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ARTICLE

Bibliometric Analysis of Electric Vehicles and Sustainability: Trends, Insights, and Future Directions

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Abstract

EVs are increasingly at the forefront of academic and policy attention in the rush to sustainable transportation. This research offers a detailed bibliometric study of EV and sustainability research to explore its intellectual architecture, trends, and opportunities for future research. This study employs 593 publications (2016-2025), with descriptive bibliometric analysis, thematic mapping, and network analysis to explore trends, leading sources, co-operation, and key research topics in this field. The results show a strong growth in research, given an annual growth rate of 28.20% is expected to reach its highest in the period 2024-2025, which reflects a growing interest worldwide. Major contributions are published in top journals, including the Journal of Cleaner Production, while at the country level, significant collaboration is observed around China and the United Kingdom. Key themes reflect an evolution from basic themes like sustainability and electric vehicles to advanced themes like decarbonization, circular economy, and infrastructure transition. Through the application of the TCCM Framework, the study highlights research gaps such as a lack of theoretical and geographical diversity (mainly developed economies) and a preference for cross-sectional research designs. The study contributes by outlining a research framework focusing on multi-theoretical perspectives, the inclusion of developing economies, and the incorporation of longitudinal and mixed methods studies. These findings offer key insights for academics, policymakers, and industry leaders to facilitate sustainable mobility transitions.

Keywords: Electric vehicle, sustainability, green energy, electric mobility, bibliometric analysis.

1 Introduction

To limit global warming to well below 2°C, as agreed in the Paris Agreement, a shift to net-zero greenhouse gas (GHG) emissions by the second half of the century is required (IEA, 2017b). Transportation is a significant source of emissions, contributing around 23% of energy-related GHG emissions, and is projected to increase significantly if adequate measures are not taken (IEA, 2015; IEA, 2017b). In this regard, electric vehicles (EVs) have emerged as a promising solution for decarbonisation and sustainable transportation (Nundy et al., 2021; Chen et al., 2020).
Electric vehicles, such as "battery electric vehicles" (BEVs), "plug-in hybrid electric vehicles" (PHEVs) and "hybrid electric vehicles" (HEVs), have benefits, including higher energy efficiency, lower fossil fuel dependency, and lower tailpipe

emissions compared to traditional internal combustion engine vehicles (ICEVs) (Poullikkas, 2015; Sierzchula et al., 2014; Nordelöf et al., 2014). But their environmental benefits need to be assessed over the life cycle, taking into account emissions from electricity generation and battery manufacturing (Vienneau et al., 2015).

Despite improvements in technology and growing policy measures, widespread EV adoption is hindered by issues such as high upfront costs, charging infrastructure availability, and performance and convenience concerns (Rezvani et al., 2015; Newbery & Strbac, 2015). Meanwhile, increasing environmental concerns and changing consumer preferences are driving consumers towards the use of sustainable products and services, which affects both markets and businesses (Chen et al., 2020; Gandhi & Sheorey, 2019; Kumar & Yadav, 2023).

The negative environmental impacts associated with traditional transport systems also highlight the need for a shift to sustainable transportation. Motorised transport is a major source of air pollution, noise and health concerns (Ellermann, 2014), as well as a large proportion of emissions from the transport sector (IEA, 2015b). Rising GHG levels are associated with climate change and species extinction, which pose serious threats to ecosystems around the world (Pachauri et al., 2014). Here, EV technology can play a vital role in mitigating fossil fuel use and improving air quality in urban areas, especially in conjunction with supportive policies and technological innovations (Pavaskar, 2016; Rahman et al., 2017).

The last 20 years have seen a significant growth in electric vehicle and sustainability-related research across various fields. Yet, the literature is fragmented with research covering a broad spectrum of topics such as technology, policy, environmental consequences and consumer attitudes. Although there have been a few review articles and bibliometric analyses of this field, many have a narrow focus, with emphasis on particular topics or research methods, thus limiting a comprehensive view of the field (Kumar & Alok, 2020; Zhao et al., 2020; Nundy et al., 2021).

1.1 Rationale of the Study

The rapid expansion and diversification of the existing research indicate the need for an integrated review of electric vehicle and sustainability literature. Bibliometric analysis provides a reliable and replicable approach to examine large volumes of literature, and the dynamics and structure of the research area (Donthu et al., 2021). Therefore, this paper carries out a bibliometric analysis of the development of research on electric vehicles and sustainability. This research brings together multiple perspectives, including publication output, relevant sources, influential researchers, co-authorship, and research topics, rather than considering only a single perspective, as have previous studies. Additionally, the paper goes beyond existing research by linking the bibliometric analysis to other perspectives such as sustainability transitions, innovation systems, and green consumption. As a result, it builds on earlier studies and provides a more analytical approach. In summary, this study aims to offer a rigorous, transparent and theoretically informed overview of the intellectual constitution of EV and sustainability research, while making the distinction between description and interpretation of the facts obvious.

1.2 Objective of the study

This study aims to conduct a bibliometric analysis of the relationship between electric vehicles (EVs) and sustainability, identifying trends, key insights, and future directions in this rapidly evolving field.
The authors addressed the subsequent research questions (RQs):
RQ1: What are the publication trends of the research on electric vehicles and sustainability?
RQ2: Which are the most productive sources (journals), countries, and their collaborative structure in the field of electric vehicles and sustainability?
RQ3: What are the trends and emerging themes in keywords related to electric vehicles and sustainability research?
RQ4: To identify research gaps and propose future research directions for scholars, policymakers, and industry stakeholders?
The structure of this paper is as follows: Section 2 outlines the study's methodology. Sections 3 provide a comprehensive analysis of the topic, covering publishing trends, bibliographic coupling, citation analysis, and keyword exploration. Section 4 presents the study's discussion, and sections 5 and 6 present the study's implications, limitations and future research, respectively. Session 7 shows the conclusion of the study.

2 Materials and Methods

This current study employs bibliometric mapping analysis. Bibliometric analysis has become popular recently across a large range of fields (Kapoor et al., 2024). Recently, bibliometric analysis has become popular in many domains (Arici et al., 2019; Kaur & Singh, 2023). This increasing awareness among scholars may be due to their appropriateness for scientific mapping (Aria & Cuccurullo, 2017). This section describes the whole process of doing the bibliometric mapping analysis carried out in this study, i.e., the process for doing data collection, screening, extraction, and synthesis.

2.1 Literature search and data collection

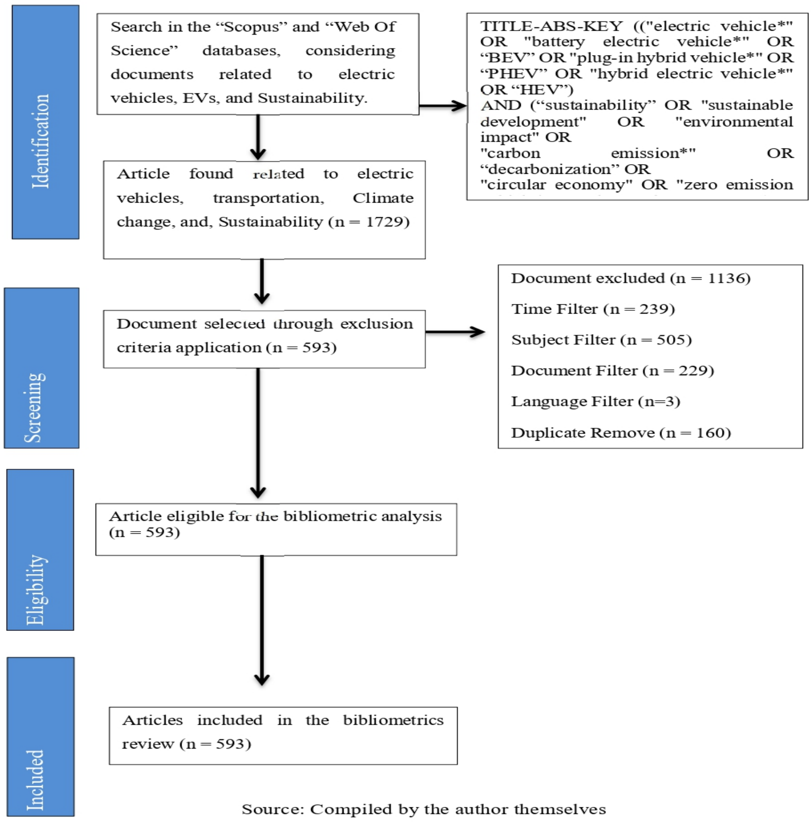
The "Web of Science" and "Scopus" are popular sources for credible social science papers. For bibliometric reviews, more journals are covered within "Scopus" and "Web of Science" databases (Kumar et al., 2021; Donthu et al., 2021). The study sample data was first searched for on April 20th, 2026. As argued by Jain et al. (2021), selecting terms is the most problematic aspect of running search queries in bibliometric databases. Based on current research, this study defines acceptable search phrases for electric vehicles. The following search term was used to find relevant articles: Electric vehicle, OR EV, AND Sustainability. The many forms of electric vehicles mentioned in the literature are what researchers call Electric vehicles. This study, based on earlier research, aimed to encompass all publications with the broad terms of "Electric vehicle" OR “EV” AND “Sustainability”. Our initial search for "(("electric vehicle*" OR "battery electric vehicle*" OR “BEV” OR "plug-in hybrid vehicle*" OR “PHEV” OR "hybrid electric vehicle*" OR “HEV”) AND (“sustainability” OR "sustainable development" OR "environmental impact" OR "carbon emission*" OR “decarbonization” OR "circular economy" OR "zero emission vehicle*" OR "low carbon transport") AND ("electric mobility" OR e-mobility OR "sustainable transport" OR "green mobility” focused on the article title, abstract, and keywords, yielding 1281 papers from Scopus and 448 from Web of Science databases. Firstly, a filter based on time was applied (From 2016 to 2025), which yielded 1091 papers from Scopus and 399 from Web of Science databases. To prioritise papers relevant to business and management, a domain-based filter ("Business, Business Finance, Management, Economics, Econometrics, and Finance, Social Science, Energy and Environmental Science") was applied to Scopus and Web of Science databases, yielding 798 and 188 articles, respectively. The research was narrowed to include articles and Reviews, including 569 from “Scopus” and 188 from “Web of Science databases”. The final filter only contained English-language papers, and 566 items were retrieved from the Scopus database and 188 from the Web of Science database. After selecting 160 articles, we must eliminate duplicate entries as some publications belong to both databases. By deleting duplicate items, the final literature review has 593 articles (Figure 1).

2.2 Data extraction, loading, and conversion

After applying the inclusion and exclusion criteria, 593 publications were collected. The data were exported to be analysed. However, when comparing Scopus with Web of Science (WoS), we realise that the Scopus platform can export up to 2000 article records at once, whereas WoS only allows up to 500 at a time. Researchers can also transfer data to and from Scopus into several file formats through Scopus, including CSV, Plain Text, BibTeX, RIS formats, etc. We entered the data in Biblioshiny by first exporting CSV and BibTex file formats.

2.3 Bibliometric analysis and software package

This is a quantitative research program, and it offers a wide choice of tools for conducting quantitative research. The analysis is done using the open-source Bibliometrix R package. Aria and Cuccurullo (2017), the authors of the R package, also wrote in the R programming language. The algorithms for statistical and scientific mapping analysis are contained in it. Then the latest versions of the bibliometrics R-package (2.0 and above) had a web interface software also called Biblioshiny that helped non-programmers in doing bibliometric analysis. BibTex, CSV, or Plain Text formats can be imported onto the Biblioshiny interface from databases such as “Web of Science” or “Scopus” (Agbo et al., 2021).



Source: Compiled by the author themselves

Figure 1: Flow Chart illustrating the PRISMA bibliometric analysis & systematic review

3 Bibliometric Analysis

3.1 Trend analysis

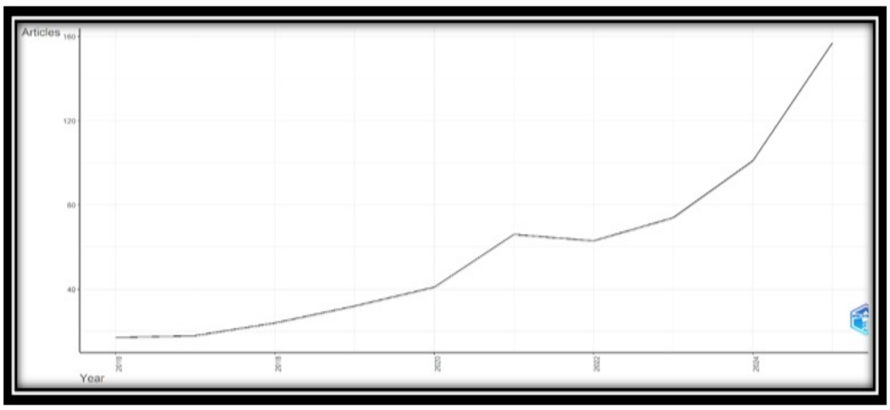


Figure 2: Trend Analysis
Source: Biblioshiny

From 2016 to 2025, Figure 2 indicates the number of scientific articles published every year, with the timing itself showing distinctive peaks and valleys. The trend of scientific output between 2016 and 2025 shows strong growth with some fluctuations. The consistent growth from 17 articles in 2016 to 41 in 2020 suggests smooth growth in the initial years. The steep rise after 2020 is due to the increased global focus on sustainability and novel technologies, which generated interest and investment in research, resulting in increased production in 2021 (66) and onwards. The minor decrease in 2022 (63) is likely due to a publication lag, post-pandemic challenges, and database indexing delays rather than a decline in research efforts. This decline is followed by a strong increase in 2023 (74), 2024 (101)and 2025 (137). In sum, this trend is indicative of a rapidly growing and increasingly prominent field.

3.2 Country Production

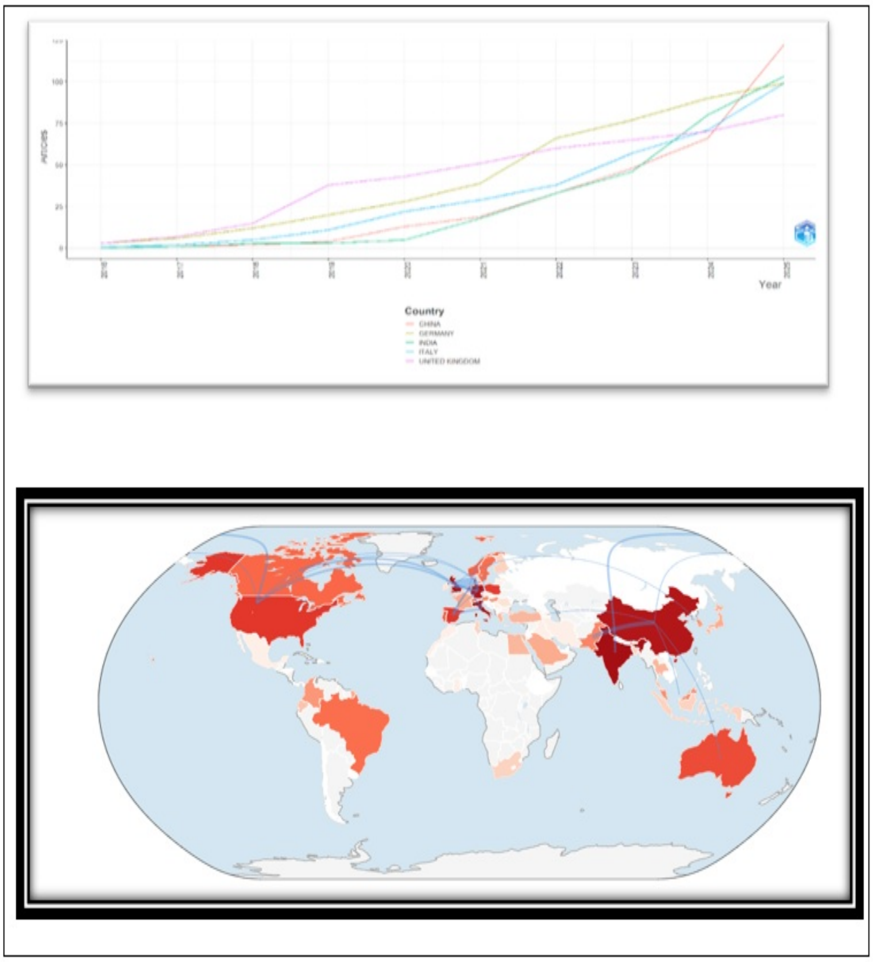


Figure 3: Country Production and Collaborative Structure
Source: Biblioshiny

The trend of country-wise production, as presented in Figure 3, reveals that there have been substantial and sustained increases in the production of research by the top-ranking countries. “Germany” equally displays a steady and stable growth in the number of publications, from 3 in 2016 to 99 in 2025, a factor of stability in research. Likewise, “Italy” adheres to a steep upward trend with 99 articles predicted by 2025 as the country is becoming more and more engaged in the field of articles. The “United Kingdom” is rather early prominent (especially in 2019), yet its increase is rather mediocre with time, peaking at 80 publications in 2025. Conversely, “China” presented exponential growth, particularly after the year 2020, and will culminate with 122 publications in 2025. “India” too has a significant development, but it has soared after 2021, with 103 articles. “India” has the top number of citations (2197), which represents a solid contribution to research, in general, and recognition. Generally, the trend indicates the shift of “European” control into the rise of “Asian” control in recent years. The upward trends may reflect increasing interest in electric vehicles and sustainability around the world, spurred by changing policies, technologies and research funding in various countries. “China” stands out as a major centre, with a range of partnerships with several other nations, including “Pakistan” (highest frequency = 5), “Australia”, “Malaysia”, and “United States” (its research range increases). The increased research funding, state-of-the-art technology and more established global collaboration in leading nations, and constrained funding and research capabilities in other regions. "Germany" is also central to "Europe", where it has a close connection with "Denmark", "Netherlands", and "United Kingdom". It is interesting to note that "the United Kingdom" exhibits the most collaborations with "Denmark" (10), which aids in the intense cooperation between the two countries. "India" exhibits moderate cooperation, especially with "the United States". The map also suggests rising cross-continental connections, particularly amongst "Asia", "Europe", and "North America". On the whole, the network can be characterised as a trend of increasing collaboration between countries at the international level, with some of the most influential countries serving as major bridges in the world research ecosystem.

3.3 Most Productive Source

Source	h_index	g_index	m_index	TC	NP	PY_start
Journal of Cleaner Production	23	29	2.3	2108	29	2017
Sustainability (Switzerland)	18	31	1.8	1221	31	2017
Energies	16	26	1.6	801	53	2017
Sustainability	15	25	1.667	694	40	2018
Transportation Research Part D: Transport and Environment	12	17	1.091	535	17	2016
Renewable and Sustainable Energy Reviews	11	11	1.1	1396	11	2017
Applied Energy	10	12	0.909	772	12	2016
Energy	10	15	0.909	548	15	2016
Resources Conservation and Recycling	9	9	1	504	9	2018
Technological Forecasting and Social Change	9	9	0.818	281	9	2016

Table 1: Most Productive Source
Source: Biblioshiny

Both of these sources are the most fruitful, as evidenced in Table 1, in terms of publication output and the citation impact in the field. "The Journal of Cleaner Production" has the highest number of h-index (23) and total citations (2108), which means it has a solid contribution and was influential throughout 2017. The productivity of "Sustainability (Switzerland)" and "Energies" is high: the publications amount to 31 and 53, respectively, which is due to the popularity of the publications as platforms. "Renewable and Sustainable Energy Reviews" has the highest total number of citations (1396) with fewer publications, indicating a high impact of the articles. Likewise, "Applied Energy" and "Energy" have equal performance in the number of outputs and citations. New sources, including "Resources Conservation and Recycling" and "Technological Forecasting and Social Change" play a consistent part. On the whole, the list of the most productive and most influential journals includes a balance between those that move the research in the direction of sustainability and those that focus on energy issues.

3.4 Thematic Analysis

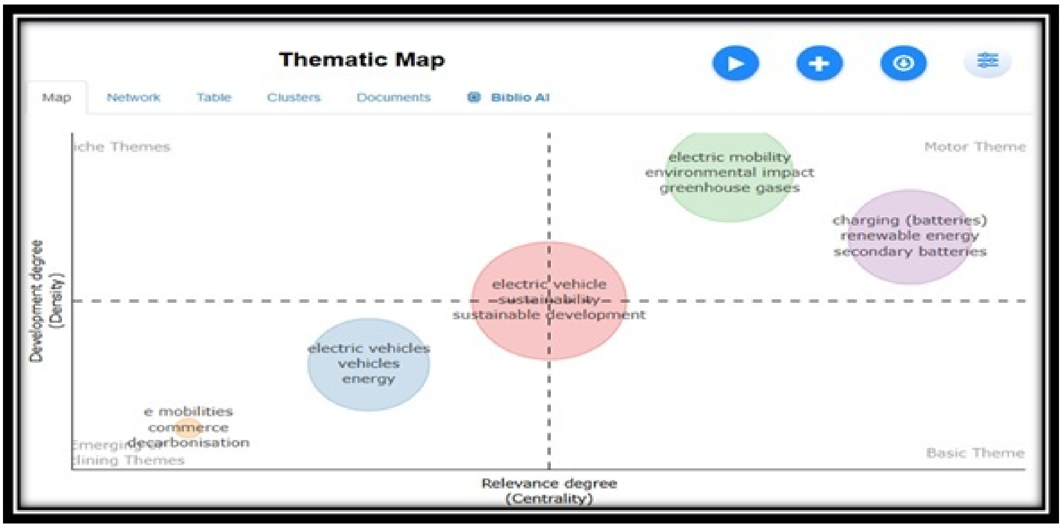


Figure 4: Thematic Map
Source: Biblioshiny

The thematic map (Figure 4) sorts the research themes by centrality (relevance) versus density (development), and discloses the intellectual structure of the field. Motor themes (high centrality, high density) are developed and important. Such themes as "electric mobility, environmental impacts, and greenhouse gases" prevail in this quadrant and show that there are mature and highly impactful areas of research that propel the field forward. In the same way, the topics, such as "charging (batteries), renewable energy, and secondary batteries", indicate the good technological and infrastructure-oriented research.

Indeed, basic themes (high centrality, low density) incorporate core yet less-developed areas. The cluster around "electric vehicles, sustainability and sustainable development" is close to the centre, which implies that they are core concepts that underpin the field but are still developing in detail. Niche themes (low centrality, high density) are narrowly specified and internally generated, yet more detached from the field. These are sparse in this map, indicating fewer individual research areas. Other emerging or dying themes (low centrality, low density) are "e-mobility, commerce, and decarbonisation". Such subjects are either still at their rudimentary level or becoming obsolete, so there may be areas to be covered in the future, or where to re-focus.

3.5 TCCM Framework

The "Theory-Context-Characteristics-Methodology (TCCM)" model, introduced by Paul and Rosado-Serrano (2019), is a highly advanced, systematic methodology that seeks to transform the descriptive aspect of conventional reviews into a multidimensional, structured synthesis of knowledge. So, this study conducts TCCM on the Top 20 Cited Papers.

S. No.	Author(s) & Year	Theoretical Foundation	Research Context	Key Characteristics	Methodological Approach
1	Kumar & Alok (2020)	Integrative Review Protocol; Five-Category Variable Framework	Global scholarly research on EV adoption (239 articles)	Identifies antecedents, mediators, moderators and consequences of EV adoption; highlights regional disparities.	Integrative literature review with systematic categorisation of variables.
2	Bhatti et al. (2021)	Digital Twin Technology; UN Sustainable Development Goals	Smart EVs, IoT-enabled transport and battery management	Explores digital twins for vehicle health, intelligent charging and energy efficiency.	Comprehensive technical review and conceptual framework development.
3	Biresselioglu et al. (2018)	Decision-Making Process; Socio-Technical Transition	Electric mobility across the European Union	Maps motivators and barriers at policy, stakeholder and consumer levels.	Systematic literature review with qualitative content analysis.
4	Chen et al. (2020)	Diffusion of Innovations Theory; Socio-Demographic Theory	EV adoption and V2G preferences in the Nordic region	Examines behavioural, technical and economic determinants of V2G adoption.	Survey-based quantitative study (n = 4885); hierarchical regression.
5	Sovacool, Kester et al. (2018)	Sustainability Transitions; Social-Demographic Theory	Decarbonising transport in the Nordic region	Examines gender, age and household influences on mobility choice.	Mixed-methods comparative demographic analysis.
6	Zhang & Hanaoka (2021)	Technology Bottom-Up Modelling; Carbon Neutrality Target	Provincial disparities in China's energy systems	Evaluates cost-effectiveness and emission reduction potential of EVs.	Transport energy modelling using bottom-up demand models.
7	Arshad et al. (2022)	Life Cycle Assessment; Circular Economy	Global lithium-ion battery production and end-of-life management	Reviews environmental impacts from extraction to recycling.	Critical review with Life Cycle Inventory analysis.
8	Cusenza et al. (2019)	Environmental Systems Theory; Battery LCA	Lithium-ion batteries for plug-in hybrid vehicles	Evaluates LMO-NMC battery technology and recycling potential.	Process-based Life Cycle Assessment and material flow analysis.
9	Zhao et al. (2020)	Scientometric Mapping; Sustainable Development Theory	Evolution of sustainable transport research (2000–2019)	Identifies major research themes and publication trends.	Scientometric mapping and bibliometric analysis.
10	Nundy et al. (2021)	UN Sustainable Development Goals; Pandemic Impact	Global transport and socio-economic sectors during COVID-19	Examines changes in emissions, energy use and mobility patterns.	Global comparative impact assessment.
11	Bosshard & Kolar (2016)	Inductive Power Transfer Theory	Wireless charging for electric vehicles	Reviews efficiency, power density and magnetic field leakage.	Comparative technical review with Pareto optimisation.
12	Ziemann et al. (2018)	Dynamic Material Flow Analysis	Lithium recycling and battery demand in Europe	Models recycled lithium availability for future demand.	Dynamic material flow analysis and scenario modelling.

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S. No.	Author(s) & Year	Theoretical Foundation	Research Context	Key Characteristics	Methodological Approach
13	Camacho et al. (2022)	Sustainable Freight Framework; Bibliometrics	Hydrogen fuel-cell heavy-duty trucks	Reviews transition towards hydrogen-powered freight transport.	Systematic literature review with bibliometric analysis.
14	Sovacool, Noel et al. (2018)	Sociotechnical Systems Theory; Social Justice	Social dimensions of Vehicle-to-Grid	Examines user behaviour, justice and gender issues in V2G adoption.	Critical systematic review with thematic synthesis.
15	Pamucar et al. (2021)	Multi-Criteria Decision Making	Alternative fuel vehicles in the USA	Ranks electric, hydrogen and hybrid vehicles using sustainability criteria.	Integrated Fuzzy FUCOM and Neutrosophic Fuzzy MARCOS approach.
16	Bubeck et al. (2016)	Total Cost of Ownership Theory	Electric passenger vehicles in Germany	Assesses economic competitiveness of BEVs and PHEVs.	Component-based TCO modelling with sensitivity analysis.
17	Sovacool et al. (2017)	Sociotechnical Transition Theory	Global Vehicle-to-Grid integration	Discusses opportunities and future research directions for V2G systems.	Conceptual sociotechnical review.
18	Manzolli et al. (2022)	Public Transport Electrification Framework	Global electric bus research	Reviews fleet operations, energy management and environmental impacts.	Systematic review with trend analysis.
19	Kumar et al. (2021)	Supply Chain Management; Game Theory	Charging infrastructure investment	Examines whether governments or manufacturers should invest in charging infrastructure.	Mathematical modelling using Stackelberg game theory.
20	Martínez-Lao et al. (2017)	Smart Grid and Charging Infrastructure	Charging systems in Spain	Evaluates charging networks and their role in sustainable transport.	Descriptive technical review.

Table 2: Summary of Selected Literature on Electric Vehicles
Source: Author's Own Creation

4 Discussion

Research Questions	Analysis / Approach Used	Outcome
RQ1: What are the publication and citation trends of research on electric vehicles and sustainability?	• Descriptive bibliometric analysis (annual scientific production and growth rate) • Temporal evolution mapping (2016–2025)	• Identified 593 publications published during 2016–2025. • Annual scientific growth rate of 28.20%. • Peak publication output observed in 2024 (101 documents) and 2025 (157 documents).
RQ2: Which are the most productive sources (journals), countries, and their collaborative structure in the field of electric vehicles and sustainability?	• Source impact analysis (H-index, G-index, M-index and total citations) • Country productivity analysis • Most-cited country analysis • Country collaboration network	• *Journal of Cleaner Production* emerged as the most influential journal. • Germany demonstrated steady and consistent publication growth. • India was the most cited country with 2,197 citations. • China exhibited the strongest international collaboration network with countries such as Pakistan, Australia, Malaysia and the United States.
RQ3: What are the trends and emerging themes in keywords related to electric vehicles and sustainability research?	• Thematic map analysis	• Motor themes include electric mobility and environmental impacts. • Basic themes comprise electric vehicles and sustainability. • Emerging and niche themes include e-mobility and decarbonisation.

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Research Questions	Analysis / Approach Used	Outcome
RQ4: What are the major research gaps and future research directions for scholars, policymakers, and industry stakeholders?	• Gap identification through bibliometric analysis • TCCM framework synthesis	• Existing studies are theoretically limited, concentrated in developed countries, focused primarily on pre-adoption behaviour, and predominantly employ cross-sectional designs. • Future research should adopt multi-theoretical perspectives, investigate emerging and rural contexts, examine post-adoption behaviour and inclusiveness, and utilise longitudinal as well as advanced analytical techniques.

Table 2: Research Questions, Analytical Approaches, and Key Outcomes
Source: Author's Own Creation

This research provides an organised bibliometric and thematic analysis of electric vehicles (EVs) and sustainability.

The results of this study report a strong upward trend in the number of published documents (593 documents and a substantial annual percentage growth of 28.20% in 2016-2025), which addresses the first research question. The striking growth in 2024-25 reflects the increased global focus on decarbonisation, climate change, and energy transitions in transportation technologies.

Regarding the second research question, the concentration of the field among top journals and countries reflects a structured but uneven development. Top journals like the "Journal of Cleaner Production" play important roles in publishing interdisciplinary findings. "India's" role as the most cited country suggests growing participation by emerging economies. Nevertheless, regional research productivity gaps are present. China plays a pivotal role in the global research network, having strong ties with both developed and emerging economies. The presence of intellectual leaders hailing from the UK also reveals the concentration of expertise. This network is vital to tackling transboundary sustainability issues.

Concerning the evolution of research topics (RQ3), the study reveals a robust knowledge structure with motor, basic and emerging themes. Established themes like electric mobility and environmental impact dominate, but also emerging themes, such as decarbonization and e-mobility, reflect the evolution towards systemic and policy-relevant research. The concentration of themes into urban mobility, infrastructure transition, and environmental-energy systems reflects the multidisciplinary aspects of EV research.

Lastly, the analysis based on the TCCM model related to the research gaps (RQ5) shows that the main limitations of EV research include narrow approaches to theory, contextual concentration in developed economies, a focus on pre-adoption EV-related behaviour, and the use of cross-sectional research methods. These insights highlight the need for more cross-disciplinary, context-relevant and methodological integration.

5 Implications

The study's implications can be explained using the TCCM framework, which offers a framework to link theoretical foundations, context, characteristics, and methods with practical and research insights. In terms of the theoretical underpinning, the results imply that governments should consider going beyond technical and economic considerations and consider behavioural factors when developing electric vehicle (EV) policies. Consumer beliefs, perceptions and behaviour play a critical role in EV uptake. From a theoretical perspective, the research suggests the need to take on a cross-disciplinary approach, incorporating behavioural science, economics and sustainability in research on electric vehicles. In the research context, the study underscores the importance of not applying a "one-size-fits-all" approach, especially in emerging economies. Countries should look to develop EV policy frameworks tailored to the specific context, including infrastructure, economy and consumer attitudes. With respect to the main characteristics, the research suggests that various interdependent factors (such as consumer awareness, incentives and infrastructure) affect EV adoption. Hence, governments should use a holistic policy approach, instead of a unilateral approach. From a theoretical perspective, this bolsters the thesis that EV adoption is a multi-faceted phenomenon and should be explained via integrated rather than single-parameter approaches. Researchers should explore further the interplay between these factors, for example, the interaction between policy requirements and awareness/knowledge of infrastructure in determining EV adoption.

6 Limitations and Future Research Directions

Certain limitations of this study provide an opportunity for future research. The first run of the bibliometric analysis based on data from "Scopus" or "Web of Science" may ignore some publications from other resources, thereby resulting in incomplete coverage. The second limitation is the temporal scope of the analysis. Because bibliometric trends in EVs and their supporting sustainability policies become quickly outdated with rapid technological advancements in EVs, it would be helpful for bibliometricians to note the data issues. Such analyses require periodic updates to keep up with emerging developments in battery technology and the integration of renewable energy, progress in the driverless vehicle sector, etc.

6.1 Future Research Direction

Additionally, the research suggests a few key gaps in the TCCM and parallel future research opportunities, drawing from existing literature. Theoretically, a noticeable gap is the overemphasis on socio-technical and sustainability theories to explain electric vehicle (EV) adoption. Although these theories offer important macro-scale analyses, they tend to neglect micro-scale behaviours. To overcome this shortcoming, researchers should take into account behavioural and psychological theories such as perception, attitude and consumer behaviour theories to better understand the adoption dynamics (Ajzen, 1991; Sovacool et al., 2018; Chen et al., 2020). In terms of setting, the existing literature is heavily weighted towards advanced economies, limiting the applicability of the results. And the socio-economic and policy contexts of emerging economies like India are still unexplored. Researchers need to broaden their scope to these settings to develop more diverse and global insights (Kumar & Alok, 2020; Nundy et al., 2021). In terms of key characteristics, current research mainly addresses pre-adoption aspects (such as intention, willingness to adopt) rather than post-adoption. Future studies should explore factors such as usage patterns, user satisfaction and switching intentions to inform post-adoption and retention (Bubeck et al., 2016; Chen et al., 2020). Lastly, from a research standpoint, the overwhelming majority of existing research being cross-sectional is a considerable constraint because such approaches are incapable of capturing dynamic consumer behaviour. Longitudinal and panel data should be used to analyse how users' behaviour changes over time in future research (Kumar & Alok, 2020; Zhao et al., 2020).

7 Conclusion

This study presents a comprehensive picture of the electric vehicles and sustainability research literature, including a bibliometric review in combination with a TCCM-inspired approach. We have indicated that the field is expanding quickly, due to its emphasis on world sustainability and political emphasis on green mobility. The most significant publication topics reflect that the EV publications have grown substantially, particularly in the last few years, so we can surmise that the area is now increasingly important. Our study also provides a focus on research concentrations in journals, organisations and countries, recognising the importance of new countries such as India". The study on collaboration shows the importance of international collaboration with nations like "China" and "the United Kingdom" as important knowledge sources. The research stresses the need for global collaboration for EV research. In terms of research themes, the field of study exhibits a mix of traditional and emerging themes. While traditional and new themes such as sustainability, electric mobility, decarbonization and integrated energy systems highlight the move towards more integrated and sustainable research. This is reflective of the complexity of sustainable transportation. Our study suggests several improvements. There is an over-focus on a narrow range of theoretical perspectives; a concentration of research in the developed world; and an over-representation of cross-sectional research designs, all of which hinder the insight and generalisability of research. Further, inclusivity in research is needed, particularly given the focus on practices post-adoption and inclusivity. Consequently, research should take a broader approach by incorporating multiple theoretical perspectives; conducting research in under-researched geographical areas, and research studies with rigorous methods, such as longitudinal and mixed methods studies. Addressing these concerns, however, can better support researchers and practitioners in informing and implementing policies and strategies to enable the transition to sustainable systems globally.

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Declaration of Interest Statement

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