

Unlocking nuclear flexibility through hydrogen production

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Abstract-

This paper proposes a novel strategy to enhance the profitability of long-term operated nuclear power plants during periods of low electricity market prices by co-producing hydrogen. The approach integrates a proton exchange membrane electrolyzer sized to utilize up to 50 % of the plant's nominal capacity (500 MW). This configuration effectively divides the nuclear facility into two conceptual units: a power-only plant and a combined hydrogen-and-power plant. The latter is capable of directing electricity to either the electrolyzer or the grid, depending on market conditions. The model employs real data from the Spanish day-ahead electricity market. Results show that, based on typical values for Spanish nuclear assets and market prices, a competitive levelized cost of hydrogen of 4.42 €/kg can be achieved. The analysis demonstrates that this combined hydrogen and power configuration significantly improves economic performance and provides a feasible pathway to enhance the competitiveness of nuclear assets in unfavorable electricity market conditions.

Index Terms- Cogeneration; Nuclear hydrogen; Electrolysis; Nuclear flexibility

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Citation:

Linares, J.I.; Pérez-Domínguez, J.R.; Arenas, E.M.; Moratilla, B.Y. "Unlocking nuclear flexibility through hydrogen production", Energy Conversion and Management, vol.349, pp.120934-1-120934-13, February, 2026.