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# Electric Vehicles and Sustainable Transportation: A Bibliometric Analysis from 1996 to 2024

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**Abstract**

Electric vehicles (EVs) have experienced a significant surge in academic and industry attention over the last ten years, driven by technological advancements, policy frameworks, and the global push toward sustainability. This paper covers an extensive bibliometric analysis of EV research from 1996 to 2024, focusing on publication trends, influential authors, key research areas, and global collaboration networks. By analyzing over 800 journal articles extracted from Scopus, this paper identifies the leading contributors in terms of countries, institutions, and academic sources. The key findings underscore the prominent influence of interdisciplinary journals spanning the fields of energy, transportation, and sustainability. Furthermore, the analysis maps out emerging themes such as charging infrastructure, consumer behaviour, and renewable energy integration, providing crucial insights into the evolving research landscape. The study summarises by highlighting the need for ongoing efforts to tackle the technical and policy hurdles that come with widespread EV adoption. It stresses how crucial this is for combating climate change and creating a sustainable future

**Keywords**: Bibliometric analysis, Electric Vehicles, EV, Sustainability, Transportation

## Introduction

Electric vehicle usage and ownership have grown substantially worldwide in recent years. (Hussain et al., 2023). In 2020, global sales of electric vehicles (EVs) reached 3 million units, reflecting a 40 per cent increase over 2019. The modern world is fundamentally reliant on the transportation sector (Ekpeni & Olabi, 2013). This sector remains predominantly dependent on fossil fuels, contributing significantly to environmental concerns (Aggarwal & Singh, 2021; Ghosh, 2020; Qiao & Lee, 2019). Recognizing the growing need for electric vehicles is crucial, particularly as carbon emissions have become a major driver of rising greenhouse gas (GHG) levels globally (Tran et al., 1865). Presently, government policies have implemented numerous initiatives to promote the advancement of electric vehicles However, the COVID-19 pandemic caused a 16 per cent decline in sales, disrupting the steady growth seen over the previous decade. Currently, more than 10 million electric vehicles are registered worldwide, and projections indicate that by 2050, nearly 300 million EVs will be on the roads—accounting for approximately 60% of all new car sales. Figures from 2021 specify robust sales growth across major automotive markets. That year was also marked by the implementation of government strategies to get net-zero greenhouse gas emissions, primarily through phasing out internal combustion vehicles (ICVs). Automotive manufacturers from various sectors are planning substantial investments in EVs to further expand this rapidly growing market (IEA, 2024).

The growing interest in electromobility is largely driven by several factors: (a) fossil fuel depletion and the ensuing rise in fuel prices (Gönül et al., 2021); (b) Increased public consciousness and a determination to tackle climate change; (c) developments in technology and the commercial potential of sustainable energy sources; and (d) improvements in supporting infrastructure (Arif et al., 2021). Many governments and companies have introduced policies and strategies to encourage the use of electric cars (EVs), facilitating their integration into society (Hasan et al., 2021). According to Filote et al. (2020), electromobility is therefore seen as a workable way to lessen the disadvantages of combustion-powered vehicles (ICVs). Numerous initiatives have been launched by various countries to further support this transition. Through the promotion of greener and more sustainable modes of transportation, this proclamation seeks to retain global warming less than 2 degrees Celsius. By 2030, EV sales must make up about 35 percent of all vehicle sales in order to accomplish this (Lévay et al., 2017).

Electric vehicles (EVs) have become a viable worldwide alternative to address several environmental challenges by lowering CO2 emissions, Consequently, lowering urban air pollution (Ahn & Yeo, 2015). Compared to conventional vehicles, EVs offer increasing environmental and economic advantages (Faria et al., 2012). To promote EV adoption, governments are implementing investments, incentives, and regulations (Skerlos & Winebrake, 2009; Graham-Rowe et al., 2011). Large automakers are demonstrating interest in electric vehicles and are dedicated to creating both passenger and commercial models (Lieven et al., 2010). If powered by nuclear energy and renewable sources, EVs have the potential to drastically cut transportation-related greenhouse gas emissions. As a result, many nations are encouraging the use of EVs for both private and public transit. Electric vehicles (EVs) are available in various forms, with the most prominent types being hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), and fully battery electric vehicles (BEVs) (Adhikari et al., 2020). Despite their potential, the widespread adoption of EVs has been relatively limited due to several significant challenges. These include high initial purchase costs and limited charging infrastructure (Adepetu & Keshav, 2017), inadequate service and maintenance facilities (Deng et al., 2020), and the considerable expense associated with replacing lithium-ion batteries (Chen et al., 2021). Hybrid car rate is high, and lack of maintenance issues (Hidrue et al., 2011). EVs provide several advantages for the environment, including lower maintenance and running expenses and less noise pollution (Teixeira & Sodré, 2016).

Over the past decade, interest in electric vehicles (EVs) has grown significantly, largely due to advancements in technology and evolving policy frameworks. This paper aims to discover the existing landscape of EV research by carrying out a bibliometric analysis with an emphasis on finding new trends in the field. The entire Scopus database was searched systematically to evaluate the key sources of EV-related publications, including papers, journals, well-known authors, countries, institutions, fields of study, and the most frequently cited areas. The analysis offers insightful information about the present direction of EV development. Bibliometric analysis, a quantitative method for evaluating scientific literature, helps uncover the evolution

of research themes, collaboration networks, and influential publications (Chen et al., 2016). A bibliometric examination of EV research is presented in this study, focusing on future trends to offer a structured overview of the field. By analysing publication trends, citation networks, and thematic patterns, the study aims to provide key insights for policymakers, industry leaders, and the academic community, highlighting the critical challenges and opportunities that accompany the shift towards electric mobility.

**Objectives**

To assess the present level of electric vehicle research and identify new directions for investigation in the future.

To determine the most influential journals in the electric vehicle research domain.

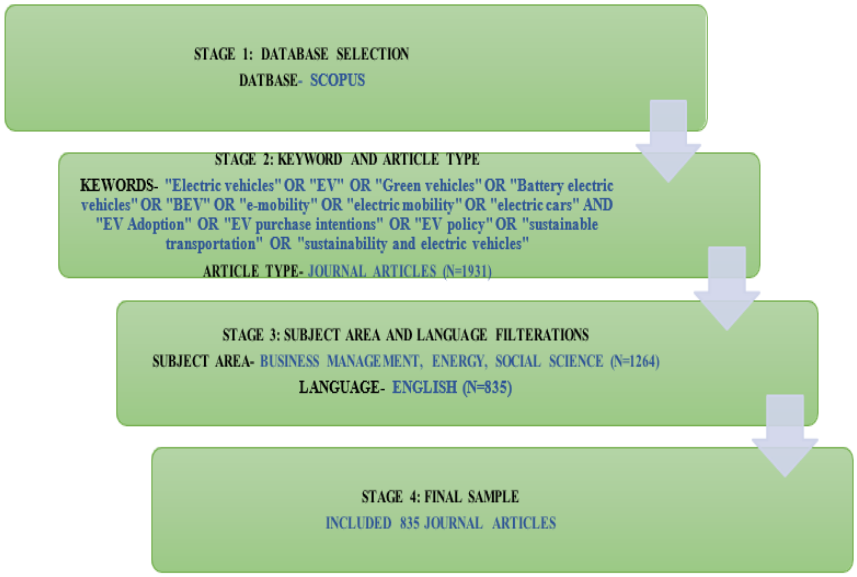
To assess the leading authors, countries, top institutions, and most highly cited articles in electric vehicle studies.

To conduct a thematic analysis of key emerging trends in electric vehicle research.

To establish a foundation for future research directions.

**Methodology**

Electric vehicle (EV) research articles were analyzed, processed, and evaluated using software tools to generate various bibliometric insights and identify technological trends. Scopus, a leading academic database that hosts high-quality publications across diverse fields, was utilized to ensure reliable data collection on EV-related studies. Given the objective of assessing the growth of EV research, a broad time frame was selected to capture meaningful trends. Data was gathered for the period from 1996 to 2024, encompassing the early development to the expansion phase of EV research, ensuring a comprehensive analysis. The study has exported the citation data, bibliographic content, and keywords into a CSV file for further analysis.




Bibliometric analysis is a recognized and effective technique for systematically examining large amount of scientific literature, offering valuable insights into emerging trends and developments within a research domain. Bibliometric study is a growth of literature and explores the trend of the field (Chellappandi & Vijayakumar, 2018 ), By employing various quantitative techniques, bibliometric analysis uncovers distribution patterns and relationships within specific subjects, disciplines, institutions, or regions. Commonly used bibliometric tools, such as RStudio, VOSviewer, HistCite, Network WorkBench, DIVA, and CiteSpace, facilitate the statistical analysis and visualization of journal distributions, authorship networks, publication trends, institutional contributions, and keyword patterns (Donthu et al., 2021). In this study, RStudio and VOSviewer were selected for their superior capabilities in conducting both detailed analysis and visualization of research outputs.

RStudio, a robust integrated development environment (IDE) for the R programming language, enables advanced statistical analysis and data processing. Through packages like bibliometrix, it supports comprehensive analyses of citations, co-citations, and co-authorships, while providing flexibility for creating custom visualizations through various R libraries. VOSviewer, by contrast, is a specialized tool for visualizing bibliometric networks. It effectively generates intuitive network maps illustrating co-authorship, citation links, and keyword co-occurrences, grouping clusters according to the strength of their interconnections. With support for data imports from databases like Scopus and Web of Science, VOSviewer offers a user-friendly interface for generating visualizations of bibliometric data. Together, these tools enable a thorough analysis and visualization of research trends and relationships in bibliometric studies.

Selection of database

Relevant literature was retrieved from the Scopus database, which offers a wide range of peer- reviewed articles. Research related to electric vehicles (EVs) and sustainable transportation was identified as particularly pertinent to the study's objectives on October, 2024. The Scopus database was chosen due to its comprehensive coverage of journals and articles, making it an ideal resource for this analysis.

Keyword selection

The foundation of a robust bibliometric review lies in the selection of appropriate search terms. Keywords should be carefully chosen to encompass the most relevant and influential research within the targeted field. Boolean search terms include "Electric vehicles" OR "EV" OR "Green vehicles" OR "Battery electric vehicles" OR "BEV" OR "e-mobility" OR "electric mobility" OR "electric cars" AND "EV Adoption" OR "EV purchase intentions" OR "EV policy" OR "sustainable transportation" OR "sustainability and electric vehicles".

Filtering (criterion for inclusion and exclusion)

The database of Scopus produced 1,931 articles when the predetermined inclusion and exclusion criteria were used. Initially, filters were implemented to define the subject areas, which encompassed Business Management, Energy, and Social Sciences. Subsequently, to maintain linguistic uniformity in the analysis, only English-language articles were considered by applying a language filter.

Final Sample

Initially, 1,931 research articles were identified through Scopus. After applying keyword searches and relevant filters, 835 articles were selected for the bibliometric analysis.

Data Analysis and Results

***Major information regarding the Data***

| Time | 1996- |
|---|---|
| Sources (Journals, Books, etc) | 236 |
| Documents | 835 |
| Annual Growth Rate % | 2.42 |
| Document Average Age | 2.41 |
| Average citations per doc | 28.27 |
| References | 4651 |
| DOCUMENT CONTENTS | 7 |
| Keywords Plus (ID) | 4192 |
| Author's Keywords (DE) | 2458 |
| AUTHORS | |
| Authors | 2560 |
| Authors of single-authored docs | 46 |
| AUTHORS COLLABORATION | |
| Single-authored docs | 47 |
| Co-Authors per Doc | 3.67 |
| International co-authorships % | 33.77 |
| DOCUMENT TYPES | |
| article | 740 |
| conference paper | 2 |
| editorial | 2 |
| erratum | 2 |
| note | 4 |
| review | 83 |
| short survey | 2 |

Total publications and number of active years of publications

***Figure 1. Shows year to year publications from 1996 to 2024***

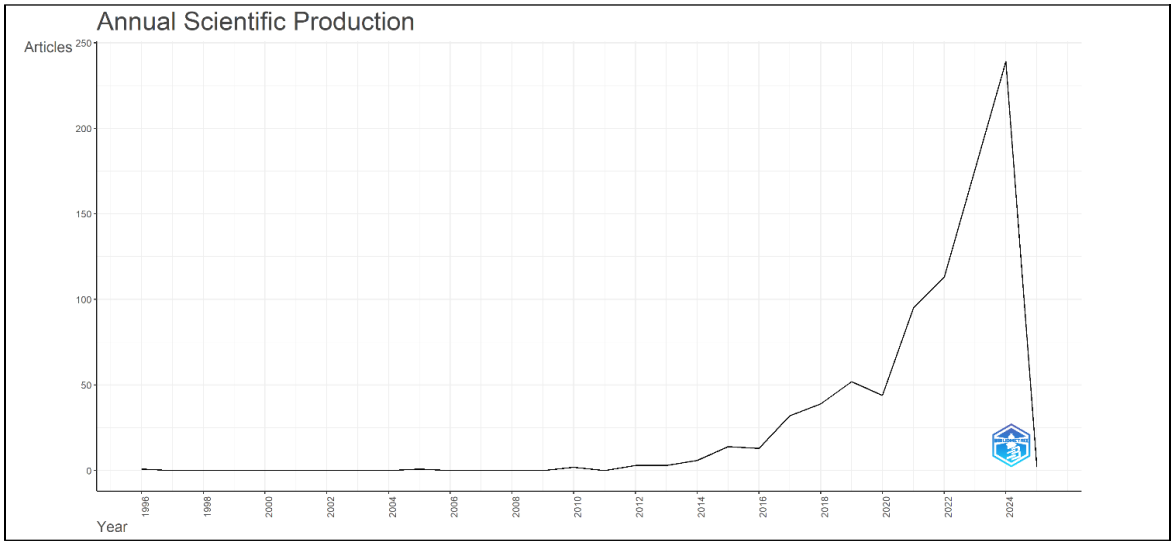



**Figure 1. Shows how many papers were published each year between 1996 and 2024. The data shows that there was very little scientific output between 1996 and 2009, with very few publications produced year. A modest increase in scientific activity is observed from 2010 to 2015, though the annual production stays below 50 articles. From 2016 to 2019, there is a gradual rise in the number of publications, with article counts approaching the range of 50 to 100 per year. The most significant trend begins in 2020, when a sharp increase in scientific output is evident, culminating in a peak of approximately 250 articles in 2023. This dramatic rise suggests sharp research interest or developments in the field during this period. However, in 2024, the graph indicates a sharp decline, likely attributable to the year being incomplete at the time of data collection. Overall, the chart reflects a marked growth in research activity, particularly over the past few years, pointing to increased attention or breakthroughs in the subject area under investigation.**

Top 10 Journals where maximum number of papers are published

*Figure 2. Shows the name of top 10 journals along with number of papers published.*

| ***Journals*** | ***Articles*** |
|---|---|
| *SUSTAINABILITY (SWITZERLAND)* | 64 |
| *ENERGIES* | 50 |
| *JOURNAL OF CLEANER PRODUCTION* | 50 |
| *TRANSPORTATION RESEARCH PART D: TRANSPORT AND ENVIRONMENT* | 47 |
| *TRANSPORT POLICY* | 30 |
| *APPLIED ENERGY* | 26 |
| *ENERGY POLICY* | 25 |
| *TRANSPORTATION RESEARCH PART A: POLICY AND PRACTICE* | 25 |
| *ENERGY* | 21 |
| *RENEWABLE AND SUSTAINABLE ENERGY REVIEWS* | 21 |

**Figure 2.** presents the distribution of papers published in different journals, emphasizing the most important sources in the area. According to the data, Sustainability (Switzerland) is the leading source, contributing the highest number of documents, with 64 publications. Following closely are Energies and the Journal of Cleaner Production, each accounting for 50 documents, reflecting their significant role in disseminating research on the subject.

Transportation Research Part D: Transport and Environment ranks fourth with 47 published documents, showcasing its relevance in transportation-related environmental research. Other notable sources include Transport Policy with 30 publications, and Applied Energy with 28 documents, both of which emphasize policy and energy-related issues. Energy Policy and Transportation Research Part A: Policy and Practice each contribute 25 documents, reinforcing their importance in energy and transportation policy discussions.

At the lower end of the list, Energy and Renewable and Sustainable Energy Reviews each account for 21 documents. Despite contributing fewer publications, these journals still play a vital role in advancing knowledge in energy and sustainability research. Overall, the chart underscores the dominance of interdisciplinary journals focusing on sustainability, energy, and transportation, highlighting their importance in the evolving body of research.

Top Sources and their Impact:

***Figure 3. Shows top sources and their impact***

| *Source* | *h_index* | *g_index* | *TC* | *NP* | *PY_start* |
|---|---|---|---|---|---|
| JOURNAL OF CLEANER PRODUCTION | 26 | 50 | 2613 | 50 | 2005 |
| SUSTAINABILITY (SWITZERLAND) | 25 | 36 | 1438 | 64 | 2014 |
| TRANSPORTATION RESEARCH PART D: TRANSPORT AND ENVIRONMENT | 23 | 43 | 1934 | 47 | 2015 |
| TRANSPORTATION RESEARCH PART A: POLICY AND PRACTICE | 17 | 25 | 963 | 25 | 2014 |
| APPLIED ENERGY | 16 | 26 | 929 | 26 | 2013 |
| ENERGIES | 16 | 25 | 740 | 50 | 2014 |
| ENERGY POLICY | 16 | 25 | 1847 | 25 | 2012 |
| RENEWABLE AND SUSTAINABLE ENERGY REVIEWS | 16 | 21 | 1630 | 21 | 2017 |
| TRANSPORT POLICY | 14 | 29 | 845 | 30 | 2015 |
| ENERGY | 11 | 21 | 696 | 21 | 2016 |

**Figure 3,** presents the top sources and their bibliometric impact in terms of h-index, g-index, total citations (TC), number of publications (NP), and the year the journal started contributing to the field (PY start). The Journal of Cleaner Production leads with an h-index of 26, g-index of 50, 2,613 citations, 50 publications, and contributions since 2005. Sustainability (Switzerland) follows closely with h-index of 25, g-index of 36, 1,438 citations, and 64 publications since 2014. Other notable sources include Transportation Research Part D with a strong impact (h-index 23, 1,934 citations), and Renewable and Sustainable Energy Reviews (h-index 16, 1,630 citations). The table highlights that many sources have a consistent presence, particularly in transportation and energy sustainability topics, reflecting their importance in the field's development over recent years.

Countries' production over time:

***Figure 4. Shows the countries production over time.***

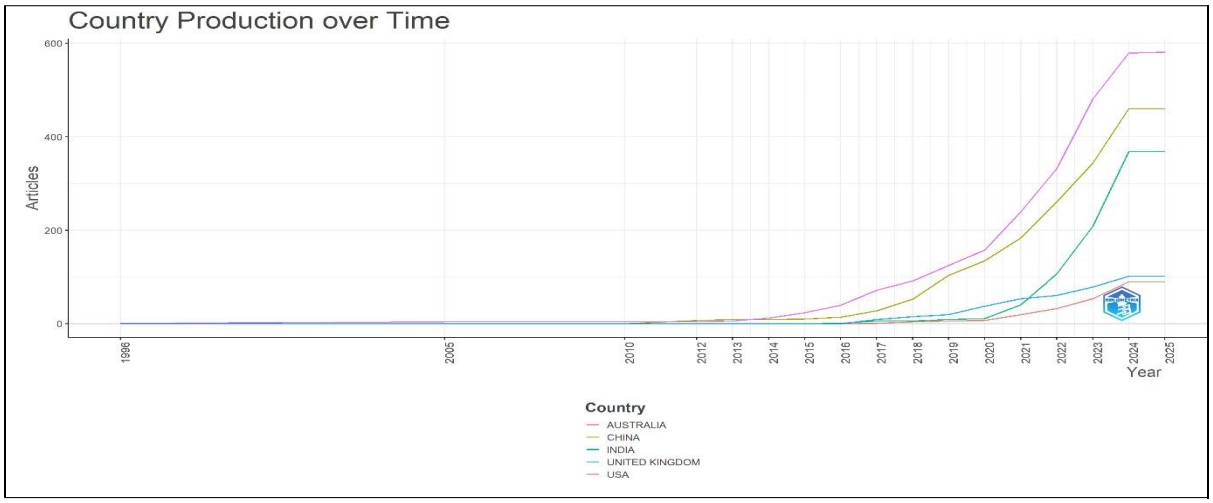



**Figure 4**, presents the evolution of research output on electric vehicles across different countries from 1995 to 2025. The most significant rise in publications has occurred since 2015, with the United States leading the production, contributing nearly 600 articles by 2024. China follows closely, displaying a steep increase in research output since 2018, producing over 400 articles.

Other notable contributors include India, the United Kingdom, and Australia, which have shown moderate but consistent growth, especially post-2020. India's research output surpasses 200 articles by 2024, indicating the country's increasing focus on electric vehicle research.

Most Relevant Authors:

***Figure 5. Shows the most relevant authors.***

| ***Authors*** | ***Articles*** |
|---|---|
| KUCUKVAR M | 12 |
| ONAT NC | 11 |
| WANG Y | 11 |
| ZHANG X | 10 |
| GKRITZA K | 7 |
| GUO J | 7 |
| WANG Z | 7 |
| WU Y | 7 |
| LI Y | 6 |
| LIU X | 6 |

**Figure 5, highlights the prolific authors contributing to the field of electric vehicle research, based on the number of articles published. The leading contributor is Kucukvar M, with 12 articles, followed closely by Onat NC and Wang Y, both with 11 articles. Other significant contributors include Zhang X with 10 articles, and Gkritza K, Guo J, Wang Z, and Wu Y, each with 7 articles. Additionally, Li Y and Liu X have also made substantial contributions, each with 6 articles.**

Top Institutions:

***Figure 6. Shows the top affiliations and no of articles published by them.***

| *Affiliation* | *Articles* |
|---|---|
| NATIONAL RENEWABLE ENERGY LABORATORY | 40 |
| QATAR UNIVERSITY | 39 |
| SOUTHEAST UNIVERSITY | 20 |
| TONGJI UNIVERSITY | 20 |
| PURDUE UNIVERSITY | 18 |
| DELFT UNIVERSITY OF TECHNOLOGY | 17 |
| UNIVERSITY OF CALIFORNIA | 16 |
| BEIJING JIAOTONG UNIVERSITY | 15 |
| NOT REPORTED | 14 |
| SANDIA NATIONAL LABORATORIES | 13 |

**Figure 6, The analysis ranks top contributing institutions by their publication output in the field. National Renewable Energy Laboratory leads with 40 articles, followed closely by Qatar University with 39. Other significant contributors include Southeast University and Tongji University, each with 20 articles, and Purdue University with 18. Delft University of Technology and University of California also feature prominently, with 17 and 16 articles, respectively. The diversity of institutions, including those from different geographical regions, underscores the global engagement in the research area, particularly in renewable energy and sustainability.**

Highly cited articles:

***Figure 7, Shows the highly cited articles.***

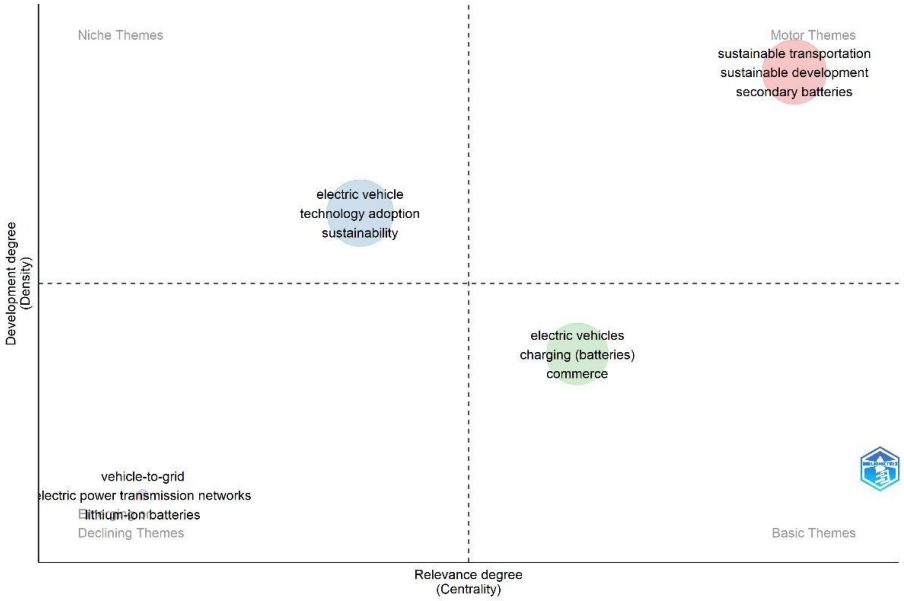
| *Paper* | *DOI* | *Total Citations* |
|---|---|---|
| BJERKAN KY, 2016, TRANSP RES PART D TRANSP ENVIRON | 10.1016/j.trd.2015.12.002 | 434 |
| COFFMAN M, 2017, TRANSP REV | 10.1080/01441647.2016.1217282 | 407 |
| EBERLE U, 2010, ENERGY ENVIRON SCI | 10.1039/c001674h | 378 |
| LANGBROEK JHM, 2016, ENERGY POLICY | 10.1016/j.enpol.2016.03.050 | 360 |
| ACAR C, 2020, INT J HYDROGEN ENERGY | 10.1016/j.ijhydene.2018.10.149 | 343 |
| SCHROEDER A, 2012, ENERGY POLICY | 10.1016/j.enpol.2011.12.041 | 325 |
| BHATTI G, 2021, RENEWABLE SUSTAINABLE ENERGY REV | 10.1016/j.rser.2021.110801 | 276 |
| HU X, 2020, PROG ENERGY COMBUST SCI | 10.1016/j.pecs.2019.100806 | 275 |
| SAXENA S, 2015, J POWER SOURCES | 10.1016/j.jpowsour.2015.01.072 | 266 |
| AGHABALI I, 2021, IEEE TRANS TRANSP ELECTRIF | 10.1109/TTE.2020.3044938 | 206 |

**Figure 7** shows the table lists some of the utmost highly cited articles in the arena of energy and transportation. The top-cited work, Bjerkan KY (2016) in Transportation Research Part D: Transport and Environment, has accumulated 434 citations. Following this is Coffman M (2017) in Transport Reviews with 407 citations. Other highly influential papers include Eberle U (2010) in Energy & Environmental Science (378 citations), Langbroek JHM (2016) in Energy Policy (360 citations), and Acar C (2020) in International Journal of Hydrogen Energy (343 citations).

Noteworthy contributions also come from Schroeder A (2012) in Energy Policy (325 citations) and Bhatti G (2021) in Renewable and Sustainable Energy Reviews (276 citations). Additionally, Hu X (2020) in Progress in Energy and Combustion Science and Saxena S (2015) in Journal of Power Sources are both highly cited, with 275 and 266 citations respectively. Lastly, Aghabali I (2021) in IEEE Transactions on Transportation Electrification has garnered 206 citations.

Thematic map and Keywords analysis:

***Figure 8. Shows the thematic map.***




The thematic map, figure 8, provides an overview of key research themes related to electric vehicles and sustainability. This thematic map helps to visualize the maturity and relevance of different themes in the research landscape of electric vehicles and sustainability. Themes are organized into four quadrants according to two dimensions—Development Level (Density) and Relevance Level (Centrality).

**Motor Themes**: These are important and well-developed themes within the field of study. Their significance in improving theory and practice is demonstrated by the fact that they encompass sustainable development, sustainable transportation, and secondary batteries.

**Basic Themes**: Though fundamental, these are not as well-developed. They include electric vehicles, charging (batteries), and commerce, which form the foundation for ongoing research in the field.

**Niche Themes**: Topics such as electric vehicle technology adoption and sustainability are highly developed but more specialized, focusing on specific areas of interest within the broader field.

**Declining Themes**: These themes, such as vehicle-to-grid, electric power transmission networks, and lithium-ion batteries, show lower development and centrality. They may be considered either emerging or declining areas of research interest.

*Figure 9. Show the keywords analysis*

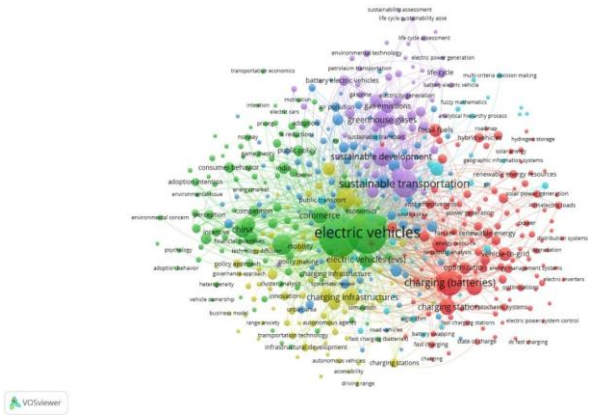



Figure 9, shows a network visualization generated using VOSviewer, showing a keyword co- occurrence analysis related to electric vehicles (EVs) and sustainable transportation. The nodes represent keywords or topics, and their sizes indicate the frequency of their occurrence. The proximity and connections between the nodes show the co-occurrence relationships, with closely linked terms having stronger connections. Electric vehicles, or EVs, are the network's focal point, with closely related topics such as sustainable transportation, charging infrastructure, and renewable energy resources. These are the most significant areas of focus in the research. Other prominent terms include greenhouse gases, charging (batteries), public policy, and consumer behavior, indicating key areas of interest in the development and adoption of EV technologies. The network visualization consists of five clusters, each representing a different thematic area. Clusters are as follows-

Green Cluster (Bottom left): Focus on Consumer Behavior, Adoption Intention, and Policy

This cluster explores the behavioral and social aspects of the adoption of electric vehicles (EVs), emphasizing the critical roles that regulatory frameworks and consumer behavior play. It encompasses key topics such as incentives, consumer behavior, adoption intentions, and the formulation of policy strategies. The central insight is the investigation of how government policies, financial incentives, and public perceptions shape the demand for EVs. The cluster further explores market dynamics in countries like China and Norway, where policy initiatives have had a profound impact on EV adoption. This analysis emphasizes that successful EV diffusion hinges on understanding consumer behavior and aligning policies to encourage adoption through strategic incentives and regulations.

Red Cluster (Bottom right): Focus on Charging Infrastructure and Renewable Energy Integration

This cluster centers on the infrastructure and technological challenges associated with electric vehicle (EV) adoption, with particular emphasis on the addition of renewable energy sources and charging infrastructure. Core topics include charging station networks, vehicle-to-grid (V2G) technologies, solar energy utilization, and optimization methodologies. The insight here is that the transition to EVs is closely tied to advancements in energy infrastructure, requiring seamless integration of charging technologies with renewable energy sources. This cluster highlights the necessity for robust charging networks and efficient energy management systems to ensure that EV charging aligns with renewable energy generation and grid optimization efforts.

Blue Cluster (Middle top-right): Focus on Sustainable Development and Environmental Impact

This cluster focuses on the advantages of electric vehicles for the environment, particularly the decrease in air pollution and greenhouse gas emissions. Key terms include air pollution, fossil fuels, greenhouse gasses, and sustainable transportation. This cluster's insights highlight how important EVs are to attaining sustainable transportation options and advancing global climate goals. EV adoption is growing in tandem with broader sustainability agendas that aim to reduce the transportation sector's carbon footprint. By moving away from fossil fuels, EVs offer tremendous potential for mitigating environmental damage.

Purple Cluster (Top center-right): Focus on Life Cycle Assessment and Sustainability Evaluation

This cluster uses a life cycle assessment (LCA) method to look into how electric vehicles affect the environment over the long run. It encompasses keywords such as life cycle, environmental technology, sustainability assessment, and multi-criteria decision-making. The insight provided by this group is a comprehensive evaluation of the sustainability of EVs from production to disposal. By adopting a life cycle perspective, this cluster explores the environmental trade- offs associated with manufacturing, battery production, usage, and end-of-life disposal. This holistic analysis helps in understanding the true environmental impact of EVs and identifies areas for improvement in their sustainability performance.

Yellow Cluster (Center-left): Focus on Innovation and Technology Diffusion

The Yellow Cluster discusses the EV industry's use of innovation and technology diffusion, with a strong focus on emerging technologies and consumer challenges. Key topics include business models, range anxiety, autonomous vehicles, and mobility solutions. The insight from this cluster highlights how technological advancements, such as autonomous driving and innovative business models like battery swapping, are shaping the future of electric mobility. Moreover, it touches on psychological barriers like range anxiety, which influence consumer adoption of EVs. This cluster emphasizes the importance of addressing both technological advancements and behavioral factors to

accelerate EV market penetration and overcome consumer hesitancy.

## CONCLUSION

Research on electric vehicles (EVs) from 1996 to 2024 was bibliometrically analysed, which offers important insights into the development and expansion of this crucial field. Over the years, the expansion of EV research has been closely linked with advancements in technology, global efforts to combat climate change, and policy initiatives aimed at reducing greenhouse gas emissions. This study has successfully mapped the key trends, influential contributors, and emerging research themes, providing an extensive knowledge of the condition and potential future directions of the field. The analysis reveals a clear trajectory of increasing research activity, particularly in the last decade. Between 1996 and 2009, research output remained minimal, reflecting the nascent stage of EV development. However, starting in 2010, the number of publications began to grow steadily, with a sharp surge in output observed from 2020 onwards. This expansion is consistent with advances in technology, renewable energy legislation initiatives, and growing public awareness of the negative environmental effects of automobiles with internal combustion engines. The peak in 2023, with approximately 250 articles published, suggests heightened interest in the field due to ongoing global initiatives like the Paris Agreement and national policies encouraging electromobility. The bibliometric findings indicate that the United States and China play a prominent role in electric vehicle research, contributing a substantial proportion of the overall scholarly output in this domain. Their prominence can be attributed to large-scale investments in EV technology and infrastructure, as well as government policies aimed at reducing carbon emissions. Other countries, including India, the United Kingdom, and Australia, have also shown steady contributions, with noticeable growth post-2020, reflecting their growing focus on sustainable transportation solutions. The findings of bibliometric analysis suggest several areas for future research. First, while the environmental benefits of EVs are well-established, further studies are needed to explore the long-term sustainability of EV technologies, particularly in terms of battery production, recycling, and energy consumption during the vehicle's life cycle. Second, research on charging infrastructure needs to continue evolving, with a focus on integrating EVs with smart grids and renewable energy systems to maximize efficiency and minimize environmental impact. Third, consumer behaviour studies should delve deeper into the psychological and socio-economic factors influencing EV adoption, particularly in emerging markets where EV penetration is still low.

Finally, as EV technology continues to advance, research should also concentrate on business strategies and regulatory frameworks that can facilitate the widespread use of electric vehicles. This study also reveals a relative scarcity of research dedicated specifically to commercial electric vehicles, underscoring the need for further academic study in this area to support the sector's growth and innovation. Governments, industry stakeholders, and academic institutions must collaborate to address the technical, economic, and policy challenges that remain.

There are certain limitations to this study, chief among them being its dependence on the Scopus database, which prevents it from incorporating important research from other sources such as Web of Science and Google Scholar. Significant contributions in other languages are missed because this analysis is limited to English-language publications. The emphasis on journal articles leaves out important conference papers, patents, and reports in the rapidly developing field of electric vehicles..

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