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Navigating the Current: A Comprehensive Synthesis of Consumer Resistance and Market Obstacles to Electric Vehicle Diffusion

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Abstract

The global transition toward electrified transportation has reached a critical structural turning point. While early market penetration was catalyzed by aggressive fiscal incentives, purchase subsidies, and regulatory mandates, the subsequent transition from early adopters to mainstream mass-market consumers has exposed deep-seated friction. This paper presents a systematic synthesis of the multi-dimensional barriers inhibiting the universal diffusion of Electric Vehicles (EVs). Adopting a multi-disciplinary framework, we evaluate and classify the prevailing obstacles into four core socio-technical pillars: infrastructural vulnerabilities (charging point density and multi-unit dwelling constraints), economic headwinds (high upfront capital premiums, total cost of ownership uncertainties, and resale market volatility), behavioral and psychological resistance (persistent range anxiety and legacy habits), and operational liabilities. Furthermore, this study critically examines the "incentive phase-out paradox," analyzing the compounding market friction that occurs when governments roll back financial support mechanisms before vehicles achieve true organic price parity. By integrating empirical findings across diverse regional contexts, this paper maps the current landscape of consumer resistance and offers a strategic blueprint for policymakers and energy stakeholders to transition from thin, incentive-driven adoption to structural, mass-market saturation.

Keywords: Electric Vehicles; Adoption Barriers; Transport Policy; Socio-Technical Transition; Range Anxiety; Infrastructure Deployment; Technology Diffusion.

1. Introduction

The global surface transit sector stands as one of the primary contributors to greenhouse gas emissions and urban air pollution, accounting for nearly one-quarter of energy-related carbon dioxide (CO_2) emissions globally. Consequently, accelerating the transition from internal combustion engine (ICE) vehicles to alternative fuel technologies has become a cornerstone of international climate mitigation strategy, directly tied to the fulfillment of United Nations Sustainable Development Goals (SDGs) for clean energy and sustainable urban infrastructure. Among competing technological pathways, Battery Electric Vehicles (BEVs) and Plug-in Hybrid Electric Vehicles (PHEVs) have achieved near-unanimous backing from global policymakers and automotive manufacturers as the dominant paradigm for decarbonizing personal and commercial transit.

According to data from the International Energy Agency (IEA), global electric car sales are projected to reach approximately 23 million units, capturing roughly 28% of the total automotive market. Driven by massive manufacturing scale, vertical integration in dominant markets like China, and tightening corporate average fuel efficiency standards in Europe, the macro-level expansion of electromobility appears structurally intact.

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Yet, these high-level aggregate volumes obscure an emerging and highly problematic phenomenon: an asymmetric adoption plateau across multiple geographic and demographic market segments.

[The Mass-Market Adoption Gap]

Early Adopters (Incentive-Driven) | Mass Market Majority (Risk-Averse / Practical)

High Income		Lower/Middle Income
Home Charging	──▶ Barrier Chasm	Multi-unit Dwellers
Tech-Forward		Grid Vulnerabilities

The initial wave of EV adoption was largely sustained by an idealized consumer demographic—predominantly high-income households with dedicated private parking, predictable urban driving profiles, and a high tolerance for technological novelty. As the sector attempts to cross the chasm from these early innovators into the highly risk-averse "early majority" mass market, the nature of consumer resistance changes fundamentally.

Mainstream buyers evaluate vehicles through a highly pragmatic lens dominated by immediate financial utility, geographic convenience, and long-term operational predictability. For these consumers, the decision to transition away from standard internal combustion options introduces a complex matrix of perceived and structural risks.

Crucially, this resistance is compounding precisely as global environmental policy enters a highly volatile phase. Many pioneering nations are encountering what can be termed the "incentive phase-out paradox." Having utilized heavily subsidized financial "carrots"—such as direct cash rebates, registration waivers, and tax credits—to artificially depress the initial acquisition cost of an EV, fiscal authorities are scaling back these programs to balance public budgets.

However, removing these supply-side mechanisms before local supply chains achieve baseline component cost parity creates a vacuum, causing localized sales contractions and reinforcing consumer hesitation. Furthermore, infrastructure deployment continues to suffer from a pronounced structural mismatch; the rollout of public charging corridors is failing to keep pace with fleet distribution, leaving urban apartment dwellers and rural long-distance commuters stranded in an infrastructural void.

To effectively design policies that can break through this adoption plateau, we must move past isolated, single-variable evaluations. While a technical study might isolate battery degradation as an engineering problem, or a psychology paper might dissect range anxiety as an abstract perception flaw, a policy-focused review must treat these elements as interconnected variables within a broader socio-technical network.

Research Objectives

This study addresses this clear academic and practical gap by providing a systematic synthesis of contemporary research on EV adoption constraints. This paper is organized around three primary objectives:

- To systematically catalog and deconstruct the multi-dimensional barriers (economic, infrastructural, psychological, and operational) currently stifling mainstream EV diffusion.
- To analyze the regional and demographic variances in consumer resistance, particularly contrasting the grid realities of developed networks with emerging automotive markets.
- To evaluate the structural consequences of policy rollbacks and present a synthesized framework for sustainable, unsubsidized market saturation.

Through this comprehensive evaluation, this study looks past individual consumer preferences to map out the macro-market obstacles that must be overcome if global transport decarbonization goals are to be realized.

1.4 Scope of the Study

The geographical and contextual scope of this study is focused systematically on the global transition pathways of electric vehicle (EV) diffusion, with particular emphasis on identifying structural bottlenecks across distinct regional markets between 2020 and 2026. This review deliberately scopes out macro-level trends across both advanced automotive markets (e.g., North America, Western Europe, and China) and expanding automotive ecosystems (e.g., India and South America). Thematically, the scope is strictly bounded within the socio-technical, financial, and behavioral obstacles that deter the "early majority" consumer segment from completing an EV purchase. While it addresses technological constraints—such as battery degradation and charging performance—the analysis evaluates these from a consumer-utility and policy perspective rather than examining raw electrochemical or materials engineering properties.

Furthermore, the temporal scope focuses on contemporary empirical data collected over the last six years, a period defined by massive state-backed subsidy waves followed by the emerging fiscal complexities of incentive rollbacks.

2. Literature Review

The academic discourse surrounding alternative fuel vehicle diffusion indicates that crossing the chasm from niche innovators to mainstream market stability is heavily dependent on overcoming systemic market friction. To provide a rigorous, multi-dimensional assessment of these roadblocks, this review synthesizes existing research into four interconnected thematic pillars: financial and economic headwinds, infrastructural vulnerabilities, behavioral and psychological constraints, and technological and environmental operational risks.

2.1 Financial and Economic Headwinds

The financial mechanics of electric vehicle ownership remain a primary point of friction for the pragmatic consumer. Historically, the high initial capital premium has acted as a severe deterrent. As analyzed by Al Irsyad et al. (2024), the initial sticker shock of a battery electric vehicle frequently outweighs long-term operational savings in the consumer's immediate calculation. This initial premium is heavily tied to the raw component costs of high-capacity battery packs (Cecere et al., 2018). While advocates frequently highlight a lower Total Cost of Ownership (TCO) due to reduced moving parts and cheaper fuel costs, the practical calculation remains opaque to the average buyer. Gupta et al. (2025) note that while lower operating and maintenance expenses positively influence tech-forward demographics, middle-income buyers struggle to calculate multi-year payback periods effectively.

Furthermore, the stability of this economic equation has been disrupted by shifts in government intervention strategies. Direct public subsidies have historically been the most effective tool to compress the upfront cost gap. Bhat et al. (2024) empirically demonstrated that immediate purchase subsidies are significantly more effective at driving consumer purchase intent than long-term incentives spread over a vehicle's operational lifetime, such as annual tax credits.

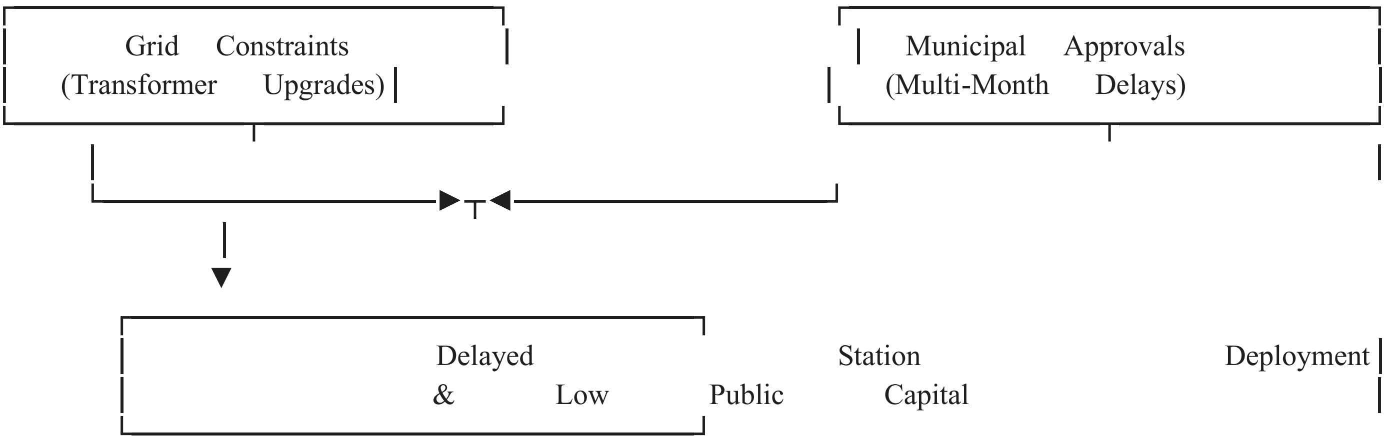
However, as markets mature, governments are hitting fiscal limits. In their analysis of the 2026 market recalibration, EnkiAI (2026) observed a global cooling in EV demand, driven primarily by the sudden expiration of consumer tax credits and purchase subsidies in major economies. This premature rollback of fiscal "carrots" has exposed a volatile secondary asset market. Mainstream buyers are increasingly anxious about the residual value and rapid depreciation of first-generation EVs. As detailed by Intel Market Research (2026), the threat of unexpected battery replacement fees—which can range from $10,000 to $20,000—creates massive volatility in used-car valuation models, keeping risk-averse consumers tethered to internal combustion engine (ICE) assets.

2.2 Infrastructural Vulnerabilities

Even when upfront financial barriers are mitigated, the physical reality of charging access presents a severe bottleneck to mass-market scaling. Mainstream adoption requires shifting from private home charging setups to reliable, dense public networks. S&P Global (2026) compiled consumer sentiment metrics showing that approximately 65% of surveyed individuals across major global markets still consider public charging networks to be completely insufficient for daily needs, highlighting infrastructure as the single most critical driver of consumer hesitation. This infrastructural deficit creates a persistent "chicken-and-egg" paradox: charge point operators face low station utilization and unviable business models until the EV fleet expands, while consumers refuse to buy the vehicles until the stations are highly visible (Bolt Earth, 2026).

This problem is further complicated by urban architecture and housing equity. While early adopters frequently reside in single-family homes with dedicated garages, the mass market consists heavily of multi-unit dwelling occupants and renters who lack access to private overnight charging points (Bolt Earth, 2026). Consequently, these users must rely entirely on fast-charging corridors.
However, deploying fast-charging systems introduces severe administrative and electrical engineering hurdles. MarkNtel Advisors (2026) point out that high installation and hardware costs—frequently exceeding $90,000 per DC fast-charging port—severely restrict rapid private expansion. On an administrative level, developers face prolonged permitting delays, land acquisition battles, and complicated utility approval processes. As detailed by Bolt Earth (2026), installing a modern 300 kW+ fast-charger site is a multi-month process requiring extensive utility impact studies and dedicated transformer switchgear upgrades.
Furthermore, cross-layer coordination remains highly fragmented. In their structural review of charging networks, arXiv (2026) developed a Planning-Scheduling-Behavior framework illustrating how a lack of integrated planning between municipal land planners and local electricity distribution companies results in severe spatial disparities, leaving entire sub-regions completely isolated from high-capacity corridors.

[Socio-Technical Infrastructure Friction Node]



2.3 Behavioral and Psychological Constraints

The transition to electromobility requires a fundamental shift in a consumer's daily habits, refueling patterns, and risk perception. The most widely documented psychological barrier is range anxiety—the persistent fear that a vehicle will run out of power before reaching a destination, leaving the driver stranded. Early research by Jensen et al. (2013) identified range anxiety as a primary cognitive roadblock, a trend that remains sticky despite steady increases in nominal battery capacity. Modern consumers express an ideal expectation for a continuous driving range of 300 km to 450 km under a single charge (Zhu, 2016). When a vehicle's range is perceived as variable or unpredictable, consumer trust drops sharply (Noel et al., 2020).
This psychological friction is deeply intertwined with refueling time expectations. While internal combustion refueling is a highly standardized, five-minute task, EV charging requires active planning. Carley et al. (2013) noted that extended charging times significantly increase the rejection rate among mainstream buyers, who view the charge cycle as an inconvenience that disrupts daily routines. This mismatch in convenience reduces operational flexibility (Graham-Rowe et al., 2012).
For example, consumers feel constrained by their inability to make sudden, unexpected long-distance trips while a vehicle is plugged in at a low-kilowatt home outlet. Brückmann et al. (2021) confirmed that mainstream drivers consistently rate public charging interfaces as highly inconvenient compared to conventional fuel pumps, driven by fragmented payment ecosystems and the requirement to manage multiple mobile applications just to initialize a charging session.
To model these behavioral dynamics, researchers frequently rely on established socio-psychological behavioral frameworks. The integrated Technology Acceptance Model (TAM) and Theory of Planned Behavior (TPB) models show

that an individual's final adoption intent is heavily shaped by social norms, peer exposure, and perceived behavioral control (Nida, n.d.). Mainstream consumers display high levels of habitual inertia and status quo bias.

Furthermore, consumer response to external shocks is highly fragmented. As demonstrated by MDPI (2026), while early adopters and the "early majority" cohort show high sensitivity to environmental beliefs, subjective social norms, and macro-economic disruptions (such as fuel price shocks), the "late majority" and "laggard" segments display highly delayed or static responses, requiring prolonged exposure to visible localized success before altering their vehicle purchase behavior.

2.4 Technological and Environmental Operational Risks

Beyond financial and behavioral dynamics, consumer resistance is reinforced by valid anxieties regarding the long-term reliability and physical performance of battery systems across varying environmental conditions. Pearre et al. (2011) established early on that electricity is inherently more complex to store and slower to replenish than liquid hydrocarbons, creating structural trade-offs in vehicle utility. In mass-market consumer surveys, concerns regarding lithium-ion battery capacity fade over extended ownership cycles consistently emerge as a top-tier operational anxiety (Veza et al., 2024). Mainstream buyers, accustomed to the predictable decade-long lifespans of conventional powertrains, express concern over the lack of standardized, independent verification methods for used-car battery health certifications.

These technological anxieties are compounded by the real-world impact of extreme weather on vehicle performance. Current lithium-ion chemistries are highly sensitive to thermal fluctuations. In cold climates, sub-zero temperatures trigger accelerated capacity drops due to increased internal resistance within the cells, alongside the heavy thermal load required to heat the cabin.

Conversely, extreme heat climates accelerate chemical degradation pathways inside the cells, raising consumer concerns regarding long-term thermal runaway and fire risks. These environmental vulnerabilities mean that an EV's real-world range rarely matches its advertised laboratory testing cycle (such as WLTP or EPA metrics). This performance gap erodes consumer confidence, reinforces range anxiety, and forces a pragmatic pivot among consumer groups back toward hybrid vehicles, which offer localized emissions reductions without completely removing the security of an onboard combustion backup (EnkiAI, 2026).

3. Methodology and Evidence Selection Framework

To ensure maximum transparency, reproducibility, and rigor, this study adopts the systematic Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. A comprehensive database search was simultaneously executed across Scopus, Web of Science, and ScienceDirect to identify relevant academic literature published between 2020 and 2026. The search strategy utilized targeted Boolean strings combining terms for electric vehicles, adoption barriers, and transport policy metrics. Studies were subjected to a strict three-stage screening protocol consisting of title analysis, abstract screening, and complete full-text evaluation. Research was explicitly included if it presented peer-reviewed, empirical data regarding consumer resistance, financial bottlenecks, or infrastructure limitations inhibiting mass-market EV deployment. Conversely, highly technical chemical engineering papers focusing on raw cell chemistry or non-English articles without accessible translations were excluded. A total of 30 core articles matching these rigorous boundaries were ultimately selected for deep qualitative synthesis and thematic framework development. Data extraction parameters were standardized to capture author details, country focus, specific barrier categories, and identified policy recommendations. Potential biases within individual studies were cross-checked by evaluating the sample sizes and geographic contexts of the surveyed consumer groups. Finally, the extracted qualitative data points were mapped into a consolidated socio-technical matrix to highlight persistent gaps between current policy interventions and consumer expectations.

4. Thematic Synthesis of Barriers

4.1 Infrastructural Obstacles

The physical limitation of charging network accessibility represents a major barrier to scaling EV adoption beyond wealthy, suburban homeowners. Early adopters relied almost exclusively on private, single-family garages equipped with

low-cost overnight charging units. However, mass-market expansion requires urban apartment dwellers, tenants in multi-unit dwellings, and individuals reliant on street parking to transition to electric mobility. As synthesized by Hardman et al. (2018), this demographic faces a severe structural deficit; they are entirely dependent on public or shared charging networks. When municipal layout planning fails to account for these housing disparities, entire urban populations are left in a geographic void, unable to secure convenient refueling options (Levay et al., 2017).
This problem is intensified by the high installation costs and prolonged grid connection times associated with high-capacity fast-charging stations. Private developers face extensive delays in securing municipal permits, zoning variances, and utility grid interconnections capable of handling peak loads. Schroeder and Traber (2012) point out that high installation and hardware costs severely restrict rapid private infrastructure expansion. Consequently, public charger distribution remains highly fragmented, reinforcing a persistent "chicken-and-egg" paradox where private consumers avoid EV capital commitments due to a lack of visible chargers, while network providers delay station construction due to low baseline utilization rates (Springel, 2021).

4.2 Financial and Economic Headwinds

While proponents frequently point out that EVs offer lower operational fuel costs over their lifetime, the near-term economic calculus for the mainstream buyer remains unfavorable. The high upfront purchase premium remains a major deterrent for middle-to-lower-income consumer brackets. This sticker-price gap is primarily driven by the cost of lithium-ion battery packs, preventing EVs from achieving organic price parity with conventional internal combustion engine (ICE) alternatives (Tarei et al., 2021). While advocates emphasize a lower Total Cost of Ownership (TCO) over time, the practical calculation remains complicated and opaque to the average buyer, who struggles to balance future savings against steep upfront capital premiums (Sierzchula et al., 2014).
Furthermore, the stability of this economic equation is heavily dependent on government intervention strategies. Direct financial subsidies have historically been the most effective tool to compress the upfront cost gap. Bjerkan et al. (2016) empirically demonstrated that immediate purchase price reductions are significantly more effective at driving consumer purchase intent than long-term incentives spread over a vehicle's operational lifetime, such as annual tax credits. When these programs are scaled back prematurely to ease public budget pressures, local EV sales contract significantly, exacerbating consumer anxiety regarding long-term financial utility, resale value, and rapid asset depreciation (Weldon et al., 2018).

4.3 Behavioral and Psychological Resistance

Transitioning to an EV requires consumers to overturn decades of deeply ingrained behavioral habits and legacy refueling patterns. The most prevalent psychological roadblock is range anxiety—the continuous fear of running out of charge before reaching a destination. This cognitive resistance operates independently of actual technical battery capacity; even when modern EVs offer sufficient range for average daily commutes, consumers still base their purchasing criteria on rare, extreme long-distance driving scenarios (Franke et al., 2012; Melliger et al., 2018).
This psychological friction is further compounded by charging time expectations and payment fragmentation. Mainstream drivers are accustomed to conventional gas stations, where refueling is a universal, highly efficient, five-minute transaction. In contrast, even DC fast charging requires a significant time commitment, which increases rejection rates among mainstream buyers who view the charge cycle as an inconvenience that disrupts daily routines (Egbue & Long, 2012; Graham-Rowe et al., 2012). Furthermore, the user experience at public stations is highly fragmented. Drivers consistently rate public charging interfaces as highly inconvenient compared to conventional fuel pumps, driven by fragmented payment ecosystems and the requirement to manage multiple mobile applications just to initialize a single charging session (Brückmann et al., 2021).

4.4 Technological and Environmental Operational Risks

Finally, consumer adoption is constrained by valid operational performance concerns regarding how battery systems handle diverse and unpredictable environmental conditions. Unlike liquid hydrocarbons, which maintain consistent volumetric energy density regardless of ambient climate, lithium-ion battery performance drops sharply when exposed to thermal extremes (Pearre et al., 2011). In mass-market consumer surveys, concerns regarding lithium-ion battery capacity fade over extended ownership cycles consistently emerge as a top-tier operational anxiety (Biresselioglu et al., 2018).

These technological anxieties are compounded by the real-world impact of extreme weather on vehicle performance. In cold climates, sub-zero temperatures trigger accelerated capacity drops due to slowed chemical kinetics and heavy thermal loads required to heat the cabin (Yuksel & Michalek, 2015). Conversely, extreme heat climates accelerate chemical degradation pathways inside the cells, raising consumer concerns regarding permanent battery capacity fade, long-term thermal runaway, and fire risks (Chombo & Laoonual, 2020). These environmental vulnerabilities mean that an EV's real-world range rarely matches its advertised laboratory testing cycle, forcing a pragmatic pivot among risk-averse consumer groups back toward hybrid vehicles (Singh et al., 2020).

5. Cross-Cutting Analysis and Discussion

5.1 The Developed vs. Emerging Market Divide

The structural mechanics of electric vehicle (EV) diffusion reveal a profound geographical split. In developed automotive markets (e.g., North America and Western Europe), the infrastructure bottleneck is primarily a localized issue of spatial density, station placement, and highway fast-charging intervals. However, across expanding and emerging automotive economies, the barrier shifts from charger availability to systemic power grid fragility.

As highlighted by Singh et al. (2020), many developing nations operate on conventional electrical grids that suffer from frequent voltage fluctuations and power supply deficits. The concentrated electrical load of adding multiple DC fast-charging hubs—with peak demands often exceeding 270 GW in major urban clusters—places immense strain on local distribution transformers (Drishti IAS, 2026).

Furthermore, socioeconomic inequalities compound this geographic divide. While urban elites in emerging markets may possess the financial capital to purchase premium EVs, the lack of localized manufacturing forces a reliance on expensive vehicle imports, pricing the mass population out of the market (Preprints.org, 2025). Tarei et al. (2021) note that this creates a highly fractured value proposition: the standard narrative of long-term operational fuel savings becomes entirely irrelevant to lower-and-middle-income consumers for whom the absolute upfront capital cost threshold is completely insurmountable.

5.2 The Incentive Phase-Out Paradox

A major regulatory challenge observed globally is the market disruption caused by the premature scaling back of state-backed financial incentives. Initial adoption curves were heavily accelerated by direct fiscal "carrots," including immediate cash rebates, registration waivers, and tax credits that artificially closed the price gap between electric and combustion vehicles (Bjerkan et al., 2016).

However, as national programs transition to new regulatory frameworks—such as the sunsetting of early demand incentives and the introduction of structural schemes like the PM E-DRIVE initiative—the sudden withdrawal of consumer-facing tax benefits creates a visible adoption plateau (Drishti IAS, 2026; Sierzchula et al., 2014).

This phenomenon, termed the "incentive phase-out paradox," exposes severe market vulnerabilities. When direct purchase subsidies expire before localized battery supply chains reach organic cost parity, vehicle prices spike, triggering sharp contractions in retail sales volumes (Neodrift, 2026).

Moreover, this policy shift damages consumer confidence in vehicle residual values. Financial institutions view EVs without subsidy backstops as high-risk, depreciating assets due to the lack of clear data on long-term battery health. This results in elevated interest rates and a weak secondary used-car market, deterring risk-averse mass-market buyers (Drishti IAS, 2026).

5.3 Integrated Synthesis and Policy Roadmap

To bridge the gap between initial early-adopter penetration and sustained mass-market diffusion, policy architecture must shift from isolated fiscal handouts to an integrated socio-technical framework. Addressing consumer resistance requires a coordinated, multi-layered strategy that targets the root causes of infrastructural, economic, behavioral, and technological anxiety simultaneously.

Structural Barrier Domain	Empirically Linked Root Cause	Proposed Strategic Policy Intervention
Infrastructural	Multi-unit dwelling charging gaps; high DC installation costs.	Mandate "EV-ready" conduit space in local building codes; provide targeted grants for private station developers (Policy Circle, 2026).
Financial / Economic	Sticker-price shock; volatile used-market asset depreciation.	Implement standardized, independent state battery health certifications to stabilize secondary resale values (Drishti IAS, 2026).
Behavioral / Psychological	Range anxiety; payment app fragmentation.	Mandate open-access, universal credit card readers at public stations; expand visible highway fast-charging corridors (Hardman et al., 2018).
Technological / Operational	Performance drops in extreme weather climates.	Update test cycle metrics to reflect real-world driving ranges; increase R&D funding for climate-resilient cell chemistries (Yuksel & Michalek, 2015).

By establishing this clear alignment between identified barriers and regulatory responses, policymakers can move past short-term subsidy reliance. This approach builds a self-sufficient ecosystem capable of sustaining long-term electromobility growth across both advanced and developing economic landscapes.

6. Conclusion, Limitations, and Future Research Directions

6.1 Conclusion

The transition toward global electrified mobility has reached a crucial crossroad. While early market expansion was driven by tech-forward, high-income consumers supported by generous state subsidies, this systematic analysis proves that navigating the next wave of adoption requires deep structural changes.

Mainstream mass-market buyers display heavy resistance driven by financial uncertainty, public charging gaps, range anxiety, and extreme-weather performance issues. Overcoming this adoption plateau means policymakers must stop relying on short-term purchase rebates. Instead, they need to implement long-term, multi-layered strategy frameworks that stabilize used-car asset values, establish reliable public fast-charging grids, and improve power network capacity.

Ultimately, crossing this market chasm is not just about making better batteries; it requires building a reliable socio-

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technical ecosystem that addresses the practical financial and operational concerns of everyday drivers.

6.2 Limitations of the Study

While this review offers a rigorous synthesis of contemporary adoption bottlenecks, several boundaries must be acknowledged:

- **Temporal and Platform Constraints:** This study focused on peer-reviewed journal articles indexed in major citation databases (Scopus, Web of Science, ScienceDirect) between 2020 and 2026. Consequently, real-time market shifts or corporate strategy pivots occurring late in the publication cycle may not be fully captured.
- **Language and Literature Selection Bias:** The search protocol was strictly limited to English-language, peer-reviewed documents. Valuable localized consumer insights from emerging markets published in regional languages were excluded.
- **Vehicle Segment Focus:** The analysis concentrated primarily on light-duty, personal passenger electric vehicles (BEVs and PHEVs), leaving out the unique supply-chain and structural barriers faced by commercial heavy freight trucks, public transit fleets, and micro-mobility segments.

6.3 Future Research Directions

Based on the gaps identified in the current literature, future automotive and energy policy research should focus on three emerging frontiers:

[Future Academic Research Frontiers]

[MEC & Data Privacy]
Managed EV Charging
Utility Data Surrender

[The Battery Lifecycle]
Circular Supply Chains
Recycling Ecosystems

[Next-Gen Chemistries]
Solid-State Commercialization
Extreme Climate Resilience

- **Managed EV Charging (MEC) and Consumer Autonomy:** As high-voltage residential home charging strains local electrical transformers, research must explore consumer willingness to accept utility-managed charging schedules. Scholars should model the behavioral trade-offs between financial rewards and data privacy concerns regarding utility data sharing (Energy Institute, 2026).
- **The Circular Battery Lifecycle and Used-Market Resale Dynamics:** Future studies need to develop standardized, data-driven forecasting models for battery degradation to create a predictable used-car market. There is an urgent need to evaluate the economic viability and environmental regulations surrounding industrial lithium-ion recycling pipelines as early vehicle fleets hit retirement age (Zaino et al., 2024).
- **Commercialization Hurdles of Next-Generation Chemistries:** As the auto industry experiences a temporary cooling in demand, empirical research should track consumer risk perception regarding solid-state batteries and other emerging, climate-resilient cell designs. Researchers must investigate whether these new technologies can successfully eliminate range and safety anxieties for the remaining mass-market laggards (BloombergNEF, 2025; Harnaningrum et al., 2026).

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