Unveiling the Future: A Comprehensive Analysis of Innovation Drivers in European Hydrogen Technologies

P22. Organizing for Sustainability: a multilevel challenge

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Abstract text

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Context and research gap

In recent decades, hydrogen technologies have advanced significantly, positioning hydrogen as the future's energy source. Hydrogen is valued for its cleanliness, safety, and high-quality fuel (Beccali et al., 2008). Additionally, hydrogen production offers a promising solution to address renewable energy intermittency, redirecting energy impacts towards various applications (Chen et al., 2011). Hydrogen technologies include production, storage, transportation, and applications like refueling stations and fuel cell vehicles (Sinigaglia et al., 2019). Hydrogen technologies have the potential to replace fossil fuels in traditional sectors, promoting a shift to sustainable energy sources during the transition (Sarkar et al., 2019). Many studies analyze the impact of the policy for promoting renewable energy and the relationship between green technologies and CO2 emissions, but few studies have evaluated the factors determining innovation in renewables (Milindi & Inglesi-Lotz, 2022; Zhang et al., 2017; Hashmi & Alam, 2019; Li & Shao, 2021). Researchers have mainly focused on studying the main factors of innovation involving the more traditional renewable energy sources such as solar, wind, geothermal, hydro, and marine (Hille et al., 2020). To the best of our knowledge, studies have yet to focus on hydrogen technologies at the European level. Based on these premises, this study aims to understand the key factors that determine innovation in hydrogen technologies within the European context. The goal is to provide valuable insights to guide policymakers and firms in effectively promoting the ecological and energy transition at the state level. We argue that innovation within companies is a process significantly influenced by the external environment in which they operate (Antonelli et al., 2013; Segarra-Ciprés & Bou-Llusar, 2018). External context can either facilitate or hinder a company's ability to innovate, making it crucial to consider several key factors (Figure 1). These factors are: human capital, sustainability commitment, and political and legal processes.

Figure 1 - Key factors that can influence innovation in hydrogen technologies. Source: personal elaboration

Research design

We developed a panel model where the 27 member states were considered observational units from 2000 to 2021. The final dataset consists of 594 observations. We decided to use a panel model to consider both the sample's diversity and the temporal evolution of the phenomenon. In particular, given the nature of the dependent variable (i.e., the number of companies patented in the hydrogen field), a panel model using Poisson logistic regression was chosen (Hille et al., 2020).

Findings

Considering human capital, increasing people with college degrees, personnel employed in HRST fields, and personnel in research and development has a positive effect on innovation in hydrogen technologies. This observation underscores the importance of human capital and education in driving innovation within hydrogen technology. Considering the sustainable commitment, the stock of patents in renewable technologies has a positive impact. In contrast, R&D spending and the enactment of Agenda 2030 have a negative impact unless we study the interaction of these, which turns out to be positive. This observation highlights the complex interplay of various factors in driving sustainable innovation. Considering the political and legal process, the legal system, property rights, and regulation have a positive impact on innovation in hydrogen technologies. This perspective aligns with the idea that a stable and supportive legal and regulatory framework can encourage innovation in emerging technologies like hydrogen.

Implications

Possible policies are: investment in education; supporting research and development by allocating financial resources; creating funding programs for research institutes, universities, and businesses; and fostering public-private collaborations. Also promote public awareness of the importance of hydrogen as a sustainable energy resource, educating society on its usefulness and career opportunities related to this technology. Collaborate with other nations to share knowledge and resources in the hydrogen sector, foster the exchange of best practices, and promote international standards. Future research could involve exploring factors that may influence research at the regional NUTS2 level to see how it develops within nations. It would be interesting to have specific data on R&D investments in hydrogen technologies.

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