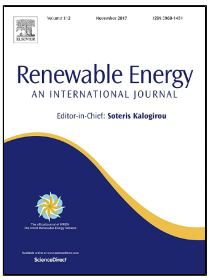

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Assessment of Power Generation from Natural Gas and Biomass to Enhance Environmental Sustainability of a Polyol Ether Process for Production of Rigid Foam Polyurethane

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Abstract

Polyol ether production process can result in emission of extremely hazardous substances besides it requires high energy demand which can also cause environmental impacts. This paper presents an exergy-aided life cycle assessment (LCA) to pinpoint the avoidable key cause of the environmental unsustainability in the period of clean energy transition, and also enhance the sustainability as much as achievable. The power generation system is pinpointed as the mitigable key source of the unsustainability of the polyol ether production under the strict process constraints imposed by the energy transition. Then, a set of possible scenarios supported by Monte Carlo simulation are defined, resulting in reducing environmental impacts from 7.17 to 7.11 MJ equivalent of nonrenewable energy sources according to the Cumulative Exergy Demand or from 3.43E-04 to 2.98E-04 according to ReCiPe. Moreover, LCA is advantageous to quantify precisely the environmental impacts of each chemical component, showing that CO_2 has much more adverse impacts than other hazardous substances on human health. Additionally, LCA reveals that the natural gas can even be less sustainable than the residual fuel oil in terms of freshwater ecotoxicity (75%), marine ecotoxicity (51%), terrestrial acidification (27%), human toxicity (43%), particulate matter formation (18%), and fossil depletion (64%) impacts.

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