Bibliometric Analysis of Electric Vehicle Charging Station Location Optimization in the Context of Sustainability

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***Abstract*— This study examines the role of green technologies for a sustainable future, focusing particularly on the optimal site selection for electric vehicle charging stations. In this context, a bibliometric analysis was conducted by reviewing the literature on the optimal location selection for electric vehicle charging stations within the framework of sustainability. Selecting the most suitable charging station locations reduces negative environmental impacts. The analysis revealed that the most frequently used topics were electric vehicles and optimization. Various statistical data based on the identified keywords were also included. As a result of the study, methods and influential topics reflecting the trends in the current literature were identified through bibliometric analysis, and the areas where future topics are likely to be addressed were analyzed. Accordingly, while studies in this field mainly focus on site selection, optimization, and modeling, conceptual topics related to social sustainability and managerial decision-making are limited.**

***Keywords*— Sustainability; Green Technologies; Electric Vehicles; Bibliometric Analysis**

I.INTRODUCTION

Environmental sustainability issues are becoming increasingly important. Green technologies, especially electric vehicles, are of strategic importance due to the constantly increasing energy demand and the emergence of climate change. Electric vehicles are considered environmentally friendly vehicles with their low energy consumption and advanced technological features (Higueras-Castillo et al. 2020). In addition to being green technology for a sustainable future, these vehicles also offer low maintenance costs and good driving performance (Krishnan and Butt 2022). Sustainability ensures the most efficient use of resources to meet the needs of current and future generations. Sustainability has become particularly important in the automotive industry (Alioğulları et al. 2024). Green technologies are a key element in ensuring environmental sustainability, improving environmental quality and human well-being. Green technology reduces carbon emissions by ensuring the efficient use of energy (Pan et al. 2019).

A literature review of some studies conducted in this field is as follows: Samat et al. (2022) addressed the GIS-based multi-criteria decision-making method in the site selection process for electric vehicle charging stations using bibliometric analysis. Mostaghis et al. (2025) conducted a comprehensive bibliometric analysis of electric vehicle research. They analyzed 85,000 electric vehicle articles indexed in the Scopus database between 2016 and 2024. The analysis identified 15 research clusters through bibliometric mapping tools. China, India, and the USA have become leaders in global electric vehicle research based on the number of publications. Miah et al. (2021) examined optimized energy management schemes for electric vehicle applications using bibliometric analysis for future trends. According to the results of the bibliometric analysis, the countries with the highest number of articles were China, the USA, France, and the United Kingdom. The study highlighted the current challenges, problems, and important discussions and recommendations for future research related to energy management systems for electric vehicle applications. Singh et al. In their study (2024), Abdel-Basset et al. (2024) addressed the adoption and sustainability of electric vehicles using bibliometric analysis. The findings obtained from clustering analysis and morphology analysis were analyzed using bibliometric analysis. In their study, Abdel-Basset et al. (2024) determined the most sustainable location for an electric vehicle charging station in Zagazig, Egypt. This study was conducted in a neutrosophic environment with the participation of four experts in the field of electric vehicles and decision-making. Mogire et al. (2025) examined smart charging for electric vehicles in urban areas using bibliometric analysis. They analyzed a total of 201 studies from the Scopus database between 2005 and 2025 and presented various statistical results. Veza et al. (2024) conducted a bibliometric analysis on Electric Vehicle Trends, Policy, Lithium-Ion Batteries, Battery Management, Charging Infrastructure, Smart Charging, and Electric Vehicle-to-Everything (V2X) Communication.

This study will examine sustainable futures, green technologies, and the optimal location of charging stations for electric vehicles through a literature review and bibliometric analysis. In this context, the study aims to contribute to the existing literature. The studies reviewed will be comprehensively examined through bibliometric analysis, and some statistical tables will be presented regarding green environments, sustainability, electric vehicles, and the optimal location of charging stations.

II.*MATERIALS and METHODS*

Air pollution and noise pollution caused by fossil fuels can be cited as the most important reasons for the increase in electric vehicle use in recent years. The use of electric vehicles will reduce carbon dioxide emissions, which are the cause of climate change, and the risk of unhealthy air and environmental conditions will decrease (He et al. 2013). Disadvantages of electric vehicles include insufficient battery capacity, insufficient infrastructure, and charging stations located in inappropriate areas (Thiel et al. 2012). Optimally locating charging stations will improve traffic networks, reduce costs, and increase efficiency. Therefore, the location of charging stations is an important issue for environmental sustainability (Liu et al. 2012). In this study, a total of 250 studies were examined using four keywords (location optimization, charging station, sustainable, electric vehicles) determined from the Web of Science (WOS) database, and a statistical analysis and bibliometric study were conducted.

B. Bibliometric Analysis Results

Bibliometric analysis is the numerical examination of publications produced within a specific period and field and the identification of relationships between them. This method provides researchers with insights into criteria such as the number of publications, citation relationships, collaborations among authors, and subject distribution (Alioğulları et al. 2025). Below are the bibliometric analysis tables obtained based on the four keywords in our study. Important information from the bibliometric results includes the thematic structure among publications, the interconnectedness of key clusters, and some statistical information.

Figure 1 provides some statistical information, such as the number of references, number of authors, and the annual growth rate of the study.

Figure 1: General data information.

Figure 2: Keyword cloud.

Figure 2 shows the frequency of keyword use. The most frequently used word is "optimization," followed by "model," "location stations," and "infrastructure. Figure 3 shows the trending topics analyzed based on the keywords we identified in the WOS. For example, electric vehicles and management were the topics of focus in 2024 and 2025, while model, network, and deployment were the topics of focus in 2022.

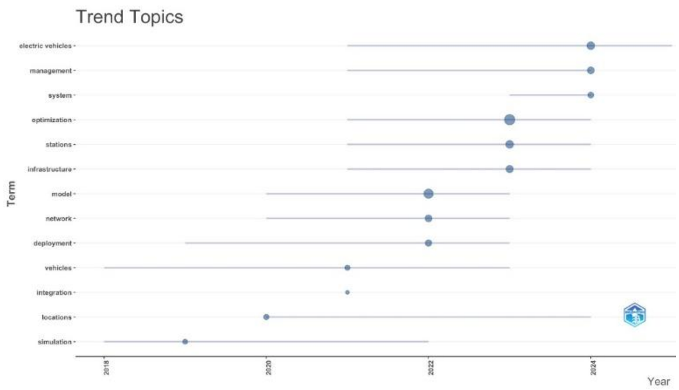

Figure 3: Factorial analysis world map

Figure 4 shows the most influential authors in the field based on the four keywords identified. Accordingly, Zhang is the most influential author with 6 articles. Following Zhang are Guo, Liu, and Wang, each with 5 articles. The top ten authors with the most publications have contributed a total of 41 articles.

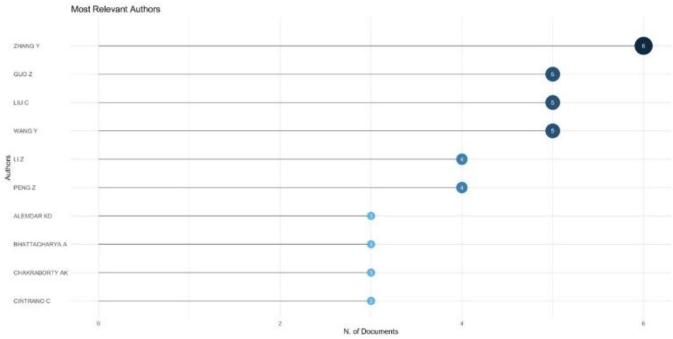

Figure 4. Most Relevant Authors

Figure 5 presents a map of the countries with the highest scientific productivity. In other words, it shows the scientific productivity levels of the countries in the field under study. Accordingly, China, the USA, and India, shown in the darkest color, have the highest productivity. The publication frequency values for these countries are as follows: China: 215, India: 11, and USA: 121. Countries with more limited but visible production are shown in light blue, while countries with low publication output in the database are shown in gray.

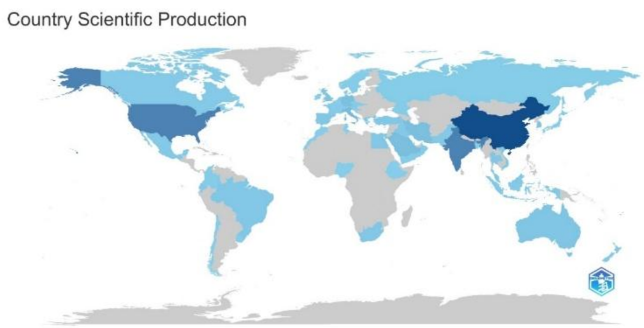

Figure 5. Country Scientific Production

Figure 6 shows the scientific output of some countries. The data used here is given as the number of single-country publications (SCP) and the number of multi-country publications (MCP). For China, 35 out of 58 studies are SCPs, while 23 are MCPs. India has 25 SCPs and 8 MCPs among 33 studies. The US has 23 SCPs and 4 MCPs among 27 studies.

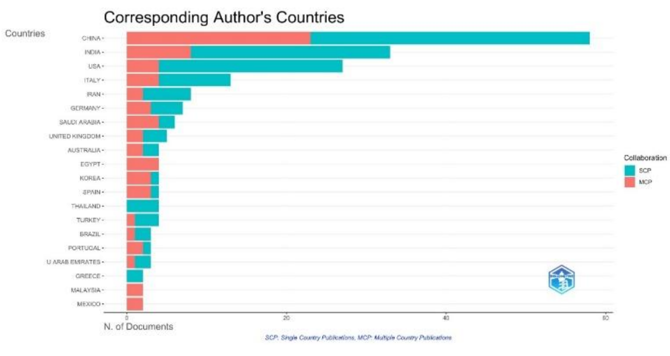

Figure 6. Corresponding Author's Countries

Figure 7 shows the amount of change in scientific output and production over time, according to some sources. The journal Sustainable Cities and Society has been shown to be the most productive journal in the identified fields since 2016. In this respect, Sustainable Cities and Society is the most productive journal. The journal peaked in 2025. While Energies, Sustainable Energy Grids, and IEEE Access journals have shown an increase in publications recently, they have not reached the number of publications of Sustainable Cities and Society.

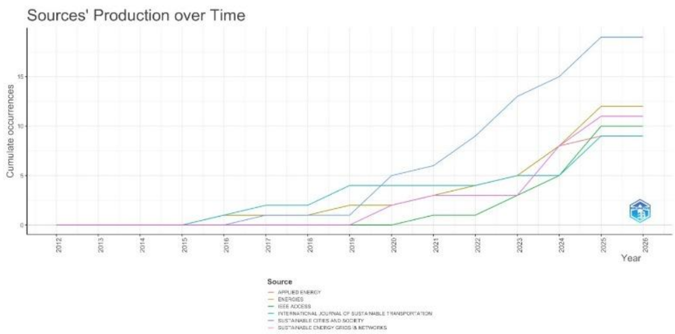

Figure 7. Sources Production Over Time

Figure 8 illustrates how journals related to Bradford's law, formulated in 1967, are distributed within the literature (Bradford, 1934; Garfield, 1980). According to Bradford's law, to create a comprehensive bibliography for a specific research area, it is first necessary to identify a limited number of core journals containing approximately one-third of the publications in the literature. A portion of the remaining publications falls into a second group encompassing more journal titles, while a third cluster, comprising the largest group of journals, contains a significant portion of the remaining publications. This demonstrates that scientific knowledge in a given field is concentrated in specific journals, while the remainder is spread across a wider and more dispersed network of publications. Figure 8 shows how core sources are concentrated according to Bradford's law. The horizontal axis represents the logarithmic order of journals based on their productivity, while the vertical axis represents the number of articles published by each journal on the relevant topic. The gray core sources represent the core journals, i.e., the centers of highest article output on the subject. Accordingly, the journal Sustainable Cities and Society is a comprehensive journal with the highest number of studies in its field. Its inclusion in the core sources section indicates a strong focus on urban sustainability and its technical aspects. Besides this journal, other journals such as Energies and Sustainable Energy and Grids and Networks also demonstrate strength in these areas.

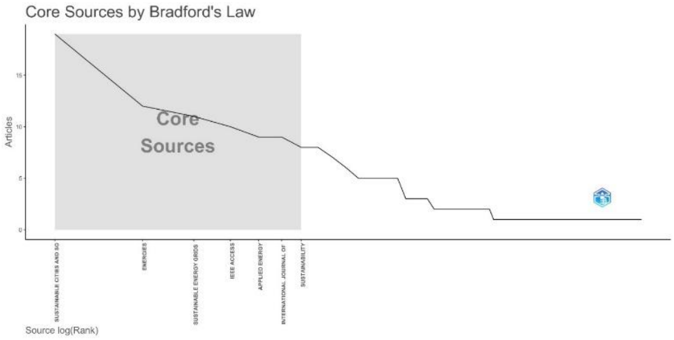

Figure 8. Core Sources by Bradford's Law

Figure 9 shows the most cited studies and their authors. The horizontal axis shows Global Citations, indicating the total number of citations received by studies in databases such as WOS and Scopus. The vertical axis shows the most prominent articles based on specified keywords and year information. According to Figure 9, while Sustainable Cities and Society is the most cited journal, the author Mozafar received the most citations with 222. The second most cited journal is the International Journal of Sustainable Transportation, with the author Kunith receiving 198 citations. The third most cited journal is Renewable & Sustainable Energy Reviews, with Metais receiving the most citations at 179. Studies in the medium-to-high impact group include Pal and Andrenacci, and the journals Sustainable Energy, Grids and Networks, and Applied Energy. Studies with fewer than 100 citations, considered below the threshold but still critical, include Energies, Sustainable Cities and Society, Annals of GIS, and Journal of Power Sources.

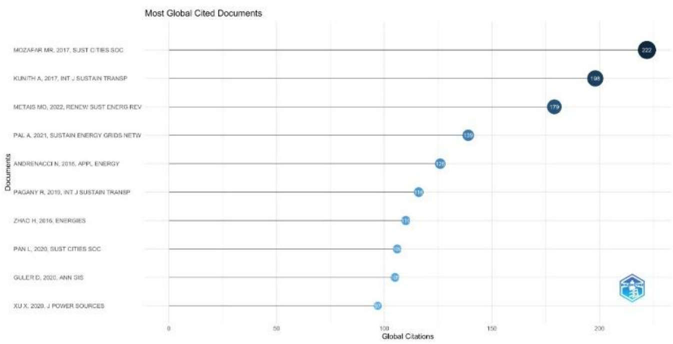

Figure 9. Most Global Cited Documents

Figure 10 shows the thematic map based on the identified keywords and years. This figure shows the positioning of keywords according to their relevance or centrality and intensity values. The themes in the upper right part of the figure represent highly developed topics. These topics are located in the motor themes section. Some prominent topics are: Management, Adoption, Life-cycle assessment, Selection, Routing problem, distribution network. These topics show that the research area focuses on optimization, modeling, and decision-making techniques. We can see that topics such as life-cycle assessment and CO2 emissions are concentrated in themes focused on environmental sustainability. The prominent concepts in the basic themes section in the lower right part of Figure 10 are: Charging stations, allocation, model, location, design, and algorithm. Based on these topics, it can be seen that the studies conducted in this field are concentrated on the site selection and optimization of electric vehicle charging stations and have a wider use in the literature. Niche Themes, located in the upper left part of the figure, include topics with more limited interaction. These include; charging infrastructure, travel, transmission, operations, and optimal power flow. While the number of studies in this area is not very large, a certain number of studies have focused intensely on this subject. These topics fall within the scope of technical departments such as energy engineering. Finally, in the lower left section, you will find emerging or declining themes. The topics in this section represent either relatively little-studied subjects that are becoming outdated or newly emerging topics. The prominent concepts in this area are regulations and representations.

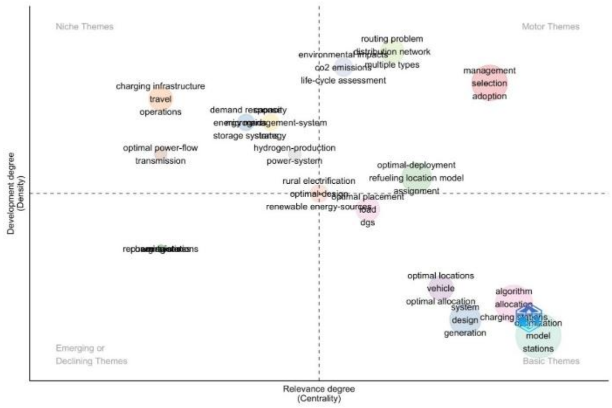

Figure 10. Thematic map

Figure 11 shows the clustering and conceptual relationships among keywords retrieved from the WOS database. Four regions are present, and the keywords within these four regions are clustered together. Concepts that are closely related are often used together in studies. Examining this figure, it can be seen that the problems are structured around three main axes: location problems, optimization, and management. Related topics are located on the right side of the horizontal axis: routing problem, algorithms, allocation, storage, load, charging stations, and placement. On the left side are analytic hierarchy process, framework, simulation, and performance. These concepts can be associated with decision-making methods. The upper region on the vertical axis contains related concepts: charging infrastructure, city, energy, demand, and travel. In the lower region, adoption, feasibility, behavior, impact, and management are related concepts used together. Based on these concepts, it can be seen that studies are heavily focused on management issues. According to Figure 11, the core concepts in the center consist of location, integration, uncertainty, optimization, system, and model. Accordingly, it has been revealed that the studies are predominantly based on optimization and algorithms. However, there are also studies related to social, sustainable, and managerial decision-making processes.

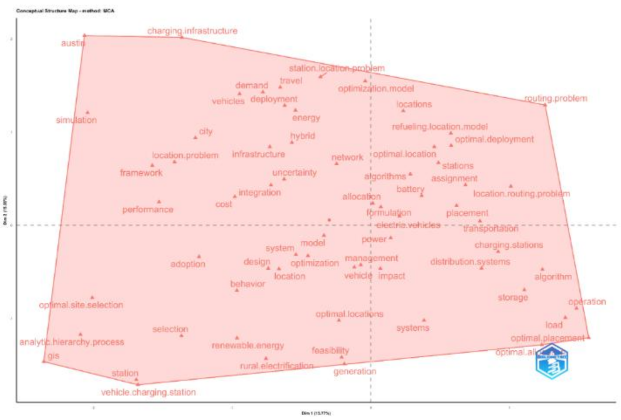

Figure 11. Factorial Map

III.RESULTS and DISCUSSION

This study examines the optimal location selection of electric vehicle charging stations in the context of sustainability through bibliometric analysis. The study systematically investigates broad trends in green sustainability. The results of the bibliometric analysis show a growing focus on environmentally sustainable electric vehicle location selection, particularly in recent years. Electric vehicles have become a popular topic in recent years. This highlights the increasing importance of environmental sustainability and green environment issues, despite some disadvantages of electric vehicle use, such as shorter battery life.

According to information obtained from bibliometric and WOS databases, the most frequently used keywords were electric vehicles and optimization. Among the sustainable development goals, affordable and clean energy ranked first, sustainable cities and communities second, and climate action third. The number of publications increased significantly, especially in 2024. The analysis results show that transportation, location selection, and energy efficiency play critical roles in environmental sustainability. To create environmentally friendly solutions, optimization studies in these areas can be conducted to make resource use more efficient, reduce carbon emissions, and develop sustainable and optimal location selection strategies.

According to the findings from the bibliometric analysis, the most frequently used topics in the literature have been optimization, modeling, and site selection. Journals such as Sustainable Cities and Society, Applied Energy, and Renewable and Sustainable Energy Reviews rank first in terms of publication volume. It can be said that the most frequent citations are within the scope of sustainable cities and transportation networks. Based on the results of the literature review and bibliometric analysis, a significant gap is observed in the field of sustainability issues related to social, governance, and environmental dimensions. In this context, it is suggested that future studies should not be limited to modeling or decision-making methods alone, but should combine environmental and social sustainability with different hybrid methods. For future studies, integrated decision models, machine learning-based demand or site selection models, and artificial intelligence-based learning models can be used. Policy and application-focused studies will also help fill the gap in the literature.

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