

## Chapter 5

# A Comprehensive Analysis of Fuel Cell–Powered Electric Vehicles in India Through the PESTLE Framework

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### ABSTRACT

*With growing concerns about climate change and pollution, electric vehicles (EVs) are emerging as an eco-friendly alternative to traditional fossil fuel-powered cars. Government policies and incentives promoting sustainable transportation are driving rapid growth in India's EV market. Fuel cell electric vehicles (FCEVs) represent a technological advancement within the EV sector. FCEVs use hydrogen fuel cells as their primary energy source, emitting only water vapour instead of pollutants. Before introducing new technologies like FCEVs, it is crucial to analyze their viability and impact. The PESTLE framework examines political, economic, sociocultural, technological, legal, and environmental factors affecting FCEV operations. This chapter explores the feasibility of FCEV technology in Indian cities considering political, legal, economic, environmental, technological, and sociological aspects. PESTLE analysis provides valuable insights for addressing fuel cell technology advancements and challenges in the EV industry.*

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## **1. INTRODUCTION**

The automotive industry is currently facing a critical turning point worldwide as countries worldwide strive to transition to sustainable transportation. The primary driving forces behind this transition are concerns over climate change, air pollution, and the need to reduce reliance on fossil fuels. In the case of India, this transition is particularly urgent due to the country's high levels of pollution in major cities and heavy dependence on imported oil. According to a survey conducted by the World Health Organization in 2018, India is home to 14 of the 20 most polluted cities globally (WHO, 2022). Furthermore, more than 80% of India's energy requirements are met through oil imports, highlighting the country's significant reliance on foreign oil sources (Petroleum Planning & Analysis Cell, 2023). This dependence not only poses economic and geopolitical risks but also contributes to air pollution and carbon emissions.

In response to the growing demand for sustainable transportation and increasing environmental concerns, EVs have gained significant attention in recent years. The Indian government has set ambitious targets for EV sales and is actively promoting the adoption of EVs through various incentives and policies. By 2030, the government aims to ensure that 30% of all vehicles sold in India are electric (IEA, 2017). To achieve this goal, several initiatives have been launched, such as the Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) scheme. This scheme provides financial incentives for EV purchases and supports the development of charging infrastructure. The increasing trend of EV sales in India, which has grown from 0.75% of total vehicle sales in 2019 to over 4% in the first half of 2022, further validates the effectiveness of these policies (Sarath Jain and Bajaj, 2022; e-AMRIT, 2023). Notably, the sales figures for electric two-wheelers and three-wheelers in India have been particularly impressive, with around 1.18 million and 1.12 million units sold, respectively, until April 27, 2023 (e-Vahan, 2023). However, the sales of electric light motor vehicles have lagged behind, with only 76,000 units sold.

If the current trend continues and gains further momentum, the nation's EV target will likely be achieved well before the anticipated timeline. This positive trajectory reflects the growing awareness and acceptance of EVs among Indian consumers. In the Indian EV market, battery electric vehicles (BEVs) have been the primary focus, with various automakers introducing electric cars. However, BEVs have limitations that make them unsuitable for long-distance travel, including their limited range, long charging times, and inadequate charging infrastructure. Consequently, there is a growing need for alternative EV technologies, such as FCEVs. FCEVs offer promising advantages over BEVs, such as extended range and faster refuelling. They utilize hydrogen as fuel, converting it into electricity to power the vehicle's motor, emitting only water vapour as a by-product. Although FCEVs are still in the early stages of development in India, they possess the potential to revolutionize the transportation industry by providing a sustainable and efficient mode of transport. By utilizing hydrogen as fuel and generating electricity for the motor, FCEVs offer numerous benefits compared to BEVs, including a greater range, faster refuelling times, and zero tailpipe emissions. In the near future, FCEVs are expected to operate complementing BEVs which promotes the use of hydrogen as an alternative to fossil fuels. Although FCEVs are still emerging in the Indian market, they can make a substantial impact on the EV industry.

India holds immense potential for FCEVs due to its abundant renewable energy resources that can be utilized for hydrogen production. FCEVs offer a sustainable and efficient transportation solution, particularly for long-distance travel in the country. They are expected to play a vital role in achieving the ambitious EV sales targets set by the Indian government. To promote hydrogen as an alternative fuel, the government has launched the National Green Hydrogen Mission (NGHM), which aims to establish a

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