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Identifying Enablers and Challenges of Electric Vehicle Adoption: A Comprehensive Review of the Literature

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Abstract: *There is global pressure to increase the adoption of Electric Passenger Vehicles (EPVs), as electric cars sold in 2024 accounted for 22%, whereas in India, adoption was only 2% in 2024. Several United Nations Sustainable Development Goals (7, 9, 11, 12, and 13) highlight the importance of clean energy and climate actions, and Electric Vehicles (EVs) play a key role in meeting these targets by promoting a sustainable and environmentally friendly future. However, in recent times, the adoption of EVs in India has raised concerns despite growing interest in sustainable mobility. Any new technology in its initial stage has a low market share. To increase adoption, it is essential to study the key factors that affect consumer usage intention. A conceptual framework is proposed linking these enablers and challenges to consumer usage intention. It is necessary to understand these factors for widespread EV acceptance.*

Keywords: *Electric Vehicles (EVs), Technology Adoption Drivers, Sustainable Development Goals (SDGs), Sustainable Transportation, Green Mobility.*

I. INTRODUCTION

There is one-fourth of global emission through transportation sector. Road transport accounts for 74% (Pamidimukkala *et al.*, 2024). It is also a major contributor to 23% of greenhouse gas emissions (Suman and Rajak, 2024). This makes it necessary for the introduction of some sustainable solutions to reduce these emissions. This highlights the need for the adoption of alternative technologies that can replace internal combustion engine vehicles (ICEVs). Electric vehicles are introduced as the solution to address these environmental issues (Patyal *et al.*, 2021). Electric vehicles not only help reduce pollution but also help achieve several United Nations Sustainable Development Goals (UNSDGs). Despite these advantages, some challenges hinder the widespread adoption of EVs. It is important to identify these enablers and challenges and their impact on consumers' intention.

Globally, EV sales crossed 14 million in 2023 (KEK *et al.*, 2024), bringing the total number of EVs on the road to around 40 million (IEA, 2024). This growth is driven by financial incentives, longer battery range, and heightened environmental awareness, which motivate consumers to adopt EVs (Clinton & Steinberg, 2019; Tran *et al.*, 2021; Wang & Witlox, 2025). The EV market in India is growing, having already achieved a milestone of 100,000 EV sales (IBEF, 2025). According to reports, EV manufacturers are launching new models early in 2026 across segments to dominate the market. This indicates industry preferences regarding emphasis on cleaner transportation technology (IBEF, 2026). EV sales in India are improving, and policy support is available, but progress is slow as many consumers remain uncertain about adopting EVs. To achieve sustainable transportation, it is important to increase adoption, which requires proper planning (Krishna, 2021).

Prior research shows that digitalisation and sustainability orientation strengthen the innovation capability of emerging ventures (Tikkha *et al.*, 2024), which is relevant to EV adoption, where new entrants are driving progress in charging infrastructure, battery technologies, and mobility services. As part of planning, understanding consumer perception of EVs is important for achieving the targets and goals set by the government. Understanding challenges and enablers can provide in-depth insights into the adoption process and consumer behavior.

Due to the presence of both enablers and challenges in EV adoption, it becomes necessary to study them together and understand how they influence consumer intention, which affects EV adoption. To identify these factors, this study conducts a comprehensive review of the literature.

II. RESEARCH GAPS AND OBJECTIVES

Previous studies used theories such as the Theory of Planned Behavior (Ajzen, 1985) (TPB), the Technology Acceptance Model (David, 1989) (TAM), Unified Theory of Acceptance and Use of Technology (Venkatesh, 2003) (UTAUT), etc., to understand consumer behavior. Although these models are widely used for technology adoption, they only provide general insights. They use broad general constructs like performance expectancy, social influence, perceived ease of use, perceived usefulness, etc. Few studies have examined EVs' specific factors and their influence on consumers (Sovacool 2017). Since this technology is new, overlooking enablers and challenges limits the understanding of consumer intention. Structural modelling approaches such as ISM have been used to identify the key drivers of emerging sectors (Tikkha *et al.*, 2025), but such approaches remain underused for EV-specific factors.

It is important to identify the EV-specific factors that are impacting consumers' intention and address this gap. Hence, this study applies the SLR to identify these enablers and challenges impacting consumer behaviour and proposes the conceptual framework based on them.

The objectives of the study are

- 1) Objective 1: To identify the enablers and challenges that impact consumer intention through a comprehensive review of the literature
- 2) Objective 2: To propose a conceptual framework that links enablers and challenges to intention.

III. METHODOLOGY

A comprehensive review of the literature approach has been used.

Search Process: Sources used to search for the papers are ABDC, SCOPUS, Web of Science, etc. Keywords like electric vehicle adoption, enablers of electric vehicles, challenges of electric vehicles, technology adoption, sustainable mobility, sustainable transportation, etc are used for searching.

- 1) Inclusion criteria: Peer-reviewed, published in English, and focused on electric vehicle adoption, electric vehicle enablers, and electric vehicle challenges are included. Apart from this, both international and national papers are also included. Papers on consumer intention and factors impacting consumers' intention are also included.
- 2) Exclusion Criteria: Papers that are not related to electric vehicles, published in a local region, non-peer-reviewed such as blogs, etc., and not published in English are excluded. Apart from this, papers not available in full text are also excluded.
- 3) Screening and Selection: To check whether the paper is relevant or not, the title and abstract were first screened to remove irrelevant papers. The remaining papers are then fully read to check their relevance. After this, around 40 papers are reviewed in detail.
- 4) Analysis: Based on the enablers and challenges of electric vehicles, selected papers are read and grouped. The primary focus is given to those papers that have discussed more than one enabler and challenges.

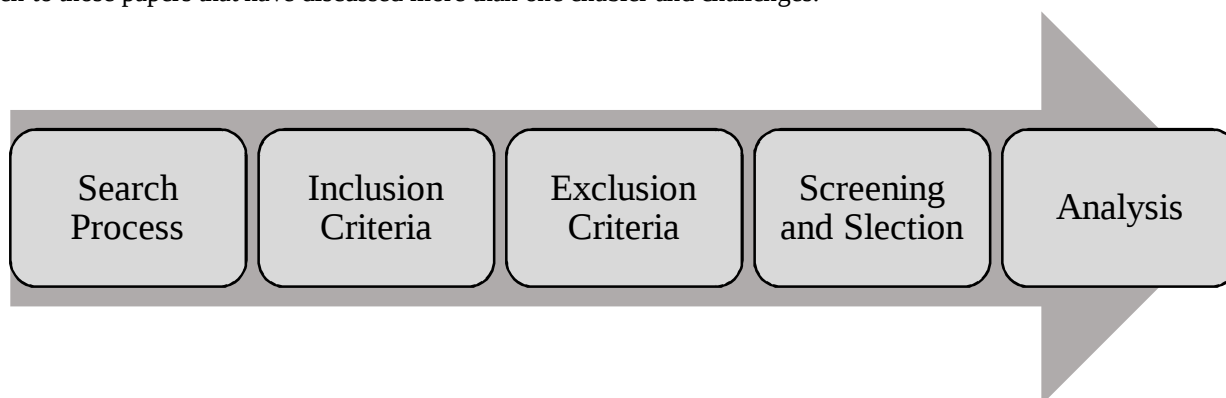


Figure 1 Methodology

A. Discussion

The literature proposed four enablers that boost electric vehicle adoption and five challenges that hinder consumer acceptance

IV. ENABLERS

A. Financial Incentives

Financial Incentives are the most important enabler of electric vehicle adoption that impact consumers' incentives. Consumers are hesitant to buy electric vehicles due its purchase cost. These incentives are introduced by the government to reduce the cost. These incentives include subsidies, tax rebates, reduced registration fees, etc that make electric vehicles affordable to consumers. These incentives not only address the issue of cost but also help in changing the perception of electric vehicles among consumers. Previous literature highlights that consumers' intention to purchase electric vehicles increases with financial benefits (Dua et. al., 2021; Chhikara et. al., 2021).

B. Maintenance Cost

Maintenance costs of Electric vehicles are another important enabler to boost adoption. Internal combustion engine vehicles have engines that constantly require oil changes and other maintenance. But electric vehicles do not have engines instead, they have batteries, for which maintenance is relatively less for example no oil change is required. This lowers service routine and maintenance costs for electric vehicles. Consumers' intention to adopt EVs increases if they find EVs more cost-effective. This can boost the overall adoption of electric vehicles (Dua et. al., 2021; Mesquita et. al., 2025).

C. Environmental Impacts

Environmental impacts are the most significant enabler for electric vehicles. Electric vehicles are introduced to reduce emissions and lower the harmful impact of ICEVs on the environment. Due to this, it is widely perceived by consumers as the cleaner alternative to ICEVs. It has many environmental benefits, such as reduced greenhouse gas emissions, reduced dependence on fossil fuels, and improved air quality. Consumers are aware of environmental issues and EVs' benefits. These benefits are making consumer attitudes towards EVs positive, especially among consumers who are environmentally conscious. This helps boost the overall adoption of electric vehicles (Rezvani et. al., 2015; Khurana et. al., 2020).

D. Government investments

Governments are actively investing in increasing electric vehicle adoption. Investments like increasing the charging infrastructure and battery technology are helping to reduce the challenges. These investments have addressed some consumers' issues like range anxiety, battery efficiency, and convenience. Apart from the government is also providing incentives to manufacturers to increase the manufacturing of electric vehicles, which will address the issue of limited model availability. Government support is changing consumers' perceptions through awareness. This has increased consumers' intention to adopt (Chhikara et. al., 2021).

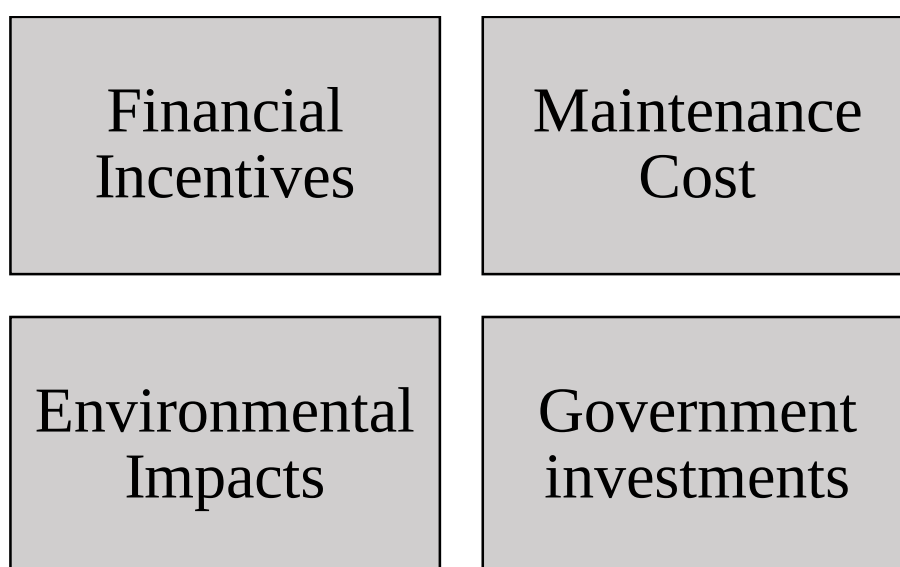


Figure 2: Enablers

V. CHALLENGES

A. Charging Infrastructure

One of the most critical challenges in electric vehicles is charging infrastructure. The charging stations are still limited. This creates range anxiety among consumers. Consumers often avoid long-distance travel in electric vehicles due to the limited availability of charging stations. Although governments are investing to increase the number of charging stations, it is still low in number, which is causing a hindrance in electric vehicle adoption. Another challenge is the duration required to charge electric vehicles. Consumers are already used to ICEVs, which do take longer to refuel. EVs take long hours to recharge, which makes it inconvenient for consumers and makes them hesitant to adopt EVs (Krishna, 2021; Goel et. al., 2021).

B. High Upfront Cost

High upfront cost remains a major challenge in EV adoption. The initial purchase cost of EVs is higher than the ICEVs. This makes them less affordable to consumers. Although government provide the incentives to reduce these costs, they are still not enough. Apart from this, battery costs of EVs are also high, and their lifespan is also short. It is required to be replaced in a few years, which makes EVs more expensive. ICEVs are comparatively less expensive. This makes consumers hesitant to adopt EVs (Krishna, 2021).

C. Driving range of EVs

Driving range is another challenge in electric vehicle adoption. Electric vehicle driving range is low compared to ICEVs. This challenge often makes consumers feel range anxiety. EVs' low driving range often disrupts consumers' travel, especially long-distance travel. Low range with limited charging stations makes consumers hesitant to adopt EVs (Kumar et. al., 2020; Goel et. al., 2021; Krishna, 2021).

D. Service and Repair

EVs are new technology that requires specialized, trained, and skilled workers for repairs and service. There is limited availability of repair and service workshops. The infrastructure is still underdeveloped, due to which proper repair and service workshops are limited. Since EVs do not have an ICE, not all workers can repair them. This makes consumers more hesitant to adopt EVs (Goel et. al., 2021).

E. Recycling batteries

EV batteries are made of lithium-ion with limited lifespan. The batteries need to be replaced. These batteries are made of harmful chemical which can harm the environment if not disposed of properly. There is limited recycling infrastructure for EV batteries. This creates environmental risk due to toxic chemicals present in batteries and limited infrastructure to dispose of or recycle them properly. This makes consumers, especially environmentally conscious consumers, hesitant to adopt EVs (Goel et. al., 2021).

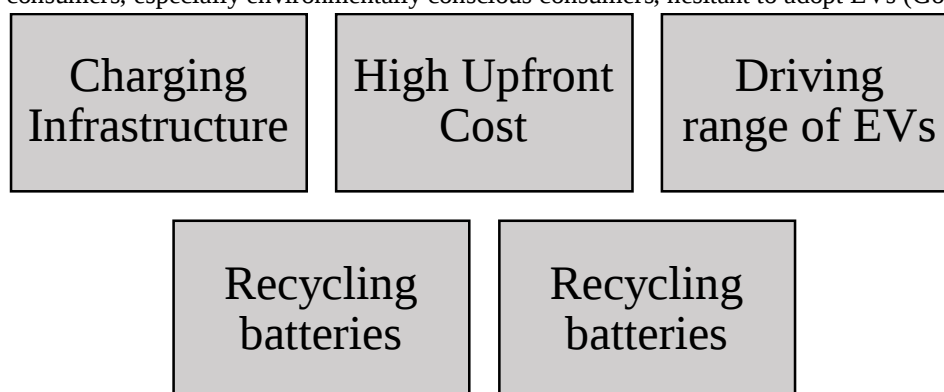


Figure 3: Challenges

F. Proposed Conceptual Framework

Based on reviewing enablers and challenges, four enablers and five challenges are proposed as antecedents to intention. They are financial incentive, environmental impact, maintenance cost, and government investment as the enablers. The challenges are charging infrastructure, high upfront cost, driving range of EVs, service and repairs, and recycling batteries.

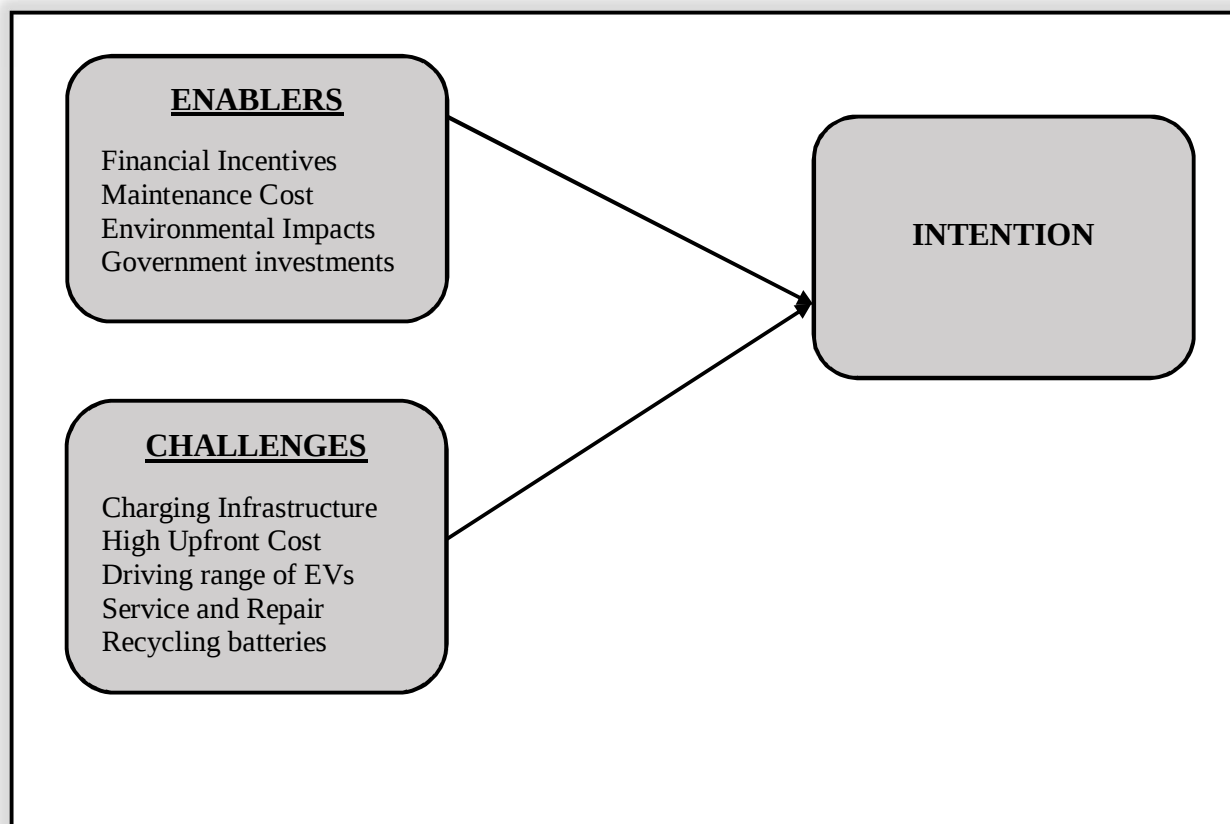


Figure 4: Conceptual Framework

G. Implications

The study contributes to the literature by identifying the enablers and challenges that impact the consumer intention to adopt electric vehicles. The study conducts a comprehensive review of the literature to identify EV-specific factors. These factors are then categorized into enablers and challenges. These factors are financial incentives, environmental impact, maintenance cost, and government investment as the enablers. The challenges are charging infrastructure, high upfront cost, driving range of EVs, service and repairs, and recycling batteries. This enhances the theoretical understanding of technology adoption of EVs. The proposed framework can be used in future research. The findings also help in taking practical actions by the manufacturers, policymakers, and government. They can work together to overcome the challenges and increase adoption.

VI. CONCLUSION

The study used a comprehensive review of literature approach to identify the enablers and challenges that impact the consumer intention to adopt EVs. The study reviewed relevant papers and identified four enablers and five challenges of electric vehicle adoption. Enablers help in boosting the adoption and change consumers' perceptions about EVs. But due to challenges, there is hesitation among consumers to adopt EVs. A conceptual framework is proposed connecting these enablers and challenges to the intention. Enablers and challenges are the antecedents, and intention is the consequence. This can be used in future research on electric vehicle adoption.

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