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Economic Assessment of Small-scale e-NH_3 Production Plant

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Ammonia has been traditionally produced in large-scale plants using natural gas as hydrogen source, leading to high energy consumption and significant CO_2 emissions. Green ammonia synthesis is a sustainable alternative, specifically electro-ammonia (e-NH_3), produced from hydrogen via water electrolysis powered by renewable energy. Moreover, advancements in energy integration and decentralized production strategies have increased the interest in small-scale e-NH_3 plants, providing a flexible solution using local renewable sources1.

However, the high capital costs associated with electrolysis-based systems require a detailed cost analysis to determine economic feasibility. Understanding the cost distribution across process units—air separation, electrolysis, and ammonia synthesis—is essential for optimizing plant design and improving the competitiveness of small-scale e-NH_3 plants2,3.

This study presents an economic assessment of a small-scale e-NH_3 production plant. The research applied established cost estimation methodologies, including Guthrie, Seider, Turton, and Matche, to determine equipment costs, highlighting the electrolyzer as the most significant cost driver. From these results, capital expenditures (CAPEX) and operational expenditures (OPEX) were evaluated and compared with literature. Finally, an analysis of the unit cost and the levelized cost of ammonia (LCOA) was conducted, considering various economic scenarios.

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Biography:

I got the Bachelor degree in Chemistry (1989) by the University of Basque Country, master's degree (Mphil) by the University of Bath (United Kingdom) in 1992 and PhD in chemistry by the University of Cantabria in 1994 where I am at present. Currently, the objective of my research is modelling and simulation of chemical and environmental processes, systems, or industrial sub-

systems and the development of methods for selecting operating conditions or configurations. This work leads to proposal for alternatives for improvement and optimization of processes, or (ii) intermediate solutions that enable improvements in the system or in the search of optimum conditions. The main areas of application of my work are: process design of water separation, simulation of operations and environmental optimization.