IN THE FAST LANE: SCIENTOMETRICS AND SYSTEMATIC EXPLORATION OF RISKS IN EV SUPPLY CHAINS

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ABSTRACT

This study conducts a thorough analysis of the EV supply chain using both scientometrics and systematic research techniques, including qualitative as well as quantitative data in response to the increasing need for EVs and the consequent likelihood of shortages of essential supplies vital for EV batteries and electronic parts. The main goals are to find developing patterns for further research and important turning points that endanger the supply chain and require concentrated attention. The bibliometric analysis, which was made possible by the Bibliometrix program, highlights the importance of electric car costs and highlights common themes in research on transparency in supply chains and sustainability. Although there appears to have been little research on managing risks in the supply chain using analysis of keywords, the PRISMA technique systematic literature review finds it to be the most researched topic. Notably, economic analysis and environmental impact assessment come in second and third, respectively, with raw material supply emerging as the main concern. A few researches look at environmentally friendly methods and try to make them more competitive. Although the battery has been the subject of the most research, this only serves to highlight the need for further investigation into other components in order to improve competitiveness in relation to traditional vehicles.

Keywords: Electric Vehicle (EV), Scientometrics, Sustainability, Carbon emission.

INTRODUCTION

The engines and battery of hybrid electric vehicles are powered by a combination of combustion of fuel and electricity (Alabi et al., 2020). Hybrid cars—whether they plug in or not—offer a practical alternative for reducing emissions as they use biofuels and power from renewable energies. The Indian electric vehicle (EV) car market is rapidly expanding, driven by government incentives, increasing fuel prices, and growing environmental consciousness. While still in its early stages compared to global counterparts, the Indian EV landscape is evolving and competitive, offering diverse options to suit various needs and budgets. Notable models include the Tata Nexon EV, a best-selling compact SUV known for its range, performance, and affordability, the entry-level Tata Tiago EV with low running costs, the premium MG ZS EV featuring an extended range and modern interior, the newly launched Mahindra XUV400 offering a spacious cabin and advanced safety features, and the stylish Hyundai Kona Electric known for its long range. Looking ahead, upcoming models like the sleek Kia EV6, value-driven

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BYD Atto 3, competitive MG Comet EV, and affordable Citroen eC3 electric hatchback aim to further diversify the market and cater to a broader range of consumers.

Despite the positive impact of this growth on emissions reduction, there is an environmental concern associated with various electric vehicle supply chains, primarily stemming from battery production (Alabi et al., 2020). These elements include cobalt, lithium, and nickel. Lithium-ion batteries are a common component of gadgets and electric cars. Focusing on natural resource supply, optimizing the supply chain, and the reuse of essential chemical substances becomes key in addressing pollution and input demand and preventing faulty disposal in the surroundings (Alabi et al., 2022).

This study examines the EV sector using a combination of systematic and bibliometric reviews. Indicators like journal volume and keyword occurrences are used in bibliometric reviews to assess published research and identify developments in the field. While providing valuable insights, this approach has limitations, including indicator selection bias and the need for a comprehensive database (Alamerew and Brissaud, 2020). On the other hand, a systematic review qualitatively analyzes existing studies, aiding in the identification and selection of relevant research for content analysis. However, systematic reviews have limitations related to the clarity of reports and variations in research quality.

The integration of both review types in this work allows for a comprehensive analysis of studied aspects and methodologies. By comparing the conclusions from quantitative and qualitative perspectives, the study aims to demonstrate the diverse insights that can be gained when approaching the analysis of electric vehicle supply chains from different angles (Betancourt-Torcat et al., 2021).

In order to supplement the methodical assessment and answer certain questions, the PRISMA approach was utilized to examine and define the study's focus. Choosing the subject of the study and source during the identification phase makes it possible to include documents from a variety of sources. Exclusion and inclusion criteria are clearly stated during the screening stage, guaranteeing focused and accurate search results. As we go on to the eligibility step, a subset of the previously assessed papers are carefully examined, and any that are rejected are supported by comments and arguments. Lastly, papers that satisfy the predetermined criteria are incorporated into the Included phase, which serves as the foundation for the meta-analysis (Bhuyan et al., 2022).

In the context of the bibliometric review, the primary focus centered on evaluating the availability of components within electric vehicle batteries. This assessment becomes pivotal as concerns regarding emissions mitigation drive the increased the penetration of EVs and its supply chain management. Furthermore, recent bibliometric works have extended their analysis to encompass charging methods, incorporating theoretical studies and the application of enhancements in charging stations (Luo et al., 2023). These initiatives help to advance our knowledge of how environmentalism and technology for electric vehicles are developing.

A number of current research on electric vehicles were subjected to the systematic examination, with an emphasis on batteries and the corresponding energy needs (Asgarian et al., 2023). Among the recommendations, one that stands out is the critical necessity of strengthening smart contract cybersecurity while carefully weighing the expenses related to their adoption and implementation. An additional comprehensive analysis examined the unified energy transport and distribution network, focusing on the infrastructure for charging electric vehicles (Alabi et al., 2022). The research's weaknesses highlighted the importance of adopting a variety of charging techniques in addition to relying solely on rapid charging.

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On the other hand, a significant obstacle was found in the latest PRISMA study carried out in a research investigation on adoption of EVs. Examined studies lacked sufficient details, hindering the understanding of the evidence needed for study replication and the development of facilitators in the field (Mathew et al., 2023). This underscores the importance of transparent reporting and comprehensive documentation in research to ensure the reproducibility of studies and facilitate advancements in the domain of battery electric vehicles.

Research employing the PRISMA method has been observed across diverse fields of study. For instance, in the realm of energy management problem-solving, studies have utilized the PRISMA method to inform decision-makers' plans, leveraging multi-criteria decision-making methodologies (Nguyen-Tien et al., 2022; Kumar et al., 2023). The researchers of (Moher et al., (2009) performed a thorough examination of the cutting-edge in clean energy production using diverse waste materials, incorporating bibliometric and systemic reviews. This study is another noteworthy example of the PRISMA technique in action.

In the current study, it uses systematic reviews, and bibliometric analysis with a particular focus on the supply chain industry for battery-powered cars to pinpoint the industry's advantages and disadvantages. To fill this vacuum, the current study uses combined bibliometric and systematic reviews to assess the modern facilities in supply chain management for battery-powered cars and trucks. This all-inclusive strategy uses a combination of the PRISMA technique for qualitative evaluation and the Bibliometrix program for statistical analysis. Finding crucial locations that pose supply chain hazards and deserving of concentrated attention, as well as identifying new trends for further research, are the main goals. The analysis also takes into account how this worldwide event would affect the supply chain for electric vehicles.

LITERATURE REVIEW

The authors address the environmental impact of urban delivery systems, highlighting the detrimental effects of the transport sector's greenhouse gas emissions, especially in perishable food transportation. Presently, high energy consumption hinders full-electric solutions. Their work introduces new refrigeration system HPRS for short-distance food transport, emphasizing cost efficiency, increased autonomy, and reduced environmental impact. Experimental validation demonstrates over 4 hours of autonomy, fuel savings exceeding 10%, and avoidance of 3650 kg of CO2 emissions annually. Shi et al. (2023) looked into what influences Chinese citizens' desire to recycle the batteries from electric vehicles. The results, which are based on an agent-based model and a structural equation model, show that recycling intention is most affected by perceived behaviour control, which is followed by self-identity, economic incentive, and subjective norm. There are offered useful recommendations for government action. The researchers in (Asgarian et al., 2023) examine how government initiatives affect the development of electric cars and environmentally friendly modes of transport in Norway while taking the removal of subsidies related to fossil fuels into account. Using game theory and the Stackelberg method, the study proposes optimal decisions for the government to attract EV customers, increase EV range, and enhance profits for EV and battery manufacturers. The authors (López and Fernández, 2020) present an electrochemical method for recovering lithium from brine, regenerated lithium-ion battery cathode materials. The study explores the effects of various parameters on lithium extraction and highlights the material's potential, offering an environmentally friendly and economical approach to lithium recovery. The authors (Li & Taghizadeh-Hesary, 2022) propose a blockchain token incentive mechanism for recycling retired power batteries, addressing challenges in traditional recycling models. Their study, grounded in

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design science research, demonstrates the efficacy of the token incentive model in curbing unqualified recyclers, despite increased costs for manufacturers, offering substantial social benefits. With an emphasis on electronic products, the researchers (Ma et al., 2022) perform a survey in Malaysia on public activities and intentions about disposing of, collecting, and reuse of batteries. Findings reveal a lack of recycling awareness and knowledge, emphasizing the need for improved education, infrastructure, and policies to establish an effective circular economy for LIBs. The effect of legislation on power battery recycling in the electric car industry is examined by the authors (Yu et al., 2021). After evaluating seven recycling models in a supply chain with closed loops, they conclude that policies based on subsidies—especially those that maintain capacity—perform best in terms of economic profitability and consumer surplus. Deposit-refund policies alleviate government financial pressure, and reward-penalty mechanisms enhance recycling rates under specific intensities. Alliance recycling models show potential for maximizing social welfare. The authors (Li et al., 2023) investigate regional disparities in EV sale. Utilizing a GRA-DWT-BiLSTM model, they analyze EV market penetration, revealing higher growth rates in demand-side scenarios by 2027. Under ideal conditions, EV penetration is projected to reach 27.31%, 42.40%, and 52.97% in 2025, 2030, and 2035, respectively. The authors (Wang et al., 2022) employ multi-criteria and time series analyses to compare performance of BRICS and G7 countries. Assessing indicators like energy intensity and renewable resource use, they find BRICS excelling in the future due to emphasis on renewables, while G7 outperformed in the base year, prioritizing energy intensity. The authors (Zhang et al., 2023) present framework for efficient and sustainable recycling of power battery. Addressing challenges like disorganization and low trust in the supply chain, the proposed system employs a four-layer blockchain platform. Experimental validation demonstrates the double-chain structure's effectiveness, offering decentralized data management and anti-counterfeiting traceability. The researchers in (Daryabari et al., 2021) evaluate the effects of moving to electric cars and an economy that is net-zero on automobile supply chains using a framework that combines systemic thinking, theory of stakeholders, and the concept of the circular economy. Considering various stakeholders and vehicle types, the study underscores the need for a circular economy to mitigate negative effects on employment while generating new business opportunities. The authors (Hache et al., 2019) provide a model that uses electric vehicles (EVs) to optimize multi-period manufacturing scheduling in a supply chain. The paper suggests a novel mixed-integer linear mathematical model that takes energy usage, traffic conditions, and journey time fluctuations into account. In order to solve real-case dimension problems, hybrid metaheuristic techniques are used, which advances the growing discipline of sustainable supply chain management. The researchers in (Gent et al., 2022) suggest BitCO2, a technique for market-driven reductions in carbon emissions in order to encourage personal consumption decisions and fight climate change. Developed in the private transport industry in Italy, the model offers savings on insurance coverage and uses BitCO2 tokens to incentivize the use of Battery Electric Vehicles (BEVs) by encouraging reduced carbon emissions. In Nepal, the researchers (Jing et al., 2021) carry out a Comparative Life Cycle Assessment, also known as an LCA, of fuel cell electric cars (FCEV), EV powered with battery (BEV), and internal combustion vehicle (ICEV). Results reveal lower greenhouse gas emissions for BEV and FCEV with surplus electricity, emphasizing the environmental benefits and potential of these alternative technologies. The authors (Li et al., 2023)) assess supply chain of cobalt, crucial for new energy materials, under electric vehicle (EV) impact and geopolitical risks. Using a system dynamics model, the study explores resilience mechanisms, revealing lower resilience due to EV demand

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and geopolitical risks. Recycling technology, inventory, and material substitution enhance resilience. The authors (Mohammadzadeh et al., 2021) analyze EV based on Li-battery network. They identify hidden disruption risks, emphasizing the hub-and-spoke structure's robust yet fragile nature, assisting firms in coping with disruption ripple effects. The authors (Franzò and Nasca, 2021) challenge the assumption of reducing cobalt in lithium-ion batteries, highlighting its essential role in achieving higher energy densities without compromising performance or safety. They predict continued cobalt use in nickel-based EV batteries, driven by techno-economic factors. The authors (Reuss et al., 2019) explore business processes contributing to material circularity in EV battery production. Using a case study, they model material circularity, providing guidance for companies. Results show that material circularity is improved when end-of-life techniques are integrated with closed-loop production. The choice of recycling mode and choices made about GHG emissions in a closed-loop battery powered EVs policy are examined by the authors (Zhang et al., 2022). The impact of competitiveness, carbon trading price, and low-carbon awareness on the total amount of recycled materials is revealed by the proposal of four recycling options. The authors (Mu et al., 2023) take economic, environmental, and geographical aspects into account when optimizing the geographic configuration of a potential Li-ion battery recycling sector in the UK. The analysis offers a comprehensive perspective, taking into account topographical, logistical, and transportation factors to determine the best sites for facilities.

RESEARCH METHODOLOGY

The methodology employed for the analysis in this study involved accessing documents from SCOPUS with a specific search string: “TITLE-ABS-KEY” (("electric vehicle*") “AND” ("supply chain" “OR” "supply chain management" OR "supply chain risk management" OR "supply chain resilience")). Following a comparison of results with the Scopus database was selected as the database of choice. Being one of the most extensive databases in this particular field and containing papers that appear in indexed journals with high impact factors, Scopus stands out for its significance.

The initial search string yielded a total of 755 documents. To refine the dataset, boundary conditions were applied to include papers in English, during 2002 and 2023, identified as ensuring full accessibility to the content without restrictions. This meticulous filtering process resulted in selection of 483 articles. Further refinement with boundary conditions like journal articles only, no conference papers, short survey or editorial work, the final selection of articles for bibliometric analysis come out to be 468 articles. Further meticulous scrutiny resulted in 60 articles for systematic review.

The present investigation involved the simultaneous execution of both systematic and bibliometric reviews. To offer a more comprehensive and nuanced examination of the supply chain management within the electric car industry, this dual method was chosen. The study sought to provide a thorough understanding of the structure of the electric automobile supply network by combining these two review techniques.

Scientometrics Analysis

The scientometrics analysis conducted in this study serves the purpose of quantifying published studies within the realm of electric vehicle supply chain management. By defining present understanding, identifying novel developments, and providing insightful information to

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academics and government organizations, this strategy seeks to direct the course of upcoming investigations and processes for making decisions. The Bibliometrix program enabled a thorough mapping of the main themes and patterns seen in research pertaining to supply chain management for electric vehicles, hence facilitating the bibliometric analysis in this study (Turner et al., 2018).

Six crucial variables were chosen to provide light on cooperation patterns, subjects, and help choose journals for additional research. These indicators are frequently used in bibliometric review studies. These included: (a) international collaborations, Engels et al., (2022) (b) authors' keywords co-occurring Engels et al., (2022), (c) annual publications (Demartini et al., (2023) (d) articles by nation (Engels et al., (2022), (e) journal impact factor (Gu et al., 2018), and areas of study (Golinucci et al., 2023).

Cooperation between Nations

The parameter focusing on partnerships between countries endeavours to pinpoint tangible global connections and suggest potential collaborations among countries that may not have existing partnerships but hold promise for exploring or implementing processes, systems, or products Guohua et al., (2023) Figures 1-9.

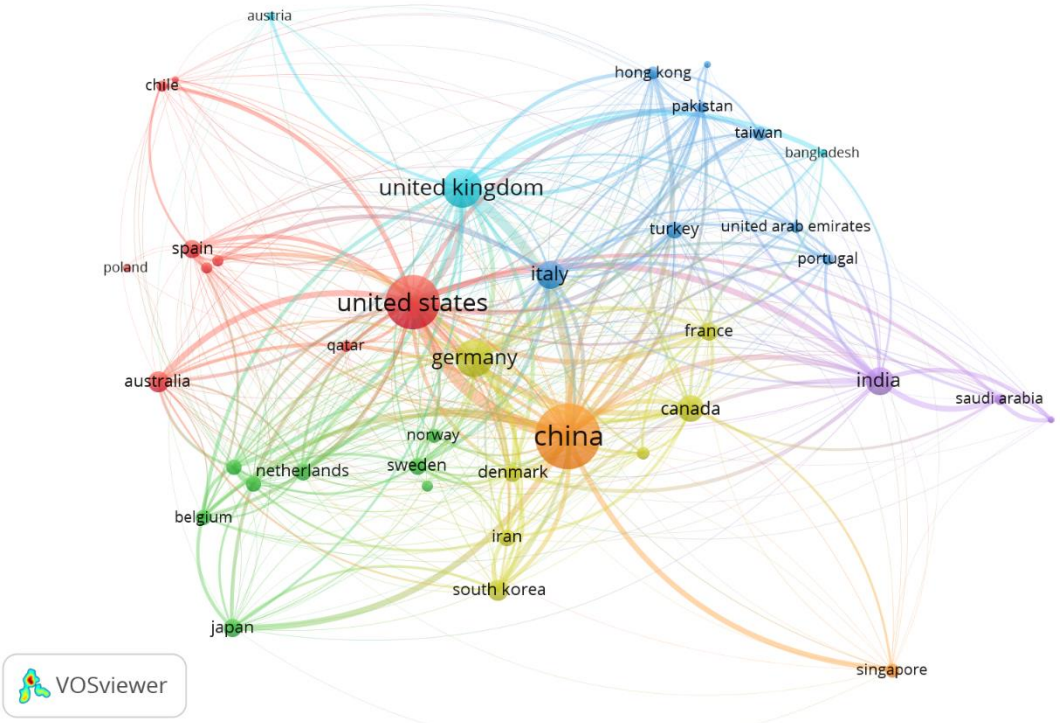

FIGURE 1
COOPERATION BETWEEN NATIONS (AUTHOR'S CREATION)

This assessment delves into both established and absent connections, identifying strong or nascent links while also proposing new collaborations. This nuanced exploration of global partnerships provides insights into shared interests and lays the groundwork for fostering international collaboration in the domain of electric vehicle supply chain management. The VOSviewer map offers a visual representation of the global landscape. Each node on the map

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corresponds to a country, and its size is indicative of the number of research papers published by that country. The edges between nodes illustrate co-authorship relationships, with warmer colours denoting stronger collaborations. Austria, Belgium, Canada, China, Denmark, France, Germany, Hong Kong, India, Iran, Italy, Japan, Netherlands, Norway, Pakistan, Poland, Portugal, Qatar, Saudi Arabia, Singapore, South Korea, Spain, Sweden, Taiwan, Turkey, United Arab Emirates, United Kingdom, and the United States are notable nations in this field. Strong co-authorship relationships are shown on the globe between important countries, including the US with Canada, the UK, Germany, and France; China with South Korea, Japan, and Taiwan; and India with Australia, the US, and the UK.

Analysis of Keywords

The examination of authors' keywords or those supplied by the database is frequently crucial for identifying patterns and gaps in the literature (Hajiaghaei-Keshteli et al.,2023). Interestingly, these are called "Keyword Plus" in Scopus but are referred to as "Index Keyword" in Scopus. Their distinctiveness is what sets the two apart from each other. Keywords from databases are typically more inclusive, including terms that are taken from referenced sources but aren't stated directly in the paper Ilankoon et al., (2022). This inclusiveness may arise when a reference is used merely for contextualization rather than addressing the main topic in the article, leading to potential inconsistencies in the retrieved keyword concerning the sought-after subject.

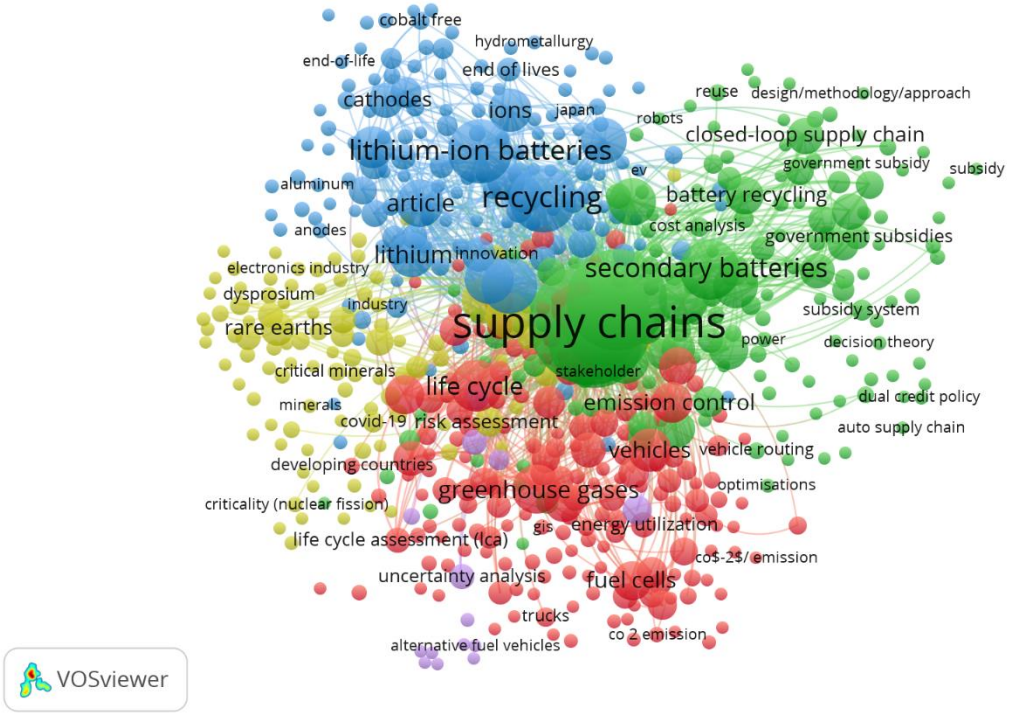

FIGURE 2
ALL KEYWORD CO-OCCURRENCE (AUTHOR'S CREATION WITH VOSVIEWER)

Author-added keywords, on the other hand, are meant to provide a more detailed description of the subject. This purposeful inclusion makes it easier to analyze the literature in greater detail and with greater nuance. In order to gain insight into the complexities in electric

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vehicles management, the current study focused on analyzing the keywords used by the authors. This allowed for a comprehensive investigation of the particular subtleties and subjects that the writers highlighted in their research. The intricate architecture of the electric automobile supply chain is shown on the VOSviewer map, which also shows the links between the various parts and operations.

Annual Publications

An essential component of studying trends and result explanation is analyzing the quantity of papers published in a certain period of time Hajiaghaei-Keshteli et al., (2023). The publication graph reveals important phenomena in addition to quantifying the production across time.

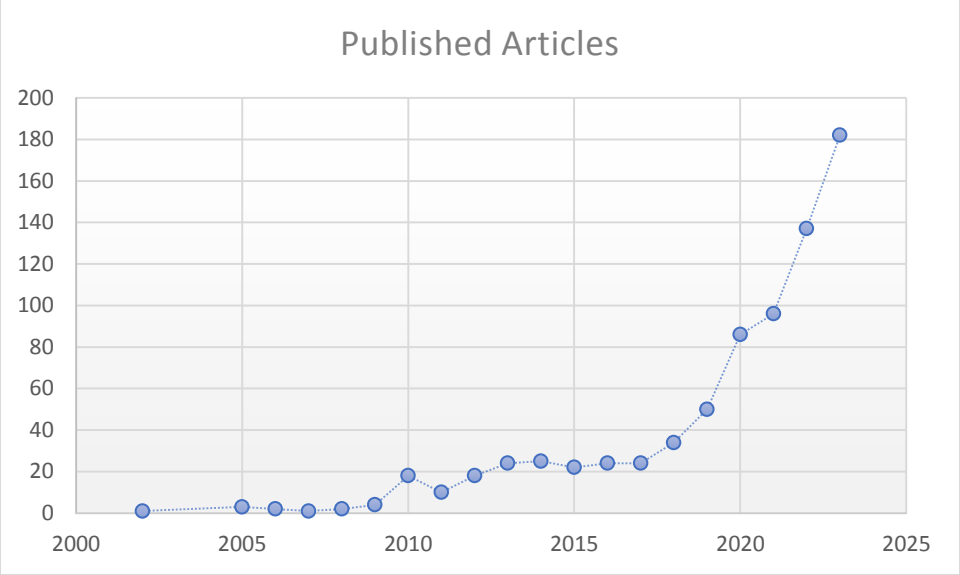

FIGURE 3
PUBLICATION TREND (AUTHOR'S CREATION)

Tracing the timeline of publications helps unveil the pivotal moments that sparked research exploration in the electric vehicle supply chain realm, offering insights into its evolutionary journey.

Publications by Country

Assessing the volume of publications on a national basis provides valuable insights into a country's interest in specific subjects (Ilankoon et al., 2022). This indicator enables the identification of whether a country is inclined towards advancing local development or focusing on exporting optimized products or services.

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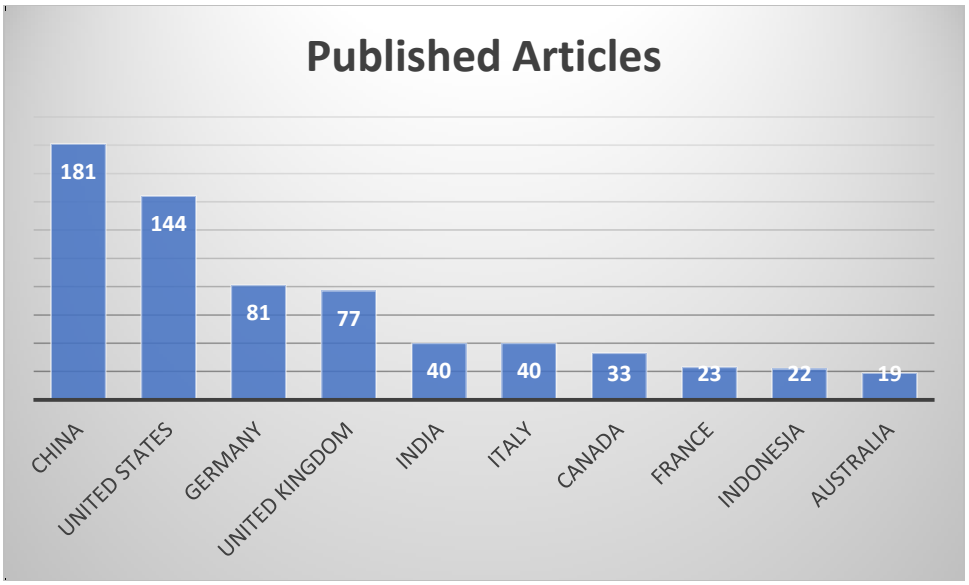

FIGURE 4
TOP TEN COUNTRIES (AUTHOR'S CREATION)

Understanding the geographic distribution of research output contributes to a nuanced comprehension of global interests and priorities in the electric automobile supply chain.

Journal Impact Factor

Finding journals with a high impact factor is essential to figuring out which publications will have the greatest influence on the suggested subject (Hajiaghaei-Keshteli et al., 2023; Ilankoon et al., 2022). This insight aids researchers in selecting appropriate journals for future work, optimizing the publication timeline. Aligning articles with the scope of chosen journals contributes to expediting the publication process, addressing one of the key factors contributing to delays in dissemination.

Research Subjects

This indicator takes into account the various research foci based on the study's emphasis, since each published paper may cover several different research topics Hajiaghaei-Keshteli et al., (2023). By highlighting emerging fields of study or unexplored opportunities, the goal is to inspire prospective research and provide insightful guidance for scientists about the supply chain environment for electric vehicles.

A Methodical Examination

The study's systematic literature review, in addition to the bibliometric evaluation, attempts to offer qualitative perspectives into previously published research by providing a thorough and targeted investigation of literature gaps. To guarantee openness of assessment procedure, the PRISMA meta-analysis approach was used (Jing et al., 2021). Using information taken from the chosen documents, a thorough table was created that made it possible to determine the main points of the most relevant research on the supply chain for electric vehicles and how they added to the body of knowledge already in existence (Zhang et al., 2022). The

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PRISMA process unfolds in four separate phases. During the "Identification" stage, the results of a search of the Scopus database using a particular search term intended to obtain research about EVs are displayed. The results of this first search were 755 documents. The documents were filtered for examination using a variety of exclusion criteria as we moved on to the "Screening" phase. Only articles were considered, and an English language filter was applied, given the prevalence of relevant research in that language. The analysis focused on recent articles, specifically those published between 2002 and 2023. Additionally, only open-access articles were included in the study, resulting in a refined selection of 60 documents. In the "Eligibility" phase, the titles and abstracts of these selected documents were scrutinized to verify their relevance to the researched topic. Some studies were excluded during this phase, as they only superficially mentioned the keyword "supply chain" without a direct correlation to supply chain discussions. Excluded from consideration were studies that examined the energy supply chain for electric vehicles, specifically with regard to gasoline, hydrogen, and renewable electricity sources. Additionally, EV SCM is the main subject of this analysis, studies looking at EVs, such as the food transportation, were disregarded. Furthermore, only citations in the papers were considered, leading to a final selection of 60 publications that satisfied the eligibility requirements.

The total number of articles that qualify for the meta-analysis is displayed in the "Included" phase. Using the same quantitative markers as the bibliometric assessment, specific questions were developed to facilitate a qualitative study of the chosen research. The queries centered on the supply chain procedure that was examined, the particular component being analyzed, the sort of analysis that was performed, and that the pinpointed study was concentrating on. A thorough analysis of EVs SCM from both a qualitative and statistical standpoint is ensured by this integrated methodology.

Findings and Discussions

To provide a thorough examination of each review style, the presentation as well as the findings are put into separate heads. The bibliometric study's findings are firstly provided with the intention of highlighting important details and pointing out gaps in the body of current literature. The conversation then turns to the systematic review, explaining the details of the created flowchart and providing information on the chosen articles. The results of the scientometrics analysis are covered in depth in Sections 3.1–3.6, and the PRISMA meta-analysis is covered in Section 3.7.

International Collaborations

The dynamics of international cooperation are highlighted in Figure 2, which depicts the country collaborations noted in the literature. China stands up as a key player with significant international cooperation. Thanks to its strategic approach, China, the largest manufacturer of high-scale production among emerging nations, can offer competitive prices on the market. In order to stay competitive, China also carefully studies the supply chain and uses techniques like just-in-time solutions to periodically lower production costs. Consequently, these studies serve as valuable resources for decision-makers, offering insights to shape policies and implement cost-reduction strategies in practical applications.

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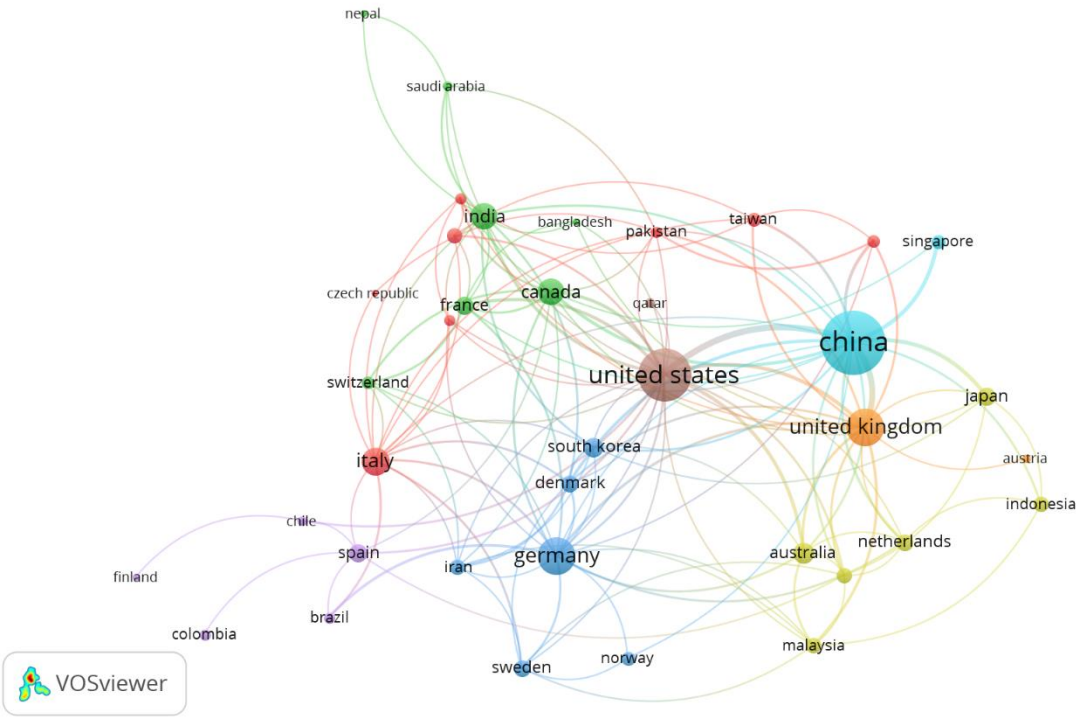

FIGURE 5
CO-AUTHORSHIP BETWEEN COUNTRIES (AUTHOR'S CREATION)

With 63 articles, the United States is the second-largest global collaboration contributor among the countries working with China. Together with cooperative efforts by European Union nations, the United Kingdom and Germany additionally actively produced in partnership with China, producing a total of 33 and 30 publications, respectively. Considering these countries' considerable purchasing power, this trend clearly demonstrates the cooperative relations among countries, motivated by their desire for cheap and mass production of EVs.

India has an opportunity to make an important contribution to lowering the cost of supplies while decreasing the environmental effects related to conventional fuels powered electricity due to its ability to produce renewable energy, especially through solar and wind energy. India boasts a predominantly renewable electricity matrix (Joshi et al., 2022), along with an abundance of minerals, the planet's most significant biodiversity, and a large amount of forest territory.

Keywords Co-Occurrences of the Authors

The analysis of keywords, considering both their frequency and co-occurrence with other terms, was conducted using the Bibliometrix software (Figure 3). This approach facilitated the identification of words with varying degrees of prominence, offering insights into potential gaps and trends within the literature. In Figure 3, it becomes evident that the keyword "circular economy, batteries, closed loop supply chain etc." garners significant attention. These are associated to diverse investigations, such as the assessment of impacts stemming primarily from electric energy consumption and battery production.

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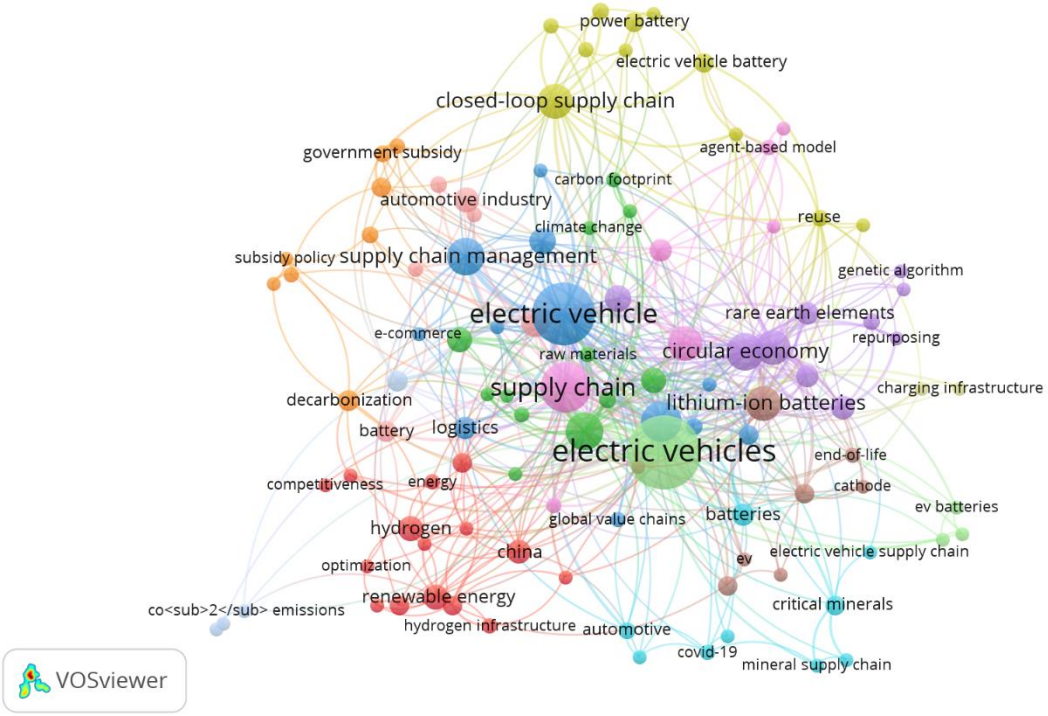

FIGURE 6
AUTHOR'S KEYWORD CO-OCCURRENCE ANALYSIS (AUTHOR'S CREATION)

A notable example from the literature involves the study by (Gu et al., 2018), wherein the authors explored synthetic fuel production chains, including hydrogen and synthetic natural gas, alongside electricity. This study examined emissions of greenhouse gases in the production of energy, both imported and domestic. According to their research, battery-powered automobiles have reduced emissions when other energy demand choices, such as seasonal storage, are taken into account. Yet, the effectiveness of battery-electric vehicles is based on various variables, like carbon footprint and the amount of electricity produced domestically using renewable resources like solar technology.

The keyword "cost analysis" is a recurring theme, reflecting numerous studies that analyze economic feasibility to complement life cycle assessments, particularly in terms of fuel or battery components that might influence overall product costs. For example, in (Lane et al., 2020), the researchers assessed the ownership and operating costs of FCEVs fuelled with green hydrogen, taking into account factors such as the supply chain and levelized cost of hydrogen production.. Factors encompassing emissions, vehicle powertrain, taxes, subsidies, charging infrastructure, and energy cost per kilometre were integral to their comprehensive cost assessment.

More and more recent research is concentrating on lowering the cost of fuel generation and parts for electric vehicles. For example, (Li et al., 2020) conducted a sensitivity analysis to pinpoint the main variables affecting hydrogen costs and forecasted a notable increase in demand

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for hydrogen after 2030. Infrastructure investments will be imperative to meet this growing demand, with feedstock prices identified as a critical determinant affecting hydrogen pricing.

The term "lithium-ion battery" has been a focal point in various studies, particularly those delving into the chemical components like "cobalt" and "lithium." To evaluate cobalt output, authors performed LCA that considered ore quality, the initial extraction, and recycling of Li-batteries (Li and Taghizadeh-Hesary, 2022). According to research, cobalt's high environmental effect until 2050 makes it important to minimize manufacturing of the metal from its ore. In order to mitigate the environmental effects of ore mining operations, improving cobalt recycling rates and efficiency is a viable alternative (Guohua et al., 2021).

Nevertheless, obstacles emerge from the lack of availability and disturbance of vital resources like Ni, Co, and Li, which may obstacles the objective of attaining a quarter of the market for Li batteries in electric vehicles by 2050 (Li et al., 2023). Sustainability issues in the battery supply chain emphasize how crucial it is to generate power from sources that are sustainable in order to successfully slow down global warming (Liu et al., 2022). However, a supply chain that is primarily powered by clean energy raises questions about water usage, land utilization, and human toxicity (Liu et al., 2022). Thus, striking a balance between costs, effects on surroundings, and impact on health of living beings is essential.

The spike in demand for batteries is correlated with a greater need for minerals, which could lead to price differences where nickel is more expensive than copper and cobalt is more expensive (Alabi et al.,2022). By offering subsidies, governments are essential in encouraging recycling industries that are profitable. Knowing how long a battery may be used is essential since it has a direct impact on demand-side management and supply chain dynamics (Liu et al.,2023).

Moreover, the drive toward decarbonization and emission reduction results in increased demand for power in the industry as well as the development of biofuels like hydrogen (Liu et al., 2021). This complex environment emphasizes how important it is to take into account all relevant factors when determining the direction that battery technology and related supply chains should take, including economic viability, environmental effect, and health results.

The keyword "rare-earth elements" shows up significantly in the word cloud shown in Figure 3, which is indicative of the significant attention that these elements have received in recent research. There are end-use applications for each rare-earth element (López and Fernández, 2020). Therefore, to allay fears of shortages, there is an urgent need for expanded supply of such elements—ideally as derivatives of other products such phosphate or bauxite. But for effective implementation, resolving the technical and financial obstacles is still necessary.

A review of current research indicates how often people search for "electric vehicle battery." (Luo et al., 2023) has done SWOT for UK's EVs battery market to evaluate its advantages, disadvantages, opportunities, and threats. The report suggests expanding battery procurement beyond a single nation, particularly lowering dependency on China, and establishing partnerships in third world countries and developed countries stressing ongoing innovation.

It is interesting to see that "supply chain risk" is one of the less popular terms. Manufacturing and marketing disruption in the electric automobile industry led to creative moves toward online sales platforms (Ma et al., 2022). In response to these difficulties, (Mathew et al., 2023) created an integrated logistics model and looked into possible effects on the world's supply chain for electric vehicles. In order to handle possible supply chain interruptions related to the coronavirus pandemic in the electric vehicle industry, this model integrates a supply chain risk management paradigm.

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There are uncertainties into the supply chain of magnetic elements, crucial components in vehicle electronics like neodymium-iron-boron (NdFeB) magnets. A proposed solution by (Moher et al., 2009) focused on reverse resilience, outlining a supply chain and logistics network design that incorporates collection, disassembly, and recycling centers. Meanwhile, the lithium supply chain's complexity, detailed by (Mohammadzadeh et al., 2021), stems from intricate interconnections among its elements. Authors suggested producing lithium hydroxide from lithium carbonate as a strategy to decrease lithium demand.

The supply chain risks for Li-batteries were carefully examined, taking into consideration variables such as political unrest and corruption in the raw material mining industry (Mu et al., 2023). It was investigated whether materials could be substituted without changing the design of the product; nevertheless, due to the scarcity of substitutes, special research on some rare-earth elements was noticed.

The supply chain is at risk due to raw material diversity, as (Murugan, et al., 2022) has shown. The focus of their investigation was on techniques for evaluating supply chain risk in relation to resource efficacy, financial scarcity, and global politics. Critical raw materials, even in small quantities, were deemed significant, and their impact on both production processes and the environment was evaluated. When the need for electric automobiles is modest, concerns were expanded to include the supply of batteries for battery packs or electronic gadgets (Mathew et al.,2023). According to a study on upstream-downstream competitive advantages (Nguyen-Tien et al., 2022), depending on outside variables, an upstream producer of batteries for EVs transacts with downstream producers. This dynamic involved cost considerations as well.

The recurring keyword "recycle" underscored the importance of recycling in various studies. However, the authors noted that incentives are essential for effective recycling, with subsidies to manufacturers proving more impactful than those to consumers (Nuri Cihat et al., 2019). A techno-economic model that was given by (Page et al., 2021)) highlighted the possibility for reusing resources to mitigate emissions and be economically feasible by comparing recycling locations and procedures for cost reduction in a global recycling of batteries economy.

A different strategy for batteries being recycled is to use them for decentralized power system projects. An approach to optimization for a supply chain using end-of-life batteries was presented by authors in (Reuss et al., 2019). This methodology not only optimizes supply chain earnings but also guarantees equitable distribution of profits. In order to improve total supply chain returns, alliances of strategic importance between manufacturers and suppliers—where the manufacturer has negotiating power and suppliers hold—were proposed (Ruedisueli et al., 2022). These alliances would be facilitated by methods such as Nash-bargaining.

The financial advantages of reusing and recycling batteries from electrical vehicles aren't always immediately evident, but they do help to reduce the consumption of raw materials and impact on the environment (Schulz-Moenninghoff et al., 2022). A "closed-loop supply chain," includes everything from manufacturing of a product to its eventual recovery, was covered in (Schulz-Moenninghoff et al., 2022).

According to the study in (Schulz-Moenninghoff et al., 2022), “a closed-loop battery supply chain” showed poorer earnings with retrieval of larger quantities of batteries, even if there was a reduced demand for input materials. It was proposed that government involvement through incentives may boost recycling-related revenues. Moreover, the analysis emphasized that higher recycling rates and lower costs lead to increased profits, emphasizing the requirement of high efficiency of recycling.

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An independent study looked at the profitability that included producer that supplied new batteries and a remanufacturer that was responsible for collecting and reusing old batteries according to return condition (Segura et al., 2023). Results indicated that the remanufacturing decision is more influenced by the price of high-quality returned batteries than low-quality ones. Incentives were deemed necessary to encourage remanufacturing, emphasizing its environmental benefits. Despite the environmental advantages, the manufacturing sector tends to be more profitable than the remanufacturing sector, posing challenges to proposing battery and component recycling initiatives.

Initiatives for recycling might have a close relationship with concepts such as the circular economy (Serohi, 2022). In contrast to closed-loop supply chains, the circular economy promotes using materials at the end of their useful lives and recovering parts through disassembly and selection procedures that would otherwise be thrown away. It significantly contributes robustness and sustainability by lowering demand for mineral components like cobalt. Even though cobalt isn't used very often, its importance can outweigh the need for other elements like nickel (Shahjalal et al., 2022). Recycling 4.0 combines the ideas of Industry 4.0 with the goal of maximizing circular economy tactics. In order to establish an effective reusing network with smart robotics and automated tactics, this entails developing markets that operate as focal points of contact, connecting suppliers and buyers (Serohi, 2022).

As Figure 6 illustrates, there seems to be less focus on sustainability. Furthermore, there hasn't been a lot of research done on supply chain transparency and sustainability. Improving internal process transparency is critical because it maximizes traceability for raw materials, components, and final products, which promotes cooperation across the supply chain Shao and Jin, 2020).

Some research has examined supply chains for synthetic gas, particularly those involving natural hydrogen gas. In (Alabi et al., 2020), scientists examined the release of greenhouse gases from an electric car running on hydrogen in a fuel cell and an electric car running on synthetic natural gas, both of which are generated by directly capturing atmospheric carbon dioxide in the air.

There are still issues with plug-in electric car supply chains and their application in the logistics industry, despite less attention being paid to them. One of the issues that logistics encounters when dealing with electric vehicles is how to accommodate greater trunk sizes for efficient object carrying during deliveries (Shi et al., 2023). Finding a balance between time efficiency and distribution costs requires careful consideration of charge times, particularly for longer delivery distances. Time considerations, however, become less important for shorter journeys because of increased range of EVs. In these situations, selecting the appropriate car model takes precedence (Shi et al., 2023).

Moreover, the incorporation of electric mobility into smaller supply chains is evident. Farmers, for instance, can utilize electric vehicles for local food market logistics. The strength of this partnership influences the inclination to use electric vehicles for such purposes (Sun et al., 2022).

Country-specific Articles

With 33, 28, and 25 publications, respectively, China, USA, and UK were the top three contributors to articles on the issue under analysis. Numerous countries within the European Union and Canada also demonstrated active participation, aligning with the observations in item (a) of this section.

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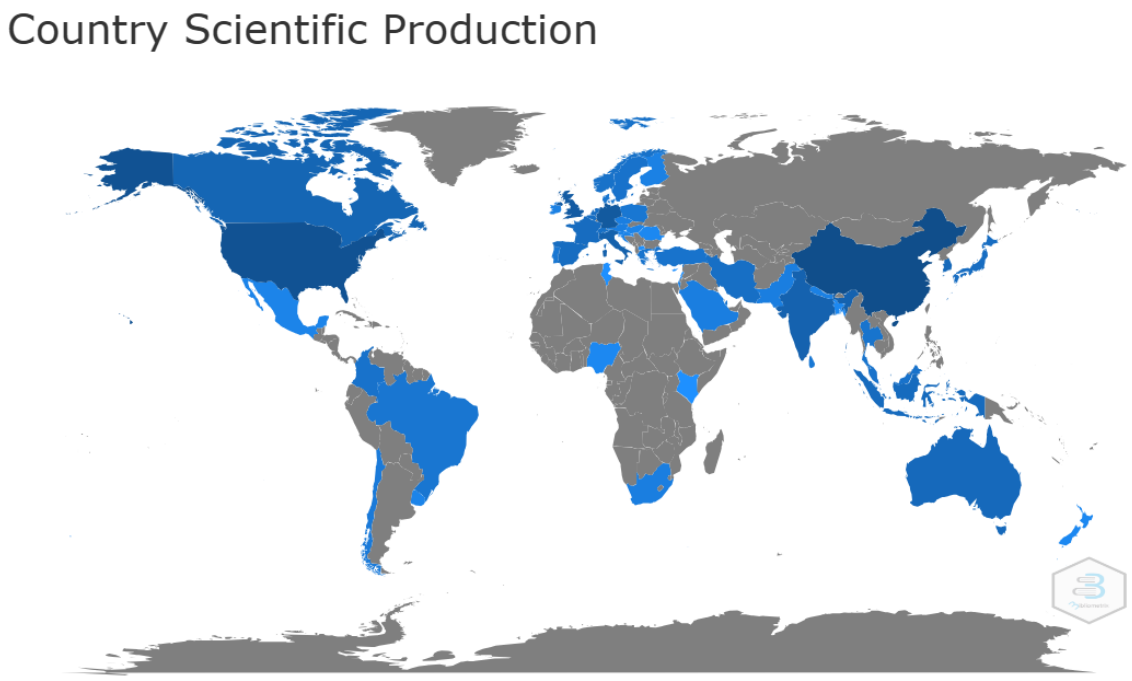

FIGURE 7
COUNTRY SCIENTIFIC PRODUCTION

Figure 7 highlights a notable disparity among the BRICS nations. While China and India played significant roles with published articles, no contributions on this topic emerged from Russia and India between 2018 and 2023, as per the applied filters. The variance observed in China and India's contributions could be attributed to their substantial populations and the imperative to explore emissions reduction alternatives, particularly in the transportation sector. In the case of South Africa, the scenario is influenced by its abundant mineral reserves, including copper, a crucial component in lithium-ion batteries (Tang et al., 2023).

European countries, situated on the continent, collectively contributed 60 articles. This heightened publication activity in Europe may be attributed to its status as the largest market for electric light vehicles, marked by sustained growth. Interestingly, emissions laws and incentive schemes contributed to a substantial 68.21% growth in hybrid electric car sales in Europe in 2021 (Xu et al., 2022).

Journal Impact Factor Analysis

The assessment of journal impact factors was conducted using h-index, a metric developed considering most cited articles (Yousefi et al., 2023). Figure 8 illustrates that Journal of cleaner production, Resources conservations, Sustainability, Applied Energy, Energies, Procedia CIRP, Energy, and Energy Policy, featuring thirty four, twenty two, twenty two, eighteen, fourteen, fourteen, eleven, nine articles, respectively from 2002 to 2023.

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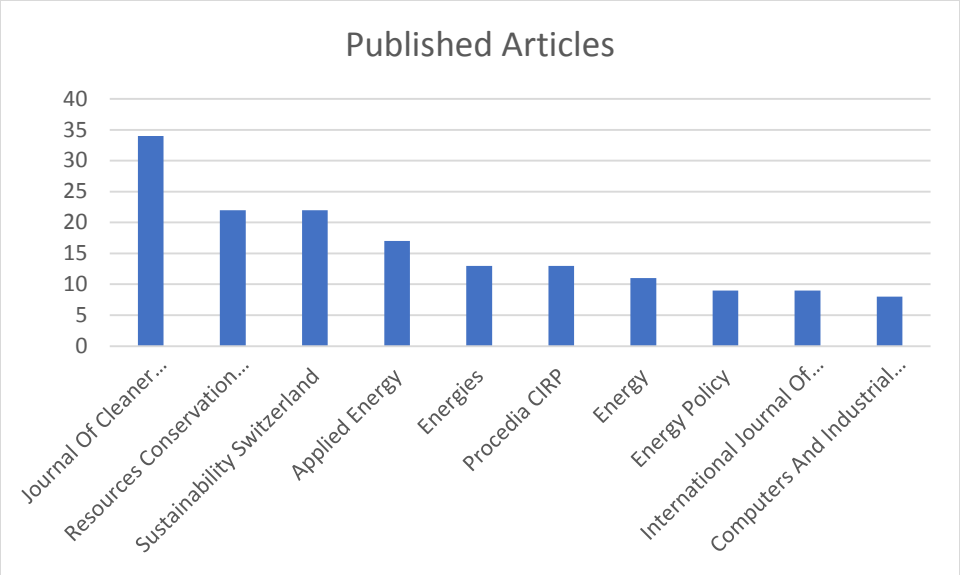

FIGURE 8
PUBLICATION TREND

Journal of Cleaner Production, renowned for its contribution to sustainability literature, features thirty-four published documents from 2002 to 2023 and holds an impactful h-index of 268. This journal plays a crucial role in advancing research on cleaner production methods, environmental conservation, and sustainable practices. Resources Conservation, with twenty-two published documents and an h-index of 170, stands as a significant publication in the realm of resource management and conservation. The journal's commitment to addressing issues related to sustainable resource use and conservation is evident in its noteworthy contributions. Sustainability, boasting an h-index of 136, and featuring twenty-two published documents, stands out as a comprehensive platform for research. Applied Energy, with eighteen published documents and an h-index of 264, is a key player in disseminating knowledge on scientific research, technological development, and energy-related issues. The journal's focus on applied energy solutions contributes significantly to the advancement of sustainable energy practices.

Energies, an open-access journal affiliated with MDPI, has fourteen published documents and an h-index of 132. Known for its commitment to scientific research, technological advancements, and energy-related studies, Energies continues to make noteworthy contributions to the field. Procedia CIRP, with fourteen published documents and an h-index of 91, serves as a valuable resource in the field of manufacturing and production engineering. The journal's emphasis on sharing critical insights and innovations contributes to the progress of sustainable manufacturing practices. Energy, featuring eleven published documents and an h-index of 232, plays a pivotal role in advancing research on various aspects of energy production, consumption, and management. The journal's comprehensive coverage ensures a holistic understanding of energy-related challenges and solutions. Energy Policy, with nine published documents and an h-index of 254, stands as a significant publication addressing policy-related aspects of energy. The journal's contributions to the discourse on energy policy, planning, and governance are reflected in its impactful publications from 2002 to 2023.

Areas of Research Focus

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The main topics of study selected for publications on supply networks for electric vehicles are shown in Figure 9. Notably, the most important sectors are those related to key elements. Notably, these fields are more relevant than the ones that are used as search terms"electric vehicle" and "supply chain management." The importance is readily expressed by the increased focus on EVs, which are the main topic of conversation when it comes to the production of electric vehicles. Materials like silicon, cobalt, and lithium that are essential to the automobile and electronics industries are used in batteries.

An essential chemical to produce semiconductors, silicon is used to make chips for a wide range of electronic gadgets, including those found in electric automobiles. The selected research areas, which include methods for recycling wasted items for the possible restoration of these vital chemical elements, demonstrate the serious worry over these critical materials. This entails studying the closed-loop supply chain, looking into its uses, and examining actual situations.

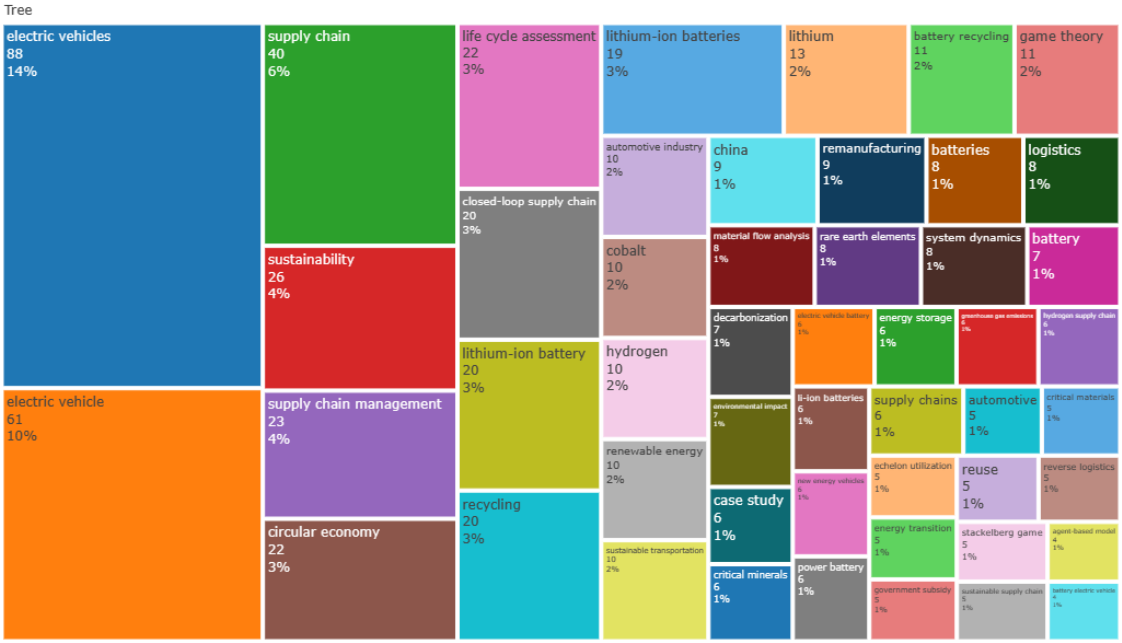

FIGURE 9
RESEARCH FOCUS (AUTHOR CREATION'S)

Overview of PRISMA Meta evaluation

Appendix A provides a thorough examination of the PRISMA meta-analysis articles that have citation counts of one or more. Many articles that covered broad topics were labelled as "unspecified." The thorough study involves answering each question separately in order to offer insights into the numerical indicators used in the bibliometric review.

Highlights of the Supply Chain: A close look at Appendix A reveals a significant focus on supply chain management for raw materials. Interestingly, the majority of the research focused on reusing used parts in remanufacturing operations. The keywords that were found by the authors' bibliometric study support this tendency. Recycling is recognized as a practical

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substitute for reducing the effects of metal and mineral extraction methods, and as a result, reducing the adverse environmental effects linked to inappropriate chemical component disposal.

Despite the extensive exploration of recycling, there is a noticeable gap in the analysis of approaches related to the reuse and allocation of electric vehicle batteries. Allocation, in this context, refers to repurposing a component for alternative uses. This aspect has been inadequately examined, and there is a call for further studies on EVs batteries. This research avenue could provide valuable insights into sustainable practices beyond conventional recycling methods.

Analytical Approaches Employed

Various studies adopted environmental impact assessments as a primary method of analysis. These assessments play a crucial role in shedding light on the environmental ramifications stemming from the production and inadequate disposal of chemical components. By highlighting these impacts, stakeholders, governmental bodies, and society at large can collaboratively develop awareness programs and promote recycling initiatives. It is essential not only to conduct environmental analyses but also to delve into cost and profit considerations. There is less incentive to address environmental issues. This underscores the significance of governmental contributions, including subsidies, to incentivize environmentally conscious practices.

The prevalence of studies addressing cost analysis underscores its importance in the discourse. Additionally, closed loop supply chain emerged as the another explored word. There remains a notable gap in the examination and formulation of policies and subsidies, necessitating further investigation. Such endeavors are crucial to establishing the viability of electric vehicles and their supply chains while fostering consumer interest in electric vehicle adoption. The bibliometric analysis, as indicated by the authors' keywords and indicators of international collaboration, facilitates a comprehensive understanding of the landscape and aligns with similar conclusions on the need for additional research in these crucial areas.

Analyzing the Focus on Supply Chain Processes

It's possible that the found articles don't specifically list the explicit words "supply chain risk management". But the fact that it keeps coming up in conversations indicates how important it is, especially when it comes to the dangers posed by the chemicals used as raw materials in electric car batteries. Furthermore, a significant lot of research has been conducted on the use of the “closed-loop supply chain” concept, which encompasses both the supply chain and the end-of-life product collection process. The frequency of this concept's recurrence in the selected papers during systematic analysis highlights the closed-loop supply chain concept's extensive significance and applicability across varied disciplines, despite the bibliometric review in this work providing minimal discussion on this subject.

The scarcity of the keyword "closed-loop supply chain" in the indexed section might contribute to its underrepresentation, emphasizing the importance of considering alternative indicators, such as authors' keywords, to capture its prevalence accurately. Additionally, the indicator of international collaboration provides valuable insights, revealing cooperative efforts among countries driven by the imperative to unite pioneering nations in critical material extraction. Nevertheless, in spite of these noteworthy areas of concentration, there is still a dearth

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of study on strategies that promote openness between supply chain operations and sustainability, provides a potential avenue for further research.

Focus of Component Analysis

The supply chain analysis's focus was on batteries for electric vehicles, specifically cobalt and lithium, which were found to be the most well researched materials. considering their crucial role as parts of Li-batteries, the bibliometric assessment and the study's keywords suggest that the expanding requirement for these elements is closely related to the increasing popularity of electric automobiles. The primary focus of the researchers' exploration of novel techniques to tackle the growing demand for cobalt and lithium was recycling as a workable alternative. In addition, the examination covered important raw minerals including aluminum, copper, manganese, and rare-earth elements, as well as other important chemical components like nickel.

CONCLUSION

This study combined quantitative and qualitative studies to conduct a thorough examination of EVs supply chain using both bibliometric and systematic review approaches. The aim was to pinpoint crucial spots that could pose threats to the supply chain and highlight regions that require additional investigation. The review was led by PRISMA approach, and the scientometrics analysis was aided by Bibliometrix software. The analysis provided insightful information by deriving important themes in the literature and highlighting the need more work to overcome gap areas. Certain restrictions were noted, though, such as the dependence on the authors' keywords, which may not be included in all publications and which could have an impact on how thorough the authors' keyword analysis is, particularly in the systematic review. Additionally, focusing on a single database could be perceived as a limitation, as cross-referencing results from multiple sources might yield different outcomes.

Despite these limitations, the qualitative and quantitative reviews yielded similar conclusions, emphasizing three main points: (1) there should be increased and widespread discussions on alternatives to bolster material recycling actions, transitioning theoretical approaches into practical solutions appealing to both consumers and manufacturers; (2) Supply chain transparency becomes a focus for additional research, with the goal of improving communication between processes and reducing risks associated with supply and demand uncertainties; and (3) Policies for incentives must be developed to support producers, guaranteeing the financial sustainability of closed-loop supply chains without putting undue strain on output cost.

The findings showed herein will guide future research endeavours and aid governmental decision-makers in shaping policies relevant to the electric vehicle supply chain domain Table Appendix 1.

Appendix A
DOCUMENTS DISCOVERED ABOUT THE EV SUPPLY CHAIN THROUGH PRISMA META-ANALYSIS

SN	Article	Focus in the Supply Chain	Analysis/Model	Supply Chain Process Analysed	Component Focus

Citation Information: Gupta, A., & Kumar Kaushik, H., & Rastogi, S. (2024). In the fast lane: scientometrics and systematic exploration of risks in ev supply chains. *Academy of Marketing Studies Journal, 28*(S4), 1-37.

1	Tang et al., (2023)	Residents' recycling behavior in EV batteries' end-of-life stage.	Structural equation model and agent-based model.	Recycling of Electric Vehicle (EV) batteries.	Analysing behaviour control, economic incentives, subjective norms, and self-identity.
2	Asgarian et al., (2023)	3-level supply chain: government, GV, EV, and EV Battery manufacturers.	Game theory, Stackelberg method, TOPSIS method.	Pricing decisions within the 3-level supply chain.	Government, manufacturer, Battery manufacturer.
3	Luo et al., (2023)	Early stages: lithium extraction from brine.	Experimental methods, SEM, TEM, XRD, Raman, cyclic voltammetry, galvanostatic, constant voltage.	Lithium extraction from brine using electrochemical recovery methods.	Hydrophilic ZnO-coated LiMn2O4 (from rLMO).
4	Li et al.,(2023)	End-of-life stage: retirement phase of power batteries.	combining government and market roles for battery recycling. Token incentive mechanism compared with government subsidy and target responsibility models.	Recycling of retired power batteries.	Improve recycling by addressing issues in traditional models. Comparison of the token incentive model with traditional models. Influence on manufacturer profits and social benefits examined.
5	Mathew et al., (2023)	Post-consumer stage, recycling of LIBs	Survey-based research method. Convenient sampling for a national online survey.	End-of-life management of spent LIBs, particularly from	Actions and willingness of the public in Malaysia. lack of knowledge

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				consumer electronics (CEs).	on proper disposal and recycling. Recommendations: laws, policies, regulations; infrastructures, technologies; education, awareness.
6	Zhang et al., (2023)	Closed-loop supply chain (CLSC) for power battery recycling in the electric vehicle industry.	Modeling approach. Construction of various recycling models to simulate different scenarios.	Closed-loop supply chain Interactions among a battery manufacturer, vehicle manufacturer, and third-party recycler.	Single battery manufacturer, Government intervention reward-penalty policies.
7	Liu et al., (2023).	Electric vehicle (EV) market cultivation.	Multi-factor prediction model. Integrated grey relation analysis (GRA), discrete wavelet transform (DWT), and bidirectional long short-term memory (BiLSTM).	forecasting and understanding EV sales characteristics under different policy scenarios.	Electric vehicle (EV) market as a whole. Dynamics between supply-side and demand-side policies. Impact on the EV market. Factors influencing EV sales, including policy incentives and regional

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					developme nt differences.
8	Yousefi et al., (2023)	BRICS and G7 countries. Energy and environme ntal policies.	Optimization model based on Holt-Winters. Analyzing and forecasting energy and environmental indicators.	Focused on evaluatin g the performa nce of countries in the broader context of energy and environm ental policies.	Key indicators related to energy and the environmen t. Energy intensity, energy import, use of renewable resources. Evaluation of BRICS and G7 countries' performanc e based on these component s in both base and forecast years.
9	Zhang et al.,(2023)	Power Batteries Reverse Supply Chain (PBRSC) Challenges in the power battery recycling process.	Explored key component technologies within the framework.	Addressin g challenge s in the recycling system, standards, efficiency , transpare ncy,	Key component technologie s: double-chain structure, battery recycling.
1 0	Demartini et al., (2023)	Automotiv e supply chain transitions to electric and net zero economies.	System dynamics and agent-based model..	Automoti ve supply chain processes:	Various component s in the automotive supply chain: manufactur ers, suppliers, and workers. Operations related to

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					different vehicle types (fuel, hybrid, electric). Effects of the transition on competitiveness, business opportunities, raw material consumption, and job implications.
11	Hajiaghaei-Keshteli et al.,(2023)	Optimization of multi-period production	Mixed-integer linear mathematical model.	Optimization of production, inventory, and distribution operations. Coordination of sequential activities.	Utilization of electric vehicles in the supply chain. Emphasis on optimizing production routing. Consideration of mileage limitation and variations in travel speed due to traffic.
12	Golinucci et al, (2023)	Diverse focus: Individual choices, BitCO2, Italian transport sector.	System Dynamics model for BitCO2's carbon reduction mechanism.	BitCO2 mechanism influenced private transportation supply chain choices.	BitCO2's impact on private transportation choices and emissions reduction.
13	Joshi et al., (2022)	Cradle to Grave life cycle assessment for vehicles.	Life Cycle Assessment (LCA) with Cradle to Grave methodology.	Life cycle analysis evaluated EVs vs. ICEVs in Italian transporta	Greenhouse gas emissions analysis for Hyundai vehicles and

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				tion.	electricity sources.
14	Liu et al., (2023)	Cobalt scrutiny: Geopolitical risks, EV industry impact on supply resilience.	System Dynamics model for cobalt supply chain resilience analysis.	Cobalt supply chain resilience assessed through price, production, supply, and demand subsystems.	EV industry resilience: cobalt prices, production dynamics, and demand.
15	Mu et al., (2023)	EV LIB network: Supplier-buyer relationships, structural characteristics, risks 2016-2020.	Meso-level approach to construct EV LIB	EV LIB supply chain analyzed for structural characteristics and disruption risks.	risky sources, and disruptions.
16	Gent et al.,(2022)	Cobalt in cathodes: Key bottleneck, layered structures' impact on EVs.	Techno-economic analysis for cobalt thermodynamic stability.	Cobalt's role in EV cathodes explored for energy density and performance.	Cobalt's role in EV batteries, impact on supply chain costs.
17	Schulz-Mönninghoff et al.,(2023)	Circular Economy for EV batteries: Material circularity in automotive manufacturing.	Framework inspired by British Standard for EV battery material circularity.	Material circularity of EV batteries studied through product development, management, production, and end-of-life.	EV battery material circularity: closed-loop production, recycling strategies.
18	Zhang et al.,(2022)	Retirement, recycling, carbon abatement optimizatio	Stackelberg game models for closed-loop supply chain dynamics.	Closed-loop recycling of power batteries	EV power battery recycling system effectivene

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		n.		examined with stakeholder involvement.	ss and sustainability.
19	Nguyen-Tien et al.,(2022)	LiB recycling: End-of-life stage, logistics, transportation, systemic view.	Geographically Sensitive Supply Chain (GSC) model for EV recycling.	UK Li-ion battery end-of-life management evaluated for recycling technologies and optimization.	LiB recycling industry in the UK: economic, environmental dimensions.
20	Huber, S. T., & Steininger, K. W. (2022).	Sustainability in energy technologies: Wind turbines, solar modules, EVs, lithium-ion batteries.	Comprehensive analysis of sustainability issues in supply chains.	Renewable energy technologies' supply chain analyzed for conflict minerals and environmental impacts.	Risks associated in batteries
21	Wasesa et al.,(2022)	LIBs recycling process: Comprehensive view, waste collection, transportation, recycling plant.	agent-based modeling,	LIBs recycling system assessed for waste collection, logistics, and metallurgical processes.	LIB recycling implications: technology, costs, energy consumption.
22	Huster et al., (2022)	Remanufacturing EV batteries: Service lifetime increase, circular economy, spare batteries.	Discrete event simulation for batteries and EV life cycle.	Electric vehicle battery remanufacturing explored for spare part integration and new battery	Remanufacturing potential of EV batteries, economic and environmental considerations.

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				demand reduction.	
23	Sun et al., (2022)	NEV subsidy strategies in China: Optimal R&D subsidy, cooperative supply chain investment.	Stackelberg game, Nash equilibrium for NEV industry subsidies.	Government subsidies' impact on NEVs supply chain decisions analyzed for R&D and advertising.	NEV subsidy strategies' impact on R&D, advertising, and supply chain.
24	Shi et al.,(2023)	Resource constraints, risks, stock market analysis.	VAR and DCC-GARCH models for risk spillover in NEV markets.	Risk spillover.	NEV industry stock prices, lithium battery suppliers, and spot markets.
25	Tang et al., (2023)	EV end-of-life stage: Retirement phase, Li-ion batteries, waste management, industrial sustainability.	Agent-based model for EV battery collection system simulation.	Collection system for retired EV batteries assessed for policy impact and collection rate.	EV battery collection system policies' impact on sustainability.
26	Zhao et al, (2022)	Distribution challenges: Photovoltaic consumption, EV batteries, charging stations, route optimization.	Mathematical model for emergency EV mobile power route optimization.	Emergency distribution of mobile power supply	Photovoltaic-energy storage-charging supply chain optimization using blockchain.
27	Zhou et al., (2022)	Long-term lithium dynamics in China: Security considerations,	System dynamics model	Long-term dynamics of the lithium supply chain.	lithium supply chain, demand, price, and resilience.

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		demand-price interplay, market dynamics.			
28	Alabi et al., (2022)	Low-carbon UK future: Decarbonization, private transport, EV rollout by 2050, economy impacts.	Computable general equilibrium model for 2050 EV economic effects.	Transition to low-carbon future analyzed, focusing on electricity network upgrades for EV rollout.	UK's low-carbon future transition: EV rollout and electricity network upgrade.
29	Shamsi et al.,(2021)	FCEV transition in Ontario: Hydrogen infrastructure vs. FCEV commercialization for successful transition.	Multi-objective model for hydrogen infrastructure in Ontario.	Early-stage transition plan for FCEVs in Ontario studied for optimal hydrogen infrastructure.	Hydrogen infrastructure development for FCEVs in Ontario.
30	Yu et al.,(2021)	Two-stage auto supply chain in China, production, pricing, EVs, ICEVs.	Stackelberg game paradigms for two-stage auto supply chain.	Two-stage auto supply chain in China analyzed for Dual Credit Policy and EV subsidies impact.	Dual Credit Policy effects on two-stage auto supply chain strategies.
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39	Li, Y., & Taghizadeh-Hesary, F. (2022)	Hydrogen energy supply chain: Production from renewables, well-to-wheel, road transport in China.	Quantitative models for economic assessments.	Economic feasibility for FCEVs evaluated through life cycle assessment.	Hydrogen fuel cell EV well-to-wheel emissions, cost of ownership in China.
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41	Liu et al.,(2022)	EV consumer perceptions: Mineral extraction	Telecoupling framework, survey, and Q-methodology for EV consumer perceptions.	Electric vehicle supply chain analyzed	Consumer perceptions of mineral extraction impacts in

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44	Dua et al.,(2021)	PEV adoption in India: Challenges, opportunities	Survey-based approach for Indian LDV ecosystem perspectives.	PEV adoption processes analyzed for market dynamics, policy influence, and infrastructure.	PEV market dynamics, challenges, policies in the Indian LDV sector.
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47	Mohammadzadeh et al., (2021)	Two-stage supply chain, pricing, FPMS decisions, subsidy implications.	Bi-level modeling and FPMS	Bi-level modeling	Market dynamics of EVs vs. FVs: pricing, periodic maintenance, TCO.
48	Shao, L., & Jin, S. (2020)	Lithium supply coping: NEV impact, supply interruption risk, resilience assessment.	System dynamics modeling for lithium supply chain resilience.	System dynamics modeling	ability: demand, supply, price resilience.
49	Nuri Cihat et al., (2019)	EV technology sustainability: Life cycle assessment, manufacturing, use, end-of-life, unique supply chain aspects in Qatar.	Hybrid I/O assessment	sustainability assessment.	Qatar's EV sustainability indicators: environmental, social, economic aspects.
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		spending, cost recovery.		related electricity network upgrades.	
51	López, F. C., & Fernández, R. Á. (2020)	Commercial EV energy consumption: Traffic regulations' impact, large companies' supply chains.	Predictive methodology using stochastic speed profiles for BEV energy consumption.	Predictive methodology used stochastic speed profiles for BEV energy consumption.	BEV energy consumption variations: traffic regulations, running costs, emissions.
52	Gu et al.,(2018)	Three-period system, remanufacturing, recycling, unique instant repurposing.	Optimization modeling	Optimization modeling developed	EV strategies, reuse, raw material consumption.
53	Alamerew, Y. A., & Brissaud, D. (2020)	Reverse supply chain dynamics: EoL product recovery, circular economy complexities, reverse logistics.	System Dynamics (SD) approach for reverse logistics in circular economy.	System Dynamics approach modeled complex system of reverse logistics in the circular economy.	Circular economy dynamics in EVB reverse supply chain.
54	Li et al.,(2020)	CV and NEV decisions: Subsidy and dual credit policy impact,	MILP for government subsidies and dual credit trading.	optimized production with government subsidies	Government subsidies, dual credit policy impact on NEV supply chains.
55	Erdem, M., & Koç, Ç. (2019).	optimization, sustainable urban transportation.	Hybrid metaheuristic approach for variant home health care routing problem.	Hybrid metaheuristic approach addressed variant	optimization for EVs in home health care services.
56	Turner et al., (2018)	LEV refueling supply chains: EV and battery	Input-output multiplier analysis for low emissions vehicle refuelling supply chains.	Input-output multiplier analysis assessed	Economic benefits, job creation in UK EV supply

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		production, infrastructure optimization.		economic impact of refuelling low emissions vehicles.	chain development.
57	Kalaitzi et al., (2019)	EV production volume dependencies: Inter-company relationships, resource dependencies during increased production.	Inter-company case study method with resource dependence theory (RDT)	Investigated dependencies	Relationships in EV supply chain: key suppliers, resource management.
58	Reuß et al., (2019)	Hydrogen infrastructure challenges: Spatial, temporal aspects, efficient nationwide deployment in Germany by 2050.	Infrastructure assessment with spatial resolution for hydrogen storage and transport in Germany.	Infrastructure assessment with spatial resolution compared hydrogen storage and transport technologies in Germany.	Hydrogen infrastructure options: storage, transportation technologies.
59	Lane et al.,(2020)	Alternative fuelling scenarios: Conventional, hybrid, electric, fuel cell vehicles, various infrastructure requirements.	Comprehensive analysis	Comprehensive analysis	Infrastructure needs for PFCEVs, BEVs, and FCEVs in California.
60	Hache et al.,(2019)	Global lithium supply chain: EV adoption impact, integration into TIAM-IFPEN,	Times Integrated Assessment Model and transportation sector	Times Integrated Assessment Model for Li supply chain and transportation sector	Lithium availability, criticality in EV battery production, and market impact.

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		understanding interactions within the broader energy system.		analysis.	

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