

Bibliometric Analysis of Green Investment in Electric Vehicles

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ABSTRACT

The present study conducts a bibliometric review of scholarly work related to green investment for electric vehicles (EVs). The main objective of the review is to provide an insight into the knowledge base of green investment in EVs in terms of the intellectual structure, theme evolution, and international collaboration. Bibliographic information collected from the Scopus database is analyzed using bibliometric techniques including co-occurrence, co-authorship, co-citation, and density analysis. Results demonstrate that the knowledge base is predominantly organized in three domains, which are: EV technological advancement (focusing on battery system and charging infrastructure development); green investment mechanisms and policy (such as subsidy programs, ESG integration, and corporate governance); and the transition towards sustainability (covering topics of renewable energy systems, such as hydrogen and solar energy). In terms of citation analysis, foundational studies cover the topic of lithium battery recycling, EV infrastructure development, and EV battery system development, whereas recent papers are concerned with system integration, decarbonization approaches, and multi-energy mobility ecosystem.

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1. INTRODUCTION

The shift towards sustainability in transport is now considered an urgent matter due to increasing environmental issues, climate change, and energy security threats. The transport sector plays a considerable role in producing greenhouse gases in the world, thus becoming the object of reduction of carbon emissions [1]–[3]. Electric vehicles (EVs) represent one of the most efficient ways to reach the desired results. There has been an increased interest among governments, international organizations, and private companies in promoting EVs. Thus, there

have been considerable investments made in relation to electric vehicles' technology, production, charging stations, and other infrastructures in recent years [4].

As EV industries have grown rapidly over the last few decades, so has the practice of green investments. Green investments refer to financial investments which are made in projects, technologies, and industries that aid in sustaining the environment and help achieve climate mitigation targets [5]. In the context of EV industries, green investments include investing in battery technology, renewable energy sources, charging

networks, intelligent transport systems, and sustainable manufacturing technologies. The rising importance of ESG criteria among investors has only made it more attractive to make EV investments. Institutional investors, venture capitalists, and even governments see EV industries as an attractive industry sector to invest in [6]–[8].

The increasing significance of green investment in electric cars has attracted much interest from academics in many different fields such as finance, economics, sustainability, environmental management, energy policy, and innovation management. Different issues related to green investments in electric cars have been addressed by researchers such as the performance of the investments, green funding mechanisms, incorporation of ESG considerations, sustainable innovations, battery value chain, consumer adoption, and policies made by the government. Moreover, the introduction of green bonds, sustainable finance models, carbon neutral investments, and climate disclosure rules has offered more research topics on electric car financing [9]–[12].

Besides the rise in the publication count, the intellectual structure of the research in green investments for electric vehicles has changed substantially. Initially, the emphasis in the research was more on the feasibility, environmental impact, and market acceptability of the electric vehicles. Recently, there has been a shift towards sustainable financing, risks of investment, performance in terms of ESG, policies for energy transition, circularity, and carbon neutrality. Issues such as green bonds, climate finance, battery recycling, sustainable value chains, renewable energy integration, and net-zero investing have gained prominence in the research area. These changes indicate global efforts towards the achievement of the targets set by the Paris Agreement and UN Sustainable Development Goals (SDGs), especially SDG 7 (Affordable and Clean Energy), SDG 9 (Industry, Innovation and Infrastructure), SDG 11 (Sustainable Cities and Communities), and SDG 13 (Climate Action) [13].

Taking into account the fast development and growing complexity of the

publications within this sphere, it is necessary to perform an analysis of the existing knowledge structure. In turn, bibliometric analysis is an important tool used for analyzing publications, key authors, countries, organizations, journals, collaboration networks and thematic evolution of a certain research area [14]. It differs from classical literature review by the possibility of determining the trends of intellectual development, hot spots, emerging topics and knowledge gaps using scientific mapping and network visualization tools like VOSviewer and Biblioshiny. For this reason, it is crucial to conduct a bibliometric analysis of green investment in electric vehicles in order to understand how this field has been developing, what its key participants are and what future research areas are.

Although there is an increasing amount of literature on green investments and electric vehicles, the existing body of knowledge is still scattered in multiple disciplines and research angles. Most of the studies consider issues related either to sustainable finance, adoption of EVs, renewable energy integration, or environmental performance but fail to provide an overview of the intellectual structure of the topic in question. In addition, few studies have ever tried to analyze the dynamics of publications, collaboration patterns, most cited authors, top institutions, key research areas, and emerging issues concerning green investments in electric vehicles. Therefore, scholars, politicians, and investors do not have a clear picture of the development of this research area and its potential for further research. This study aims to analyze the global research landscape of green investment in electric vehicles through a comprehensive bibliometric analysis.

2. METHODS

The current study adopts the methodology of bibliometric analysis to investigate scientific literature about green investment in electric vehicles. Bibliometric analysis can be defined as a quantitative approach in research that helps to assess the

publication patterns, research productivity, collaboration, and intellectual structure of a specific field of research [15]. Data was extracted from the Scopus database that is considered one of the largest and most complete abstract and citation databases of peer-reviewed literature. This database was chosen due to its extensive coverage of quality journals, conference papers, and scholarly works within various academic disciplines. A search for articles related to "green investment" and "electric vehicles" was performed based on appropriate keywords. Retrieved articles were saved in CSV format containing bibliographic data such as authors, affiliations, dates of publications, sources, abstracts, citations, and keywords.

This study was done by using VOSviewer, one of the most popular computer programs that are used to generate

bibliometric networks [16]. This software was used to analyze co-word networks, co-author networks, citation patterns, and research themes in the body of literature on green investments in electric vehicles. In this study, three types of visualization techniques were used, including network visualization, overlay visualization, and density visualization. Network visualization was used to find out relationships between different research themes and authors, overlay visualization to investigate changes over time of research themes, and density visualization to find out the most intensively studied areas.

3. RESULTS AND DISCUSSION

3.1 Keyword Co-Occurrence Network

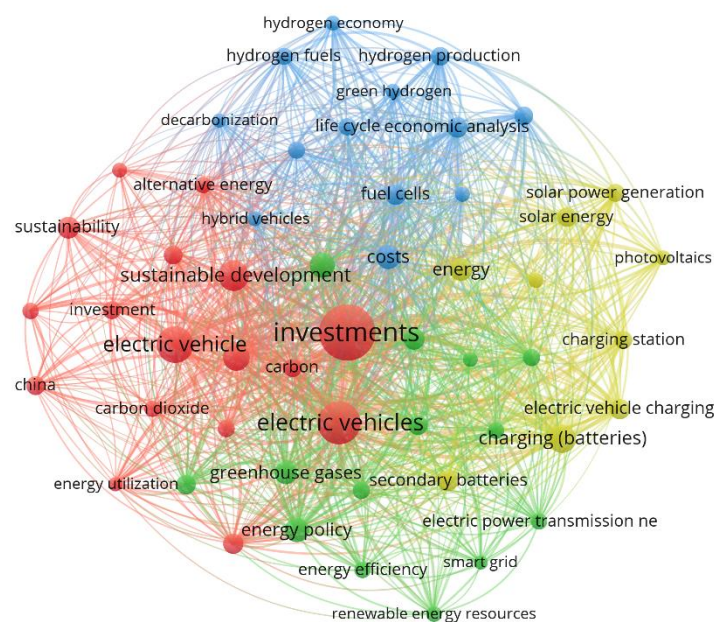


Figure 1. Network Visualization

Source: Data Analysis Result, 2026

The cognitive network of the research in electric vehicles and green investments is shown in Figure 1, where "investments" and "electric vehicles" form the most central nodes of the network. It means that the domain is tightly linked to the convergence point of financial capital management and

technology development of EVs. The high density of the nodes around those concepts implies that the majority of thematic flows in the domain finally lead to the issue of financing, the effectiveness of investments, and the economic viability of the transition to electric mobility.

The cluster to the left with the color red is mostly made up of sustainability issues, including "sustainable development," "investment," "carbon dioxide," and "China." This cluster is the representation of the policy and macroeconomic aspect of the EV research, wherein the emphasis lies on decarbonization policies, investment at the national level, and minimizing the environmental impacts. The inclusion of China into this cluster suggests the significant importance of China as a base of research and a case study for EV adoption and green investment policies.

The cluster that revolves around terms like "electric vehicles", "greenhouse gases", "energy policy" and "secondary batteries" belongs to the technological-environmental integration trend. In this cluster, emphasis is laid on emission reduction, energy efficiency and battery technology, which constitutes an important

infrastructure component for electric vehicles. The link between electric vehicles and reduction of greenhouse gases indicates that one of the major assumptions of literature is that electricity-based transportation is one of the main strategies for addressing climate change.

The blue and yellow groups denote new energy transition paths that complement each other. The blue group is based on the concepts of the hydrogen economy, like "fuel cells," "hydrogen production," and "decarbonization," suggesting that hydrogen technologies are seen as alternatives or complements to electric vehicles. On the other hand, the yellow group is closely related to "solar energy," "photovoltaics," and "charging station." This points to an effort by green investment researchers to extend their focus from vehicles to renewable energy systems, specifically charging stations.

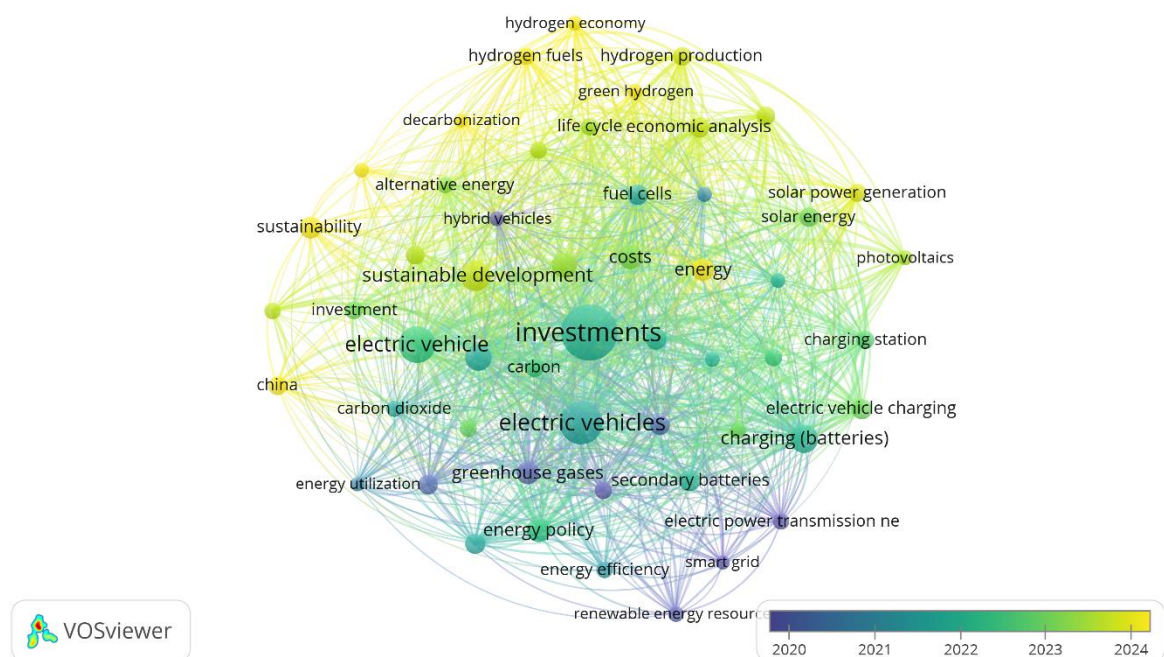


Figure 2. Overlay Visualization

Source: Data Analysis Result, 2026

The overlay graph shows the development over time in research into electric cars and green investments during 2020-2024. The color scale shows the recency of the published material, with darker blue meaning older publications (from around

2020-2021), while yellow marks more recent topics (2023-2024). The center nodes "investments" and "electric vehicles" have been consistently strong during the whole observed period and thus make up the solid core of the topic.

Prior research on the subject (blue-green zones, 2020-2021) revolves mainly around foundational and infrastructural topics, which include “energy policy,” “energy efficiency,” “smart grid,” “renewable energy sources,” and “greenhouse gases.” This implies that the research at hand is currently dealing with system decarbonization, infrastructure transition to a green economy, and environmental justification of electric mobility. At this stage, the literature review is mostly focused on the feasibility of technologies and policies for a low-carbon energy future.

Further developments from the more recent years (yellow zones, 2023-2024) illustrate a visible tendency towards the integration and practical orientation of themes, such as “hydrogen economy,” “green hydrogen,” “solar energy,” “photovoltaics,” “charging stations,” and “life cycle economic analysis.” It suggests that there is a diversification of the area in question towards multi-energy systems and practical aspects of their implementation, especially when it comes to the introduction of renewable energy sources into the infrastructure of EV ecosystems.

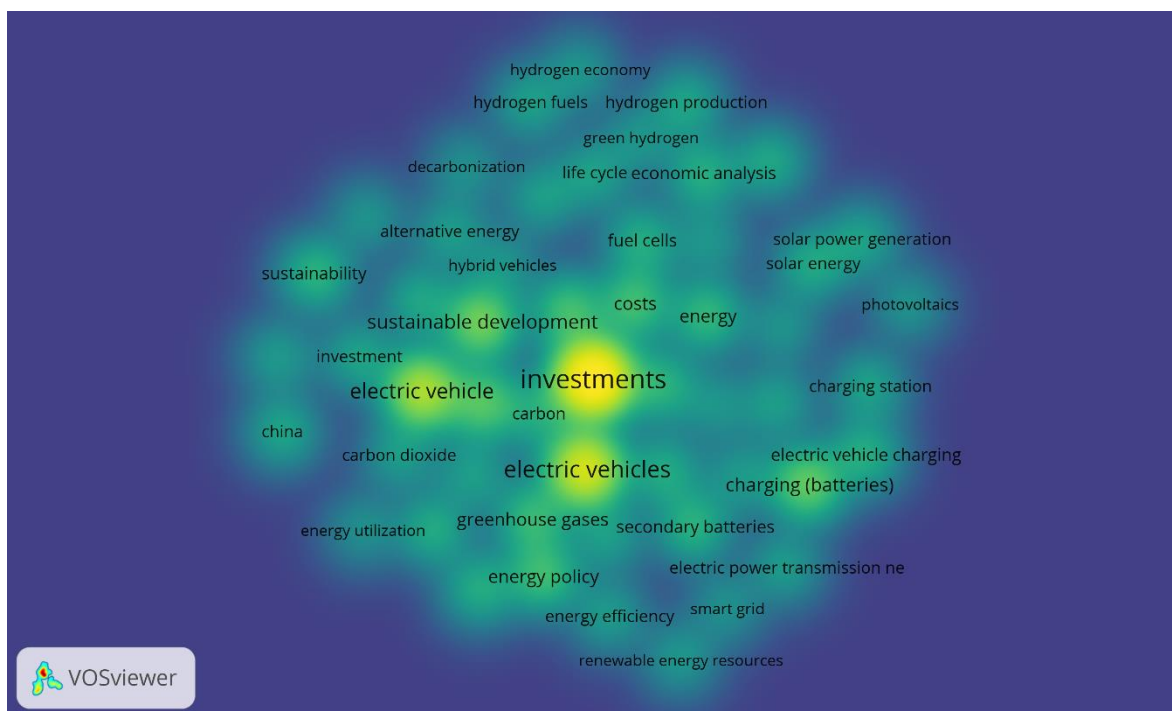


Figure 3. Density Visualization

Source: Data Analysis Result, 2026

The density visualization is meant to capture the intensity of research effort within the knowledge space of the “green investments – electric vehicle.” The brightest spot of the visualization can be found around the concepts of “investments” and “electric vehicles,” which suggests that they are among the most co-occurring terms in the database and hence carry the greatest weight within the knowledge space. Therefore, the topic itself is based on financial resources directed at the creation of EVs and thus has investment as an integrative concept. In turn, surrounding

concepts of “energy,” “sustainable development,” “carbon,” and “electric vehicle charging” can be seen as secondary dense spots. Lower-density peripheral regions (dark blue areas) indicate less frequently explored or more emerging topics, such as “smart grid,” “electric power transmission network,” and parts of “hydrogen economy” and “photovoltaics.” These areas represent expanding but still comparatively fragmented research directions, particularly those involving system integration between EV

infrastructure and renewable energy ecosystems.

3.2 Co-Authorship Analysis

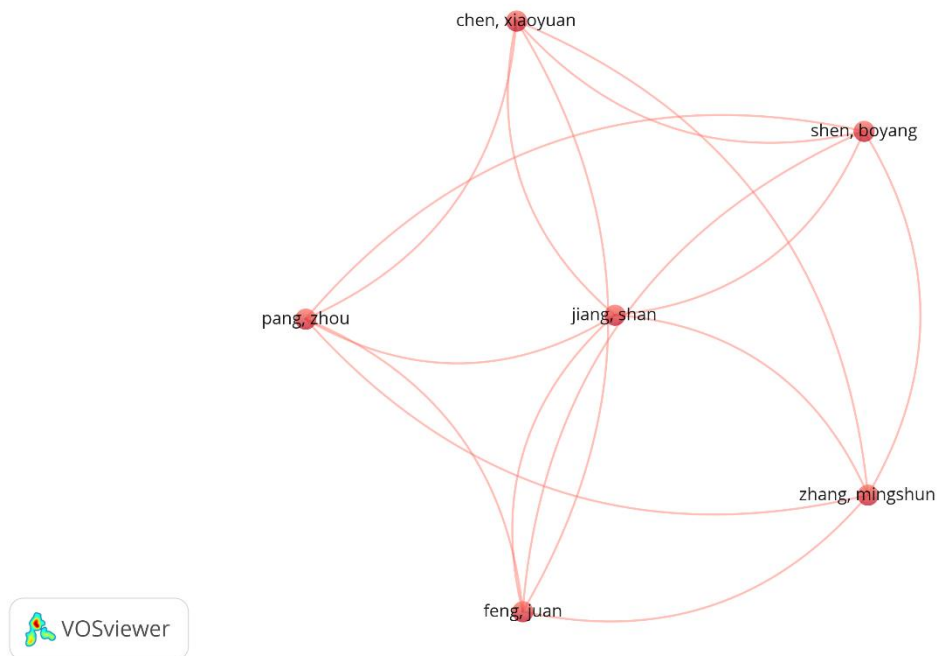


Figure 4. Author Visualization

Source: Data Analysis Result, 2026

From the co-authorship network, there is evidence of a relatively compact team of researchers who work very interlinked in their collaboration network. Jiang Shan emerges as the central actor in this network of collaboration, with his involvement suggesting his importance in the coordination or facilitation of research conducted by all other actors. The centrality of Jiang Shan is indicated by the many connections that he has with Chen Xiaoyuan, Shen Boyang, Zhang Mingshun, Feng Yuan, and Pang Zhou. There seems to be no differentiation of clusters of connections; hence, the research work is generated from one cohesive team of academics.

This structure represents a single collaboration cluster with high cohesiveness and low fragmentation. Such a structure is common for new or specialized research groups because the bulk of their intellectual products is created by the same set of co-authors repeatedly. In addition, the structure implies that knowledge generation in this database is not yet internationalized and dispersed to separate research centers; rather, it involves continuous cooperation of a certain number of researchers, with Jiang Shan being the main connection point in the network.

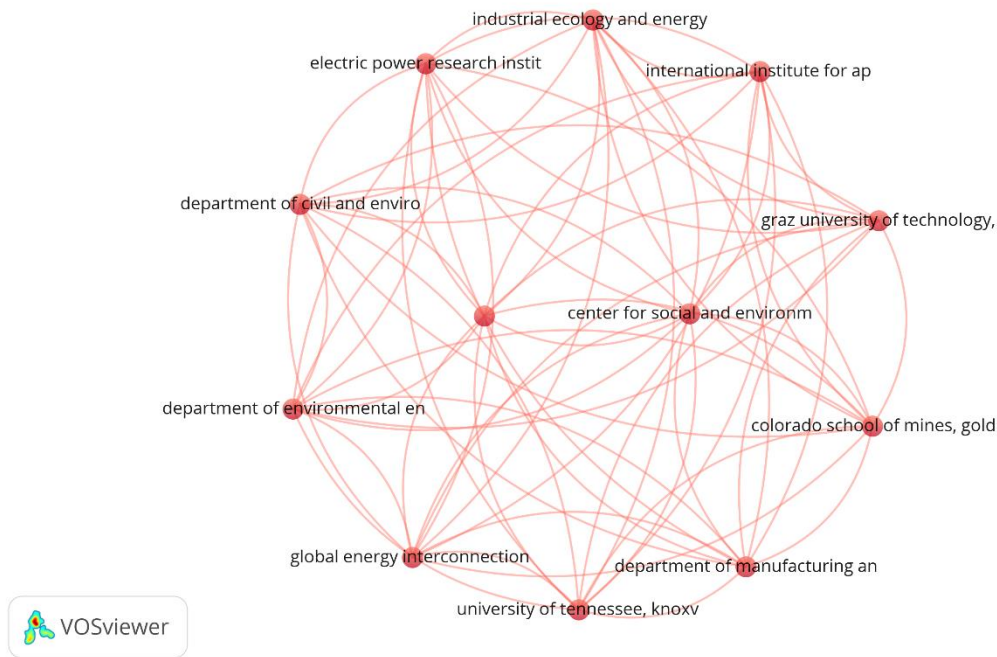


Figure 5. Institution Visualization

Source: Data Analysis Result, 2026

It is an example of the institutional co-authorship network in the field of research, which depicts an extremely well-knit collaboration pattern existing among universities and research institutes. Organizations like the Center for Social and Environmental Systems Research, Global Energy Interconnection, University of Tennessee (Knoxville), and the Colorado School of Mines hold positions relatively closer to the center, implying their high levels of participation and collaboration with others. The presence of such a network signifies the fact that knowledge generation in the field is a collaborative effort rather than an independent one.

Another distinct aspect of this network is the connection between engineering departments (for example,

departments of civil engineering, environmental engineering, and manufacturing engineering) and energy system study institutions such as the Electric Power Research Institute and the Industrial Ecology and Energy Research Centers. It demonstrates the multidisciplinary approach to the research on green investments and electric vehicles since it involves the combination of engineering knowledge with environment and energy systems modeling. The participation of European universities like Graz University of Technology and international research institutes also shows globalization of research cooperation; however, the network seems to be partly based on a few central hubs.

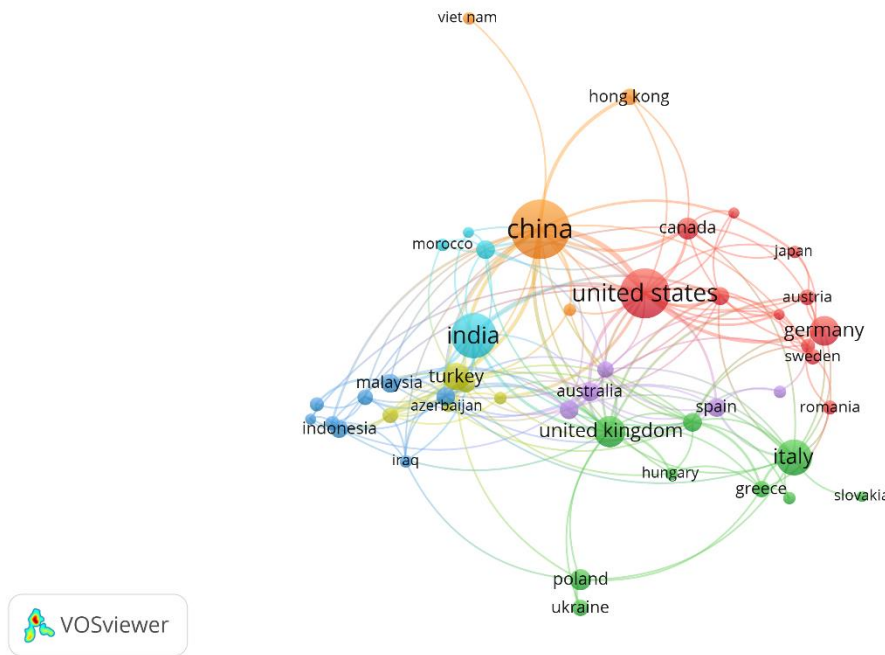


Figure 6. Country Visualization
 Source: Data Analysis Result, 2026

The network map is a country-level co-authorship or collaboration network in the area of electric vehicles and green investment studies, wherein the size of each node denotes prominence while the density of links denotes the intensity of collaboration. The four major nodes in the network include China, the United States, India, and the United Kingdom, wherein China and the United States are considered the two dominating hubs in the network. China is the largest node that indicates the key role of China in producing research output and conducting international collaboration, especially on EV research.

A second layer of important nations is comprised of Germany, Italy, Japan, Canada, and Australia, which have connectivity not

only with the core nations but also with their regional partners. It should be noted that Germany and Italy in particular belong to a dense sub-network within Europe, implying cooperation of research related to sustainable mobility and energy in the framework of EU nations. As for other nations like Japan and Canada, they serve as mediators among Asia, North America, and Europe in this respect. Peripheral countries such as Indonesia, Vietnam, Morocco, Iraq, and several Eastern European states exhibit weaker but still present connections to the main network. These nodes indicate emerging participation in the research field, often through collaborations with dominant countries rather than independent research clusters.

3.3 Citation Analysis

Table 1. Top Cited Research

Citations	Authors and year	Title
1063	[17]	Recovery and recycling of lithium: A review
491	[18]v	Infrastructure planning for electric vehicles with battery swapping
489	[19]	Electric vehicle battery technologies: From present state to future systems
336	[20]	Government subsidy and corporate green innovation - Does board governance play a role?

Citations	Authors and year	Title
213	[21]	A comprehensive analysis of Vehicle to Grid (V2G) systems and scholarly literature on the application of such systems
187	[22]	Electric vehicles in logistics and transportation: A survey on emerging environmental, strategic, and operational challenges
159	[23]	Levelized cost of hydrogen for refueling stations with solar PV and wind in Sweden: On-grid or off-grid?
152	[2]	Reducing transport sector CO2 emissions patterns: Environmental technologies and renewable energy
138	[24]	Governing the electric vehicle transition – Near term interventions to support a green energy economy
132	[25]	Advancing toward sustainability: The emergence of green mining technologies and practices

Source: Scopus, 2026

The cited literature clearly suggests that the intellectual roots of studies carried out in the field of electric vehicles and green investment are strongly embedded in the study of batteries, infrastructures, and energy transition systems. The most cited paper by [17], which revolves around lithium recovery and recycling, demonstrates the importance of battery supply chains and sustainable resources in the context of EVs. In addition, the works of [18] and [19] illustrate the technological issues faced at the initial stage, such as the issue of battery swapping system and advanced battery technologies.

The second set of high citation papers involves system optimization and policy integration in areas such as governmental subsidies, green innovations from firms, and V2G technologies. The works by [26] and [21] demonstrate that there is a trend towards studying how governance and intelligent energy integration affect the scalability and efficiency of EV ecosystems. These papers link the technological aspect to the economic and policy aspects of EV innovation, thus indicating that innovation in the domain of electric vehicles adoption cannot be done without the help of institutions.

The other studies which influence the literature on electric vehicles expand the scope towards logistics, renewable energy utilization, and decarbonization efforts as evidenced by studies on hydrogen refueling, transport carbon dioxide emissions reduction, and eco-mining technologies. The variety of such influences implies that the field has

become a multi-disciplinary system in which the research on electric vehicles is not a stand-alone endeavor.

4. CONCLUSION

This bibliometric analysis of green investments into electric vehicles (EVs) shows a dynamic field which has developed over time into an ever-widening discipline characterized by the presence of three dominant pillars, namely: technological innovation in battery systems, infrastructure, energy integration and sustainable investment frameworks driven by policies. The core of the knowledge base in this literature is heavily grounded in EVs adoption and investment frameworks, where foundational studies have largely focused on lithium extraction, battery technologies and infrastructure investments as key ingredients for the development of EVs technology. Over time, this field has matured from initial engineering-oriented studies into a more complicated analysis involving the involvement of green finance, ESG investments, governmental subsidy policies and smart energy systems like V2G and renewable energy charging systems.

This can also be seen in the findings obtained through the analysis of network and thematic approaches that reveal a definite tendency towards the development of sustainable systems that integrate electricity and mobility and view this phenomenon not as an innovation but as a part of the energy transition system which includes hydrogen

economy, solar energy, and de-carbonization. Collaboration between countries shows a considerable dominance of big economies like

China and the USA together with the increasing involvement of Europe and emerging economies.

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