INTERNATIONAL JOURNAL OF AUTOMOTIVE SCIENCE AND TECHNOLOGY

2024, VOL. 8, NO:2, 212-224 www.ijastech.org e-ISSN: 2587-0963

Electric Vehicles: Manuscript of a Bibliometric Analysis Unveiling Trends, Innovations and Future Pathways

Abdullaev Ibrokhimjon[1*], Ni Lin[2] and Jasur Rashidov[3]

[1] *Faculty of Automotive Engineering, Andijan Machine Building Institute, Andijan, 170119, Uzbekistan*
[2] *Faculty of Mechanical Engineering, Beijing Institute of Technology, Beijing, 100811, China*
[3] *Faculty of Civil Engineering, Tashkent Institute of Architecture and Civil Engineering, Tashkent, 100194, Uzbekistan*

Abstract

This review paper facilitates the examination of the comprehensive thought patterns within electric vehicles (EVs) technologies and elucidates the primary significance derived from recent research. Furthermore, it systematically identifies and explores key themes related to EVs through the incorporation of the keyword "electric vehicle" in the bibliometric analysis. The selection of the Scopus database for this research is grounded in its superior importance compared to other databases, emphasizing its utilization in the bibliometric analysis. The VOSviewer software served as the analytical tool employed to visually represent crucial data, including information about countries, authors, journals, and keywords. The analysis, conducted on November 19, 2022, encompassed a thorough examination of 1074 documents spanning from 1985 to 2023. While the analysis of the number of publications over the years revealed in 2020 were 190 publications, marking the highest point for research and work on electric vehicle studies. The most of the articles were Conference paper among all 1074 documents with 61.7 % while review papers were identified as lowest document type with only 1.3 % of all of selected documents. Bagheri, M is the top writer with 25 documents on the Scopus database regarding to the key words, while others have publications around 11 and 16 number of papers. Russian Federation is the top contributor to the research of EVs with 61 % of all documents while Egypt is contributed with 1 % among all selected areas on the Scopus database. Notably, the IOP Conference Series Materials Science and Engineering was hold as one of the primary sources, accounting 76 documents to the electric vehicle studies. The outcomes of this investigation reveal noteworthy advancements in the volume of publications and the growing interest in electric vehicles, particularly within the academic and manufacturing sectors.

Keywords: Bibliometric analysis; Electric vehicle; Future perspectives; VOSviewer.

Review Article

History
Received 24.01.2024
Revised 24.03.2024
Accepted 16.04.2024

Contact
* Corresponding author
Abdullaev Ibrokhimjon
ibroxim1995jon@gmail.com, 3820239004@bit.edu.cn
Address: Mechanical Engineering Department, Faculty of Mechanical Engineering, Beijing Institute of Technology, Beijing, China.
Tel: +8618810908382

***To cite this paper*:** Ibrokhimjon, A., Lin, N., Rashidov, J. Electric Vehicles: Manuscript of a Bibliometric Analysis Unveiling Trends, Innovations and Future Pathways. International Journal of Automotive Science and Technology. 2024; 8 (2): 212-224. https://doi.org/10.30939/ijastech..1424879

1. Introduction

Before delving into the main characteristics of articles in bibliometric analysis related to Electric Vehicles (EVs), it's crucial to establish a foundational understanding of Electric Vehicles. To do so, let's commence by exploring the definition of a vehicle. According to reputable and widely-recognized sources, a vehicle is described as a mechanical apparatus equipped with an engine, such as an internal combustion engine or an electric motor in the case of electric vehicles. Its primary function is the transportation of people or goods, primarily on land. Certainly, choosing a definition from a reliable source like Cambridge Dictionary adds clarity to the understanding of the term. Regarding the impact of urbanization, it is evident that the ongoing trend of urbanization is placing a substantial demand on energy resources while simultaneously contributing to the rise in emissions and waste globally. This poses significant challenges that need to be addressed in the context of sustainability and environmental impact. If you have specific points or details you would like to include or elaborate on, please let me know, and I can further assist you. [1–4]. The International Energy Agency reports that the global CO2 level surged to its peak at 36.3 gig tons in the year 2021. Despite this concerning rise, there is a positive aspect as Electric Vehicles (EVs) are actively playing a role in reducing emissions [3,5,6]. This situation arises due to the pressing issue of global warming, and nations worldwide have been addressing this challenge by leveraging the assistance of the modern and advanced automotive industry [3,7–9]. As an

illustration, in contemporary times, people across the globe have universally embraced the term "zero-emission cars" for Electric Vehicles. This nomenclature underscores the significance of these vehicles in contributing to the preservation of life on Earth by mitigating the growth of CO2 levels [10–12].

There are also some reasons to accept EVs into our social life in order to reduce the demand of fossil fuel and improve the contribution rate for saving our clime system as well as grow the wishes for using renewable energy among individuals [4,13,14] For instance, many countries are actively promoting the integration of electric vehicles (EVs) into their citizens' daily lives as a means of enhancing both their economy and the environment. This is attributed to the widespread acknowledgment of electro mobility as a pivotal and efficacious solution [12,15,15,16]. Hence, numerous initiatives and agreements, such as the France Declaration established in 2015, aim to reduce global temperatures by 2 degrees. These efforts rely on the support of a sustainable automotive industry and manual cleaning practices [17]. Electric Vehicles (EVs) necessitate fewer components compared to fuel-powered cars. For example, EVs utilize emission-free electric motors and advanced electronic technologies. Innovations in energy management methods are also contributing to the efficient operation of EVs, enhancing the overall performance of energy sourcing and storage [9,18]. Furthermore, there is ongoing growth in the sales of Electric Vehicles (EVs), with a significant increase to 16.5 million units sold in 2022, three times more than the sales in 2018. Projections suggest that the number of EVs in use is anticipated to reach 300 million by the year 2050 [5,19,20]. As per the International Energy Agency (IEA), the production of electricity through renewable energy sources has been advancing. It is recognized as the most efficient method for minimizing electricity generation costs compared to the use of fossil fuel energy sources [19,21–23]. While Electric Vehicles (EVs) may appear ideal to consumers, they do have certain drawbacks in daily use. These include challenges such as a scarcity of charging stations, extended charging times, and the high cost of battery systems for storage [19,24,25].

2. Materials and Methods

A substantial amount of research and contributions related to Electric Vehicles (EVs) has been conducted, as documented by the Scopus database since the discovery of EVs. This work highlights some of the major ongoing research and the current conditions of EVs. The primary objective is to disseminate up-to-date information about EVs and establish connections within the database, encompassing top writers, universities, countries, sponsors, subject areas, and publication years. The paper includes a vast array of research dates, types of documents, and source titles, providing an extensive overview of EV research. Divided into three sections, the paper covers material and methods. Section 1 (Data collection and the purpose the research) collects data and illustrates documents from the Scopus database. Section 2 (Data visualization and bibliometric analysis) presents the visualized results and discussions by utilizing VOSviewer application under the 1.6.18 version, developed by Leiden University in the Netherlands. Finally, Section 3 (Data analysis and discussion) comprises a literature review discussing the current and future states of electric vehicles based on the analysis conducted using the Scopus database. The inclusion of various diagrams, tables, and images enhances the readability and interest for readers.

The major steps involved in the methodology aimed at systematically collecting, visualizing, and analyzing data from the Scopus database. The criteria used in the analysis were carefully selected to provide a comprehensive understanding of the current state and trends in EV research. Certainly, your explanation provides a clear understanding of bibliometric analysis. Bibliometric analysis is a fundamental method in research and scientific development that aims to understand authors, establish links between research topics in articles, and create systematic structures within research papers. This analysis is facilitated by the use of computer programs such as VOSviewer and Map Chart, which help visualize and interpret the relationships and patterns present in academic literature. It plays a crucial role in mapping out the landscape of research, identifying influential authors, and uncovering the connections between various research themes [4,26–31].

The materials for the documents were gathered from the Scopus data platform, recognized as an optimal database for bibliometric analysis due to its extensive collection of information across indexed journals among various disciplines. The wealth of data available in this database has been utilized in conducting bibliometric analyses for the searches conducted in this review. Scopus provides a comprehensive and interdisciplinary approach, making it a valuable resource for studying and understanding research trends, author contributions, and links across diverse fields of study [4,15,32,33].

Additionally, the bibliometric analysis was visualized and constructed using software programs, specifically VOSviewer, version 1.6.18, developed by Leiden University in the Netherlands. This tool played a key role in visualizing relationships and patterns within the collected data, contributing to a comprehensive understanding of the bibliometric landscape associated with the research on electric vehicles [9,28,34,35]. The network platform, VOSviewer, provides the capability to categorize the number of publications based on publication years, authors, and sponsor organizations. It proves to be instrumental in enhancing visualizations by linking keywords with different colors, thereby improving the overall understanding and interpretation of the relationships between various elements in the dataset. This feature contributes to a more nuanced and insightful analysis of the publications related to electric vehicles [17,24,28,33,36].

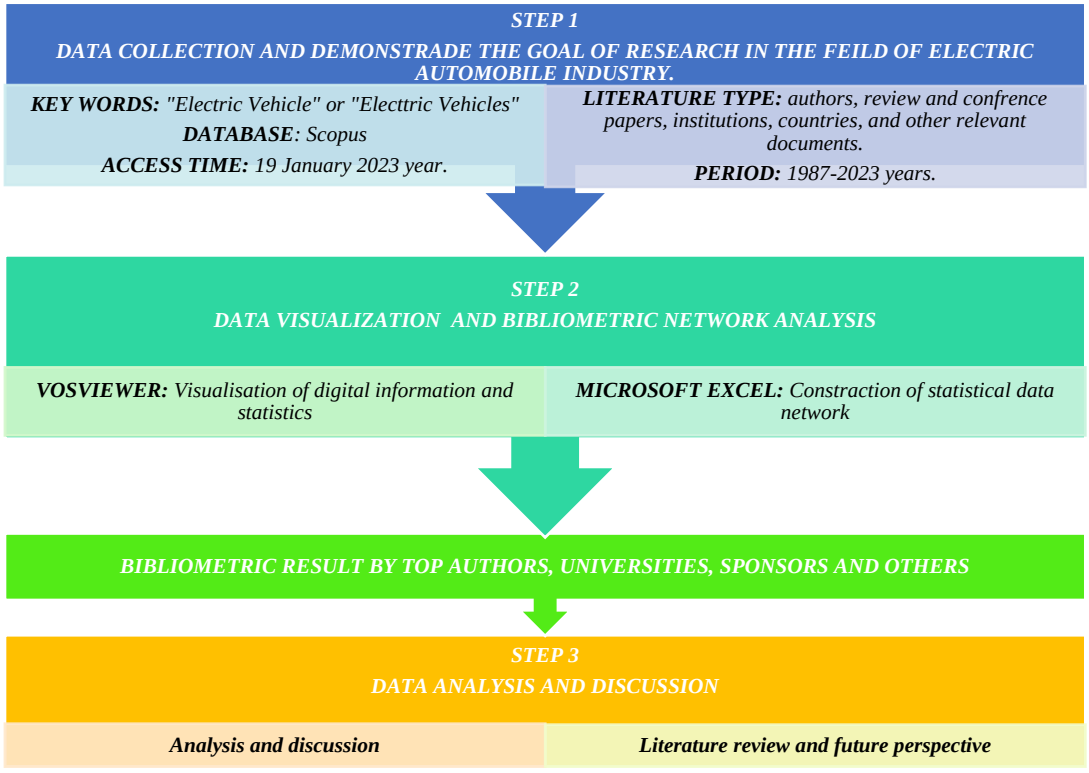

Fig. 1. Methodology of the review paper and its major steps with analyzed criteria appealed to this work

The methodology of the review paper involved several key steps and criteria, as outlined below:

- Data collection and describe the main goal of study (STEP 1):
  - Defined search criteria in the Scopus database.
  - Identified records in the Scopus database.
  - Refined the obtained information from the Scopus website.
- Data visualization and bibliometric analysis (STEP 2):
  - Conducted a bibliometric analysis using VOS viewer software.
  - Examined publications, authors, institutions, countries, and other relevant documents.
- Discussion of data analysis and conclusions (STEP 3):
  - Analyzed and discussed information according to the main themes and development trends of Electric Vehicles (EVs).
  - The usage of analyzed criteria to draw conclusions and insights from the gathered data.

The search for data to create the review paper took place on January 19, 2023, using the keywords "electric vehicle." The search period was intentionally varied to introduce differences among articles. The research included a total of 1074 publications from the Scopus database. Certain limitations, including affiliations, top countries, and keywords, were considered, leading to the generation of network maps. Other data, such as co-authorships, document types, and various factors, were presented and illustrated using relevant programs throughout the review. The limitations applied, included some criteria and definitions. For example, “electric vehicles” was used as key word while “engineering” was selected as subject area. English language was selected as main language of papers wile pub stage was chosen as final stage in the Scopus database. In the search of documents, four types of documents like “Conference and review papers, articles and book chapters” were selected as the main doc types in this review paper. There are also other limitations according to specific areas researching on electric vehicles listed below in the table 1.

Table 1. List of the countries applied for search as limitations in the Scopus database

List of countries.	
Russian Federation	Kazakhstan
Ukraine	Uzbekistan
Belarus	Azerbaijan
Moldova	Tajikistan
Russia	Kyrgyzstan

3. Result and Discussion

The search in the Scopus database was conducted with limitations and preselection based on affiliation, authors, countries, document types, sponsors, sources, subjects, and the number of publications in specific years. Utilizing "electric vehicles" as keywords, a total of 1074 publications were identified in the Scopus database. The analysis of the number of publications over the years revealed that in 2020, there were 190 publications, marking the highest point for research and work on electric vehicle studies. The publication trend over the years showed a gradual increase from 1 to almost 20 between 1985 and 2014.

However, there was a substantial rise from 40 publications in 2015 to 190 publications in 2020. In contrast, the number of studies on electric vehicles in the subsequent years, particularly in 2021 and 2022, significantly decreased from the peak 190 documents in 2020 to 83 research papers in 2022. It describes that during three years, there has been a significant decrease in the research of electric vehicles until access time to collect data from Scopus database on January 19, 2023. Moreover, only 2 publications were recorded at the beginning of 2023 based on the specified preselection and limitations. The line graph illustrates the number of yearly publications connected with electric vehicle in Figure 2.

The search for data in order to compare the number of publications took place on March 21, 2024, using the same structure of limitations as before. The usage of "electric vehicles" as keywords, a total of 1321 documents were identified in the Scopus database. In comparison with Figure 2, in Figure 3, there was a considerable number of improvements in the electric vehicles' studies during the decade, while the number of publications between the years 1987 and 2014 was a gradually rose from 1 to 20 publications in those selected areas. 192 research papers published associated with research of electric vehicles in 2020 was top moment. After high point of the number of publications, it was fluctuated during 3 years from 192 to 181 papers despite the dramatic decrease in 2021 year. At the beginning of 2024 year, the number of publications in electric vehicles' studies has reached 22 papers till March 21, 2024. According to the comparison of both figures, there would be a significant increase in the following days and years in the field of research of EVs. For instance, in the beginning of 2023 year during 20 days there are only 2 publications connected with EVs' studies. However, during 80 days in the beginning of 2024 year, 22 papers in the Scopus database associated with research area of EVs. If we simply calculate with dividing days by the number of published documents, we can see the results for each condition. According to the simple calculations, the number of publications in 2024 will become over 200 research papers. The following equations (1-3) will describe the way of calculations to predict the number of publications in 2024 year.

$$A_{days} = \textit{the number of annual predicted publication} \quad (1)$$

$$A_d = \frac{Days}{number\ \ of\ \ documents} = \frac{20}{2} = 10\ \ days \quad (2)$$

for each publication.

$$A_d = \frac{Days}{number\ \ of\ \ documents} = \frac{80}{22} = 3.63\ \ days \quad (3)$$

almost 4 days for each application.

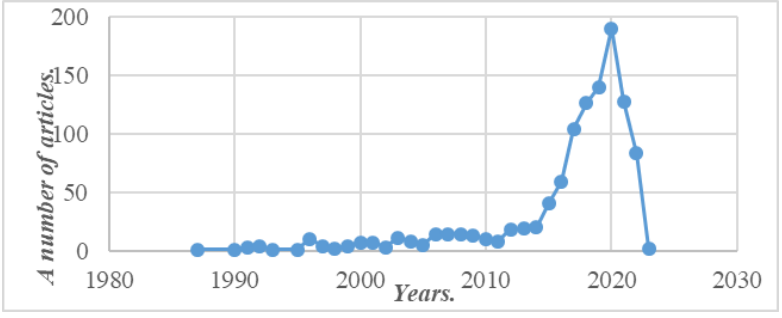

Fig. 2. Annual publications by the usage of key words "electric vehicles"

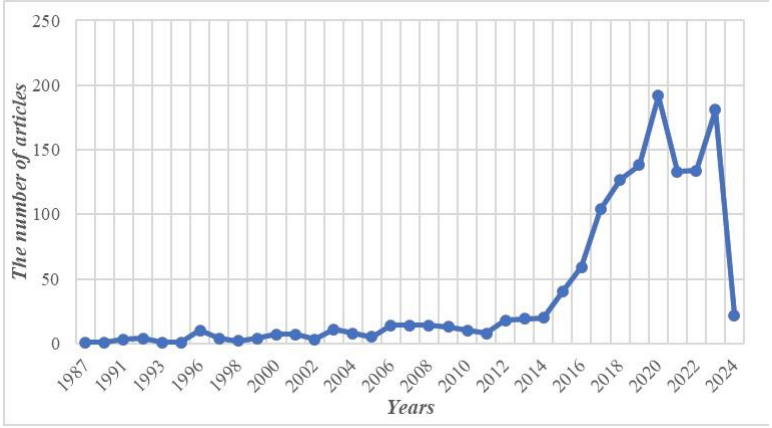

Fig. 3. Yearly publications connected with the field of EVs

In relation to document types, the 1074 documents can be categorized into four groups: 1) Conference papers (663 = 61.7%). 2) Research articles (381 = 35.5%). 3) Book chapters (16 = 1.5%). 4) Review articles (14 = 1.3%). The findings indicate a significant increase in the examination of electric vehicles and the publication of related content in Scopus database journals, particularly in the year 2020, as outlined in the classification of document types presented in Figure 4 using a line graph.

Researchers and scientists have been conducting researches and analyses in order to obtain much information about impacts of electric vehicles so far. For example, this report includes only 160 publications of authors and the number of articles is differed from 1 to 24 research paper which are suitable to each author. Although, some authors published 2 or more articles and research papers in the journals of Scopus database, but some of them have only 1 publication on the database of Scopus linked with electric vehicle. However, Figure 5 consists of only top 11 authors who wrote and had more documents based on the theme of electric vehicle. Bagheri, M is the top writer with 25 documents on the Scopus database regarding to the key words, while other such as Anuchin A, Lu M, Farrokhifar M, Karpukhin K, Terenchenko A, and finally Karpukhin K have publications with differing from 11 documents to 16 papers respectively.

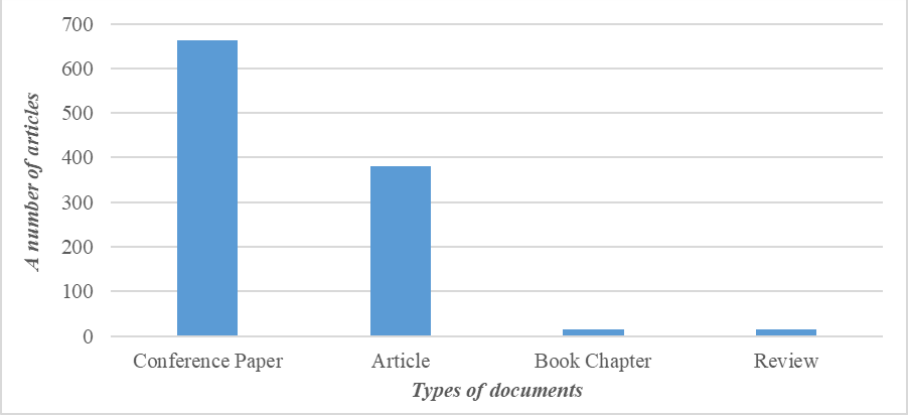

Fig. 4. Types of publications on electric vehicle studies.

Fig. 5. Top authors of publications based on the number of documents on the Scopus database

Figure 6 depicts the countries that have contributed the most research papers in the Scopus database based on keyword restrictions. As evident from the bar chart, the majority of research papers, accounting for 61% of publications, were conducted by the Russian Federation with 768 documents. Ukraine follows as the second leader in electric vehicle research, contributing 218 documents (17%). The United States holds the third position with 54 documents (4%). Additionally, Egypt is the lowest contributor among the mentioned countries, reporting 15 (1%) publications on electric vehicles in the Scopus database. The index of research papers on electric vehicle studies from countries like Kazakhstan, China, United Kingdom, Germany, Iran, Belarus, and Poland ranged from 46 (4%) to 18 (1%) respectively.

To enhance the visibility of the indicators for the top countries in electric vehicle studies, a Map chart was organized using the Map Chart online platform. This additional visualization tool aims to provide a clearer representation of the geographical distribution of research contributions in the field of electric vehicles across different countries (27). As a result, the visualization of the top publisher countries has been presented in the Figure 7.

The countries with the highest research outputs in Electric Vehicles (EVs) are as follows:

Russian Federation: 768 documents (61% of publications)

Ukraine: 218 documents (17%)

United States: 54 documents (4%)

Kazakhstan, China, United Kingdom, Germany, Iran, Belarus, and Poland: Ranging from 46 (4%) to 18 (1%) documents each.

These countries have shown significant productivity in terms of contributing research papers on electric vehicles.

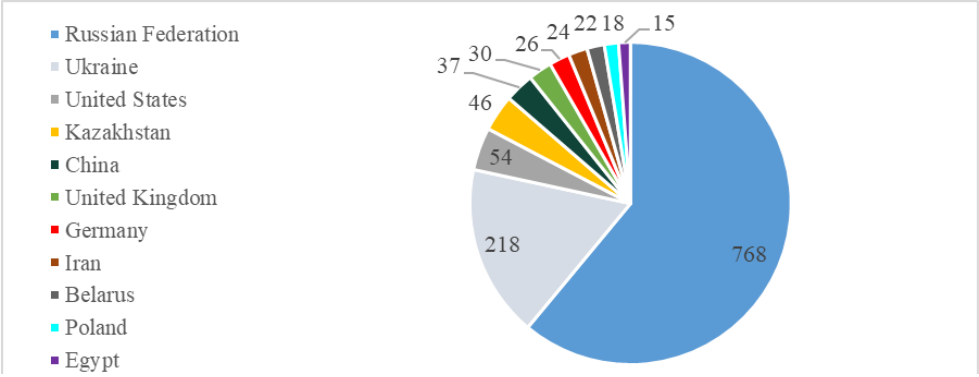

Fig. 6. The list of top countries on the electric vehicle research papers.

Fig. 7. The most productive countries in EVs research outputs

Another supportive result from our bibliometric analysis is that the most publications in the electric vehicle studies of universities are included in the following section. According to the Figure 8, the leadership in the publication of research paper related to EV research area belongs to the South Ural State University with 47 publications. In general, total number of research paper of EV studies is 1074 but only 160 universities have published their research papers on the Scopus database related to the limitations of search. To be more precise, Kazan State University of Architecture and Engineering has had only 3 publications of electric vehicle studies, while Ural Federal University, Bauman Moscow State Technical University and National Research University “Moscow Power Engineering Institute” printed their 27 publications. Moscow Aviation Institute National Research University and Skolkovo Institute of Science and Technology had the same indicators in the electric vehicle research paper with 30 documents. The index of publications of electric vehicle studies is differed from 34 to 47 documents following by Nazarbayev University and South Ural State University which is leader in the printing research papers on the Scopus database. The search and data were limited by the universities of the Asian counties.

Another crucial aspect to analyze in this paragraph is the selection of journals. Journal selection is paramount for both publications and the general readership, ensuring the acquisition of credible and valuable information related to the research theme. The choice of journals is intertwined with important and significant factors, including the journal's h-index and its publication requirements. These considerations play a vital role in ensuring the reliability and impact of the information presented in the publications [33,37–39].

The search yielded a total of 1074 research papers from the Scopus database related to electric vehicles. Notably, the IOP Conference Series Materials Science and Engineering emerged as one of the primary sources, contributing 76 documents to the electric vehicle studies. On the other end of the spectrum, the Lecture Notes in Electrical Engineering source in the Scopus database had the lowest number of research papers on electric vehicles, totaling 6 documents.

As shown in table 2, the number of publications on electric vehicle studies varies, ranging from 6 documents in the Lecture Notes in Electrical Engineering to 47 documents in the Russian Electrical Engineering journal. Some journals, such as Mechanical Engineering and Technology, Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu, and Russian Engineering Research, share the same publication indicators. SAE Technical Papers secured the third position with 34 documents in the sources of the Scopus database concerning electric vehicle studies.

The significance of sponsors in converting research and innovations into reality is paramount. The bar chart illustrates some of the top sponsors that have supported a range of articles and conference papers for the publication of research on electric vehicles. According to Figure 9, the Ministry of Education and Science of the Russian Federation has been a major supporter, backing 72 projects to disseminate their articles and works globally. Russian Foundation for Basic Research and Russian Science Foundation supported 27 and 24 articles and conference papers, respectively. Nazarbayev University, National Natural Science Foundation of China, and Government Council on

Grants in the Russian Federation sponsored 14, 13, and 11 documents, respectively. Additionally, the European Regional Development Fund contributed 8 research papers to publish documents related to their projects on the Scopus database. The Ministry of Education and Science of the Republic of Kazakhstan and the Ministry of Education and Science of Ukraine both sponsored an equal number of projects, resulting in 8 documents each. Notably, the Ministry of Science and Higher Education of the Russian Federation provided sponsorship for 9 research projects related to Electric Vehicles (EVs).

Fig. 8. The list of top universities related to the publications of the electric vehicle on the Scopus database

Table. 2. Number of publications on the electric vehicle studies according to the sources of Scopus database

№	Title of Scopus source	Number of publications
1.	Russian Engineering Research	12
2.	Matec Web Of Conferences	10
3.	Proceedings Of The International Astronautical Congress Iac	10
4.	Applied Sciences Switzerland	8
5.	Acta Astronautica	7
6.	IEEE Access	7
7.	Proceedings Of SPIE The International Society For Optical Engineering	7
8.	IEEE Transactions On Vehicular Technology	6
9.	International Journal Of Applied Engineering Research	6
10.	Journal Of Thermoelectricity	6
11.	Lecture Notes In Electrical Engineering	6
12.	IOP Conference Series Materials Science and Engineering	76
13.	Russian Electrical Engineering	47
14.	SAE Technical Papers	34
15.	Energies	21
16.	Lecture Notes In Mechanical Engineering	20
17.	Technical Electrodynamics	15
18.	Advances In Intelligent Systems And Computing	14
19.	Procedia Engineering	14
20.	Eastern European Journal Of Enterprise Technologies	13
21.	International Journal Of Mechanical Engineering And Technology	12
22.	Naukovyi Visnyk Natsionalnoho Hirnychoho Universytetu	12

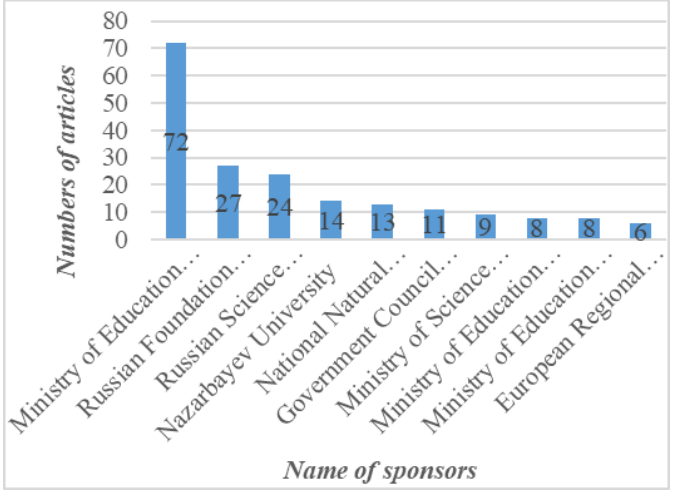

Fig. 9. The list of top sponsors on the research and publications of electric vehicle studies on the Scopus database

Moreover, the correlation between engineering and other fields of study is highly significant, with engineering playing a crucial role in improving the performance of various special-ties in our community. Particularly in the realm of vehicle engineering, engineering is indispensable for our daily routines. According to table 3, the number of publications in the field of electric vehicle research is outlined across different subject areas. Engineering emerges as the most productive specialty with 1074 documents, followed by Energy and Computer Science at the 2nd and 3rd positions with 277 and 268 research papers, respectively. Notably, even fields like Psychology and Pharmacology, Toxicology, and Pharmaceutics, which may not be directly associated with electric vehicles, have each published one paper in this domain. Table 3 also presents other subject areas that have contributed documents on electric vehicle studies to the Scopus database.

Table. 3. Quantities of research papers on electric vehicle related to field of specialization

№	Subject area	Number of pubications
1.	Engineering	1074
2.	Energy	277
3.	Computer Science	268
4.	Mathematics	215
5.	Materials Science	182
6.	Physics and Astronomy	153
7.	Environmental Science	68
8.	Earth and Planetary Sciences	55
9.	Chemical Engineering	50
10.	Social Sciences	49
11.	Decision Sciences	36
12.	Business, Management and Accounting	24
13.	Chemistry	19
14.	Agricultural and Biological Sciences	7
15.	Medicine	6
16.	Biochemistry, Genetics and Molecular Biology	5
17.	Economics, Econometrics and Finance	5
18.	Arts and Humanities	3
19.	Multidisciplinary	2
20.	Pharmacology, Toxicology and Pharmaceutics	1
21.	Psychology	1

Certainly, extracting main keywords and delving into the content of each document are crucial aspects of bibliometric analysis, enhancing the comprehensibility of articles. The visualization of keywords can significantly influence the identification of trends and extensions within the field of study, providing insights into total link strengths based on keywords. In the analysis of keywords associated with Electric Vehicles (EVs), a total of 8654 mentions were identified in this review paper. Furthermore, the number of co-occurrences of keywords in each article and research paper is 59, based on the limitation of frequency set at 25 times. More detailed information about the usage and occurrences of keywords can be obtained from the visualization presented in Figure 10. This figure provides a comprehensive overview of the distribution and relationships among keywords, offering valuable insights into the key thematic elements within the electric vehicle studies covered in the analyzed documents.

Regarding Figure 10, while the keywords were categorized into five clusters, the most prominently highlighted keyword across all clusters is "electric vehicle." The figure illustrates that the term "EVs" is consistently and predominantly used in all clusters. Each cluster is distinguished by a unique color, and the range of total link strength is presented.

To provide more precision about the clusters:

The 1st cluster (red) encompasses diverse terms related to the automobile, such as electric power transmission and electric power systems.

Cluster 4 (lilac) focuses on engines, control systems, and other related aspects.

The 2nd cluster concentrates on parts of electric cars, emphasizing terms like electric drives and electric machine control.

Cluster 3 (green) highlights the term "vehicle and electric power systems" and emphasizes the efficiency of power electronics and electric inverters, with references to winding and magnetic levitation vehicles.

The final cluster, cluster 5 (yellow), emphasizes the common usage of the term "Unmanned Aerial Vehicles (UAV)," indicating the widespread application of electric vehicles in military services.

Additionally, table 4 provides important details, including the number of total link strength and frequency of occurrences, across all 1074 documents. This table offers a comprehensive overview of the significance and prevalence of various keywords within the electric vehicle studies analyzed in this review.

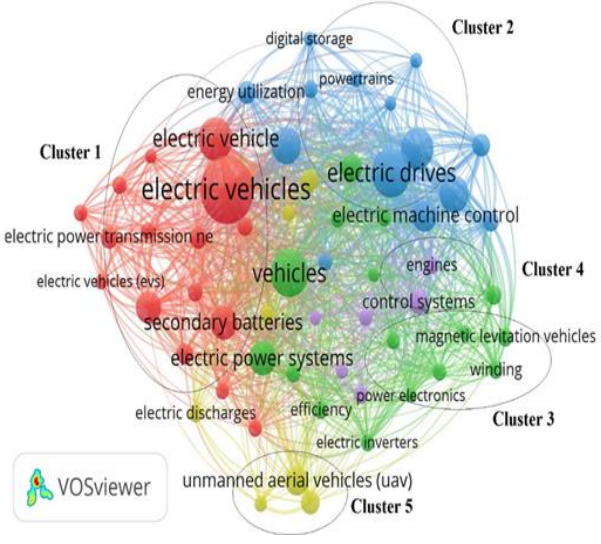

Fig. 10. Network visualization of key words based on the total link strength

Table. 4. Frequency of occurrences and the number of total link strengths

ID number	Keyword	Occurrences	Total link strength
350	Antennas	49	110
486	Automobile manufacture	25	78
497	Automobiles	30	131
934	Charging (batteries)	75	321
946	Charging station	30	130
1348	Control systems	50	170
1363	Controllers	32	106
1599	DC-DC converters	31	134
1797	Digital storage	25	85
2107	Efficiency	33	87
2143	Electric automobiles	34	138
2145	Electric batteries	30	137
2186	Electric discharges	32	73
2190	Electric drives	135	529
2222	Electric generators	27	87
2239	Electric inverters	30	154
2252	Electric machine control	71	360
2270	Electric motors	31	120
2303	Electric power supplies to apparatus	32	113
2305	Electric power system control	25	112
2313	Electric power systems	83	292
2316	Electric power transmission networks	44	145
2323	Electric propulsion	29	49
2359	Electric traction	104	477
2368	Electric transport	27	98
2376	Electric vehicle	110	380
2393	electric vehicles	209	746
2395	electric vehicles (EVs)	27	86
2400	Electric windings	36	163
2712	Energy efficiency	91	330
2734	Energy management	25	94
2769	Energy storage	44	157
2789	Energy utilization	46	181
2819	Engines	31	103
3828	Hybrid vehicles	59	233
3982	Induction motors	40	194
4151	Internal combustion engines	31	112
4421	Lithium-ion batteries	35	121
4601	Magnetic levitation vehicles	34	91
4668	Manufacture	30	114
4736	Matlab	29	149
5555	Optimization	41	115
5734	Permanent magnets	30	128
5989	power electronics	25	110
6100	Powertrains	28	114
6203	Propulsion	33	99
6546	Renewable energy resources	32	108
6653	Roads and streets	33	94
6781	Secondary batteries	80	358
7904	Traction control	45	242
7925	Traction motors	91	481
8204	Unmanned aerial vehicle	28	74
8208	Unmanned aerial vehicles (UAV)	65	149
8291	Vehicle	25	75
8354	Vehicle transmissions	45	159
8360	Vehicle wheels	26	85
8364	Vehicle-to-grid	30	110
8370	Vehicles	130	420
8575	Winding	32	137

Certainly, another important aspect to be analyzed is the categorization of electric vehicles into distinct groups. According to the categories of electric vehicles, there are five highlighted groups, as discussed in the following paragraph [5,9,31,40–43]

Battery Electric Vehicles (BEVs):

Battery Electric Vehicles (BEVs) are 100% electric vehicles that operate solely on the energy derived from electricity. These vehicles are equipped with an electric motor, an electric storage battery, and controllers. The electric motor is responsible for powering the vehicle, drawing energy from the onboard battery, making BEVs a fully electric and environmentally friendly transportation option [38,44].

Hybrid Electric Vehicles (HEVs):

Hybrid Electric Vehicles (HEVs) offer increased convenience compared to Battery Electric Vehicles (BEVs) due to their utilization of two energy sources. These vehicles incorporate both a traditional internal combustion engine and an electric motor, allowing them to operate using either power source or a combination of both. The dual power sources enhance flexibility and efficiency in hybrid vehicles [7,9,45–48]. Hybrid Electric Vehicles (HEVs) are further classified into different series, such as parallel or power-split hybrids. Unlike Battery Electric Vehicles (BEVs), HEVs do not require external recharging, and there is no need to plug them into the electrical power system to charge the battery. Instead, these hybrid vehicles generate electric power through internal processes, providing a self-sustaining power source for the electric motor [4,7,15,35,49,49–51].

Plug-In Hybrid Electric Vehicles (PHEVs):

Plug-In Hybrid Electric Vehicles (PHEVs) share characteristics with hybrid cars, featuring both an internal combustion engine and an electric motor. However, what sets PHEVs apart is their capability to be recharged by plugging into the electrical network. This allows users to replenish the electric power storage by connecting the vehicle to an external power source, offering the flexibility of electric-only driving for a certain distance before the internal combustion engine engages [7,10,15,35,49,50].

Fuel Cell Electric Vehicles (FCEVs):

Fuel Cell Electric Vehicles (FCEVs) employ an electric powertrain similar to Battery Electric Vehicles (BEVs). However, the distinctive feature of FCEVs is that they generate electricity by utilizing a fuel cell energized by hydrogen. These vehicles are often classified as zero-emission vehicles, as they produce electricity through the chemical reaction of hydrogen and oxygen in the fuel cell, emitting only water vapor as a byproduct [35,38,43].

Extended Range Electric Vehicles (EREVs):

Extended Range Electric Vehicles (EREVs) are engineered to operate by utilizing fuel for energy consumption while simultaneously generating electricity to charge the onboard battery system. In EREVs, the internal combustion engines have the specific function of charging the battery and are not directly con-

nected to the wheels of the vehicle. This design provides extended range capabilities, offering a combination of electric-only driving and the ability to use fuel for longer distances [31,51,54,55].

In the context of interactions with networks and environmental sources, Electric Vehicles (EVs) can operate in various types of working modes, including loading and unloading modes. There are distinct working modes associated with electrical networks. For example, Grid-to-Vehicle (G2V), Vehicle-to-Grid (V2G), Vehicle-to-Home (V2H), and Vehicle-to-Building (V2B). These modes define how electric vehicles can interact with the electrical grid, homes, and buildings in terms of energy flow and utilization [7,56–60]. When Electric Vehicles (EVs) are plugged into the electrical mains for charging the battery, the converter and rectifier play a crucial role in controlling the energy flow between the engine and battery systems. These components manage the conversion and rectification of electrical energy to ensure efficient charging and operation of the EV. The converter and rectifier work together to regulate the flow of energy, optimizing the charging process and overall performance of the vehicle's electrical systems [17,39,44,58,60].

The battery management system (BMS) plays a pivotal role in Electric Vehicles (EVs). The BMS is responsible for ensuring the proper functioning of EVs by controlling and overseeing essential processes such as loading and unloading, data acquisition, thermal management, and monitoring the charging state. It is a critical component that actively manages and maintains the health, performance, and safety of the battery in an electric vehicle. The BMS helps optimize the overall operation of the battery, ensuring efficient energy usage and extending the lifespan of the battery pack [4,8,16]. The battery charging state is a fundamental and significant technology in Electric Vehicles (EVs), providing essential information to drivers about the driving situation and offering data related to the charging and discharging of the battery. This technology plays a crucial role in keeping drivers informed about the current status of the vehicle's battery, enabling them to make informed decisions regarding charging and usage. It enhances the overall user experience by supplying real-time data that contributes to efficient and optimized management of the electric vehicle's energy resources [58-60]. Indeed, currently, lithium-ion batteries are commonly integrated into the technologies of battery systems for Electric Vehicles (EVs) due to their high energy density, power, and efficiency. Lithium-ion batteries have become a popular choice in the electric vehicle industry because they offer a favorable combination of energy storage capacity, power output, and overall efficiency. This technology contributes to enhancing the performance and range of electric vehicles, making them a practical and efficient choice for contemporary electric transportation [8,54]. While lithium-ion batteries are widely adopted for their low discharge rate and high voltage, they come with certain drawbacks that are acknowledged across manufacturing factories. These drawbacks include relatively long charging times, high material costs, and concerns regarding safety for passengers and drivers. Despite their popularity, addressing these challenges remains a focus of ongoing research and development efforts in the electric vehicle industry to further improve the technology [7,9,15].

Furthermore, there is noteworthy information about the current state of Electric Vehicles (EVs) in Uzbekistan. According to the Statistic Agency under the President of the Republic of Uzbekistan, the agency reported that the number of imported EVs to Uzbekistan was approximately 800 from January to February in the year 2023. The ownership of Electric Vehicles (EVs) cost consumers approximately $26.8 million USD. In the full year of 2022, the number of imported EVs to Uzbekistan reached about 2,180, with an expenditure of $69.8 million USD. It's noteworthy that there was a notable increase in the quantity of imported EVs to Uzbekistan, with an additional 1,371 imports in the year 2021 [18].

4. Conclusion

This review paper offers comprehensive information about Electric Vehicles (EVs) that have been researched thus far. The research on EVs has witnessed remarkable and sustained progress across countries worldwide since the discovery of EVs. Additionally, EVs have become a subject of great interest for educational institutions and manufacturing companies. Among the countries discussed in this review paper, Russia stands out with the highest percentage of publications on the theme of EVs, contributing to 61% of the total publication percentage among the selected countries. Ukraine follows in the second position, actively engaging in research on EVs, while Egypt holds the last position with only 15 (1%) of all research papers published among the selected countries. Examining the top writers among publishers, Bagheri, M emerges as the top contributor with 25 documents in the Scopus database related to the keywords. Other prominent writers, such as Anuchin A and Lu M, have publications ranging from 11 documents to 16 papers, respectively. The most common form of publication for EV-related research is in the form of conference papers, with the IOP Conference Series Materials Science and Engineering leading in the number of published papers on the theme of EVs.

The analysis of the most cited keywords has revealed several significant challenges in the realm of Electric Vehicles (EVs). Notably, issues such as energy storage systems, battery management systems, and the impact of temperature on battery working principles have garnered attention from researchers. Scientists are particularly focused on optimizing battery management systems and finding ways to enhance temperature reduction strategies. Another emerging problem in the EV domain involves the exploration of new technologies, including Intelligent Battery Systems (IBS) and Integrated Thermal Management Systems (ITMS). Researchers are actively engaged in manufacturing the main components of batteries using newly researched materials. Charging systems pose yet another challenge in the EV landscape. Presently, scientists and EV manufacturing companies are working towards the development of new charging systems

aimed at reducing charging times and improving overall efficiency. One such innovation is the Wireless Power Transfer System (WPTS) for cars, which holds promise as a prospective solution for the future of EV charging systems.

Electric Vehicles (EVs) are currently playing a crucial role in reducing greenhouse gases and emissions. They are actively undergoing development for future prospects, with support from governmental agreements in various areas, leading to investments in practical and financial projects. The outcomes of these studies and research can serve as contributors to the continuous improvement of EV performance across various aspects of our lives. Looking ahead, advancements in EV technology can lead to increased energy storage system capacity, enhanced passenger security, and optimized charging systems. Future developments may provide faster and simpler charging methods, along with expanded charging point infrastructure. Additionally, there is a focus on utilizing new sources of energy, such as renewable energy sources like solar energy and wind energy. These developments not only benefit the environment but also hold the potential to enhance the quality of life for people in society in the future.

Acknowledgment

The authors of this article express their gratitude to Ni Lin for the support and funding that made the publication of this review paper possible in journals. Special thanks go to Mukhiddin Juliev and Jasur Rashidov for providing guidance on methodology and tools such as VOSviewer and Zatero apps. The authors are also appreciative of Andijan Machine Building Institute for organizing courses to instruct researchers on the rules of publishing high-quality papers in journals. Furthermore, the authors extend they're thanks to Beijing Institute of Technology for their cooperation on this publication. The contributions of professors including Almataev Tojiboy, Karimkhodjaev Nazirjon, Qayumov Bakhrom, Saidaliev Ismoiljon from Andijan Machine Building Institute, and Mirzaabdullaev Jakhongir, Khakimov Jamshid, and Daminov Oybek from Tashkent State Technical Institute named after Islam Karimov, Jasur Rashidov from Tashkent Institute of Architecture and Civil Engineering are also acknowledged for their assistance in the publication of this review paper.

Nomenclature

BEVs	: battery electric vehicles
BMS	: battery management system
EREVs	: extended range electric vehicles
EV	: electric vehicle
FCEVs	: fuel cell electric vehicles
G2V	: grid-to-vehicle
HEVs	: hybrid electric vehicles
IBS	: intelligent battery systems
ITMS	: integrated thermal management system
Kwh	: kilowatt-hour
PHEVs	: plug-in hybrid electric vehicles
UAV	: unmanned aerial vehicles
V2B	: vehicle-to-building
V2G	: vehicle-to-grid
V2H	: vehicle-to-home
WPTS	: wireless power transfer system

Conflict of Interest Statement

The authors declare that there is no conflict of interest in the study.

CRediT Author Statement

Abdullaev Ibrokhimjon: Conceptualization, Methodology, Software, Writing-original draft, Reviewing and editing, Visualization,
Ni Lin: Conceptualization, Reviewing and editing, Visualization, Supervision
Rashidov Jasur: Methodology, Reviewing and editing, Visualization,

References

[1] Miah MdS, Hossain Lipu MS, Meraj ST, Hasan K, Ansari S, Jamal T, et al. Optimized Energy Management Schemes for Electric Vehicle Applications: A Bibliometric Analysis towards Future Trends. Sustainability 2021;13:12800. https://doi.org/10.3390/su132212800.

[2] Sumabat AK, Lopez NS, Yu KD, Hao H, Li R, Geng Y, et al. Decomposition analysis of Philippine CO2 emissions from fuel combustion and electricity generation. Appl Energy 2016;164:795–804. https://doi.org/10.1016/j.apenergy.2015.12.023.

[3] Barbosa W, Prado T, Batista C, Câmara JC, Cerqueira R, Coelho R, et al. Electric Vehicles: Bibliometric Analysis of the Current State of the Art and Perspectives. Energies 2022;15:395. https://doi.org/10.3390/en15020395.

[4] Shokrgozar S, Remme D, Stock R. "We Have to Convince Them Whatever it Takes:" The Climate Necropolitics of Energy Transitions in India and Zambia 2024. https://doi.org/10.1016/j.geoforum.2024.103945.

[5] Goel S, Sharma R, Rathore AK. A review on barrier and challenges of electric vehicle in India and vehicle to grid optimisation. Transp Eng 2021;4:100057. https://doi.org/10.1016/j.treng.2021.100057.

[6] Omariba ZB, Zhang L, Sun D. Review of Battery Cell Balancing Methodologies for Optimizing Battery Pack Performance in Electric Vehicles. IEEE Access 2019;7:129335–52. https://doi.org/10.1109/ACCESS.2019.2940090.

[7] Hannan MA, Hoque MM, Mohamed A, Ayob A. Review of energy storage systems for electric vehicle applications: Issues and challenges. Renew Sustain Energy Rev 2017;69:771–89. https://doi.org/10.1016/j.rser.2016.11.171.

[8] Geller B, Quinn C, Bradley TH. Analysis of Design Tradeoffs for Plug-in Hybrid Vehicles. Electr. Hybrid Veh., Elsevier; 2010, p. 159-91. https://doi.org/10.1016/B978-0-444-53565-8.00006-3.

[9] Gharibeh HF, Khiavi LM, Farrokhifar M, Pozo D. Life Cycle Cost Analysis of Electric Vehicles based on Critical Price and Critical Distance. Proc. 2019 IEEE PES Innov. Smart Grid Technol. Eur. ISGT-Eur. 2019, Institute of Electrical and Electronics Engineers Inc.; 2019. https://doi.org/10.1109/ISGTEurope.2019.8905527.

[10]Filote C, Felseghi R, Raboaca MS, Aşchilean I. Environmental impact assessment of green energy systems for power supply of electric vehicle charging station. Int J Energy Res 2020;44:10471–94. https://doi.org/10.1002/er.5678.

[11]Avramenko A, Vnukova N, Kozlovskyi O, Zipunnikov M, Hradovych N, Darmofal E, et al. Revealing the Effect of Plasma-Chemical Treatment of Propane-Butane Fuel on the Environmental Characteristics of the Internal Combustion Engine. East-Eur J Enterp Technol. 2022; 117(10). https://doi.org/10.15587/1729-4061.2022.259477.

[12]Ahmadigorji M, Mehrasa M. A Robust Renewable Energy Source-oriented Strategy for Smart Charging of Plug-in Electric Vehicles Considering Diverse Uncertainty Resources. International Journal of Engineering, Transactions A: Basics. 2023; 36(4): 709-719. https://doi.org/10.5829/ije.2023.36.04a.10.

[13]Hasan MK, Mahmud M, Ahasan Habib AKM, Motakabber SMA, Islam S. Review of electric vehicle energy storage and management system: Standards, issues, and challenges. J Energy Storage 2021; 41: 102940. https://doi.org/10.1016/j.est.2021.102940.

[14]Abadi SAGK, Choi J, Bidram A. A Method for Charging Electric Vehicles With Battery-Supercapacitor Hybrid Energy Storage Systems to Improve Voltage Quality and Battery Lifetime in Islanded Building-Level DC Microgrids 2023. https://doi.org/10.1109/TSTE.2023.3254597.

[15]Lévay PZ, Drossinos Y, Thiel C. The effect of fiscal incentives on market penetration of electric vehicles: A pairwise comparison of total cost of ownership. Energy Policy 2017; 105: 524-33. https://doi.org/10.1016/j.enpol.2017.02.054.

[16]Teoh T, Kunze O, Teo C-C, Wong Y. Decarbonisation of Urban Freight Transport Using Electric Vehicles and Opportunity Charging. Sustainability 2018; 10: 3258. https://doi.org/10.3390/su10093258.

[17]Abdubannaev J, Lu S, Ai X, Sun Y, Makhamadjanova N, Khasanov M. Investigate the Use of Electric Vehicles to Improve Resilience for Active Distribution Network System. 5th IEEE Conf. Energy Internet Energy Syst. Integr. Energy Internet Carbon Neutrality EI2 2021, Institute of Electrical and Electronics Engineers Inc.; 2021. https://doi.org/10.1109/EI252483.2021.9713572.

[18]Agati G, Borello D, Migliarese Caputi MV, Cedola L, Gagliardi GG, Pozzessere A, et al. Effect of the Degree of Hybridization and Energy Management Strategy on the Performance of a Fuel Cell/Battery Vehicle in Real-World Driving Cycles 2024. https://doi.org/10.3390/en17030729.

[19]Aliberti D, Ortenzi F, La Battaglia V, Marini S, Vellucci F. Evaluation of the efficiency of a hybrid ICE vehicle fuelled with hydrogen compared with a fuel cell vehicle, based on a simulation model, 2023. https://doi.org/10.1088/1742-6596/2648/1/012082.

[20]Alpaslan E, Karaoğlan MU, Colpan CO. Investigation of drive cycle simulation performance for electric, hybrid, and fuel cell powertrains of a small-sized vehicle 2023. https://doi.org/10.1016/j.ijhydene.2023.08.358.

[21]Narasipuram RP, Mopidevi S. A technological overview & design considerations for developing electric vehicle charging stations. J Energy Storage 2021;43:103225. https://doi.org/10.1016/j.est.2021.103225.

[22]Abdalla MAA, Min W, Bing W, Ishag AM, Saleh B. Double-layer home energy management strategy for increasing PV self-consumption and cost reduction through appliances scheduling, EV, and storage 2023. https://doi.org/10.1016/j.egyr.2023.10.019.

[23]Han J, Kang H-J, Kim M, Kwon GH. Mapping the intellectual structure of research on surgery with mixed reality: Bibliometric network analysis (2000–2019). J Biomed Inform 2020;109:103516. https://doi.org/10.1016/j.jbi.2020.103516.

[24]CetiN E, SeyiToglu SS. A bibliometric overview of research on auxetic structures: Trends and patterns. Int J Automot Sci Technol 2024. https://doi.org/10.30939/ijastech..1374313.

[25]Seyitoglu SS, Kiliçarslan A. The Related Study Tendencies in the Field of Gasification: A Bibliometric Approach. Gazi Univ J Sci 2022;35:980–95. https://doi.org/10.35378/gujs.874093.

[26]Puma-Benavides DS, Izquierdo-Reyes J, Calderon-Najera JDD, Ramirez-Mendoza RA. A Systematic Review of Technologies, Control Methods, and Optimization for Extended-Range Electric Vehicles. Appl Sci 2021;11:7095. https://doi.org/10.3390/app11157095.

[27]Li X, Yang J, Zhang L, Jin G, Xu L, Fang F, et al. A Bibliometric Analysis of Leprosy during 2000–2021 from Web of Science Database. Int J Environ Res Public Health 2022;19:8234. https://doi.org/10.3390/ijerph19148234.

[28]Singh VK, Singh P, Karmakar M, Leta J, Mayr P. The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. Scientometrics 2021;126:5113–42. https://doi.org/10.1007/s11192-021-03948-5.

[29]Van Eck NJ, Waltman L. Software survey: VOSviewer, a computer program for bibliometric mapping. Scientometrics 2010;84:523–38. https://doi.org/10.1007/s11192-009-0146-3.

[30](Melrose) Pan M, Uddin M, Lim H. Understanding Electric Vehicle Ownership Using Data Fusion and Spatial Modeling. Transportation Research Part D: Transport and Environment. 2024; 127: 104075. https://doi.org/10.1016/j.trd.2024.104075.

[31]Aarniovuori L, Pyrhonen J, Liu D, Kauranen P, Korhonen J, Tikka V. Energy Efficiency Analysis of Electric Vehicle System Components. 2023 IEEE Transportation Electrification Conference and Expo, Asia-Pacific; 2023; Chiang Mai, Thailand. https://doi.org/10.1109/ITECAsia-Pacific59272.2023.10372377.

[32]Zhao X, Wang S, Wang X. Characteristics and Trends of Research on New Energy Vehicle Reliability Based on the Web of Science. Sustainability 2018;10:3560. https://doi.org/10.3390/su10103560.

[33]Beshta O, V. Boroday, S. Khudolii, S. Pirienko. A Review of Topologies of Quick Charging Stations for Electric Vehicles. Proc. 20th IEEE Int. Conf. Mod. Electr. Energy Syst. MEES 2021, Institute of Electrical and Electronics Engineers Inc.; 2021. https://doi.org/10.1109/MEES52427.2021.9598796.

[34]Habib AKMA, Hasan MK, Mahmud M, Motakabber SMA, Ibrahimya MI, Islam S. A review: Energy storage system and balancing circuits for electric vehicle application. IET Power Electron 2021;14:1–13. https://doi.org/10.1049/pel2.12013.

[35]Arif SM, Lie TT, Seet BC, Ayyadi S, Jensen K. Review of Electric

Vehicle Technologies, Charging Methods, Standards and Optimization Techniques. Electronics 2021;10:1910. https://doi.org/10.3390/electronics10161910.

[36]Sam CA, Jegathesan V. Bidirectional integrated on-board chargers for electric vehicles—a review. Sādhanā 2021;46:26. https://doi.org/10.1007/s12046-020-01556-2.

[37]Alferov VI. Current status and potentialities of wind tunnels with MHD acceleration. High Temp 2000. https://doi.org/10.1007/BF02755960.

[38]Bibak B, Tekiner-Moğulkoç H. A comprehensive analysis of Vehicle to Grid (V2G) systems and scholarly literature on the application of such systems. Renew Energy Focus 2021;36:1–20. https://doi.org/10.1016/j.ref.2020.10.001.

[39]Abbink V, Landes D, Altinsoy ME. Experimental Determination of the Masking Threshold for Tonal Powertrain Noise in Electric Vehicles. Acoustics. 2023; 5(4): 882-897. https://doi.org/10.3390/acoustics5040051.

[40]G H, B S, Ananthapadmanabha. Hybrid and electric vehicle tribology: a review. Surf Topogr Metrol Prop 2021;9:043001. https://doi.org/10.1088/2051-672X/ac2bf6.

[41]Nanaki EA. Electric vehicles. Electr. Veh. Smart Cities, Elsevier; 2021, p. 13-49. https://doi.org/10.1016/B978-0-12-815801-2.00006-X.

[42]Abd-Elhaleem S, Shoeib W, Sobaih AA. A New Power Management Strategy for Plug-In Hybrid Electric Vehicles based on an Intelligent Controller Integrated with CIGPSO Algorithm. Energy. 2023; 265, 126153 . https://doi.org/10.1016/j.energy.2022.126153.

[43]Hannan MA, Lipu MSH, Hussain A, Mohamed A. A review of lithium-ion battery state of charge estimation and management system in electric vehicle applications: Challenges and recommendations. Renew Sustain Energy Rev 2017;78:834–54. https://doi.org/10.1016/j.rser.2017.05.001.

[44]Abbasi MH, Arjmandzadeh Phd Z, Zhang J, Xu B, Krovi VN. Reinforcement Learning Based Fast Charging of Electric Vehicle Battery Packs, 2023. https://doi.org/10.4271/2023-01-1681.

[45]Sami I, Ullah Z, Salman K, Hussain I, Ali SM, Khan B, et al. A Bidirectional Interactive Electric Vehicles Operation Modes: Vehicle-to-Grid (V2G) and Grid-to-Vehicle (G2V) Variations Within Smart Grid. 2019 Int. Conf. Eng. Emerg. Technol. (ICEET); 2019; Lahore, Pakistan. https://doi.org/10.1109/CEET1.2019.8711822.

[46]Alaraideh H, Habib M, Yaghi M, Al-Tarifi M. Advancements, Challenges, and Outlook of Fuel-Cell Electric Vehicles: Review Study. 2023 14th International Renewable Energy Congress (IREC); 2023; Sousse, Tunisia. https://doi.org/10.1109/IREC59750.2023.10389237.

[47]Albatayneh A, Juaidi A, Jaradat M, Manzano-Agugliaro F. Future of Electric and Hydrogen Cars and Trucks: An Overview. Energies. 2023; 16(7): 3230. https://doi.org/10.3390/en16073230.

[48]Zheng G, Tan L, Tian G, Yang B, Li Q, Sun G. Dynamic crashing behaviors of prismatic lithium-ion battery cells. Thin-Walled Structures. 2023; 192: 110902. https://doi.org/10.1016/j.tws.2023.110902.

[49]Al-Nimr M, Haddad O, Al-Samamah L. The feasibility of using magnetic refrigeration cycles in the thermal management of rechargeable batteries in electric cars 2023. https://doi.org/10.1016/j.energy.2023.129131.

[50]Lin N, Ci S, Wu D. A novel low-cost online state of charge estimation method for reconfigurable battery pack. 2016 IEEE Appl. Power Electron. Conf. Expo; 2016; APEC, Long Beach, CA, USA. https://doi.org/10.1109/APEC.2016.7468321.

[51]Lin N, Ci S, Li H. An enhanced circuit-based battery model with considerations of temperature effect. 2014 IEEE Energy Convers. Congr. Expo. ECCE; 2016; Pittsburgh, PA, USA. https://doi.org/10.1109/ECCE.2014.6953943.

[52]Billy RG, Müller DB. Aluminium use in passenger cars poses systemic challenges for recycling and GHG emissions 2023. https://doi.org/10.1016/j.resconrec.2022.106827.

[53]Dobretsov RY, Porshnev GP, Semenov AG, Bulakh DV, Bondar KA. The estimation of main parameters of the power plant and electromechanical powertrain for the wheeled vehicle. Int Rev Mech Eng 2020. https://doi.org/10.15866/ireme.v14i2.18262.

[54]Zhou W, Zheng Y, Pan Z, Lu Q. Review on the Battery Model and SOC Estimation Method. Processes 2021;9:1685. https://doi.org/10.3390/pr9091685.

[55]Abduraxman BM, Harrison T, Ward CP, Midgley WJB. Optimal intermittent electrification and its effect on battery sizing and energy saving using a high-fidelity train model 2023. https://doi.org/10.1177/09544097231159179.

[56]Afzal A, Abdul Razak RK, Mohammed Samee AD, Kumar R, Ağbulut Ü, Park SG. A critical review on renewable battery thermal management system using heat pipes 2023. https://doi.org/10.1007/s10973-023-12100-9.

[57]Yang B, Wang J, Cao P, Zhu T, Shu H, Chen J, et al. Classification, summarization and perspectives on state-of-charge estimation of lithium-ion batteries used in electric vehicles: A critical comprehensive survey. J Energy Storage 2021;39:102572. https://doi.org/10.1016/j.est.2021.102572.

[58]Achariyaviriya W, Wongsapai W, Janpoom K, Katongtung T, Mona Y, Tippayawong N, et al. Estimating Energy Consumption of Battery Electric Vehicles Using Vehicle Sensor Data and Machine Learning Approaches 2023. https://doi.org/10.3390/en16176351.

[59]Almeida A, Sousa N, Coutinho-Rodrigues J. Quest for Sustainability: Life-Cycle Emissions Assessment of Electric Vehicles Considering Newer Li-Ion Batteries. Sustainability 2019;11:2366. https://doi.org/10.3390/su11082366.

[60]Ci S, Lin N, Wu D. Reconfigurable Battery Techniques and Systems: A Survey. IEEE Access 2016;4:1175–89. https://doi.org/10.1109/ACCESS.2016.2545338.