EXTENDED ABSTRACT

An Empirical Study on Factors Influencing Hydrogen Fuel Cell Vehicles Adoption-Intention Leading to Achievement of Sustainable Development Goals in India

Name of the student: Sidhartha Harichandan   **Roll No.:** 20MS0009

Name of Department: Management Studies

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Prof. Sanjay Kumar Kar

(*NAME OF THE SUPERVISOR)*

Transportation is critical to a country's socio-economic development. However, it also poses significant environmental and human health challenges, as it accounts for a large share of global energy consumption and greenhouse gas emissions. Moreover, transport activities also generate air pollutants, noise, congestion, and accidents that affect the quality of life of millions of people. Therefore, there is an urgent need to promote sustainable transport, which is defined in the sustainable development goals (SDGs) as "the provision of services and infrastructure for the mobility of people and goods that do not endanger human health, ecosystems, or the equitable functioning of the economy". Sustainable transport aims to balance economic development's social and environmental dimensions and support achieving the 2030 Agenda for SDGs and the Paris Agreement on climate change.

One of the key aspects of sustainable transport is fostering sustainable consumer behaviour, which refers to the consumption of goods and services that have a minimal impact on the environment, society, and economy. Various factors can influence sustainable consumer behaviour, such as awareness, attitudes, values, norms, incentives, policies, regulations, infrastructure, technology, innovation, and social norms. Understanding how these factors affect consumer choices and preferences in different contexts is essential for designing effective interventions and strategies to promote sustainable transport.

This study focuses on adopting hydrogen fuel cell vehicles (HFCVs) in India as a potential solution for reducing emissions and enhancing energy security in the transportation sector. HFCVs are vehicles that use hydrogen as a fuel to generate electricity through a chemical reaction in a fuel cell. HFCVs have several advantages over conventional vehicles, such as zero tailpipe emissions (only water vapour), high efficiency, low noise, fast refuelling time, and long driving range. However, HFCVs face several challenges: high cost, lack of infrastructure, safety concerns, public awareness, and policy support.

India is one of the fastest-growing economies in the world, with a population of over 1.4 billion people and a fleet of over 300 million vehicles. The demand for mobility is expected to increase further in the coming years, driven by urbanisation, income growth, and social aspirations. However, this also implies a growing dependence on fossil fuels, especially oil imports, which poses risks to energy security, balance of payments, and environmental sustainability. India is also one of the most vulnerable countries to the impacts of climate change, such as extreme weather events, sea level rise, water scarcity, and food insecurity. Therefore, India is interested in developing and deploying alternative fuels and technologies to reduce its carbon footprint

and enhance its energy resilience. Through its "National green hydrogen mission," the country aims to promote the production, storage, distribution, and utilisation of green hydrogen in various sectors of the economy. One of the critical applications of hydrogen is in the transportation sector, where HFCVs can offer a clean and efficient mode of mobility.

This study addresses the research gaps on the induction of HFCVs in the Indian transportation sector by empirically analysing the factors influencing consumer behaviour towards their adoption intention. The study will also explore the strategies and policies that can facilitate the adoption of HFCVs in India by addressing the barriers and enhancing the drivers for consumer behaviour change. The research contributes to the literature on sustainable transport and consumer behaviour by providing insights from an emerging market context with unique opportunities and challenges for HFCV adoption. These are following objectives of this thesis:

• To identify and assess the socio-economic, environmental, psychological, and technological factors that affect adoption intention for HFCVs in India.

• To assess the strategies and policies that facilitate the adoption of HFCVs in India.

• To provide recommendations for stakeholders on fostering sustainable consumer behaviour and accelerating the transition to a hydrogen economy in India.

The research uses a structured questionnaire-based quantitative survey approach on potential adopters of HFCVs in different regions and segments of India. Based on the 455 responses generated from the sample responses, the study employs structural equation modelling (SEM) techniques to analyse the results of this study. The findings reveal that deteriorating environmental standards and motivation towards sustainability are the prime drivers towards adopting HFCVs. The challenges for HFCV adoption include the high cost of vehicles; lesser refuelling stations; lack of standards and regulations; low consumer awareness; and lesser coordination among different actors. Further findings reveal that policy interventions play a significant role in influencing consumer adoption intention towards HFCVs. Also, it was found that by adopting HFCVs, sustainable goals related to cleaner and greener mobility systems can be achieved.

Collaborative and comprehensive actions from all the key stakeholders, which involve both central and state government, vehicle manufacturers, original equipment manufacturers (OEMs), distributors, hydrogen manufacturers and refuelling station operators, are the need of the hour. Free registration costs for hydrogen-operated or blended vehicles, hassle-free land

acquisition for refuelling stations, investment facilitation for vehicle manufacturers, Production-linked incentive schemes, developing standards and regulatory norms and engaging customers through Artificial intelligence and virtual reality mediums are some of the crucial policies that could foster faster adoption HFCVs in the country.