Chapter 1
A Study on Challenges and Barriers in the Adoption of Hydrogen Energy

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ABSTRACT

The Future of Hydrogen, provides a clear and fair look at hydrogen. It covers current conditions, possible uses, and how hydrogen could help build a safe, affordable, and sustainable energy system. Several technological and economic factors influence the cost of making hydrogen from natural gas. Overcoming more barriers and lowering costs will need bold, immediate steps. To do this, a detailed review of existing studies has been done. This review identifies the main challenges and ranks them using the MARCOS(Measurement of Alternatives and Ranking According to the Compromise Solution) method.

INTRODUCTION

Energy use worldwide rises with population growth and development. Almost everyone depends on fossil fuels to meet energy needs. While fossil fuels are essential for power, they are also highly controversial because of their environmental harm. Burning coal, oil, and natural gas releases large amounts of carbon dioxide and other greenhouse gases. These gases are major causes of global warming and climate change. Extracting, processing, and transporting fossil fuels can lead to

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deforestation, habitat destruction, and pollution of soil and water. Hydrogen energy is gaining popularity over fossil fuels because it is better for the environment, more efficient, and more sustainable. It also benefits from being more developed in technology. Still, many people are not familiar with hydrogen fuel. To address this, rules and laws need to be made. These regulations should aim to stop pollution caused by fossil fuels and protect the environment.

BACKGROUND

Nanda et al. (2021) explain that hydrogen energy has gained a lot of attention recently. It is a renewable solution that can replace fossil fuels (Singh et al. 2022). Using fossil fuels like oil, coal, and natural gas harms the environment and intensifies global warming (Ali et al. 2024). Hydrogen has a high energy density; it stores about seven times more energy per weight than fossil fuels (Tarhan & Çil 2021). Yang et al. (2009) argue that hydrogen will be a key energy source in the future, but some problems still need fixing. Once hydrogen is made, transporting and storing it can be difficult, as Murray (2018) points out. Baykara (2018) claims hydrogen energy is friendly to the environment and climate. In the future, hydrogen could replace oil in cars, planes, trains, and ships (Farrell et al. 2003). The European Union predicts this will happen. The High-Level Group for Hydrogen (2003) forecasted that by 2040, 35% of vehicles in Europe will run on hydrogen.

RESEARCH METHODOLOGY

A thorough review of existing studies on hydrogen energy was carried out to identify its challenges. A questionnaire with 17 questions was created and shared with experts from academia and industry. Respondents were asked to rate each statement on a scale of 1 to 3, where 1 means disagree, 2 indicates no opinion, and 3 stands for agreement. Based on their responses, the main barriers to adopting hydrogen fuel were identified. The MARCOS method was used to rank these challenges in order of importance. Table 1 lists the key obstacles faced when adopting hydrogen energy.