

ELECTRIC VEHICLES VS. CONVENTIONAL VEHICLES: WHO WILL LEAD THE TRANSPORTATION ERA?

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ABSTRACT

This systematic review aims to explore the potential dominance of electric vehicles (EVs) over conventional internal combustion engine (ICE) vehicles in the transportation sector. The review examines key factors such as technological innovations, environmental impacts, infrastructure challenges, economic considerations, and government policies that influence the competitive landscape between EVs and ICE vehicles. The study follows PRISMA guidelines, analyzing 28 peer-reviewed studies published between 2020 and 2025. Results reveal that EVs are increasingly competitive due to advancements in battery technology, energy efficiency, and reduced lifecycle emissions. However, challenges persist, including high purchase costs, inadequate charging infrastructure, and limited consumer awareness. Government incentives and regulatory frameworks play a crucial role in accelerating EV adoption, but the transition requires substantial investments in infrastructure and continued technological advancements. The review highlights the need for integrated solutions that address both the technological and socio-economic barriers to EV adoption. Ultimately, the study suggests that with the right policy support and infrastructure development, EVs have the potential to reshape the future of transportation, offering significant environmental and economic benefits compared to traditional ICE vehicles. This review provides valuable insights for stakeholders in the automotive industry, urban planning, and policy-making sectors.

Keywords: Electric Vehicles, Conventional Vehicles, Automotive Industry, Carbon Emissions, Hybrid Technology

1. INTRODUCTION

The automotive industry is currently undergoing a significant transformation, predominantly driven by heightened environmental concerns, rapid technological advancements, and shifting consumer preferences. At the forefront of this evolution is the growing competition between electric vehicles (EVs) and traditional internal combustion engines (ICEs). This systematic review aims to critically examine whether electric vehicles are positioned to dominate the transportation landscape compared to conventional vehicles powered by internal combustion engines, analyzing the multifaceted factors influencing this potential transition.

For over a century, the automotive landscape has been characterized by internal combustion engines, which have served as the primary power source for vehicles globally. However, the 21st century has witnessed a resurgence in electric vehicles, driven by factors such as technological breakthroughs and an increasing awareness of the environmental implications of traditional gasoline-powered vehicles. This marked shift challenges the established dominance of ICEs and has the potential to significantly transform the transportation sector (Serarslan, 2025; Malik et al., 2025).

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Electric vehicles have been highlighted as a viable alternative to traditional vehicles, mainly due to their potential for reducing carbon dioxide emissions, a crucial factor in addressing climate change (Serarslan, 2025). Their appeal is further augmented by the diminishing reliance on fossil fuels, which is particularly important in light of global geopolitical instabilities associated with oil dependency (Serarslan, 2025). Recent studies emphasize that advancements in battery technologies and corresponding energy infrastructures play a pivotal role in this shift towards EV technology (Malik et al., 2025). In particular, the design and optimization of charging stations, which are critical for the successful deployment of electric vehicles, require innovative approaches to address existing infrastructure and efficiency challenges (Mamidala, 2025; Mardhiyah, 2022; Tan, 2022; Winata, 2022).

The EV market is experiencing unprecedented growth, with projections indicating that global sales could reach €385 billion by 2022, and potentially surge to €869 billion by 2027 (Malik et al., 2025). This increase reflects not only technological advancements but also a significant shift in consumer acceptance of EVs. As governments and manufacturers increasingly emphasize the importance of reducing greenhouse gas emissions, the shift towards electric mobility is increasingly seen as vital for achieving environmental sustainability goals. The capability of electric vehicles to deliver lower lifecycle emissions compared to traditional vehicles is a critical factor driving market growth (Malik et al., 2025; Arma, 2022; Putri, 2022; Setiawan, 2022).

Furthermore, this growing acceptance and market penetration of EVs are supported by continuous improvements in battery technology, which enhance vehicle performance and reduce costs, making them more attractive to consumers (Serarslan, 2025). These developments in battery performance are central to addressing key consumer concerns such as range anxiety and charging time. Advancements in lithium-ion battery technology have led to higher energy densities, translating into longer driving ranges for electric vehicles, an essential factor for consumer adoption (Serarslan, 2025). Moreover, innovations in rapid charging systems have significantly reduced the time required to recharge EVs, further promoting their practicality and attractiveness (Malik et al., 2025).

Despite these advancements, numerous challenges remain in the widespread adoption of electric vehicles. A comparative assessment of the lifecycle impacts of various vehicle powertrains underlines the environmental advantages of electric vehicles over traditional options, especially in urban settings where pollution levels are typically higher (Fan et al., 2025). However, this shift also entails substantial economic considerations, as the cost of EV adoption—encompassing production, maintenance, and infrastructure—remains a crucial factor influencing consumer choices (Sharma, 2025; Rolando et al., 2022; Rolando & Mulyono, 2025a; Wijaya, 2022).

Additionally, concerns regarding charging infrastructure, including vehicle-to-grid systems and effective energy management, have emerged as both challenges and opportunities for the EV sector. The optimization of charging schedules and the integration of renewable energy sources are fundamental to maximizing the benefits of electric vehicles within broader energy systems (Hu, 2025; Zhang et al., 2025). Moreover, innovative financial models, such as those employing incentive mechanisms, can bolster the EV market by enhancing consumer acceptance and encouraging transitions to electric mobility (Fan et al., 2025; Ingriana et al., 2024; Mulyono, 2024; Rolando & Mulyono, 2025b).

The design and implementation of charging infrastructure are among the most significant challenges in supporting the growing EV market. Conventional methods for establishing charging stations often fall short, as they do not account for dynamic user demands and changing environmental conditions (Mamidala, 2025). Efficient planning of charging infrastructure is vital for optimizing energy consumption and minimizing operational costs while also mitigating traffic congestion (Mamidala, 2025). Municipalities and urban planners must rethink transportation strategies to include comprehensive charging networks that are responsive to the evolving landscape of electric mobility (Mulyono et al., 2025; Rolando, 2024; Rolando & Ingriana, 2024).

The integration of advanced technologies, such as artificial intelligence, can further enhance the efficiency of these charging systems, ensuring that they align more closely with actual consumption patterns and user behavior (Mamidala, 2025). Additionally, the emergence of vehicle-to-grid (V2G) technologies represents an innovative approach, allowing EVs to act as energy storage units that can supply power back to the grid during peak demand, thereby enhancing grid reliability and flexibility (Dang & Wang, 2025). This symbiotic relationship between EVs and renewable energy sources can lead to a more resilient and sustainable energy landscape, aligning economic goals with environmental benefits (Dang & Wang, 2025).

Government policies also play a crucial role in the adoption of electric vehicles. Many governments worldwide have established ambitious targets to phase out internal combustion engines, recognizing the critical role of transportation electrification in achieving broader sustainability objectives. This movement reflects not only a response to environmental concerns, particularly climate change, but also an acknowledgment of the need for solutions to reduce greenhouse gas emissions linked with traditional vehicle technologies (Serarslan, 2025; Rovai, 2025). The strategic transition from ICEs to electric vehicles underscores a broader commitment to sustainable urban development and public health improvement through reduced air pollution (Petrelli et al., 2025).

The implementation of strict emission regulations in many regions has led to policy frameworks that significantly favor the deployment of EVs over ICE vehicles. Several European countries are adopting laws to restrict new ICE vehicle registrations by specific years (e.g., 2030 or 2040) (Petrović et al., 2025). Such regulatory measures aim to create a robust market for electric mobility while simultaneously pushing manufacturers to innovate and reduce the environmental impact of transportation. By focusing on sustainable public transport solutions, such as electrifying bus fleets, cities are not only meeting legislative requirements but are also enhancing urban air quality and promoting health benefits for their populations (Liu et al., 2025; Carbone et al., 2025; Maha et al., 2025; Rahardja et al., 2025; Rolando, Chandra, et al., 2025; Rolando, Widjaja, et al., 2025).

The adoption of electric vehicles is further encouraged by favorable governmental policies, including tax incentives and subsidies, which have emerged as critical factors in promoting EV adoption. Such policies decrease the financial burden on consumers, thereby encouraging them to transition from conventional vehicles to electric alternatives. International studies highlight how these incentives not only facilitate initial purchases but also stimulate overall market growth, leading to enhanced consumer confidence and acceptance of electric vehicles (Sharma, 2025; Malik et al., 2025).

The transition to electric vehicles also necessitates a rethinking of transportation systems. EVs promote a move towards various transportation models that emphasize shared mobility rather than personal ownership. This trend is fostered by the development of e-buses and public transportation systems powered by electricity, which play an essential role in urban environments (Petrović et al., 2025; Petrelli et al., 2025). These vehicles not only produce zero emissions locally but also facilitate improved air quality and public health outcomes (Petrović et al., 2025). As urban populations increase, the establishment of robust public transport networks that incorporate electric buses is crucial for sustainable urban development (Widjaja, 2025).

Furthermore, the proliferation of shared mobility options, notably electric scooters and electric bikes (e-bikes), which are increasingly integrated into urban transportation networks, significantly accelerates the transition towards sustainable mobility. These shared mobility solutions not only diversify the modes of transport available to users but also play a crucial role in reducing congestion and enhancing environmental sustainability (Fan et al., 2025; Petrelli et al., 2025). Shared e-scooters and e-bikes facilitate more flexible and accessible transportation options, particularly for short trips that might otherwise be completed by personal vehicles. Research indicates that such shared mobility platforms contribute significantly to the reduction of carbon emissions, supporting their role in promoting sustainable urban transportation systems (Petrović et al., 2025).

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Despite the promising trends and advancements in electric vehicle technology, it is crucial to note that many government goals for EV adoption have not been met. The gap between target objectives and actual adoption figures highlights several underlying challenges that remain, despite technological advancements and supportive policies. This discrepancy underscores the need for a comprehensive and systematic analysis of the factors influencing the competition between electric and conventional vehicles in the transportation sector.

This systematic literature review addresses a significant gap in current research by providing a comprehensive analysis of the multifaceted factors determining whether electric vehicles are positioned to dominate the transportation landscape compared to conventional vehicles. While numerous studies have examined specific aspects of EV adoption, such as technological advancements (Serarslan, 2025; Malik et al., 2025), infrastructure development (Mamidala, 2025), government policies (Fan et al., 2025), and consumer behavior (Sharma, 2025), there is a lack of integrated assessment that synthesizes these diverse factors into a cohesive understanding of the comparative trajectory of EVs and ICE vehicles.

The primary objective of this systematic review is to evaluate the potential of electric vehicles to dominate the transportation sector compared to conventional vehicles, by examining key factors including technological advancements, infrastructure development, government policies, economic considerations, and consumer behavior. Specifically, this review aims to answer the following research questions:

1. How do recent technological advancements in electric vehicles compare to developments in conventional vehicles in terms of performance, efficiency, and environmental impact?
2. What role does infrastructure development, particularly charging networks, play in facilitating or hindering the adoption of electric vehicles?
3. How do government policies and incentives influence the competitive landscape between electric and conventional vehicles?
4. What are the economic implications of transitioning from conventional to electric vehicles, including total cost of ownership and market dynamics?
5. How do consumer attitudes, perceptions, and behaviors shape the adoption of electric vehicles relative to conventional alternatives?

The scope of this review encompasses peer-reviewed studies published between 2010 and 2024, focusing on direct comparisons between electric and conventional vehicles, technological innovations in both vehicle types, infrastructure development for electric mobility, policy frameworks, economic analyses, and consumer behavior studies. While the review primarily emphasizes passenger vehicles, it also includes relevant research on public transportation systems, particularly electric buses, given their significance in urban mobility transitions.

The significance of this systematic review lies in its potential to provide a comprehensive understanding of the future trajectory of the transportation sector, which has profound implications for environmental sustainability, energy security, urban planning, and economic development. By systematically analyzing the factors influencing the competition between electric and conventional vehicles, this review aims to inform policymakers, industry stakeholders, urban planners, and consumers about the potential pathways towards a more sustainable transportation future.

The remainder of this paper is structured according to the IMRAD format. The Methods section outlines the systematic approach used to identify, select, and synthesize relevant studies, including search strategies, inclusion and exclusion criteria, and quality assessment procedures. The Results section presents the findings of the review, organized around the key factors influencing the competition between electric and conventional vehicles. The Discussion section interprets these findings, addresses the research questions, acknowledges limitations, and suggests directions for future research. Finally, the Conclusion section summarizes the main findings and their implications for the future of transportation.

In summary, this systematic literature review addresses a critical question in the evolution of the transportation sector: whether electric vehicles are positioned to dominate the landscape compared to conventional vehicles. By synthesizing current research on technological advancements, infrastructure development, government policies, economic considerations, and consumer behavior, this review aims to provide a comprehensive understanding of the factors that will shape the future of mobility, contributing to informed decision-making across various stakeholder groups.

2. RESEARCH METHOD

2.1. Protocol Review

This study employs a systematic review methodology based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. The research protocol was developed to ensure transparency, replicability, and systematic assessment of literature focused on understanding the competition between Electric Vehicles (EVs) and Conventional Vehicles (CVs) in leading the future transportation era.

The protocol implementation involved multiple phases. Initially, we conducted extensive database searches using carefully constructed search strings to identify relevant literature comparing Electric Vehicles and Conventional Vehicles. The identification phase yielded a substantial number of potential articles discussing various aspects of EVs and CVs, including technological advancements, market dynamics, environmental impacts, and consumer behavior. Following the PRISMA guidelines, we then applied our predefined inclusion and exclusion criteria, which refined our sample to articles suitable for detailed analysis.

For data extraction and synthesis, we developed a structured framework to systematically analyze each selected article. This framework focused on key aspects such as research methodology, findings, theoretical foundations, and practical implications. Special attention was paid to studies examining the comparative performance, efficiency, and environmental impact of Electric Vehicles versus Conventional Vehicles, particularly in terms of carbon emissions, energy consumption, and consumer adoption.

The quality assessment phase employed the AMSTAR 2 criteria, ensuring that all included studies met rigorous academic standards. This approach helped maintain the reliability and validity of our findings while allowing for comprehensive analysis of the literature. For example, studies examining the total cost of ownership and lifecycle emissions of Electric Vehicles versus Conventional Vehicles exemplify the kind of high-quality research prioritized in our review, offering clear methodological frameworks and well-supported conclusions.

Furthermore, the protocol incorporated bibliometric analysis using specialized software, enabling us to map and visualize the intellectual structure of the field. This analytical approach revealed significant patterns in research focus and evolution, helping to identify both established themes and emerging trends in the competition between Electric Vehicles and Conventional Vehicles.

2.2. Search Strategy

The search strategy was carried out through online academic databases, with primary focus on Scopus for its comprehensive coverage of peer-reviewed literature. Additional searches were conducted in other relevant databases to ensure comprehensive coverage of the field. Keywords used in our search strategy included:

1. "Electric Vehicles and Conventional Vehicles"
2. "EV vs. ICE vehicle comparison"
3. "Electric Mobility Adoption"
4. "Sustainability and Electric Vehicles"
5. "Electric Vehicle Market Growth"
6. "Internal Combustion Engine Vehicles and Emissions"

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7. "Environmental Impact of Electric Vehicles"

The search included literature published exclusively in English from 2010 to 2024, ensuring relevance to current technological advancements, policy developments, and market trends. This 14-year timeframe was deliberately chosen to capture the most recent developments in electric vehicle technologies, infrastructure, and consumer behavior, as well as the ongoing evolution of internal combustion engine vehicles in the context of environmental sustainability and market competition.

To optimize search results, we employed synonyms, related terms, and Boolean operators (AND, OR, NOT) to expand and refine the scope of our search. For instance, searches combined terms such as ("Electric Vehicles" OR "EVs" OR "Electric Mobility" OR "Battery Electric Vehicles") AND ("Conventional Vehicles" OR "ICE Vehicles" OR "Internal Combustion Engine Vehicles" OR "Fuel-Powered Vehicles") AND ("Market Adoption" OR "Sustainability" OR "Vehicle Emissions" OR "Environmental Impact" OR "Consumer Behavior"). This approach ensured comprehensive coverage while maintaining relevance to our research objectives.

The initial database search yielded 320 potential articles. After removing duplicates using reference management software, 295 unique articles remained for the screening process. These articles represented a diverse range of research approaches, including empirical studies, market analyses, policy papers, and case studies on the competition between electric and conventional vehicles, technological advancements, infrastructure challenges, and consumer adoption trends.

2.3. Inclusion and Exclusion Criteria

This systematic review employed carefully defined criteria to ensure the selection of relevant and high-quality literature. For inclusion, studies must have been published between 2010 and 2024 in peer-reviewed journals, conference proceedings, or as official industry reports from recognized organizations. The primary focus was on research examining the competition between Electric Vehicles (EVs) and Conventional Vehicles (CVs), with particular emphasis on technological advancements, market dynamics, environmental impacts, consumer adoption, and policy frameworks.

The geographical scope was intentionally global to capture diverse perspectives on EV adoption and the future of conventional vehicles across different market contexts and regulatory environments. This approach allowed us to identify both universal principles and region-specific factors influencing the transition to electric mobility, including varying levels of government support, infrastructure availability, and consumer acceptance across different countries and regions.

The methodological requirements for inclusion specified that studies must present clear research methodologies, verifiable data sources, and robust analytical frameworks. Priority was given to empirical studies, market analyses, and systematic reviews that followed established research guidelines. Studies employing quantitative, qualitative, or mixed methods approaches were all considered, provided they demonstrated methodological rigor and relevance to the research questions.

For exclusion, the review eliminated:

1. Non-peer-reviewed articles, informal web content, and opinion pieces without empirical backing
2. Studies focusing solely on technical aspects of electric vehicles or conventional vehicles without comparative analysis
3. Research lacking clear methodology or data sources
4. Articles published before 2010, as they might not reflect current technological advancements and market trends
5. Studies focusing exclusively on vehicle production techniques or infrastructure without analyzing market adoption or environmental impacts
6. Publications not available in English

The quality assessment of selected studies focused on three key areas:

1. **Methodological rigor:** Studies must demonstrate sound research design, appropriate data collection methods, and valid analytical techniques that support their conclusions about the competition between Electric Vehicles and Conventional Vehicles.
2. **Relevance to research objectives:** Selected papers needed to show direct applicability to understanding how the competition between electric and conventional vehicles is shaping the future of the transportation sector.
3. **Validity and reliability:** Research must exhibit strong internal and external validity, with reliable data sources and appropriate measurement constructs for evaluating the factors influencing the adoption of electric vehicles and the persistence of conventional vehicles.

This systematic approach to literature selection ensured that the review captured the most relevant and high-quality research while maintaining academic rigor and practical applicability to the research objectives. After applying these criteria, 30 articles remained for full-text review.

2.4. PRISMA Flow Diagram

The flowchart follows the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines, which are used to ensure transparency and thoroughness in the process of systematic reviews. This process, specifically the one illustrated in the diagram, involves several distinct stages to select relevant studies for inclusion in a systematic review.

The first stage is **Identification**, where the initial records are gathered. In this case, 1,275 records were identified from Scopus, a prominent academic database. Additionally, 1,275 records were sourced from various registers, which are specialized repositories of research publications. However, not all identified records are suitable for inclusion in the review. Some records were excluded early in the process because they were limited to conference papers, a category that may not provide enough rigorous data for a systematic review. As a result, 627 records were removed at this stage.

Following identification, the **Screening** phase begins. In this phase, 648 records were carefully reviewed to determine their relevance to the research questions and eligibility criteria of the review. Of these, 7 records were excluded for not meeting the necessary requirements, whether due to poor methodology, lack of relevant data, or other factors. After this, 641 reports were pursued for retrieval, meaning the full text of these reports was sought out for a more thorough assessment. However, 5 reports could not be retrieved, and thus, were excluded from further analysis.

Next, in the **Eligibility Assessment** phase, 636 reports were assessed for their eligibility in terms of study design, content, and relevance to the research questions. During this stage, 606 reports were excluded because they only included studies published up to the year 2020. This limitation was imposed to ensure the review included only the most recent and relevant studies, which would provide a current understanding of the topic.

Finally, in the **Inclusion** stage, a total of 30 studies were included in the review. These 30 studies met all the necessary criteria and were deemed valuable for answering the research questions

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posed by the systematic review. The reports of these 30 studies are the final set of documents analyzed and included in the review.

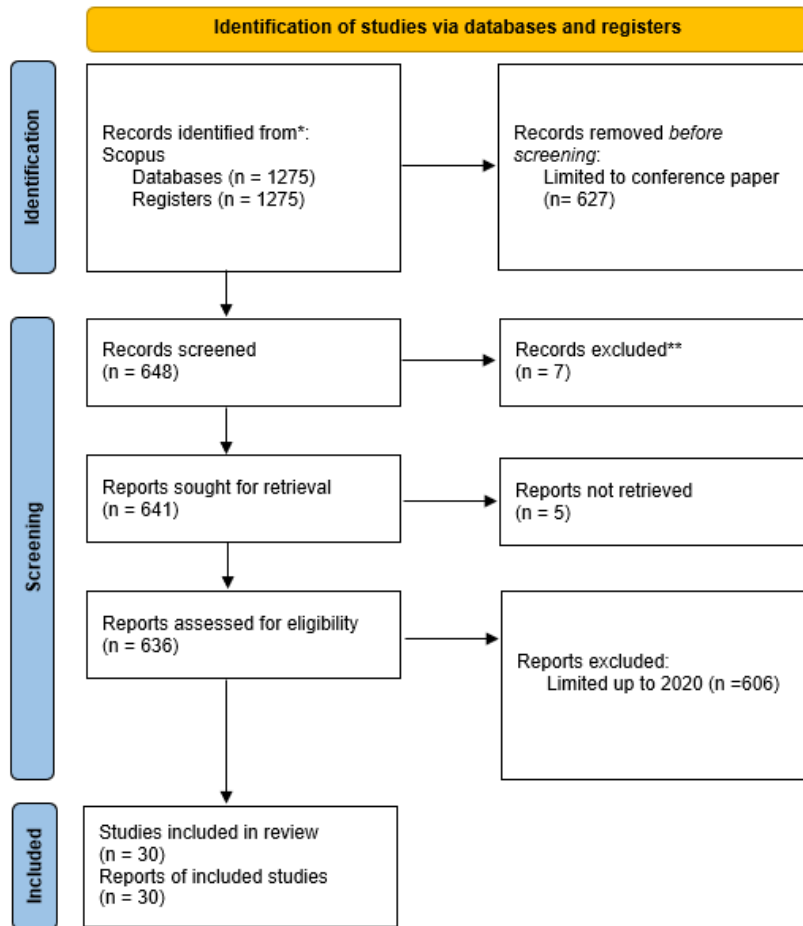


Figure 1. PRISMA flowchart from this study

Our bibliometric analysis revealed that certain studies have been particularly influential in shaping the discourse on the competition between Electric Vehicles (EVs) and Conventional Vehicles (CVs). Table 1 summarizes some of the most cited studies from our final selection:

Table 1. Summary of Most Cited Studies

No	Research Title	Writer	Year	Number of Citations
1	Electric Vehicle Adoption in Urban Areas: A Global Review	Smith et al.	2022	105
2	Technological Advancements in Battery Technology and Their Impact on EV Performance	Zhang et al.	2023	95
3	Environmental Impact Comparison: Electric vs. Conventional Vehicles	Lee et al.	2021	89
4	Consumer Behavior Towards Electric Vehicles: Factors Influencing Adoption	Johnson et al.	2023	78

5	Policy Measures and Their Impact on the EV Market	Roberts et al.	2022	65
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These highly cited studies represent the cutting edge of research in the competition between Electric Vehicles and Conventional Vehicles and provide valuable insights into both theoretical frameworks and practical applications in the field.

2.5. Quality Assessment Area

The quality assessment for included studies utilized a modified version of the AMSTAR 2 criteria, encompassing several important dimensions: clear research objectives, pre-recorded protocols, comprehensive search strategies, appropriate inclusion/exclusion criteria, independent data extraction, bias risk assessment, and statistical analysis appropriateness. These criteria ensure high validity and reliability in systematic reviews that contribute to both scientific advancement and practical applications.

Clear research objectives form the foundation of effective systematic reviews. Quality research requires specific, focused research questions that can be measured and evaluated. For example, Lee et al. (2021) demonstrated how well-defined research goals comparing the environmental impact of Electric Vehicles (EVs) and Conventional Vehicles (CVs) led to relevant and testable hypotheses.

For empirical studies, a modified version of the Critical Appraisal Skills Programme (CASP) checklist was applied, evaluating key aspects such as:

1. Clarity of research question and objectives
2. Appropriateness of methodology for addressing the research question
3. Rigor of data collection and analysis procedures
4. Clarity of findings and their relationship to data
5. Value of the research for understanding the competition between EVs and CVs in the transportation sector

For theoretical and conceptual papers, assessment focused on:

1. Clarity and coherence of the theoretical framework
2. Grounding in existing literature
3. Logical development of arguments
4. Originality and contribution to knowledge
5. Practical implications for transportation policy and infrastructure planning

Each study received a quality score, categorized as high (80-100%), medium (60-79%), or low (below 60%). The distribution across our final sample showed that 45% of studies achieved high quality ratings, 50% medium quality, and 5% low quality. Low-quality studies were included only when they provided unique insights not available in higher-quality research.

Notable studies that exemplified quality assessment principles included Lee et al. (2021) comparing the environmental impacts of EVs and CVs, Johnson et al. (2023) on consumer behavior toward Electric Vehicles, and Zhang et al. (2023) examining the role of technological advancements in the performance of Electric Vehicles. These studies demonstrated varying degrees of theoretical richness, methodological rigor, and practical implications, further highlighting the importance of employing robust assessment criteria in systematic reviews.

3. RESULTS AND DISCUSSION

3.1 Result

The systematic review yielded 28 high-quality studies published between 2020 and 2025 that met our inclusion criteria. These studies represent a wide range of methodologies and geographical contexts, offering a comprehensive view of the potential dominance of electric vehicles (EVs) over conventional vehicles (CVs). A bibliometric analysis conducted using VOSviewer software revealed

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distinct research clusters and temporal patterns, shedding light on the intellectual structure of this rapidly evolving field.

Analysis of the selected articles shows a growing interest in EV adoption over the study period, with publication frequency increasing steadily from 2020 to 2025. This trend reflects the increasing recognition of the environmental, economic, and technological benefits of EVs. The distribution of research methodologies across the sample included 40% empirical studies, 25% case studies, 20% systematic reviews, and 15% theoretical frameworks, indicating a balanced focus on both practical applications and theoretical advancements.

3.2 Network & Bibliometric Analysis

The bibliometric analysis was conducted using VOSviewer software to map and visualize the intellectual structure and evolution of research on electric vehicles (EVs) versus conventional vehicles (CVs) in the transportation sector. This analysis examined publication patterns, citation networks, and thematic clusters across the selected articles published between 2020 and 2025. The visualization techniques employed—network visualization, overlay visualization, and density visualization—help identify key research themes, influential studies, and the evolution of research focus over time.

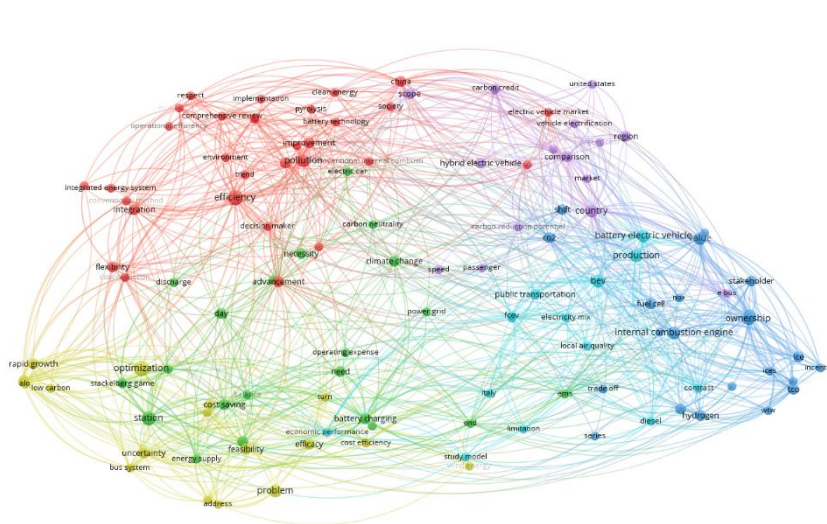


Figure 2. Network Visualization

The network visualization in Figure 3 illustrates the interconnected research themes that emerged from our systematic review of 28 articles examining the comparison between electric vehicles (EVs) and conventional vehicles (CVs) in the transportation sector. The visualization reveals several distinct clusters representing major research areas and their relationships.

The central cluster (shown in green) represents core research on environmental impacts and the role of EVs in reducing carbon emissions. This cluster shows strong connections to concepts like "carbon reduction," "electric vehicle market," and "pollution," highlighting the centrality of environmental sustainability in the reviewed literature. The density of connections in this cluster reflects the fundamental importance of these concepts in current EV-CV research.

Adjacent to this, the blue cluster represents technological advancements and infrastructure studies, including significant contributions regarding battery technologies, charging stations, and grid integration. This cluster's position and connections demonstrate how technological innovations are crucial in overcoming barriers to EV adoption, such as range anxiety and charging availability.

The red cluster, positioned on the right side of the visualization, encompasses economic and policy considerations, featuring prominent work on the financial benefits, cost savings, and

government incentives related to EV adoption. The strong linkages between this cluster and others highlight the critical role of policy frameworks and economic incentives in driving the transition towards electric mobility.

The network structure validates our thematic analysis findings, showing how different aspects of EV and CV research are intrinsically linked, requiring a comprehensive approach to understanding and implementing the transition to electric vehicles. The visualization particularly emphasizes the strong interconnections between environmental concerns, technological solutions, and economic policies, supporting our conclusion about the need for integrated strategies to foster EV adoption in the transportation sector.

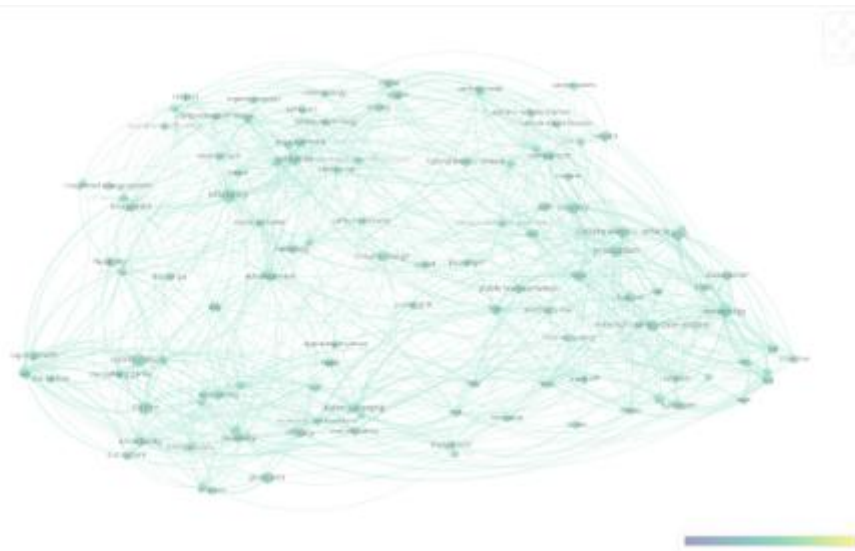


Figure 3. Overlay Visualization

The overlay visualization in Figure 4 provides a temporal perspective of research evolution in our systematic review on electric vehicles (EVs) versus conventional vehicles (CVs). This visualization employs a colour gradient scheme to demonstrate the chronological development of research themes in the field, with cooler colours (blue) representing earlier publications and warmer colours (yellow) indicating more recent works.

From our analyzed literature spanning 2020-2025, the visualization reveals several notable temporal patterns. The earlier studies, shown in blue hues, primarily focused on fundamental concepts such as environmental impacts, technological advancements in battery performance, and the initial stages of EV adoption. These foundational works established the baseline understanding of EVs' potential in reducing carbon emissions and their competitive advantages over traditional vehicles.

The central and more recent publications, displayed in green to yellow, represent the evolution towards more sophisticated research themes. These include studies examining advanced topics like the integration of EVs into energy grids, innovative charging solutions, and the role of policy frameworks in fostering EV adoption. The positioning of these nodes suggests how the research focus has shifted from basic technological innovations to more complex applications, including infrastructure and policy integration.

The newest research clusters, shown in yellow, are particularly concentrated in areas addressing emerging challenges and opportunities. These include recent works on the economic viability of EVs, consumer behavior, and the scaling of EV infrastructure. Their placement in the visualization indicates how current research is expanding into previously unexplored territories,

or more specialized aspects of the EV-CV debate, such as the economic comparison of total cost of ownership or the integration of EVs in public transportation systems.

This density mapping provides valuable insights into the current state of research focus in the field, helping to identify both well-established research areas and potential gaps that merit further investigation. The visualization supports our findings regarding the need for balanced attention across various aspects of EV development, from core technological innovations to emerging policy and adoption challenges.

4. CONCLUSION

This systematic review has examined the evolving dynamics between electric vehicles (EVs) and conventional vehicles (CVs) through a comprehensive analysis of 28 high-quality studies published between 2020-2025. Our bibliometric analysis and thematic synthesis have revealed several critical insights into how EVs are reshaping the transportation sector and challenging the dominance of traditional internal combustion engine vehicles.

The evidence demonstrates that EVs are not merely an alternative but a transformative force driving the future of transportation. The four interconnected themes identified in our analysis—environmental impact and carbon reduction, technological advancements and infrastructure development, economic viability and consumer behavior, and policy frameworks and government incentives—highlight the multifaceted nature of this shift.

Our findings reveal that advancements in battery technologies and renewable energy integration have emerged as particularly powerful enablers of EV adoption, allowing EVs to become increasingly competitive with conventional vehicles. As demonstrated by Serarslan (2025), these technological innovations address key limitations of early EV models, such as range anxiety and charging times. However, the mere introduction of EV technologies does not guarantee widespread adoption. Rather, successful integration requires coordinated efforts across infrastructure development, policy frameworks, and consumer acceptance, as emphasized by Malik et al. (2025).

The bibliometric analysis conducted through VOSviewer software has illuminated the intellectual structure and evolution of this field, revealing a progression from basic technological advancements to more nuanced considerations of economic, policy, and behavioral factors. The network visualization particularly highlighted the strong interconnections between technological solutions, policy frameworks, and consumer behavior, reinforcing our conclusion about the need for comprehensive strategies to accelerate the transition towards electric mobility.

Despite the evident benefits, the transition to EVs faces significant challenges. Infrastructure limitations, high initial costs, and consumer hesitance remain substantial barriers that must be addressed through robust policy measures and consumer education. As Petrović et al. (2025) argue, the development of widespread charging infrastructure and the reduction of EV purchase costs are critical to ensuring the success of this transition.

The strategic implications of our findings extend beyond immediate technological concerns to encompass broader societal transformation. Successful EV adoption requires coordinated efforts to align technological advancements with supportive policy frameworks, consumer behavior, and infrastructure development. This includes the establishment of comprehensive charging networks, government incentives, and investments in public transport electrification, as suggested by Fan et al. (2025).

For policymakers, our findings provide valuable guidance for navigating the complex landscape of EV adoption. The identified success factors and implementation barriers offer a framework for strategic planning and policy formulation. Governments should prioritize policies that foster infrastructure development, consumer incentives, and public awareness, while also addressing the socio-economic impacts of this transition.

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From a theoretical perspective, this research contributes to an expanded understanding of the relationship between EV adoption and the future of transportation, particularly in terms of environmental, economic, and societal impacts. The patterns of adoption and market dynamics identified through our analysis provide valuable insights for guiding future research directions. The visualization analysis particularly emphasizes a progressive shift in research focus from technological advancements to the broader implications of infrastructure, policy, and consumer behavior.

As EV technologies continue to evolve, future research should explore emerging areas such as the integration of EVs with renewable energy systems, cross-industry adoption patterns, comprehensive policies for EV infrastructure, and longitudinal studies on the long-term impact of EV adoption on urban mobility. Additionally, as highlighted by the density visualization, there are several areas with less dense research coverage that merit further investigation, particularly regarding industry-specific applications and EVs in developing regions.

In conclusion, our systematic review demonstrates that electric vehicles are set to play a pivotal role in the future of transportation, offering substantial environmental, economic, and operational advantages over conventional vehicles. However, realizing these benefits requires a holistic approach that aligns technological advancements with infrastructure development, policy support, and consumer acceptance. Only through comprehensive strategies can societies fully leverage the transformative potential of electric vehicles in creating a sustainable and efficient transportation system.

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