NUCLEAR ENERGY-BASED HYDROGEN PRODUCTION : A COST ANALYSIS OF DIVERSE GEOGRAPHICAL REGIONS

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Overview

About 95% of our hydrogen today comes from steam methane reforming and has a large associated carbon footprint. The pace of Hydrogen technologies is accelerating with production pathways based on different renewable energy sources like solar, wind, water and conventional technologies. Nuclear power, which now generates 10% of the world's electricity, is essential in transitioning the energy industry away from uncontrolled fossil fuel use. New possibilities arise from using nuclear electricity to generate heat and hydrogen. Together with the more well-known kinds of hydrogen like green and blue, hydrogen produced from nuclear energy can also play a significant role in the energy transition phase. This research assesses the techno-economic feasibility of producing hydrogen using nuclear energy. For this study, three standardized and comprehensive case studies involving different nuclear power plants at different locations and hydrogen production facilities were taken into consideration. The case studies were selected based on their different characteristics, such as the type of reactor and geographical locations.

Methods

The cost analysis is performed using the HEEP (Hydrogen Economic Evaluation Program) developed by IAEA (International Atomic Energy Agency). HEEP considers several reactor designs as well as various hydrogen production pathways. The tool requires technical and financial input parameters to calculate the Levelized cost of Hydrogen produced from Nuclear power. The most promising technology such as conventional electrolysis was coupled with different active reactor types from the USA , India and South Korea for the analysis purpose. The Levelized cost of Hydrogen was calculated for each combination of reactor and electrolysis technology, taking into account factors such as overnight capital costs, operating costs, and the cost of nuclear fuel.

Results

The results suggest that harnessing nuclear energy to produce hydrogen is economically viable in parts of the world. Three comparable and comprehensive case studies were done, and the outcomes were evaluated using several factors that range from nation to nation. The most affordable hydrogen was discovered to be that generated in South Korea, at $2.74/kg, while the most expensive hydrogen was shown to be that produced in US and Indian facilities, at $4.12/kg and $3.31/kg, respectively. Significant differences in overnight capital costs by nation were also discovered by the study, notably between the developing industrial economies of East Asia and the established markets of Europe and North America. These variations in structural parameters could affect the economic feasibility of producing hydrogen using nuclear energy in different countries. Moreover, the study results could have significant implications for the future of the energy industry, as hydrogen is considered a promising fuel for reducing greenhouse gas emissions and mitigating climate change.

Conclusions

The levelized cost of hydrogen from Nuclear power was estimated using various techno-economic assumptions . Overall, the results point to nuclear energy as a stable, scalable, and low-emission source of energy for hydrogen generation, which may play an important part in the shift to a low-carbon economy. Interest in nuclear hydrogen production has been growing in several Member States over the past decade. Nuclear power can play a significant role with respect to large scale hydrogen production. Different reactor types and thermo-chemical cycles are seen as promising technologies for nuclear hydrogen production. To fully exploit the promise of this strategy, further study and funding are required, along with advancements in nuclear technology and the creation of infrastructure and markets for hydrogen.

References

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