HYDROGEN AS AN ALTERNATIVE FUEL: KEY CHALLENGES AND POTENTIAL

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ABSTRACT

Rapid growth of world population and economic activities continue to cause the increase of anthropogenic greenhouse gases (GHG) emissions. To mitigate GHG emissions and limit global warming, researchers and practitioners around the globe search for clean energy solutions. Many researchers believe that hydrogen (H_2), with its high energy density, has a promising potential. Yet, practical implementation of H_2-based energy generation faces technical and economic challenges. So far, over 95% of global hydrogen production relies on fossil fuels. Green H_2 produced via electrolysis remains 3-5 times more expensive than grey H_2 and generates up to 8.5 kg of carbon dioxide (CO_2) per kg of H_2 production. Hydrogen production itself requires substantial energy input, but this could originate from hydroelectric, nuclear power plants, and other renewable energy sources. As a fuel, H_2 should be used at the most efficient combined-cycle gas turbines (CCGT) to maximize economic and environmental benefits. Currently, CCGT operating on hydrogen can achieve an electrical efficiency of over 60 %; for H_2 fuel cells, this parameter can exceed 80 %. Coordinated efforts are now needed to improve storage and transportation technologies, lower production costs, and establish policies supporting crucial role of hydrogen in sustainable energy transition. The authors offer a view on a topic that is becoming increasingly vital. This article intends to explore ways to use hydrogen as an alternative energy source encouraging readers' interest to investigate further.

Keywords: energy transition, net-zero emissions, energy generation, hydrogen production, hydrogen storage techniques

INTRODUCTION

The concerns of global warming caused by the anthropogenic emissions of greenhouse gasses remain a top priority in the international climate agenda. Over 190 countries joined the legally binding international treaty, 'the Paris Agreement'. Its overarching goal is to maintain "*the increase in the global average temperature to well below 2° C above pre-industrial levels*" and pursue efforts "*to limit the temperature increase to 1.5° C above pre-industrial levels*."

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