

Techno-Economic Model for Hydrogen Production using Advanced Nuclear Power Plants in Saudi Arabia

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The Kingdom of Saudi Arabia is exploring the use of advanced nuclear power plants for hydrogen production as a sustainable and clean alternative to conventional hydrogen production methods. In this paper, a techno-economic model for hydrogen production using advanced nuclear power plant technologies in Saudi Arabia is presented. In this model, the capital and operating costs of advanced nuclear reactor technology, as well as the costs of hydrogen production plant were considered. Two distinct hydrogen production approaches are evaluated; a standalone electrolysis process and an integrated system that combines high-temperature steam electrolysis (HTSE) with nuclear cogeneration. The cogeneration process involves the production of both hydrogen and electricity from the same advanced nuclear power plant, utilizing electricity and high-temperature steam produced by the reactor. In this study, the Hydrogen Economic Evaluation Program (HEEP) was employed to evaluate various scenarios, including variations in the capital cost of the advanced nuclear power plants, the hydrogen production cost, and other factors such as the cost of nuclear fuel, operation and maintenance costs, and safety considerations. To ensure the safe and efficient integration of advanced nuclear power plant-based hydrogen production into Saudi Arabia's energy system, the technical implications of factors such as the design and operation of the nuclear reactor, the compatibility of the HTSE unit with the reactor, and the balance of plant requirements for hydrogen production were analyzed. The study provides valuable data-driven insights into the feasibility and economic viability of utilizing advanced nuclear power plants for hydrogen production in Saudi Arabia and can support in the decision-making process regarding investments in this emerging field.

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