

Review

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[Eric Mogire](#)*

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Review

Light Electric Vehicles and Sustainable Urban Transport: A Bibliometric Review

Eric Mogire

Department of Transport and Supply Chain Management, and Institute of Transport and Logistics Studies (Africa),
University of Johannesburg, Auckland Park, Johannesburg 2006, South Africa; emogire@uj.ac.za

Abstract

The use of light electric vehicles, such as e-bikes and e-scooters, is increasingly gaining momentum due to their potential to improve the sustainability of cities. This has numerous benefits, including efficient energy consumption, reduced carbon emissions, improved relationships with other modes of transportation, and faster navigation within the city. This paper uses a bibliometric review to understand the research structure in Electric micromobility and urban sustainability. It adopts the Scopus database and focuses on 552 publications from 2000 to 2025. The R-studio software was used to perform bibliometric analysis. Results revealed that the publication trend steadily rose from 2015, with a significant upsurge after 2020, with an annual growth rate of 18.69%. Three dominant themes were identified: sustainability, integration with public transport, and technological innovations, alongside underexplored areas such as shared e-micromobility and policy frameworks. Future research should capture full lifecycle impacts, expand LEV access beyond current user groups, and align rapid technological advances with inclusive governance frameworks.

Keywords: light electric vehicle; LEV; sustainable transport; urban; city; bibliometric; review

1. Introduction

Urban areas globally face transport-related challenges, including traffic jams, infrastructural limitations, air and noise pollution [1, 2, 3, 4, 5]. Due to this, there has been a shift from the use of private cars to emerging mobility solutions such as micro-vehicles to improve urban transportation [1, 6]. Light electric vehicles (LEVs), such as e-bikes, e-scooters, and e-skateboards, have emerged as a key innovation for promoting urban sustainability [1, 2, 7]. Cities that have integrated LEVs into their broader transport systems have witnessed transformations in urban form, land use, and citizen mobility behaviors [8, 9]. In addition, due to the global commitments to the United Nations' Sustainable Development Goal (SDG) 11 on sustainable cities and communities, many urban areas are working toward clean and accessible transport systems. These developments illustrate the growing potential of LEVs in promoting a more sustainable city living.

There has been no clearly agreed definition of light electric vehicles [1]. However, different scholars have diverse definitions: Light electric vehicles refer to micromobility modes powered by a battery-powered electric motor, and are characterised by light weight, energy, and spatial demands [10]. These include e-scooters and e-bikes, which are limited to 25 kilometres per hour, as well as electric two-wheelers with a speed limit of 45 kilometres per hour [10]. Similarly, LEVs refer to small, lightweight electric-powered vehicles weighing less than 350 kg and a maximum speed of 45 km/h [11]. A light vehicle is a low-weight motorised transport with limited speed, often up to 45 km per hour, used mainly for urban trips [1]. This ranges from micro-vehicles, such as e-cotters, to light three- or four-wheeled vehicles [1]. In this study, light electric vehicles can be defined as small, lightweight battery-powered transportation modes designed for short urban trips, with a limited speed of up to 45 km/h.

From an urban sustainability perspective, LEVs align closely with the goals of sustainable urban development. LEVs are changing how people travel over short distances in various cities effectively transforming urban transportation [12]. LEVs reduce carbon emission, utilise less urban space, and offer flexible transportation options to conventional vehicles, particularly for short distance travel in urban areas [13, 14]. They have the potential to support clean, quiet urban areas that enhance the physical well-being of citizens [15, 16]. In addition, LEVs promote equity in transportation by providing affordable, reliable, and equitable transportation options. They enhance the human experience of urban transport by providing a pleasant atmosphere created by the built environment [17].

Despite the benefits, use of LEVs in urban areas is hindered by numerous barriers, including safety concerns and inadequate charging infrastructure [18]. Furthermore, the LEVs uptake is hindered by high initial capital costs, limited riding range, and long charging times [19, 20]. While LEVs such as e-scooters, e-bicycles, and lightweight personal mobility devices can potentially reduce pollution and noise ([21]), riders can be exposed to atmospheric pressure and noise pollution in cities [22] as well as particles from vehicle exhaust systems [23]. Riders also use more physical energy than other modes, which accrues to health benefits [24].

Although there exists numerous studies on LEVs, the current literature remains fragmented and lacks an integrated understanding of how LEVs contribute to sustainable urban transport. Studies are dispersed across multiple disciplines, such as urban planning, public health, engineering, and environmental science. Existing studies focus on isolated themes, such as barriers [19, 20], adoption intentions [3, 11, 25, 26], sustainability impacts [27, 28], and safety [29]. While some reviews have explored some aspects such as safety [30], policy frameworks [7], and environmental benefits [13], little is known of a study that employed bibliometric techniques to review existing studies on LEVs and sustainable urban transport. Thus, this review aims to address the gap through bibliometric analysis to identify dominant and emerging research themes from which areas for future inquiry can be proposed. The following research objectives guide the study:

1. To identify the key themes used in light electric vehicles and sustainable urban transport research.
2. To propose future research agendas in light electric vehicles and sustainable urban transport research.

The next phase of the paper is structured as follows: Section 2 focuses on the materials and methods; Section 3 presents the results; Section 4 discusses the findings; and Section 5 concludes the study with recommendations for future research.

2. Materials and Methods

Given the rapid growth and interdisciplinary nature of this field, a bibliometric review offers a timely and rigorous approach to mapping its intellectual structure. Bibliometric analysis allows for the systematic quantification of research patterns, including the evolution of themes, prolific authors and institutions, influential publications, and knowledge gaps [31]. To achieve the objectives, 762 publications were retrieved from the Scopus database on 30 September 2025 using the following search query: Title-Abs-Key(("electric") AND ("bike" OR "bicycle" OR "cycle" OR "two wheeler" OR "three wheeler" OR "trike" OR "tricycle" OR "motorbike" OR "motorcycle" OR "scooter" OR "rickshaw" OR "micromobility" OR "moped" OR "hoverboard" OR "skateboard" OR "rideable" OR "quadricycle" OR "unicycle") OR "e-bike" OR "e-bicycle" OR "e-cycle" OR "e-two wheeler" OR "e2w" OR "e3w" OR "e-three wheeler" OR "e-trike" OR "e-tricycle" OR "e-motorbike" OR "e-motorcycle" OR "e-scooter" OR "e-rickshaw" OR "e-micromobility" OR "e-moped" OR "pedelec" OR "personal electric vehicle" OR "PEV" OR "light electric vehicle" OR "LEV" OR "micro electric vehicle" OR "MEV" OR "e-quadricycle" OR "L-category vehicle" OR "neighborhood electric vehicle" OR "e-unicycle" OR "shared micromobility") AND (("sustainable") AND ("transport" OR "transit" OR "mobility")) AND ("urban" OR "city" OR "town" OR "metropolitan" OR "cities")). The Scopus database was utilised because its reputation as a trusted source of bibliometric data [32], offering broader and more comprehensive coverage for research evaluation than the Google Scholar and the Web of Science [33]. The publications, including articles, conference papers, book chapters, and reviews, were limited to those in English, published between 2000 and 2025.

The abstracts and topics of the 767 publications were reviewed for relevance, resulting in 552 publications. The excluded publications lacked topics, abstracts, or were irrelevant. The irrelevant publications related to topics on heavy electric vehicles, such as buses and trucks, non-urban, urban transport studies, but not related to LEVs, and sustainability studies not specific to LEVs. The 552 publications were exported from the Scopus database in a CSV Excel file for bibliometric analysis. The analysis, comprising of performance analysis and science mapping was performed using the Biblioshiny app in the R-studio. Results show that research on LEVs and sustainable urban transport is rapidly growing (18.69% annual growth), and relatively young (average age 3.64 years) (Table 1). The dominance of articles and conference papers, with few reviews, highlights the need for synthesis and consolidation of existing knowledge on the topic.

Table 1. Descriptive summary of the 552 publications (2000–2025).

Description	Results
Timespan	2000:2025
Sources (journals, books, etc.)	207
Documents	552
Annual growth rate %	18.69
Document average age	3.64
Average citations per doc	14.68
References	4144
DOCUMENT CONTENTS	
Keywords plus (ID)	3042
Author's keywords (DE)	3960
AUTHORS	
Authors	3295
Authors of single-authored docs	0
AUTHORS COLLABORATION	
Single-authored docs	0
Co-authors per doc	11
International co-authorships %	20.83
DOCUMENT TYPES	
Article	324
Book chapter	28
Conference paper	188
Review	12

3. Results

This section is organized into two parts: performance analysis and science mapping. These results will be used to understand the underlying themes and underexplored areas from which future research agendas will be proposed.

3.1. Performance Analysis

The first phase, from 2000 to 2014, reveals little research output, with less than six publications per year (Figure 1). The use of LEVs for sustainable urban transport was a new concept during this phase. From 2015, the number of publications began to grow steadily, increasing from 9 to 15 by 2019. This phase coincided with the early implementation of Sustainable Development Goals (SDGs). The phase, from 2020 to 2023, reveals significant research output, peaking at 118 publications in 2024. The use of LEVs became common in urban areas during this phase driven by demand for clean transport, and technological advancements. The drop in publications to 103 in 2025 is due to the incomplete year, but is expected to rise above 2024 once all publications are indexed.

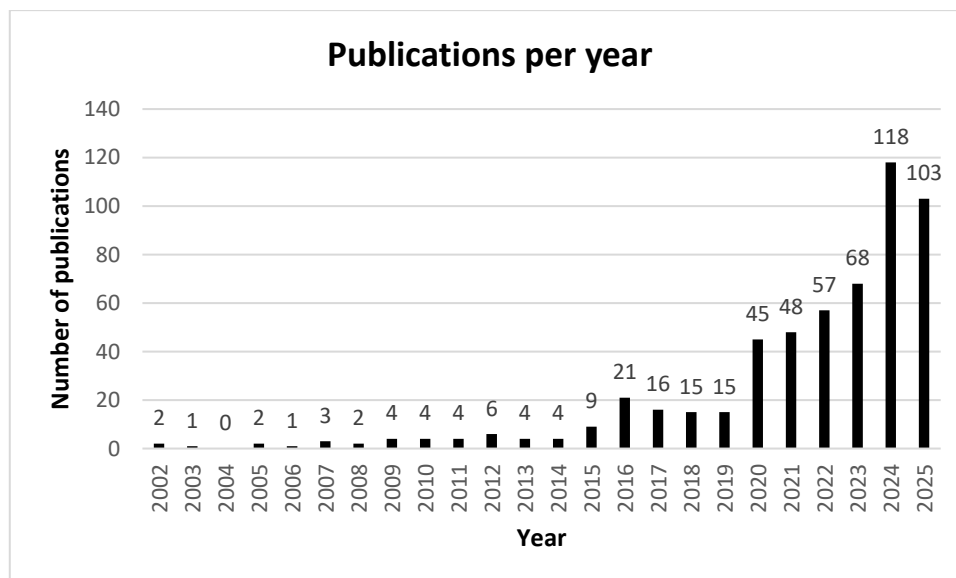


Figure 1. Annual output of publications.

3.1.1. Top journals on the Topic

The *Sustainability* journal is the most influential journal, with 33 publications, an h-index of 15, an m-index of 1.667, and 726 total citations calculated from 2017 (Table 2). This is a broad emerging journal with the highest m-index, focusing on areas like the environment, policy, and technological aspects directly linked to LEVs and sustainable urban transport. The *Energies* and *Transportation Research: Part A and D* are also emerging journals focusing on specialised topics. For instance, the *Energies* journal covers specialised topics in energy technologies, batteries, and charging systems. The top journals, such as *Sustainability*, *Sustainable Cities and Society*, *Transportation Research Part D*, *Energies*, and *Journal of Cleaner Production*, focus on the environmental and urban sustainability theme, while *Transportation Research Part A*, *Journal of Transport Geography*, and *Case Studies on Transport Policy* focus on the policy theme. Journals like *Sustainability*, *Energies*, and the *Journal of Cleaner Production* focus on an additional theme known as technological advancements in LEVs, particularly in areas such as batteries, charging systems, and cleaner manufacturing. Thus, the top journals concentrate on sustainability, policy, and technology.

Table 2. Top 10 journals on LEVs and sustainable urban transport (2000–2025).

Rank	Journal	h-Index	g-Index	m-Index	TC	NPPY_Start
1	Sustainability (Switzerland)	15	26	1.667	726	33 2017
2	Transportation Research Part D: Transport and Environment	14	20	1.273	1306	20 2015
3	Sustainable Cities and Society	12	15	0.8	516	15 2011
4	Transportation Research Part A: Policy and Practice	10	15	1.111	549	15 2017
5	Energies	9	17	1.125	310	17 2018
6	Journal of Cleaner Production	8	11	1	417	11 2018
7	Journal of Transport Geography	8	9	0.8	419	9 2016
8	Transportation Research Procedia	6	12	0.6	146	15 2016
9	Case Studies on Transport Policy	4	6	0.667	79	6 2020
10	European Transport Research Review	4	6	0.364	240	6 2015

3.1.2. Top authors on the Topic

Table 1 reveals 3 295 authors contributed to publications on the topic. *Campisi Tiziana* is the most influential author, with nine publications, a h-index of 5, an m-index of 1.25, and 38 total citations

calculated as from 2022 (Table 3). This is an influential emerging author with the highest m-index, focusing on areas such as user behavior, policy, and infrastructure design, as well as the safety of LEVs in sustainable urban mobility. *Severengiz Semih* is also an influential emerging author with an m-index of 1.25 from seven publications computed from 2022. The author focuses on areas like user acceptance, charging innovations, shared mobility, and the role of LEVs in reducing emissions for both passenger and freight transport. *Cherry Christopher R.* is a veteran author with the highest number of total citations (333) from four publications, counted from 2007. The author's influential studies focus on LEV areas like user behavior, sustainability impacts, and integration with public transport.

Table 3. Top 10 authors on LEVs and sustainable urban transport (2000–2025).

Rank	Element	h-Index	g-Index	m-Index	TC	NP	PY_Start
1	Campisi, Tiziana	5	5	1.25	38	9	2022
2	Severengiz, Semih	5	6	1.25	40	7	2022
3	Cherry, Christopher, R.	4	4	0.211	333	4	2007
4	Comi, Antonio	4	5	1	77	5	2022
5	Schelte, Nora	4	4	1	35	4	2022
6	Tesoriere, Giovanni	4	4	1	26	4	2022
7	Abbasi, Sorath	3	3	0.5	301	3	2020
8	Behrendt, Frauke	3	4	0.3	215	4	2016
9	Castiglione, Marisdea	3	3	0.75	68	3	2022
10	De Vincentis, Rosita	3	3	0.75	68	3	2022

3.1.3. Top Author Affiliations on the Topic

Top author affiliations are institutions linked to the most prolific researchers based on the number of publications credited to them. Table 4 shows Italy leads with nine institutions, followed by 169 publications, and is then followed by Germany and China, each with three institutions. Developing economies in Africa and South America are underrepresented in the list of top author affiliations.

Table 4. Top author affiliations on LEVs and sustainable urban transport (2000–2025)

Rank	Institution	Frequency
1	Università Degli Studi Di Brescia	40
2	Ruhr-Universität Bochum	28
3	Alma Mater Studiorum Università Di Bologna	21
4	Politecnico Di Milano	21
5	College of Engineering	20
6	Southeast University	20
7	Budapest University of Technology and Economics	19
8	Not reported	19
9	Deutsches Zentrum Für Luft- Und Raumfahrt (Dlr)	18
10	Università Degli Studi Di Firenze	17
11	Tongji University	15
12	Università Degli Studi Di Enna "Kore"	15
13	Università Degli Studi Roma Tre	15
14	Universidad Politécnica De Madrid	14
15	Università Degli Studi Di Padova	14
16	Sapienza Università Di Roma	13
17	Technische Universität Braunschweig	13
18	Università Degli Studi Di Roma "Tor Vergata"	13

19	Aristotle University of Thessaloniki	12
20	Beijing Jiaotong University	12

3.1.4. Top countries On the Topic

Table 5 shows that Italy leads in scientific production with 304 publications, followed by India (182), Germany (169), and China (165). Research in Italy primarily focuses on LEVs, smart digital mobility, and inclusive urban transport solutions. Research in India mainly focuses on electric scooters as affordable, low-carbon solutions for urban mobility and last-mile delivery. Furthermore, research on the topic shows Europe as the dominant hub (13 countries), with Asia as an emerging region with four countries. Africa and South America are not featured in the list of most productive countries.

Table 5. Top 20 countries' scientific production on LEVs and sustainable urban transport (2000–2025).

Rank	Country	Frequency
1	Italy	304
2	India	182
3	Germany	169
4	China	165
5	Spain	118
6	United States of America	106
7	United Kingdom	90
8	Portugal	67
9	Poland	58
10	Indonesia	54
11	Greece	46
12	Netherlands	39
13	France	32
14	Belgium	31
15	Sweden	30
16	Turkey	28
17	Colombia	26
18	Ireland	24
19	Australia	21
20	Switzerland	21

3.2. Science Mapping

3.2.1. Co-Authorship Analysis

Co-authorship analysis helps identify collaboration patterns in a topic, for example, among countries affiliated to various researchers [31]. Country collaboration maps are used to graphically represent the direction and intensity of research collaborations among countries [34]. European countries (specifically, Italy, Germany, and the United Kingdom) have the strongest collaborations (thickest line) with China (Figure 2). The USA also reported stronger collaborations with the European countries and China. For instance, research collaborations between the USA and China relate to themes such as LEV innovations, service quality improvement, and transportation energy efficiency. The highest research output (represented in dark blue) was also noted in European countries (specifically, Italy, Germany, and the United Kingdom), the USA, China, and India. Some research output (represented in light blue colour) is emerging from countries such as Brazil, South Africa, Canada, and Australia. For instance, research emerging from South Africa relates to the feasibility assessment of LEVs in terms of their impact on the grid and charging infrastructure. Most countries in Africa are underrepresented in research output (represented in grey colour).

Country Collaboration Map

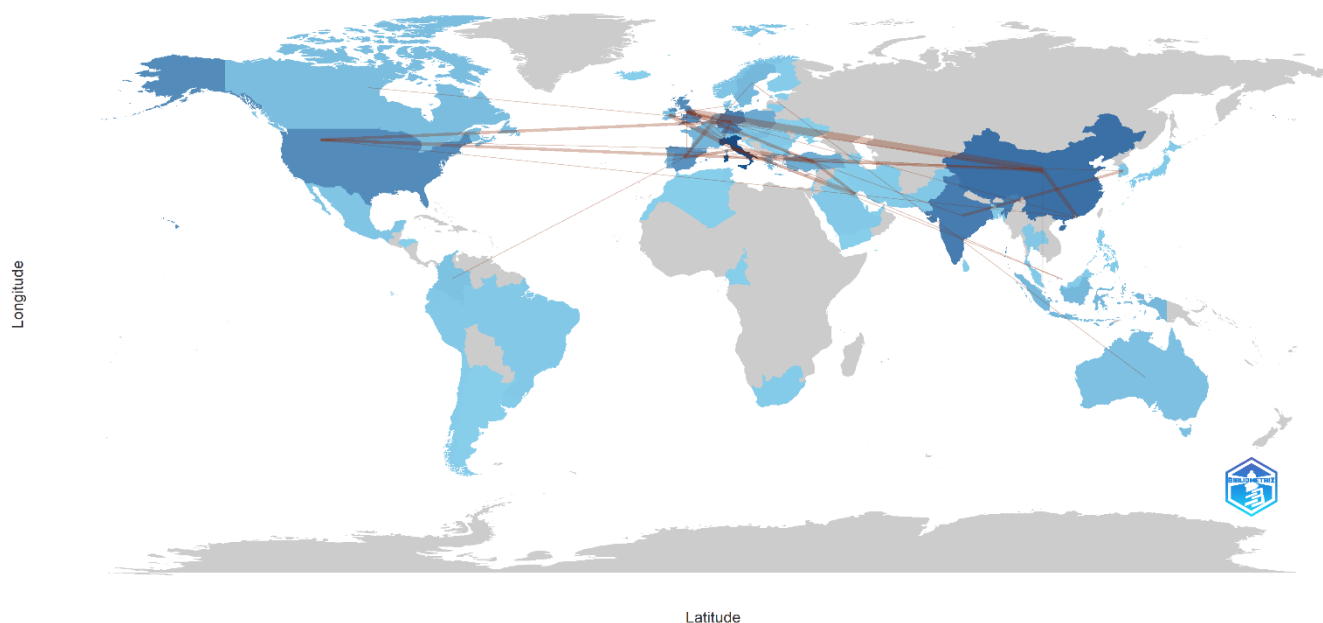


Figure 2. Country collaboration map on LEVs and sustainable urban transport (2000–2025).

3.2.2. Word Analysis

Word analysis helps in identification of commonly used keywords from publications on a topic and their interrelationships. For instance, a word cloud is used in word analysis to visually represent the keywords commonly used in publications and their relationships on a topic [35]. Figure 3 shows that *sustainable development* and *sustainability* are the most dominant keywords. Other keywords that fall in this cluster include *gas emissions*, *emission control*, *greenhouse gases*, *carbon emission*, *sustainable transportation*, *global warming*, *air pollution*, *lifecycle*, *energy efficiency*, *energy utilisation*, *climate change*, *environmental impact*, *economic and social effects*. This reflects the foundational role that the LEVs play in reducing emissions, improving energy efficiency, and the quality of life in urban areas. Close to the sustainability cluster are keywords like *micromobility* and *public transport*. Other keywords in this cluster include *cycle transport*, *shared mobility*, *secondary batteries*, *machine learning*, and *smart city*. This cluster demonstrates how LEV technologies and digital urban systems facilitate the promotion of sustainable urban transportation. The operational and planning cluster is emerging with keywords like *urban planning*, *transportation planning*, *travel behaviour*, *fleet operations*, *decision making*, *sensitivity analysis*, *life cycle assessment*, *transportation policy*, *economics*, *last mile*, and *transportation mode* situated at the periphery of the word cloud. This highlights the need for policy frameworks, economic viability, and user-centered mobility planning in urban areas. However, the word cloud underrepresents keywords related to governance, equity, infrastructure, health and safety of LEVs.



Figure 3. Word cloud on LEVs and sustainable urban transport (2000–2025).

3.2.3. Thematic Mapping

Thematic mapping uses keywords to visually represent the importance or development of words within a topic [35]. This is visualised using four quadrants displayed in Figure 4: motor themes - central and developed, basic themes - central but undeveloped, emerging or declining themes - peripheral and undeveloped, and niche themes - peripheral yet well-developed [36, 37].

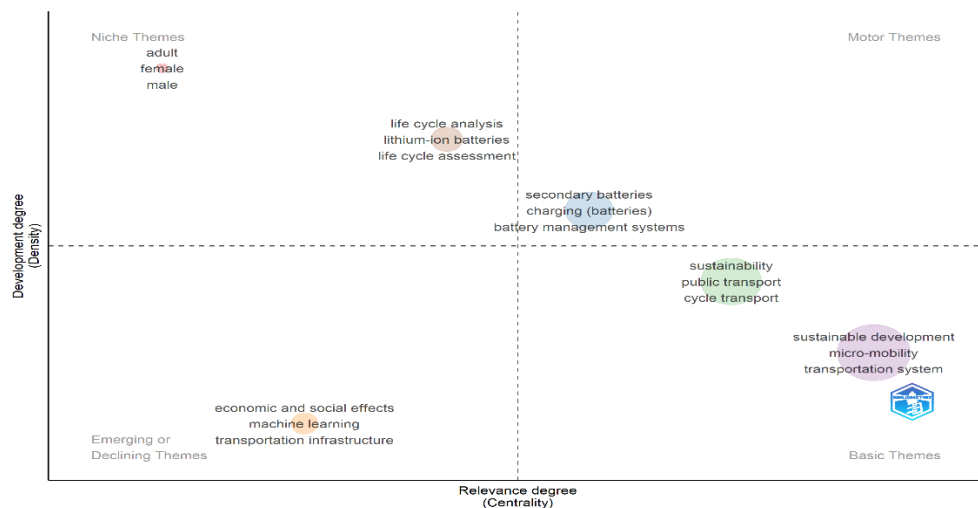


Figure 4. Thematic map on LEVs and sustainable urban transport (2000–2025).

Figure 4 shows that technology-related research including keywords like *battery management systems*, *charging*, and *secondary batteries* positioned as motor theme. This is a well-developed and central theme to the topic, thus forming the foundation of LEVs and sustainable urban transport. Basic themes with keywords like *sustainable development*, *micro-mobility*, *transportation systems*, *sustainability*, *cycle transport*, and *public transport* are central but less developed. Since these are relevant but underexplored areas, extensive research is necessary to harness the potential of LEVs for sustainable urban transport. Niche themes include keywords like *adult*, *female*, and *male*, which show that social and demographic studies remain underexplored. Emerging or declining theme, including keywords like *economic and social effects*, *machine learning*, and *transport infrastructure*, show areas that are either just beginning to gain attention or are not receiving enough attention from researchers.

3.2.4. Thematic Evolution

Thematic evolution was divided into four periods based on the trend in the increasing number of publications, as shown in Figure 1. The evolution of LEVs and sustainable urban transport research shifts from a broad technical focus to a narrower policy-oriented concern (Figure 5). From 2000 to 2014, researchers primarily focused *battery electric vehicles*, *energy efficiency*, and *sustainability* issues, thereby laying the technological foundations for LEVs. The period from 2015 to 2019 was characterised by a focus on *e-mobility*, *freight transport*, *mass transportation*, and *public transport* issues. This coincides with the United Nations' Sustainable Development Goals, increasing pressure for the reduction of carbon emissions, and supportive government policies toward integrating LIEVs with public transport. From 2020 to 2023, most researchers focused on *environmental impact*, *secondary batteries*, and *SDG11*. This indicates an increasing recognition of LEV technologies as an integral part of building sustainable urban areas. The 2024 to 2025 period reveals a shift in research toward *climate change*, *energy policy*, *greenhouse gas reduction*, and *micro-mobility* issues. This highlights the role of LEVs in tackling environmental challenges in urban areas. The post-2025 period has already started focusing on *equity*, *energy*, *machine learning*, *policymakers*, *shared mobility*, and *road safety* issues. This highlights the need to start addressing social justice, governance, and intelligent systems in sustainable urban transport. It was noted that the topic of *sustainable development* was a recurring theme across all periods, underscoring its foundational role.

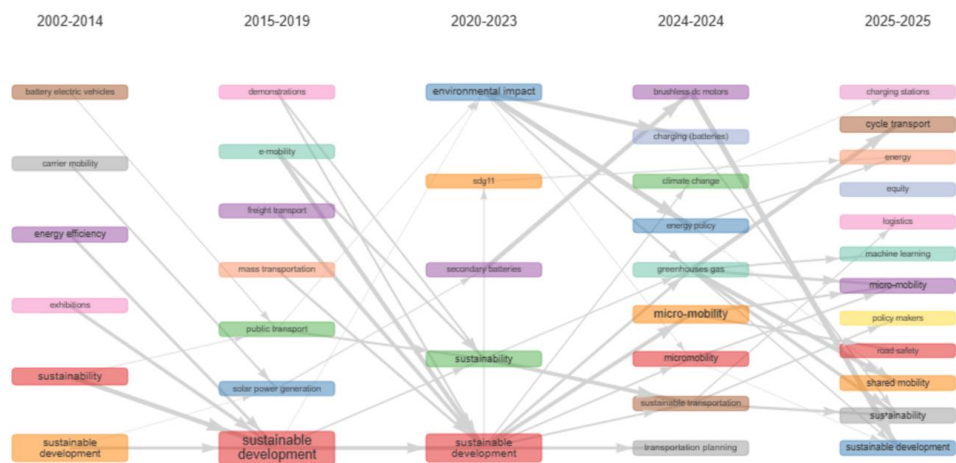


Figure 5. Thematic evolution on LEVs and sustainable urban transport (2000–2025).

3.2.5. Citation Analysis

Table 6 outlines the most-cited studies on LEVs and sustainable urban transport. Oeschger et al. [12] have the highest citations per year, at 43.50, for their review of the integration of micromobility and public transport. The review is influential on the topic by setting research priorities in the social impacts of integrating micromobility and public transport. These include reducing inequalities and promoting social inclusion. The top cited publications focus on key themes like integration with public transport, adoption drivers and sociodemographic profiles, sustainability and efficiency trade-offs, and safety. Integration of LEVs with public transport emerges as a key theme in the top cited publications on the topic [12, 38, 39, 40]. Although studies have explored user preferences and the reasons for integrating micromobility with public transport, few have examined its social impacts. These include reducing societal inequalities and promoting social inclusion [12]. Existing studies show that bike sharing and e-scooters are utilised to either replace or complement other modes of transport like walking and public transport [38, 39, 40]. For instance, in Norway, bike sharing complements public transport in areas lacking a metro and rail network [39]. However, the LEVs are used primarily by young, educated men [38, 39, 41]. This reveals some underexplored groups like the low-income groups, women, and older people. The use of e-scooters for transportation is discouraged due to safety issues, arising from the non-use of helmets, inconsistent regulations, and riding under the influence [29]. This shows that gaps remain in the regulatory frameworks that can bring safety in the use of LEVs. The theme of sustainability and efficiency trade-offs also feature prominently in the list of top-cited publications [27, 28, 40, 41]. Weiss et al. [27] noted that LEVs such as e-bikes and scooters have the potential for energy efficiency. Bike-sharing has been adopted mainly in densely populated areas, particularly by individuals concerned about climate change [41]. Ecer et al. [28] developed a robust framework to assess the sustainability of micromobility options. Despite the focus on sustainability studies, little attention is given to the lifecycle impacts of LEVs, including those from manufacturing, maintenance, and disposal. Adoption drivers and sociodemographic profiles also emerge as a theme in the top-cited publications [25, 28, 38, 41]. For instance, the key sustainability factors used to evaluate and rank micromobility solutions include scenic adoption, accidents and computing time [28]. Behavioral factors include perceived values, risks, performance, and social image [25, 26]. Adoption is also influenced by policies and charging infrastructure [25, 26]. However, there remain some gaps in the models on shared LEV usage and safety concerns. It was noted that most of the top-cited publications are based in urban areas from Europe, the USA, and Asia, leaving a gap in African and South American urban areas where infrastructure and cultural contexts differ.

Table 6. Top 10 most cited publications on LEVs and sustainable urban transport (2000–2025).

Author(s)	Total Citations Per Year	Title	Findings
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Oeschger et al. [12]	43.50	Micromobility and public transport integration: The current state of knowledge.	The paper reviewed studies on the integration of micromobility and public transport. While most studies have focused on user preferences and reasons for integration, few have examined the social impacts, such as reducing societal inequalities and promoting social inclusion.
Laa & Leth [38]	33.17	Survey of e-scooter users in Vienna	The paper analysed the socio-economic profiles and usage patterns of e-scooter users in Austria. Most users are young males with good education, moving away from walking and public transport. It was recommended that cities should have policies that adequately allocate more space to cycling infrastructure.
Eccarius & Lu [25]	30.33	Adoption intentions for micro-mobility–Insights from electric scooter sharing in Taiwan.	The paper examined factors influencing the usage of e-scooter sharing services in Taiwan among university students. Students are most likely to use the service if it meets their values and transport needs.
Badia & Jenelius [40]	27.33	Shared e-scooter micromobility: review of use patterns, perceptions and environmental impacts	The paper reviewed studies on usage patterns, perceptions, and environmental impacts of shared e-scooter micromobility. Most studies indicate that shared e-scooters are used for leisure and are replacing walking and public transportation. However, limited studies have been undertaken on integration with public transport.
Böcker et al. [39]	25.67	Bike sharing use in conjunction to public transport: Exploring spatiotemporal, age and gender dimensions in Oslo, Norway.	The paper analysed the potential use of bike sharing when combined with public transport in Norway and how its use differs by age and gender. Bike sharing is used to complement public transportation, especially in areas without a metro or rail network. It is mainly used by young men, with women and older users underrepresented.
Weiss et al. [27]	25.67	Energy efficiency trade-offs in small to large electric vehicles	The study analysed the energy efficiency trade-offs in electric vehicles using energy consumption data from Germany, supplemented with additional data from China, Norway, and the USA. Results showed that energy use increases with vehicle mass, highlighting the efficiency potential of lighter EVs such as e-bikes and scooters.
Ecer et al. [28]	22.67	Sustainability performance analysis of micro-mobility solutions in urban transportation with a novel IVFNN-Delphi-	The study presented a robust decision-making framework to evaluate the sustainability performance of micro-mobility solutions. Results showed that scenic adoption, computing time, and

		LOPCOW-CoCoSo framework	accidents are key sustainability factors, with electric scooters identified as the most promising micro-mobility solutions.
Mouratidis [41]	20.50	Bike-sharing, car-sharing, e-scooters, and Uber: Who are the shared mobility users and where do they live?	The study examined the factors influencing the use of bike-sharing and e-scooters in Norway. While bike-sharing is mostly used by young, single men concerned about climate change, e-scooter users are young, less educated men without disabilities in populated areas.
Eccarius & Lu [26]	19.00	Powered two-wheelers for sustainable mobility: A review of consumer adoption of electric motorcycles	The review paper on electric motorcycle adoption found that perceived value, risks, performance, social image, policies, and charging infrastructure influence consumer adoption. There still exist gaps in how shared use models operate, how social norms influence adoption, and how safety concerns affect users.
Kazemzadeh et al. [29]	19.00	Electric scooter safety: An integrative review of evidence from transport and medical research domains	The paper reviewed studies on the safety of e-scooters. Inexperienced riders, parking risks, and interaction risks were identified as the primary safety concerns associated with e-scooters. In addition, accidents primarily involve young male users. However, gaps remain in helmet use, consistent regulations, and riding under the influence.

4. Discussion

The findings presented in Section 3 reveal that the publication trend in existing research has had a substantial rise since 2020. This substantial rise in recent years is driven by technological advancements and demand for clean transport. Furthermore, the findings aided in uncovering of key themes and underexplored areas. From the findings, existing studies primarily focus on three dominant themes. These include sustainability, integration with public transportation, and technological innovations. Prominent authors, including *Campisi Tiziana*, *Severengiz Semih*, and *Cherry Christopher*, focus their research efforts on the three dominant themes. Findings from thematic evolution further summarise the dominant themes by starting with technical foundations, such as *energy efficiency* and *batteries*, in early periods, and then moving on to recent concerns with *climate change*, *equity*, and *governance*. The country collaboration map highlights strong research collaborations between the USA and China on LEV innovations and energy efficiency.

The sustainability theme was identified as the most dominant theme in the word cloud, based on keywords such as *sustainability*, *sustainable development*, and *environmental impact*. Top-cited publications emphasise the energy efficiency benefits of LEVs such as e-bikes and scooters [27], but lifecycle impacts from production to disposal remain underexplored. Prominent journals like *Sustainability* and the *Journal of Cleaner Production* contain research that primarily focuses on sustainability issues. The integration of LEVs with public transport was also identified as a dominant theme. For instance, research from India, a country listed among the prominent countries, primarily focuses on e-scooters as an affordable, low-carbon solution for urban mobility and last-mile delivery. Most top-cited publications indicate that LEVs can complement or replace public transport, particularly among young, educated male residents in urban areas [12, 38, 39, 40]. This raises concerns about social inclusion, hence need to ensure that underrepresented groups, such as women, older generations, and lower-income groups in urban areas, can effectively use LEVs. Furthermore, findings from the thematic map further reveal that social and demographic aspects remain

underexplored. Technological innovation was also identified as a dominant theme on the topic. Findings from the thematic map reveal that technology-related research, such as *battery management systems* and *charging*, forms the foundation of the topic. In addition, Italy, one of the most productive countries, has made significant advances in research on smart digital mobility and inclusive transportation. The word cloud also revealed the existence of technological innovations, including *secondary batteries*, *digital platforms*, and *smart city* applications. Prominent journals such as *Energies* and the *Journal of Cleaner Production* primarily promote research that focuses on technological advancements and the viability of LEVs in urban transportation.

Some underexplored themes were also identified in existing research about LEVs and sustainable urban transport. These include user adoption, shared electric micromobility services, as well as policy and planning frameworks. Top authors, such as *Campisi Tiziana*, *Severengiz Semih*, and *Cherry Christopher*, focus their research efforts on some of the underexplored themes. Findings from the top-cited publications revealed that adoption of LEVs in urban areas is influenced by functional aspects such as performance, safety, and cost. Furthermore, adoption is influenced by psychosocial factors like perceived risks, environmental values, and social image [25, 26, 28, 41]. Other factors include enabling infrastructure, policies, and charging availability [26]. However, gaps remain in how shared use models work for LEVs, how social norms, and safety concerns influence the adoption of LEVs. Oeschger et al. [12] proposed further research on the underexplored areas of the social impacts of e-micromobility. These include the potential to reduce inequalities and promote inclusion in the urban use of LEVs. Policy and planning frameworks also emerge as an underexplored theme. Journals such as *Transportation Research Part A* and *Case Studies on Transport Policy* emphasise the importance of regulatory measures and infrastructure planning for sustainable urban transport. Findings from the word cloud highlight the role of *fleet operations*, *travel behavior*, and *transportation policy* in urban transport. Furthermore, findings from the thematic evolution post-2025 indicate that *equity*, *governance*, and *intelligent systems* are among the emerging areas of research.

5. Conclusions

A bibliometric review was undertaken to identify dominant and underexplored themes and recommend future research agendas on LEVs and sustainable urban transport. It was observed that there is an increasing trend in research on LEVs and sustainable urban transport driven by policy changes, technological advancements, and growing demand for clean urban transport. It was also established that existing research revolves around three dominant themes. These include sustainability, integration of LEVs with public transport, and technological innovations. A few studies highlighted two underrepresented themes: shared e-micromobility and policy frameworks. The future research agenda should focus on the research gaps identified in these themes.

- Sustainability emerged as one of the most dominant themes. This included studies on the role of LEVs in relation to air quality and energy efficiency at the operational phase, ignoring the lifecycle impacts from manufacturing, maintenance, and disposal. Future studies should focus on assessing the lifecycle impacts of LEVs across various urban areas, especially in developing economies.
- Integration of LEVs with public transport was identified as a dominant theme. In addition, it was found that LEVs are commonly used in urban areas by younger generations. Future studies should focus on how LEVs can be more effectively integrated with public transport to promote equitable and sustainable mobility in urban areas. For example, future research studies should focus on the excluded groups, such as older generations, women, and individuals from low-income backgrounds.
- Technological innovation emerged as a dominant theme. However, social and policy frameworks supporting technological innovations remain underexplored. Future studies should examine how smart mobility applications influence equity in the use of LEVs in urban areas. In addition, comparative studies can be conducted across urban areas to identify best practices for aligning technological innovations with supportive regulatory and policy environments.
- Shared e-micromobility was identified as an underexplored theme. However, gaps exist about the equity impacts and safety concerns of shared e-micromobility in urban areas. Future studies can examine the shared services provided to disadvantaged groups, the safety risks associated with shared usage, and viable governance and business models to support these shared services.

The bibliometric review was based on studies indexed in the Scopus database. Whereas the extracted studies are relevant, some studies available in other databases might have been excluded. Future studies can utilise more databases, such as the Web of Science and Google Scholar, to ensure a broad coverage. The review utilised keywords captured in Section 2 to identify relevant publications on LEVs and sustainable urban transport. Due to the young nature of the topic, emerging concepts not commonly used in the topic may have been excluded. Future studies can update the search strings with the new keywords as the topic advances. Finally, the review only included publications written in English, excluding relevant studies published in several languages like Chinese and Russian. Future studies can incorporate multilingual databases or translation tools to capture a more diverse list of publications.

Overall, this bibliometric review extends knowledge on LEVs and sustainable urban transport. The review has consolidated fragmented studies by identifying a coherent framework of three dominant themes (sustainability, integration with public transport, and technological innovations) and two underexplored themes (shared e-micromobility and policy frameworks). This establishes a foundation for future frameworks on the topic. The review also emphasises the shifting focus in research from a broad technical focus to a narrower policy-oriented concern. This provides more robust evidence for policymakers and urban planners on the long-term role of LEVs in sustainable e-micromobility transitions. For instance, policymakers need to design regulations that promote equitable access to LEVs in urban areas. In addition, policymakers can also utilise these insights to develop inclusive e-micromobility policies that strike a balance between innovation and sustainability goals.

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