World Electric Vehicle Journal

MDPI

Review

Electric Vehicles in Last-Mile Delivery: A Bibliometric Review

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Abstract: The rapid growth in e-commerce calls for research on the potential of electric vehicles in improving last-mile delivery. Whereas existing studies have examined aspects of last-mile delivery, such as challenges, acceptance/benefits, and feasibility, the studies are fragmented, with conflicting findings and regional differences. Thus, there is a need for a comprehensive understanding of the studies to map out current research trends and propose future research agendas. To address this research gap, a bibliometric review was conducted on 375 publications from the Scopus database. Findings reveal that pioneering countries such as the USA have researched integrating electric vehicles into last-mile delivery systems, focusing on technological advancements such as battery technologies and smart grids. The sustainability theme is common in most studies, focusing on controlling carbon emissions and energy efficiency. The electric micro-mobility theme has grown in recent years, while emerging technologies remain underexplored, especially in developing economies. Future research should address the underexplored areas. These include charging infrastructure optimisation, electric micro-mobility innovations, and integration in urban environments, alongside the social and ethical implications of electric vehicle adoption for last-mile delivery.

Keywords: electric vehicle; last-mile delivery; bibliometric review

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Academic Editor: Michael Fowler

Received: 16 December 2024
Revised: 14 January 2025
Accepted: 18 January 2025
Published: 20 January 2025

Citation: Mogire, E.; Kilbourn, P.; Luke, R. Electric Vehicles in Last-Mile Delivery: A Bibliometric Review. *World Electr. Veh. J.* **2025**, *16*, 52. https://doi.org/10.3390/wevj16010052

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1. Introduction

Electronic commerce (e-commerce) allows people to order goods online without leaving home [1]. Globally, sales from e-commerce are projected to reach $8.034 trillion in 2027 from $5.784 trillion in 2023 [2], a 38.9% growth within four years. The rapid growth in global e-commerce sales is expected to continue, increasing the demand for last-mile delivery. Last-mile delivery (LMD) refers to the last transport of a consignment in a supply chain from the dispatch point to the delivery point where the consignee receives it [3–5]. The vehicles used in last-mile delivery can run on different power sources (i.e., either fossil, hybrid, or fossil-free) [6]. Unfortunately, the last-mile process is often the most polluting, inefficient, and expensive part of the supply chain [3], due to its reliance on fossil-powered vehicles. The rising demand for last-mile delivery has led to a significant number of fossil-fueled vehicles on the road, contributing to environmental issues such as traffic congestion [3,5,7–10], greenhouse gas emissions [3,9,10], noise and air pollution [3,9–11], and habitat loss [9,10]. Using fossil-fueled vehicles also leads to high delivery costs [5,7,8], arising from traffic congestion, fuel consumption, and high vehicle maintenance expenses. The growing volume of goods in last-mile delivery and tight delivery deadlines [3,8], necessitate faster delivery options. These last-mile delivery challenges have provided motivation to look for alternatives to fossil-powered vehicles, making electric vehicles (EVs) increasingly popular in recent years due to their attractive features [11].

An electric vehicle is any vehicle that uses electric or traction motors for its propulsion [12,13]. These include battery electric vehicles (BEVs), hybrid electric vehicles (HEVs), plug-in hybrid electric vehicles (PHEVs), fuel cell electric vehicles (FCEVs), and extended-range electric vehicles (EREVs) [14–16]. BEVs run solely on electricity stored in rechargeable batteries, powered by an electric motor, and have no internal combustion engine [14,16]. PHEVs combine a conventional internal combustion engine with an electric motor and a rechargeable battery [14,16]. HEVs use a conventional combustion engine and an electric motor to power the vehicle. The electric motor provides additional power when needed, e.g., during acceleration, and the internal combustion engine provides range and power for longer trips [14,16]. FCEVs run on electricity generated by a fuel cell (i.e., using hydrogen as a fuel) to power an electric motor. They have a more extended driving range after recharging than BEVs [14,16]. EREVs operate primarily on electricity stored in a battery, with an internal combustion engine kicking in when the battery is depleted to extend the driving range [14,16]. Thus, a variety of electric vehicles can be used in last-mile delivery.

Sustainability concerns, such as greenhouse gas reduction, energy security and independence, resource conservation, air pollution reduction, and socioeconomic impacts, are key drivers of the adoption of electric vehicles [17,18]. The potential economic impacts of electric vehicles include creating new manufacturing, maintenance, and charging infrastructure jobs. The potential social impacts of electric vehicles include improved air quality and reduced noise pollution [16,18], contributing to better health outcomes and a higher quality of life [18]. Electric vehicles can also offer comfort and efficiency in operations not provided by gasoline vehicles [12]. Environmental impacts of electric vehicles relate to reduced greenhouse gas emissions and improved energy efficiency [15,16]. Green vehicles (including electric vehicles) may contribute to the alleviation of problems such as environmental pollution, global warming, and oil dependency [19]. Due to being a clean and environmentally friendly mobility option, electric vehicles represent a promising alternative to conventional internal combustion engine vehicles [16,20].

Whilst electric vehicles offer numerous benefits, the uptake is hindered by various limitations. Among the limitations is the scarcity of critical materials used in electric vehicle batteries and electronic equipment [21]. In addition, the disposal of electric vehicle batteries raises significant environmental concerns due to toxic materials [22]. Economic factors also contribute to the slow uptake of EVs. These factors include high purchase prices [15,17,20,23–26], high total cost of ownership [17,23,25], concerns over battery replacement and maintenance costs [20,23], and low resale value of EVs [17]. In addition, the enormous investments required to set up charging infrastructure [15], additional costs associated with training drivers [23], and shifts in employment and business operations [15] also limit the uptake of EVs. Many regions suffer from inadequate charging infrastructure [20,23,24,26] and poor /unreliable grid systems [20,24,25], particularly in developing economies, which significantly hinder the uptake of EVs. There are also notable variations in infrastructure standards across different regions [15]. The authors emphasise the need for greater clarity concerning legal matters, inconsistent regulations, and liabilities associated with electric vehicles. In France and the United Kingdom (UK), anxieties about limited driving range, risk of queueing at charging stations, and payload restrictions contribute to reluctance to accept electric vehicles [25]. Due to their battery capacities, EVs have a limited driving range, requiring visits to recharging stations while serving customers along their routes [13,27]. This can lead to increased operational costs and delays in last-mile delivery. In addition, the insufficient technological development of batteries poses a key barrier to transitioning to electric vehicles for last-mile delivery [26].

The preceding discussion shows a growing body of research on electric vehicles. Existing studies have addressed particular aspects of last-mile delivery, such as chal-

lenges [23,25], acceptance/benefits [28,29], and feasibility [30]. However, there are conflicting findings and regional disparities. Thus, there is a need for a comprehensive study, as the research is currently fragmented. In addition, as e-commerce grows and electric vehicle technology advances, a bibliometric review can reveal emerging trends supporting last-mile delivery as well as identification of areas that require future research. A search in the Scopus database using keywords (article title ("electric vehicle*") AND ("last mile" OR "last-mile") AND ("bibliometric") did not find any studies directly matching the focus of this review. Thus, there is a need to investigate the current state of research and propose a future research agenda for electric vehicles in last-mile delivery. This is meant to guide policy formulation and promote widespread adoption of electric vehicles in last-mile delivery. The specific research questions are:

1. What are the current trending themes in the study of electric vehicles in last-mile delivery?
2. What are the research gaps and proposed future research areas on electric vehicles in last-mile delivery?

The remainder of the paper is organised as follows: Section 2 describes the materials and methods, Section 3 presents the results, Section 4 discusses findings, and Section 5 presents conclusions.

2. Materials and Methods

This review followed a bibliometric analysis to answer the research questions. A bibliometric review uses quantitative techniques to examine a large body of scholarly publications [31]. It aims to identify patterns, trends, and relationships within a specific field of study by analysing bibliographic data [21,31]. This approach was adopted to identify the topics of electric vehicles that received the most attention. This will offer insightful information to policymakers and researchers to guide future technological development in electric vehicles, implementation, and research to address last-mile delivery challenges.

The main categories of bibliometric analysis are performance analysis, which accounts for the contributions of different research constituents, and science mapping, which focuses on relationships between research constituents [31]. Performance analysis techniques include the productivity of different research constituents such as authors, institutions, countries, and journals in a field. In contrast, science mapping techniques include citation, co-citation, co-word, and co-authorship analyses [31]. Thus, this review first presents performance analysis descriptives, followed by science mapping findings to visualise the relationships in the topic.

The required data was searched to conduct the bibliometric analysis, and appropriate data analysis techniques were applied to achieve the aims of the review. The search strategy involved the selection of appropriate keywords, databases, and inclusion criteria. A search was conducted on the Scopus database on 14 October 2024 using a combination of the following keywords: (Article title, Abstract, Keywords ("electric vehicle *" OR "electric car *" OR "electric bike *" OR "electric scooter *" OR "electric rickshaw *" OR "electric automobile *" OR "electric truck *" OR "electric mobility" OR "electric micromobility" OR "EV" OR "BEV" OR "HEV" OR "PHEV" OR "FCEV" OR "EREV" OR "e-vehicle *" OR "e-car *" OR "e-bike *" OR "e-scooter *" OR "e-rickshaw *" OR "e-automobile *" OR "e-truck *" OR "e-mobility" OR "e-micromobility" OR (("battery" OR "plug-in battery" OR "hybrid" OR "fuel cell" OR "extended range") AND "electric vehicle *"))) AND ("last mile" OR "last-mile") AND ("delivery" OR "logistics" OR "distribution" OR "transport *"). The search was limited to journal articles, conference papers, review papers, and book chapters published in the English language between 2010 and 2024. The search provided a total of 434 publications. The Scopus database was used because it is considered among

the largest databases of peer-reviewed scientific literature [32]. Even though Scopus and the Web of Science databases index similar journals, Scopus indexed 66.07% more unique journals than the Web of Science [33]. The 434 publications were manually inspected, and those that were not relevant to the topic, without titles or abstracts, were deleted. This reduced the number to 375 publications, which were then exported as a CSV Excel file for further analysis. The Bibliometrix package version 4.3.0 (specifically the Biblioshiny app version 4.3.0) was used for performance analysis and science mapping. Performance analysis (quantitative measures representing authors, journals, and countries) was used to identify the scholars, sources, and countries that have contributed the most, as well as identify the dominant themes and trends used in the study of the topic. Science mapping (citation analysis, co-citation analysis, co-word analysis, and thematic mapping) helped to identify the dominant themes and trends used in the study of the topic. Table 1 provides the main information about the data. Even though the search was limited to publications between 2010 and 2024, it was noted that the first publication was in 2013, indicating that this is a young field. The average citations per publication is high (17.3), highlighting the research's significant impact and relevance.

Table 1. Main information about the publications (2013–2024).

Description	Results
Timespan	2013:2024
Sources (Journals, Books, etc.)	205
Documents	375
Annual Growth Rate %	−5.61
Document Average Age	2.73
Average citations per doc	17.3
References	13,927
DOCUMENT CONTENTS	
Keywords Plus (ID)	2149
Author's Keywords (DE)	1069
AUTHORS	
Authors	1145
Authors of single-authored docs	18
AUTHORS COLLABORATION	
Single-authored docs	19
Co-Authors per Doc	3.7
International co-authorships %	19.73
DOCUMENT TYPES	
Article	224
book chapter	25
conference paper	123
Review	3

Source: Authors' own.

3. Results

This section provides a comprehensive description of the results obtained and their interpretation.

3.1. Performance Analysis

Between 2013 and 2015, there was little research on the topic, with no more than ten publications per year (Figure 1). This may be attributed to a few government incentives and policies (e.g., subsidies on electric vehicles), the slow growth in e-commerce, and most e-commerce companies relying on conventional delivery vehicles. There were incentive policies for revitalising the automobile industries between 2009 and 2011 [14]. From 2016,

there was a double-digit publication growth, rising from 11 to 15 publications in 2019 (Figure 1). During this period, there were rising environmental concerns and regulatory pressures for green logistics. The adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015 is partly responsible for interest in electric vehicles during this period [17]. From 2020, there was a significant increase in publications, rising from 31 to a high of 80 publications in 2023 (Figure 1). However, a slight decline in publications in 2022 could be attributed to the impact of Coronavirus disease 2019 (COVID-19) disruptions on research outputs. In recent years, the growing interest in electric vehicles in last-mile delivery can be attributed to technological advancements, increasing environmental concerns, and energy security [16]. Many governments have implemented policies to promote environmentally friendly and innovative transport technology to mitigate the climate change threat brought on by transport sector emissions and minimise dependence on other countries for oil [16]. Thus, the sharp increase in recent years can be attributed to conducive government incentives and policies, increasing environmental regulations (e.g., the Paris Agreement), technological advancements, and the rapid growth of e-commerce.

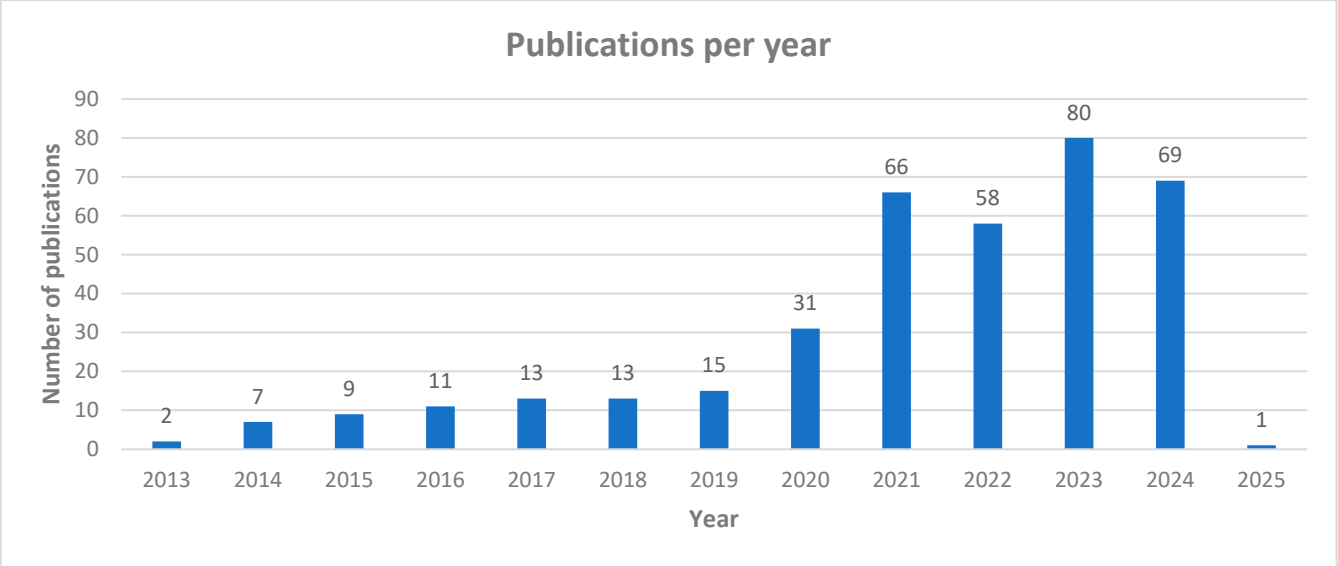

Figure 1. Number of publications on EVs in LMD research (2013–2024). Source: Authors' own.

3.1.1. Most Productive Journals

The top-ranked journal is Transport Research Part D: Transport and Environment, with 914 citations, an h-index of 13, and a g-index of 17 calculated from 2017 (Table 2), thus the most influential journal. The Sustainability journal is ranked second with 380 citations, an h-index of 9, and a g-index of 17, calculated from 2015 (Table 2). The two journals cover a broad range of topics. In contrast, the World Electric Vehicle Journal and the Transportation Research Part C: Emerging Technologies cover specialised research topics. The Transportation Research Part C: Emerging Technologies journal has five publications with 469 citations (Table 2), implying highly impactful studies. The journal focuses on specialised topics such as machine learning and artificial intelligence in electric vehicles. The European Journal of Operational Research is relatively new, starting its publication in 2022 with an m-index of 1.667 (Table 2), implying a few highly impactful studies. The studies focus on optimisation and modeling problems in last-mile delivery (route optimisation, and energy consumption modeling). The Energies journal and the Transportation Research Part A: Policy and Practice started publishing in 2020, each with a high m-index of 1.6 (Table 2), implying few high-impact studies despite being new.

Table 2. Top 20 most productive journals on EVs in LMD research (2013–2024).

Rank	Journal	h-Index	g-Index	m-Index	TC	NP	PY_Start
1	Transportation Research Part D: Transport and Environment	13	17	1.625	914	17	2017
2	Sustainability	9	17	0.900	380	17	2015
3	Energies	8	13	1.600	186	13	2020
4	Transportation Research Part A: Policy and Practice	8	10	1.6	378	10	2020
5	Journal of Transport Geography	6	8	1	164	8	2019
6	Transportation Research Procedia	6	8	0.667	156	8	2016
7	European Journal of Operational Research	5	5	1.667	83	5	2022
8	Transportation Research Part C: Emerging Technologies	5	5	0.556	469	5	2016
9	Case Studies on Transport Policy	4	7	1.000	88	7	2017
10	Lecture Notes in Computer Science (Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics)	4	5	0.444	29	6	2016
11	Sustainable Cities and Society	4	5	1.000	186	5	2021
12	World Electric Vehicle Journal	4	6	0.333	59	6	2013
13	2013 World Electric Vehicle Symposium and Exhibition, EVS 2014	3	3	0.273	20	3	2014
14	Applied Sciences	3	3	0.750	23	3	2021
15	Environmental Science and Technology	3	3	0.600	68	3	2020
16	IEEE Access	3	4	0.600	93	4	2020
17	Transportation Research Record	3	7	0.333	63	10	2016
18	2020 Forum on Integrated and Sustainable Transportation Systems, FISTS 2020	2	2	0.4	7	2	2020
19	2021 7th International Conference on Models and Technologies for Intelligent Transportation Systems, MTITS 2021	2	2	0.5	19	2	2021
20	Computers and Industrial Engineering	2	3	0.333	66	3	2019

Source: Authors' own.

SCImago ranks all the listed journals in different subject categories. Journals such as Sustainability, Energies, Journal of Transport Geography, Environmental Science and Technology, Sustainable Cities and Society, and the 2020 Forum on Integrated and Sustainable Transportation Systems cover sustainability subjects. The Transportation Research Part C: Emerging Technologies, the Lecture Notes in Computer Science (Artificial Intelligence and Bioinformatics), the IEEE Access journal, and the 2021 International Conference on Models and Technologies for Intelligent Transportation Systems focus on technological innovations. The World Electric Vehicle Journal and the 2013 World Electric Vehicle Symposium and Exhibition focus on electric vehicles, while the European Journal of Operational Research focuses on operational research. The Transportation Research Part A: Policy and Practice, and the Case Studies on Transport Policy focus on policy and regulation. The journals focusing on operations and transportation cover issues such as routing problems, operational costs, and range anxiety resulting from electric vehicles. The journals focusing on sustainability cover issues such as carbon emission control and improved energy efficiency. The jour-

nals focusing on technological innovations cover technological advancements in electric vehicles, such as routing algorithms and battery technologies. Thus, the multidisciplinary approach is essential in considering all perspectives from different subject categories to understand electric vehicles fully. Combining insights from transportation, operational research, sustainability, and technological innovations can lead to more comprehensive and innovative electric vehicle solutions for last-mile delivery. For instance, integrating operational research findings on route optimisation with battery technology from technological innovation journals would extend electric vehicle range and reduce delivery times.

3.1.2. Most Productive Authors

Table 1 shows 1145 authors have contributed to research on the topic, with 18 (1.6%) being single authors. This suggests a collaborative research approach to the topic. The top three researchers (i.e., Andaloro L., Antonucci V., and Napoli G.) have the highest impact and productivity on the topic, each with five publications, 72 citations, an h-index of 4, and a g-index of 5 calculated from 2014 (Table 3). They have co-authored five publications focusing on infrastructure for smart cities (e.g., charging stations) and electric vehicle technological innovations (e.g., energy storage and battery technology). These are published in high-impact journals, likely to influence subsequent research on energy storage and charging technologies. Emerging researchers (such as Hosseinzadeh A. and Kluger R.) have a high m-index of 0.75 and 202 citations from the three publications calculated from 2021 (Table 3). They have co-authored three studies focusing on the factors influencing the use of electric micro-mobility (the use of small, low-speed, electric-powered vehicles such as electric bikes and electric scooters) in last-mile delivery. The most recent researcher is Kepaptsoglou K, who has a high m-index of 1.5 from the four publications calculated from 2023 (Table 3). The author focuses on using electric micro-mobility (e.g., e-bikes and e-scooters) in last-mile delivery. These studies are crucial for addressing barriers of electric micro-mobility in last-mile delivery. Veteran researchers (such as Lebeau P., Macharis C., and Van Mierlo J.) each have 113 citations from the three publications, having started their publication in 2013 (Table 3), suggesting a sustained contribution and possibly more foundational work on electric vehicles in last-mile delivery. They have co-authored three publications focusing on how electric vehicles affect delivery efficiency, environmental benefits, and operational performance compared to conventional vehicles.

Table 3. Top 20 most productive authors on EVs in LMD research (2013–2024).

Rank	Author	h-Index	g-Index	m-Index	TC	NP	PY_Start
1	Andaloro L	4	5	0.364	72	5	2014
2	Antonucci V	4	5	0.364	72	5	2014
3	Napoli G	4	5	0.364	72	5	2014
4	Sergi F	4	4	0.364	44	4	2014
5	Bieliński T	3	3	0.600	222	3	2020
6	Hosseinzadeh A	3	3	0.75	202	3	2021
7	Keoleian G	3	3	0.750	36	3	2021
8	Kepaptsoglou K	3	4	1.500	36	4	2023
9	Kluger R	3	3	0.75	202	3	2021
10	Lebeau P	3	3	0.250	113	3	2013
11	Li Z	3	4	0.75	195	4	2021
12	Macharis C	3	3	0.250	113	3	2013
13	Micari S	3	3	0.300	51	3	2015
14	Northrop W	3	3	0.500	48	3	2019
15	Simic V	3	3	0.6	122	3	2020
16	Van Mierlo J	3	3	0.250	113	3	2013
17	Vasan A	3	5	0.375	25	5	2017
18	Ważna A	3	3	0.600	222	3	2020
19	Çatay B	3	4	0.500	65	4	2019
20	Agnello G	2	2	0.200	23	2	2015

Source: Authors' own.

3.1.3. Author Affiliations

Author affiliations indicate the institutions where the authors are working. As shown in Table 4, the USA has five institutions, while China has one. Italy and Germany lead in Europe with three institutions each. Thus, geographic diversity in research on the topic is evident, with the top 20 institutions across the USA, Europe, and Asia. However, Africa is not represented.

Table 4. Top 20 author affiliations on EVs in LMD research (2013–2024).

Rank	Affiliation	Frequency
1	National Technical University of Athens	27
2	Polytechnic University of Bari	14
3	Universidad Politécnica De Madrid	14
4	University of Michigan	14
5	University of Texas at Austin	14
6	Delft University of Technology	13
7	Not reported	13
8	University of Minnesota	13
9	Tsinghua University	12
10	Carnegie Mellon University	9
11	Politecnico Di Milano	9
12	Rwth Aachen University	8
13	University of Louisville	8
14	University of New South Wales	8
15	University of Palermo	8
16	University of the Aegean	8
17	Bonn-Rhein-Sieg University of Applied Sciences	7
18	Institute of Transport Research	7
19	Nanyang Technological University	7
20	Sabanci University	7

Source: Authors' own.

3.1.4. Most Productive Countries

The top five countries based on the frequencies of scientific production (i.e., by corresponding authors) are the United States of America (USA) (227), Germany (157), Italy (135), India (123), and China (103) (Table 5). The high ranking of the USA can be attributed to government policy pushing for electric vehicle adoption, which is expected to ensure that half of new passengers and trucks sold in the country have zero emissions by 2030 [34]. In China and the USA, the rapid expansion of e-commerce companies such as Jingdong (JD.com, Inc), Alibaba, and Amazon is at the forefront of experimenting with new delivery vehicles such as electric vehicles. The high rankings of the USA and China relate to pioneering research on integrating electric vehicles into last-mile delivery systems, focusing on technological advancements such as autonomous driving, battery technologies, and smart grid integration. Germany's and Italy's high rankings result from their automotive companies' contributions to the development of innovative electric vehicle technologies. Emerging markets such as India's ranking can be attributed to research aimed at overcoming local challenges and promoting electric vehicle adoption (mostly e-scooters). Brazil, an emerging economy, is ranked 16th (Table 5), with research focusing on electric vehicle technology adaptation and infrastructure development to address urban mobility and environmental challenges. No African country was among the top 20 most productive countries (Table 5), underscoring a significant regional disparity in scientific research. Thus, the leading countries have contributed substantially to research on electric vehicles in last-mile delivery. This includes policy analysis, battery technology, and charging infrastructure. The emerging countries are addressing local challenges and opportunities related to electric vehicle adoption.

Table 5. Top 20 countries' scientific production on EVs in LMD research (2013–2024).

Rank	Country	Frequency
1	USA	227
2	Germany	157
3	Italy	135
4	India	123
5	China	103
6	Greece	65
7	Spain	54
8	South Korea	38
9	UK	35
10	Netherlands	33
11	Poland	32
12	Turkey	28
13	Sweden	26
14	France	25
15	Australia	23
16	Brazil	22
17	Belgium	21
18	Canada	20
19	Portugal	19
20	Japan	16

Source: Authors' own.

3.2. Science Mapping

3.2.1. Co-Authorship Analysis

The country collaboration map visually represents the intensity (indicated by colours) and direction (shown by lines) of collaboration between countries in a specific field. The thickness of the lines indicates the frequency/rate of collaboration among different countries. For example, the USA has the highest collaboration rate, mainly with Canada, China, India, and European countries (Figure 2). The USA's collaborations (specifically with India) focus on integrating electric vehicles (e.g., e-scooters) by evaluating challenges and barriers to their adoption. In Europe, the United Kingdom has the highest rate of collaboration with Sweden (Figure 2), showing intracontinental collaborations. In Asia, China has the highest collaboration rate, mainly with Australia and Korea (Figure 2). China's collaborations with Australia focus on two-wheeled transport (e.g., e-bikes), green vehicle routing, and efficient e-scooter charging solutions. Africa has a low rate of collaboration (Figure 2). While Tunisia collaborates with Luxembourg, Morocco collaborates with France. Studies in Nigeria explored challenges to adopting electric vehicles (e.g., scarce infrastructure, affordability issues, and unequal access to energy) and opportunities for renewable energy utilisation. Tunisia's collaboration with Luxembourg explored the potential for modular electric vehicles to improve last-mile delivery efficiency (e.g., by addressing challenges of limited battery capacity and optimising vehicle routing). The dark blue colour on the map (e.g., USA, China, India, Germany, and Italy) represents high-intensity collaborations, while the light blue colour (e.g., Canada, Australia, Brazil, and Nigeria) signifies medium-intensity collaborations. The grey colour (most countries in Africa and Russia) denotes low-intensity collaborations. Thus, the USA, China, India, and a few European countries dominate the research collaborations on electric vehicles in last-mile delivery.

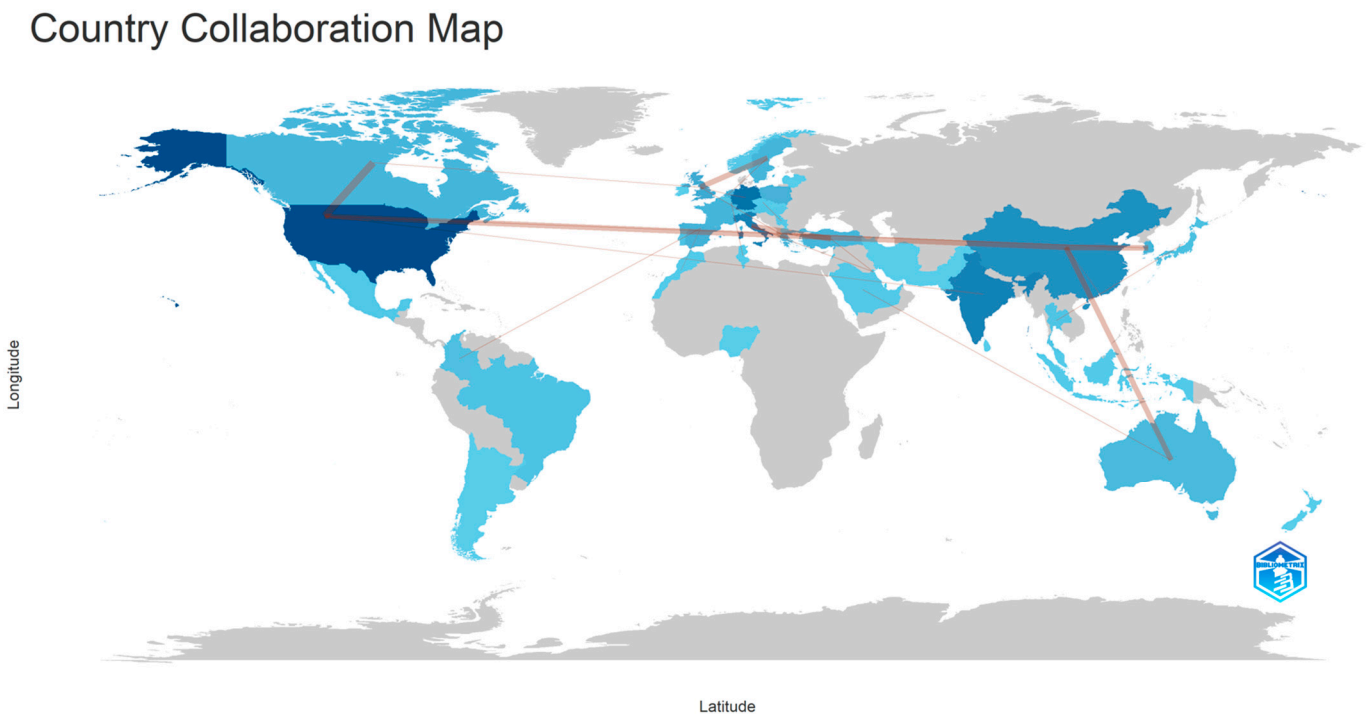

Figure 2. Country collaborations map on EVs in LMD research (2013–2024). Source: Authors' own.

3.2.2. Co-Citation Analysis

Authors are split into several clusters, defined by the similarity of the research areas in which the author works [15]. Similarity in a research topic is measured by the frequency with which two publications are cited together [16]. Figure 3 shows three major themes: The main cluster (orange) led by Schneider M. (2014) forms the core of the network and is likely to be a foundational study in the topic. Schneider M. (2014) explores the theme of electric vehicle performance (i.e., the electric vehicle routing problem due to the limited battery capacities and vehicle freight capacities). The second cluster (red) includes Smith C.S. (2018) and Gossling S. (2020), exploring policy implications for the adoption of electric vehicles, e.g., infrastructure and dedicated parking. The third cluster (blue), led by Hardt C. (2019) and Gruber J. (2014), relates to the use of electric micro-mobility, e.g., e-scooters and e-bikes in last-mile delivery. The connection between the red and blue clusters implies a need to make policy-driven decisions when using electric micro-mobility. The purple cluster, led by McKenzie G. (2019) and Hollingsworth J. (2019), focuses on shared electric micro-mobility in urban areas, emphasising usage behaviours, environmental considerations, and related policy implications. The green cluster, led by Arnold F. (2018) and Melo S. (2017), and the brown cluster, led by Laa B. (2020), are isolated clusters focusing on unique aspects or methodologies, such as spatial analysis or regional case studies. Overall, all the clusters appear detached from each other, an indicator of the early phases of research on the topic. A more mature research topic looks at influences between topics, resulting in interconnected clusters.

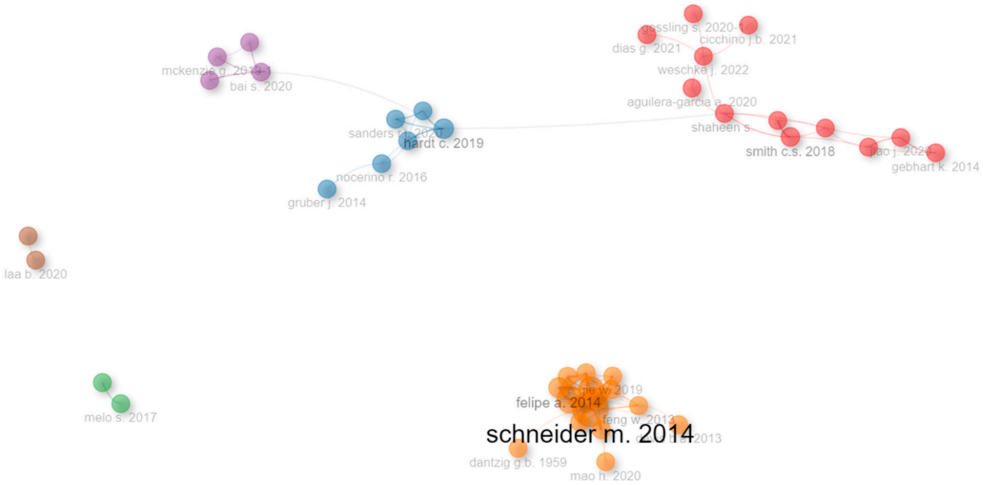

Figure 3. Co-citation network on EVs in LMD research (2013–2024). Source: Authors' own.

3.2.3. Co-Word Analysis

The analysis identified 2, 149 keywords plus on electric vehicles in last-mile delivery publications (Table 1). The high number of keywords highlights the topic's diverse range of research. In addition, Table 6 lists the top 50 most frequently used keywords. From the top 50 keywords, the four main themes include sustainability, technological innovations, operational efficiency, and electric micro-mobility. The operational efficiency of electric vehicles includes keywords such as fleet operations, vehicle routing, optimisation, costs, travel time, and transport planning (Table 6). The performance of electric vehicles has a positive effect on the intention to buy the vehicles [16]. The theme of technological innovations includes keywords such as secondary batteries, charging (batteries), integer programming, learning systems, routing algorithms, drones, autonomous vehicles, and automation (Table 6). Optimising routes using advanced routing algorithms and advances in battery technology is crucial for the widespread adoption of electric vehicles in last-mile delivery. Many researchers have recently focused on developing advanced battery systems due to the high demand for alternative secondary batteries [14]. The sustainability theme includes keywords such as energy utilisation, sustainable development, greenhouse gases, sustainability, energy efficiency, traffic congestion, carbon dioxide, emission control, environmental impact, energy management, and life cycle (Table 6). The uptake of electric vehicles in last-mile delivery is often motivated by the aim to achieve Sustainable Development Goals by reducing greenhouse gas emissions, especially carbon dioxide, in urban areas. The theme of electric micro-mobility includes keywords such as micro-mobility, cycle transport, electric scooters (e-scooters), and electric bikes (Table 6). The electric micro-mobility alternatives are becoming common in last-mile delivery over short distances in urban areas. Thus, co-word analysis shows that embracing electric vehicles for last-mile delivery can help in operational efficiency and sustainable transportation in last-mile delivery.

Table 6. Top 50 most frequent words on EVs in LMD (2013–2024).

Rank	Word (s)	Occurrences	Rank	Word (s)	Occurrences
1	urban transportation	54	26	public transportation	13
2	fleet operations	43	27	traffic congestion	13
3	public transport	37	28	carbon dioxide	12
4	vehicle routing	37	29	drones	12
5	energy utilisation	33	30	electric bikes	12
6	micro-mobility	33	31	urban areas	12
7	secondary batteries	31	32	carbon footprint	11
8	sustainable development	31	33	optimisation	11

Table 6. *Cont.*

Rank	Word (s)	Occurrences	Rank	Word (s)	Occurrences
9	charging (batteries)	28	34	autonomous vehicles	10
10	freight transportation	26	35	costs	10
11	greenhouse gases	26	36	decision-making	10
12	urban transport	25	37	energy consumption	10
13	cycle transport	21	38	learning systems	10
14	travel time	21	39	optimisations	10
15	energy efficiency	19	40	routing algorithms	10
16	sustainability	19	41	sales	10
17	vehicle routing problems	19	42	transportation planning	10
18	electric scooters	18	43	urban area	10
19	integer programming	17	44	automation	9
20	freight transport	16	45	behavioral research	9
21	travel behavior	16	46	COVID-19	9
22	city logistics	15	47	e-scooter	9
23	environmental impact	15	48	energy management	9
24	gas emissions	14	49	greenhouse gas	9
25	emission control	13	50	life cycle	9

Source: Authors' own.

A word trend analysis was used to understand word growth over time. In the early stages (2013 to 2015), the words electric vehicle(s) and urban transportation were common (Figure 4), although the frequencies were relatively low. The words last-mile and fleet operations were used from 2014 (Figure 4), although they did not report significant frequencies. During this period, interest in electric vehicles for last-mile delivery was limited. Most e-commerce businesses relied on conventional delivery vehicles. The moderate growth period between 2016 and 2019 saw a moderate increase in the frequencies of the words electric vehicle(s), urban transportation, and last-mile (Figure 4). The emphasis from 2013 to 2020 was on integrating electric vehicles into logistics. The significant growth period between 2020 and 2023 saw the highest frequencies of the words electric vehicle(s) and last-mile (Figure 4). Energy utilisation, vehicle routing, fleet operations, urban transportation, public transport, and bicycles also reported a significant rise in frequencies (Figure 4). From 2020 onwards, the emphasis was on the sustainability theme, particularly energy utilisation and bicycles. In addition, the growth in words over time moved from broad (e.g., electric vehicles, last-mile, and urban transport) to specific (energy utilisation, vehicle routing, and fleet operations).

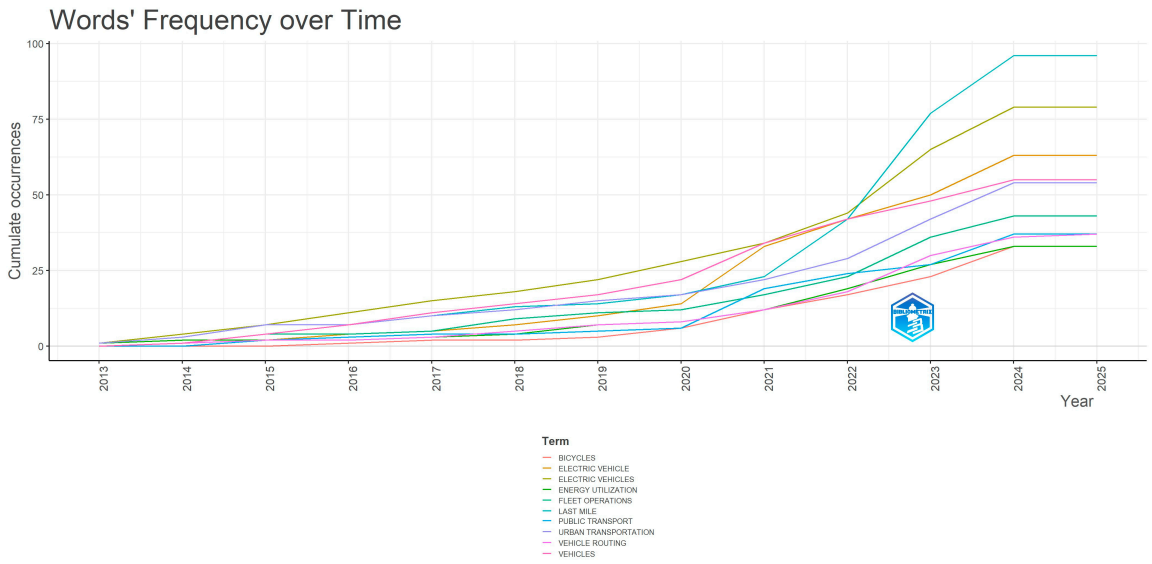

Figure 4. Keywords' frequency over time on EVs in LMD research (2013–2024). Source: Authors' own.

3.2.4. Thematic Mapping

Thematic mapping of published documents helps to discover themes in a field, categorising them as motor, basic, emerging or declining, and niche themes [35]. These themes can be visualised using a two-dimensional diagram divided into four quadrants with the horizontal axis as density/development degree and the vertical axis as centrality/relevance degree [36,37]. High centrality indicates that the scientific community considers a research theme as crucial, while density signifies a theme's ability to maintain itself and develop over time in a field [36]. Figure 5 shows motor themes (quadrant one), which are central and developed; basic themes (quadrant two), which are central but undeveloped; emerging or declining themes (quadrant three), which are peripheral and undeveloped; and niche themes (quadrant four), which are peripheral but developed [36,37].

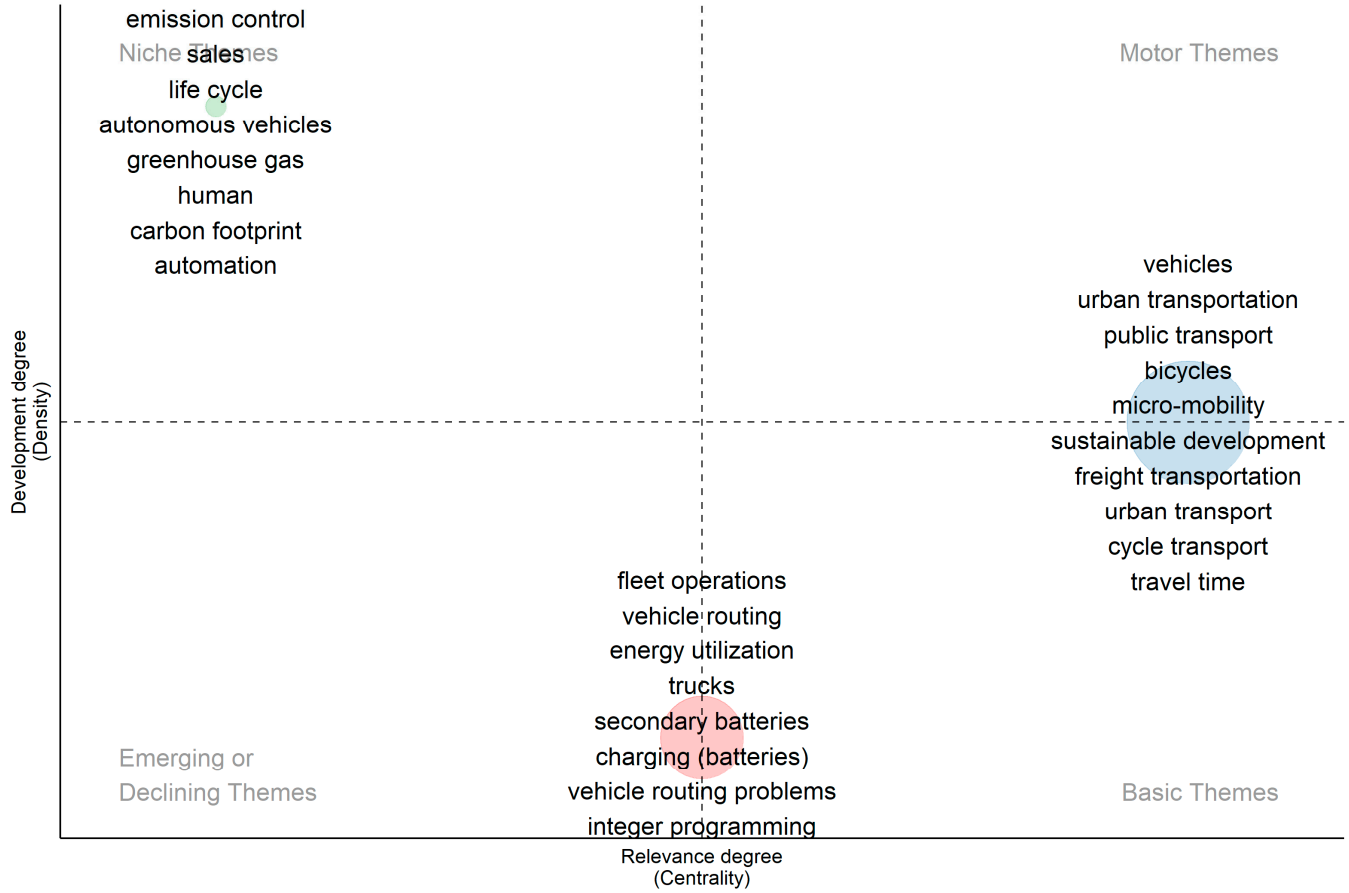

Figure 5. Thematic map on EVs in LMD research (2013–2024). Source: Authors' own.

The motor theme (quadrant one) relates to electromobility (Figure 5), forming the foundation of discussions around electric vehicles. The keywords represented in this theme include electric vehicles and urban transportation. The finding might imply that electric vehicles are crucial in addressing urban transportation challenges. The basic theme (quadrant two) relates to electric micro-mobility (Figure 5), which is considered fundamental but has yet to mature. The keywords in the theme are bicycles, micromobility, cycle transport, urban transport, and public transport. Since the theme is relevant but underexplored, more research is required to fully exploit the potential of electric micromobility in urban areas for last-mile delivery. The niche theme (quadrant four) relates to environmental sustainability (Figure 5) and is considered mature, i.e., well-established and still relevant. The keywords in the niche theme include greenhouse gases, emission control, and lifecycle. Emission control refers to decreasing greenhouse gas emissions, such as

carbon dioxide, contributing to climate change [17]. Todorovic et al. [15] noted that the main reasons for introducing electric vehicles are environmental factors, i.e., greenhouse gas emission reduction and targeting net zero emissions. The high uptake of electric vehicles can potentially reduce environmental carbon footprint [16]. As such, electric vehicles offer an opportunity to control emissions and reduce carbon footprint. At the intersection of quadrant three (the emerging or declining theme) and quadrant two (the basic theme) are two themes: technological innovations (keywords such as secondary batteries and integer programming) and operational efficiency (keywords such as fleet operations, vehicle routing, and energy utilisation). As basic themes, there is potential for technological innovations to improve the operational efficiency of electric vehicles in last-mile delivery. As emerging themes, the specific application of technological innovations such as integer programming and charging (batteries) might still be in the early stages. Limited driving range, reduced payload, uncertain battery lifespan, and long recharge waiting times are among the challenges of electric vehicle adoption in final parcel delivery [23].

3.2.5. Citation Analysis

Citation analysis will help to identify the seminal publications on electric vehicles in last-mile delivery. Table 7 presents the ten most cited publications on electric vehicles in last-mile delivery. The most cited publication, 74.58 citations per year, was by Schneider et al. [38], which focuses on electric vehicle-routing problems with time windows and recharging stations (i.e., an operational aspect of electric vehicles). The high citations per year imply that this is a groundbreaking work on the topic, addressing the operational challenge of integrating electric vehicles in last-mile delivery.

Table 7. Top 10 most cited publications per year on EVs in LMD (2013–2024).

Rank	Authors	Total Citations Per Year	Title	Journal	Summary
1.	Schneider et al. [38].	74.58	The electric vehicle routing problem with time windows and recharging stations	Transportation Science	The paper considered the electric vehicle routing problem with limited time windows, freight capacities, and charging stations. A recharging scheme (i.e., a hybrid heuristic combining variable neighbourhood search and tabu search) was proposed, showing high performance.
2.	Campbell et al. [39].	35.30	Factors influencing the choice of shared bicycles and shared electric bikes in Beijing.	Transportation Research Part C: Emerging Technologies	A survey on factors influencing the choice of shared e-bikes in Beijing found that trip distance, high temperatures, and poor air quality negatively impact bike-share demand. Even though e-bike sharing is attractive as a bus replacement, it is unclear if it is attractive as a last-mile solution.
3.	Sanders et al. [40].	26.83	To scoot or not to scoot: Findings from a recent survey about the benefits and barriers of using e-scooters for riders and non-riders	Transportation Research Part A: Policy and Practice	A survey in the USA found that e-scooters are a convenient travel option during hot weather compared to walking. However, traffic safety concerns and the unavailability of working equipment when needed were noted among the barriers.
4.	Yang et al. [41].	22.83	Safety of micro-mobility: analysis of e-scooter crashes by mining news reports	Accident Analysis and Prevention	The study examined media reports to identify safety concerns related to the rise of shared e-scooter systems in the USA. A total of 169 incidents were reported between 2017 and 2019, highlighting the need for safety measures such as helmet use and not riding under the influence.

Table 7. *Cont.*

Rank	Authors	Total Citations Per Year	Title	Journal	Summary
5.	Kirschstein [42].	21.83	Comparison of energy demands of drone-based and ground-based parcel delivery services	Transportation Research Part D: Transport and Environment	The paper presented an energy consumption model for drones, comparing their energy demand to diesel and electric trucks. Results showed that a stationary drone-based parcel delivery system requires more energy than a truck-based parcel delivery system, particularly in urban areas where customer density is high and truck tours are comparatively short.
6.	Hosseinzadeh et al. [43].	21.20	E-scooters and sustainability: Investigating the relationship between the density of e-scooter trips and characteristics of sustainable urban development.	Sustainable Cities and Society	The study aimed to identify spatial factors associated with scooter trips in the USA. Results showed that commercial and industrial land use, scores of walks, and bikes influenced the trip density of e-scooters.
7.	Bieliński & Ważna [44].	20.50	Electric scooter sharing and bike sharing user behaviour and characteristics.	Sustainability	The study investigated user behaviour/characteristics of e-scooters and bike sharing in Poland. Results showed that the public e-bike sharing system was more popular than e-scooter sharing, with residents citing concerns about e-scooter safety, high prices, and lack of perceived usefulness. However, both systems suffer from limited availability and fleet size, affecting user satisfaction.
8.	Baek et al. [45].	18.40	Electric scooter sharing: How do people value it as a last-mile transportation mode?	Transportation Research Part D: Transport and Environment	The study investigated preferences for electric scooter sharing (ESS) as last-mile transportation in South Korea. Results showed that ESS is preferred over walking but had similar preferences with town buses.
9.	Hosseinzadeh et al. [46].	17.20	Spatial analysis of shared e-scooter trips	Journal of Transport Geography	The study investigated the factors influencing e-scooter trips in the USA. Results showed that land use, age, and gender distribution impact acted on the density of e-scooter trips in the traffic analysis zones.
10.	Dias et al. [47].	15.60	The role of shared e-scooter systems in urban sustainability and resilience during the COVID-19 mobility restrictions	Sustainability	The study conducted a systematic literature review and a case study on the role of shared e-scooter systems in Portugal. Results showed that the shared e-scooter system can help cities with environmental issues, such as reducing air pollution, reducing inequality in access to transport, and improving mobility resilience.

Source: Authors' own.

Publications in Table 7 show that the two dominant themes are electric micro-mobility and sustainability. Several publications in the list focus on the environmental benefits of electric vehicles and alternative delivery vehicles [42,47]. These studies emphasise the potential of electric vehicles to reduce energy consumption, air pollution, and carbon emissions in last-mile delivery. There is significant research in electric micro-mobility [39–41,44–47] and autonomous vehicles [42] in last-mile delivery. The study by Campell et al. [39], which has the second highest number of citations per year (35.30 citations), highlights the growing interest in electric micro-mobility in congested cities such as Beijing. Research on electric micro-mobility addresses topics such as their potential in last-mile delivery, safety concerns, and user behaviour. While Yang et al. [41] highlighted the need for e-scooter safety measures, such as the use of helmets, Saunders et al. [40] discussed barriers to using e-scooters, such as traffic safety concerns and equipment unavailability. Dias et al. [47] found that shared e-scooter systems can reduce air pollution, improve transport equity, and enhance urban mobility resilience. Autonomous vehicles, such as drones, hold the potential to further reduce carbon emissions and energy

consumption compared to electric vehicles [42]. However, there is a lack of research on how to integrate emerging technologies (e.g., artificial intelligence, data analytics, and the internet-of-things) into electric vehicle research for last-mile delivery. Several studies focus on users' acceptance of electric vehicles [39,40,44–46]. Distance, safety, price/cost, environmental conditions, demographic factors (age and gender), and perceived usefulness influence user acceptance of electric vehicles in last-mile delivery. The publications show a recurring theme of infrastructure and charging networks to support the adoption of electric vehicles in last-mile delivery. Schneider et al. [38] emphasise that the effective use of electric vehicles in last-mile delivery requires careful route planning due to limited recharging stations. Hosseinzadeh et al. [43] highlight the importance of integrating electric mobility into urban planning and land use by examining spatial factors (such as commercial and industrial land use). From the preceding discussion, the covered topics tend to be broad (e.g., drone-based and ground-based parcel delivery services) or narrow (e.g., shared e-bikes and e-scooters). In addition, the geographic diversity of covered studies is noted in various countries such as Beijing [39], the USA [40,41,43,46], South Korea [45], Portugal [47], and Poland [44]. This underscores the need for context-specific electric vehicle solutions in last-mile delivery.

4. Discussion

The rapid growth in e-commerce calls for urgent research on the potential of electric vehicles in transforming last-mile delivery. Although some studies have addressed particular aspects of last-mile delivery, such as challenges [23,25], acceptance [28,29], and feasibility [30], there is a need for a comprehensive study as the research is currently scattered. Performance analysis reveals that leading authors such as Andaloro L., Antonucci V., and Napoli G. have extensively researched electric vehicle technological innovations (such as energy storage and battery technology) and infrastructure for smart cities (e.g., charging stations). In contrast, emerging authors such as Hosseinzadeh A. and Kluger R. have researched factors influencing the use of electric micro-mobility (e.g., electric bikes and electric scooters) in last-mile delivery. The USA, Germany, Italy, India, and China are top-ranked scientific producers in the topic. This is reinforced by the country collaboration map, which shows considerable international input into research on the topic, especially from the USA and China. The USA and China have conducted pioneering research on integrating electric vehicles into last-mile delivery systems, focusing on technological advancements such as autonomous driving, battery technologies, and smart grid integration. Among leading countries in electric vehicle research, the USA has contributed significantly to charging infrastructure, battery technology, environmental issues, and policy analysis [16,17]. In contrast, little research from African countries highlights regional disparity in research contributions. The country collaboration analysis identified that Tunisia collaborates with global researchers, exploring the potential for modular electric vehicles to improve last-mile delivery efficiency (e.g., by addressing challenges of limited battery capacity and optimising vehicle routing). The potential of modular vehicles might be overstated in African countries without considering other factors, such as economic feasibility and infrastructural limitations. Nigeria's collaborations explored challenges to adopting electric vehicles (e.g., scarce infrastructure, affordability issues, and unequal access to energy) and opportunities for renewable energy utilisation. The collaborative approach emphasizes the importance of teamwork and shared expertise across disciplines in advancing research. Ullah et al. [16] noted that collaborations can assist researchers in developing joint ventures and exchanging innovative technologies and ideas. Analysis of the top-ranked journals revealed that there is a broad range of journals, such as the Sustainability Journal and the Transport and Research Part D: Transport and Environment. The

broad journals emphasise sustainability (e.g., environmental), technological innovations (e.g., electric vehicles), and operational (e.g., transportation) aspects. The specialised journals such as the Transport Research Part C: Emerging Technologies and the World Electric Vehicle Journal explore areas such as machine learning and artificial intelligence in electric vehicles. The newer journals, such as the European Journal of Operational Research and Transportation Research Part A, explore areas such as optimisation and policy solutions.

The critical themes used to study electric vehicles in last-mile delivery were identified. Thematic mapping reveals that sustainability is critical in using electric vehicles in last-mile delivery. Oe and Abdullah [48] agree that sustainability is a central theme in business initiatives and developing new ideas, innovations, and products (e.g., electric vehicles). Analysis of the top-cited publications reinforces that electric vehicles are associated with environmental benefits such as reduced carbon emissions, air pollution, and energy consumption in last-mile delivery [42,47]. Electric micro-mobility is a common theme in the research on electric vehicles in last-mile delivery. The role of micro-mobility might expand, especially in densely populated areas where the other types of electric vehicles are less efficient. For instance, analysis of the most cited publications highlights the growing interest in electric micro-mobility in congested cities such as Beijing [39]. The studies on electric micro-mobility focus on the potential to further reduce carbon emissions and energy consumption compared to electric vehicles. The co-word analysis reinforces the electric micro-mobility theme using keywords such as micro-mobility, cycle transport, electric scooters (e-scooters), and electric bikes. The electric micro-mobility alternatives are becoming common in last-mile delivery over short distances in urban areas to address the growing sustainability concerns in last-mile delivery. However, analysis of the most cited publications revealed a need for more research on integrating emerging technologies (e.g., data analytics, artificial intelligence, and the internet-of-things) in the use of electric vehicles for last-mile delivery. For instance, artificial intelligence can be used to optimise delivery routes through the use of real-time data on weather, traffic, and charging station availability, resulting in efficiency in last-mile delivery. The co-citation analysis revealed a foundational study on electric vehicle performance (i.e., the electric vehicle routing problem due to the limited battery capacities and vehicle freight capacities [38]. In addition, Smith C.S. (2018) and Gossling S. (2020) explored policy implications for adopting electric vehicles, e.g., infrastructure and dedicated parking.

Thematic mapping identified two central themes: electric micro-mobility and technological innovations. These are considered fundamental but yet-to-mature themes. Electric micro mobility can reduce operational costs in last-mile delivery compared to other electric vehicles. However, widespread adoption may be hindered by infrastructure limitations, limited battery life, and safety concerns for riders. Secondary batteries are one technological advancement that can significantly increase the operational efficiency of electric micromobility. Further analysis of the most cited publications revealed that distance, safety, price/cost, environmental conditions, and perceived usefulness influence user acceptance of electric vehicles in last-mile delivery [39,44]. Therefore, it is necessary to intensify research efforts to overcome the economic, operational, technological, and infrastructural challenges to increase the uptake of electric vehicles in last-mile delivery.

5. Conclusions

Notably, there is an increasing trend in research on electric vehicles in last-mile delivery, a positive sign for the future of e-commerce. This could be attributed to the electric vehicles' economic, environmental, and operational advantages. Research on electric vehicles in last-mile delivery revolves around four themes, namely sustainability, electric micro-mobility, electric vehicle performance/operational efficiency, and charging infras-

tructure/technological innovations. The future research agenda will focus on addressing several research gaps relevant to these four themes.

- Developing economies, particularly in Africa, face unique last-mile delivery challenges, yet little research originates from these countries. Future research in developing economies should focus on electric vehicle charging infrastructure and operational feasibility to support last-mile delivery. This includes assessing energy grid capacity and charging infrastructure optimisation. In addition, future research on charging infrastructure should focus on systemic challenges faced by developing countries. These challenges include external shocks such as power blackouts, inadequate transport policies, lack of government support, and logistical inefficiencies. Investigating how these external shocks affect electric vehicle operations can help develop resilient charging infrastructure tailored to local conditions.
- Although sustainability dominates research on electric vehicles in last-mile delivery, more focus is on environmental issues, giving little attention to social and economic issues. Patella et al. [19] assert that sustainability includes environmental, economic, and social considerations in evaluating logistics configurations. The future research agenda will need to focus on integrating social issues into research on electric vehicles for last-mile delivery. These may include safety, standards/regulations, and ethical and privacy concerns arising from using electric vehicles in last-mile delivery. The future research agenda will also need to focus on integrating economic issues into research on electric vehicles in last-mile delivery. These include analysing funding models for charging infrastructure, consumers' willingness to pay for electric vehicle delivery options, potential for job creation, and the role of economic policies in promoting the uptake of electric vehicles in last-mile delivery.
- While interest in electric micro-mobility is growing, particularly in congested cities, the focus remains on acceptance/adoption. Electric micro-mobility (e.g., e-bikes and e-scooters) could support the penetration and acceptability of electric vehicles because they are considered a sustainable mobility option for city logistics [49]. Thus, future research should focus on underexplored areas such as micro-mobility charging infrastructure integration in urban environments, advancements in micro-mobility battery technologies, regulatory barriers, and safety concerns.
- While technological advancements dominate research on electric vehicle performance in last-mile delivery, little attention is given to emerging technologies (such as artificial intelligence, data analytics, and the internet of things). Future research should focus on how the use of electric vehicles can benefit from integrating these emerging technologies to improve last-mile delivery. In addition, ethical issues such as perceived safety, data security, and privacy will be on the rise, and future research should explore these issues arising from using emerging technologies.

The current review is limited to findings from publications extracted from the Scopus database. Other databases, such as Web of Science and Science Direct, exist and should be considered for future research to include any publications that might have been missed. This review also focused on specific keywords for a meaningful analysis. Despite being relevant, future researchers can expand the search criteria to undertake a more comprehensive search as more innovations emerge in the electric vehicle industry. In agreement, Mogire et al. [50] concluded that electric vehicles are expected to continue evolving to support last-mile delivery. Overall, this bibliometric review extends knowledge of the current state of research. It has provided a comprehensive understanding of the dominant themes used in current research on electric vehicles in last-mile delivery. Thus, sustainability and technological advancements are the main drivers for the increased use of electric vehicles in last-mile delivery. Managers should concentrate on investing in sustainable technological

innovations such as electric micro-mobility and other emerging technologies to improve last-mile delivery efficiency.

Author Contributions: Conceptualization, E.M., P.K. and R.L.; methodology, E.M., P.K. and R.L.; software, E.M.; validation, P.K. and R.L.; formal analysis, E.M.; investigation, E.M.; data curation, E.M.; writing—original draft preparation, E.M.; writing—review and editing, E.M., P.K. and R.L.; visualization, P.K. and R.L.; supervision, P.K. and R.L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: The original contributions presented in the study are included in the article. Further inquiries can be directed to the corresponding author.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Lauenstein, S.; Schank, C. Design of a sustainable last mile in urban logistics—A systematic literature review. *Sustainability* **2022**, *14*, 5501. [CrossRef]
2. eMarketer. Worldwide Ecommerce Forecast 2023. Available online: https://www.emarketer.com/content/worldwide-ecommerce-forecast-2023 (accessed on 20 March 2024).
3. Ha, N.T.; Akbari, M.; Au, B. Last mile delivery in logistics and supply chain management: A bibliometric analysis and future directions. *Benchmarking Int. J.* **2023**, *30*, 1137–1170. [CrossRef]
4. Mogire, E.; Kilbourn, P.; Luke, R. Customer satisfaction with last mile delivery in Kenya: An online customer perspective. *J. Transp. Supply Chain Manag.* **2023**, *17*, 844. [CrossRef]
5. Mogire, E. Last Mile Delivery and Customer Satisfaction Created by Online Retailers in Nairobi. University of Johannesburg. 2022. Available online: https://ujcontent.uj.ac.za/esploro/outputs/doctoral/Last-mile-delivery-and-customer-satisfaction/9921406107691 (accessed on 5 January 2025).
6. Risberg, A.; Jafari, H. Last mile practices in e-commerce: Framework development and empirical analysis of Swedish firms. *Int. J. Retail. Distrib. Manag.* **2022**, *50*, 942–961. [CrossRef]
7. Mogire, E.; Kilbourn, P.; Luke, R. The last mile delivery problem: A Kenyan retail perspective. *Acta Logist.* **2022**, *9*, 4. [CrossRef]
8. Boysen, N.; Fedtke, S.; Schwerdfeger, S. Last-mile delivery concepts: A survey from an operational research perspective. *OR Spectrum* **2021**, *43*, 1–58. [CrossRef]
9. World Economic Forum. The Future of the Last-Mile Ecosystem. 2020. Available online: https://www.weforum.org/publications/the-future-of-the-last-mile-ecosystem/ (accessed on 2 July 2024).
10. Mucowska, M. Trends of environmentally sustainable solutions of urban last-mile deliveries on the e-commerce market—A literature review. *Sustainability* **2021**, *13*, 5894. [CrossRef]
11. Hussan, U.; Majeed, M.A.; Asghar, F.; Waleed, A.; Khan, A.; Javed, M.R. Fuzzy logic-based voltage regulation of hybrid energy storage system in hybrid electric vehicles. *Electr. Eng.* **2022**, *104*, 485–495. [CrossRef]
12. Ramirez Barreto, D.A.; Ochoa Guillermo, E.V.; Peña Rodriguez, A.; Cardenas Escorcia, Y.D.C. Bibliometric analysis of nearly a decade of research in electric vehicles: A dynamic approach. *ARPN J. Eng. Appl. Sci.* **2018**, *13*, 4730–4736.
13. Keskin, M.; Çatay, B. Partial recharge strategies for the electric vehicle routing problem with time windows. *Transp. Res. Part C Emerg. Technol.* **2016**, *65*, 111–127. [CrossRef]
14. Barbosa, W.; Prado, T.; Batista, C.; Câmara, J.C.; Cerqueira, R.; Coelho, R.; Guarieiro, L. Electric vehicles: Bibliometric analysis of the current state of the art and perspectives. *Energies* **2022**, *15*, 395. [CrossRef]
15. Todorovic, M.; Aldakkhelallah, A.; Simic, M. Managing transitions to autonomous and electric vehicles: Scientometric and bibliometric review. *World Electr. Veh. J.* **2023**, *14*, 314. [CrossRef]
16. Ullah, I.; Safdar, M.; Zheng, J.; Severino, A.; Jamal, A. Employing bibliometric analysis to identify the current state of the art and future prospects of electric vehicles. *Energies* **2023**, *16*, 2344. [CrossRef]
17. Singh, V.; Singh, H.; Dhiman, B.; Kumar, N.; Singh, T. Analyzing bibliometric and thematic patterns in the transition to sustainable transportation: Uncovering the influences on electric vehicle adoption. *Res. Transp. Bus. Manag.* **2023**, *50*, 101033. [CrossRef]
18. Singh, G.; Misra, S.C.; Daultani, Y.; Singh, S. Electric vehicle adoption and sustainability: Insights from the bibliometric analysis, cluster analysis, and morphology analysis. *Oper. Manag. Res.* **2024**, *17*, 635–659. [CrossRef]
19. Patella, S.M.; Grazieschi, G.; Gatta, V.; Marcucci, E.; Carrese, S. The adoption of green vehicles in last mile logistics: A systematic review. *Sustainability* **2020**, *13*, 6. [CrossRef]

20. Purwanto, E.; Irawan, A.P. Bibliometric analysis of electric vehicle adoption research: Trends, implications, and future directions. *Int. J. Saf. Secur. Eng.* **2023**, *13*, 789–800. [CrossRef]
21. Soares, L.O.; Reis, A.D.C.; Vieira, P.S.; Hernandez-Callejo, L.; Boloy, R.A.M. Electric vehicle supply chain management: A bibliometric and systematic review. *Energies* **2023**, *16*, 1563. [CrossRef]
22. Amusa, H.K.; Sadiq, M.; Alam, G.; Alam, R.; Siefan, A.; Ibrahim, H.; Raza, A.; Yildiz, B. Electric vehicle batteries waste management and recycling challenges: A comprehensive review of green technologies and future prospects. *J. Mater. Cycles Waste Manag.* **2024**, *26*, 1959–1978. [CrossRef]
23. Anosike, A.; Loomes, H.; Udokporo, C.K.; Garza-Reyes, J.A. Exploring the challenges of electric vehicle adoption in final mile parcel delivery. *Int. J. Logist. Res. Appl.* **2023**, *26*, 683–707. [CrossRef]
24. Agyekum, E.B.; Adebayo, T.S.; Ampah, J.D.; Chakraborty, S.; Mehmood, U.; Nutakor, C. Transportation in Africa under Paris Agreement 2 C goal—A review of electric vehicle potentials, cleaner alternative fuels for the sector, challenges, and opportunities. In *Environmental Science and Pollution Research*; Springer: Berlin/Heidelberg, Germany, 2023; pp. 1–36.
25. Morganti, E.; Browne, M. Technical and operational obstacles to the adoption of electric vans in France and the UK: An operator perspective. *Transp. Policy* **2018**, *63*, 90–97. [CrossRef]
26. Corti, F.; Nava, A. Investment in Greening Last-Mile Logistics: A Case Study. In *Smart and Sustainable Planning for Cities and Regions: Results of SSPCR 2022*; Springer: Cham, Switzerland, 2023; p. 7584.
27. Keskin, M.; Çatay, B. A matheuristic method for the electric vehicle routing problem with time windows and fast chargers. *Comput. Oper. Res.* **2018**, *100*, 172–188. [CrossRef]
28. Alnıpak, S.; Toraman, Y. Acceptance of e-vehicles for last-mile parcel delivery from the perspective of drivers: A study in Turkiye. *LogForum* **2023**, *19*, 3. [CrossRef]
29. Ngoc, A.M.; Nishiuchi, H.; Nhu, N.T. Determinants of carriers' intentions to use electric cargo vehicles in last-mile delivery by extending the technology acceptance model: A case study of Vietnam. *Int. J. Logist. Manag.* **2022**, *34*, 210–235. [CrossRef]
30. Wei, H.; Callegari, C.; Fiorini, A.C.O.; Schaeffer, R.; Szklo, A. Technical and economic modelling of last-mile transport: A case for Brazil. *Case Stud. Transp. Policy* **2024**, *16*, 101219. [CrossRef]
31. Donthu, N.; Kumar, S.; Mukherjee, D.; Pandey, N.; Lim, W.M. How to conduct a bibliometric analysis: An overview and guidelines. *J. Bus. Res.* **2021**, *133*, 285–296. [CrossRef]
32. Mohammad, W.A.; Nazih Diab, Y.; Elomri, A.; Triki, C. Innovative solutions in last mile delivery: Concepts, practices, challenges, and future directions. *Supply Chain. Forum Int. J.* **2023**, *24*, 151–169. [CrossRef]
33. Singh, V.K.; Singh, P.; Karmakar, M.; Leta, J.; Mayr, P. The journal coverage of Web of Science, Scopus and Dimensions: A comparative analysis. *Scientometrics* **2021**, *126*, 5113–5142. [CrossRef]
34. Locke, S.L. Household characteristics and electric vehicle adoption: Changes from 2017 to 2022. In *Applied Economics Letters*; Taylor & Francis: Abingdon, UK, 2024; pp. 1–4.
35. Luke, R.; Mageto, J. Impact of China's belt and road initiative on logistics management in Africa: A bibliometric analysis. *J. Int. Logist. Trade* **2023**, *21*, 204–219. [CrossRef]
36. Callon, M.; Courtial, J.P.; Laville, F. Co-word analysis as a tool for describing the network of interactions between basic and technological research: The case of polymer chemistry. *Scientometrics* **1991**, *22*, 155–205. [CrossRef]
37. Mageto, J. Current and future trends of information technology and sustainability in logistics outsourcing. *Sustainability* **2022**, *14*, 7641. [CrossRef]
38. Schneider, M.; Stenger, A.; Goeke, D. The electric vehicle routing problem with time windows and recharging stations. *Transp. Sci.* **2014**, *48*, 500–520. [CrossRef]
39. Campbell, A.A.; Cherry, C.R.; Ryerson, M.S.; Yang, X. Factors influencing the choice of shared bicycles and shared electric bikes in Beijing. *Transp. Res. Part C Emerg. Technol.* **2016**, *67*, 399–414. [CrossRef]
40. Sanders, R.L.; Branion-Calles, M.; Nelson, T.A. To scoot or not to scoot: Findings from a recent survey about the benefits and barriers of using e-scooters for riders and non-riders. *Transp. Res. Part A Policy Pract.* **2020**, *139*, 217–227. [CrossRef]
41. Yang, H.; Ma, Q.; Wang, Z.; Cai, Q.; Xie, K.; Yang, D. Safety of micro-mobility: Analysis of e-scooter crashes by mining news reports. *Accid. Anal. Prev.* **2020**, *143*, 105608. [CrossRef] [PubMed]
42. Kirschstein, T. Comparison of energy demands of drone-based and ground-based parcel delivery services. *Transp. Res. Part D Transp. Environ.* **2020**, *78*, 102209. [CrossRef]
43. Hosseinzadeh, A.; Algomaiah, M.; Kluger, R.; Li, Z. E-scooters and sustainability: Investigating the relationship between the density of E-scooter trips and characteristics of sustainable urban development. *Sustain. Cities Soc.* **2021**, *66*, 102624. [CrossRef]
44. Bieliński, T.; Ważna, A. Electric scooter sharing and bike sharing user behaviour and characteristics. *Sustainability* **2020**, *12*, 9640. [CrossRef]
45. Baek, K.; Lee, H.; Chung, J.H.; Kim, J. Electric scooter sharing: How do people value it as a last-mile transportation mode? *Transp. Res. Part D Transp. Environ.* **2021**, *90*, 102642. [CrossRef]

46. Hosseinzadeh, A.; Algomaiah, M.; Kluger, R.; Li, Z. Spatial analysis of shared e-scooter trips. *J. Transp. Geogr.* **2021**, *92*, 103016. [CrossRef]
47. Dias, G.; Arsenio, E.; Ribeiro, P. The role of shared e-scooter systems in urban sustainabil-ity and resilience during the COVID-19 mobility restrictions. *Sustainability* **2021**, *13*, 7084. [CrossRef]
48. Oe, H.; Abdullah, M.N. An exploratory discussion on electric cars and sustainable innovation. *Econ. J. Sci. J. Account. Manag. Financ.* **2022**, *2*, 174–181. [CrossRef]
49. Castiglione, M.; Comi, A.; De Vincentis, R.; Dumitru, A.; Nigro, M. Delivering in urban areas: A probabilistic-behavioral approach for forecasting the use of electric micromobility. *Sustainability* **2022**, *14*, 9075. [CrossRef]
50. Mogire, E.; Kilbourn, P.; Luke, R. Green innovations in last mile delivery for e-commerce: A bibliometric review. In Proceedings of the 17th International Business Conference (IBC), Stellenbosch, South Africa, 22–25 September 2024.

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