International Journal of Research and Review
[Indexed, Peer-Reviewed Journal]
Volume 13; Issue: 4; April 2026
Website: www.ijrrjournal.com
Review Paper *E-ISSN: 2349-9788; P-ISSN: 2454-2237*

Temporal Evolution of Circular Economy Research in the Indian Automotive Industry: A Bibliometric Review

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DOI: https://doi.org/10.52403/ijrr.20260413

ABSTRACT

The shift of the Indian automotive industry from a linear to a circular economy (CE) model is an important strategy for addressing resource scarcity, environmental damage, and sustainability challenges in a resource-intensive sector. Although research on CE practices is growing, studies remain fragmented regarding their development over time and their alignment with national sustainability initiatives. This study aims to bridge this gap by examining how CE research has evolved and its connection to policy frameworks in India. It does so through a bibliometric review of CE research within the Indian automotive sector, accompanied by a policy-research temporal mapping approach. Data were collected from the Scopus and Web of Science (WoS) Core Collection databases. After a structured screening process, 30 papers were chosen for detailed analysis. The analysis comprises a publication trend analysis, a citation analysis, and a keyword co-occurrence analysis to highlight key contributions. The results show an increase in research output over the past decade, especially since 2021, indicating a transition from an emerging to an expanding field. Three development phases are identified: the foundational phase (2017–2020), the expansion phase (2021–2023), and the acceleration phase (2024–2026). Furthermore, there is a strong temporal correlation between research development and major sustainability milestones, notably the shift from the Sustainable Development Goals (SDGs) period to the Environmental, Social, and Governance (ESG) era, with the implementation of the National Vehicle Scrappage Policy and the Business Responsibility and Sustainability Report (BRSR) framework acting as catalysts for increased research activity. Overall, this study enriches the literature by offering a structured timeline of research on the CE in India's automotive sector.

Keywords: Circular Economy (CE), Indian Automotive Industry, Sustainable Development (SD), Environmental, Social, and Governance (ESG), Bibliometric Review, Temporal Mapping

INTRODUCTION

Rising resource scarcity, environmental damage, and increasing greenhouse gas emissions have prompted governments, industries, and scholars to reconsider the traditional linear economy and explore alternative economic models that can decouple economic growth from environmental impacts [1]. In response, the concept of the CE has attracted significant attention in both academic and policy

debates. Unlike the linear economy, which is characterised by a "take-make-dispose" pattern [1], the CE framework aims to promote sustainable resource use by encouraging restorative and regenerative systems through resource efficiency, waste reduction, material recirculation, product lifecycle extension, and closed-loop production systems [2]. In this closed-loop system, materials, products, and resources are reused, repaired, remanufactured, and recycled.

The automotive industry is among the most resource-intensive sectors globally [3]. Automotive manufacturing involves complex supply chains, substantial material consumption, and energy-intensive processes, with vehicle life cycle stages causing significant environmental impacts [4]. Consequently, the sector has increasingly been targeted by sustainability initiatives focused on incorporating CE principles into manufacturing, supply chains, and product design. Practices such as remanufacturing automotive parts, recycling metals and plastics, developing electric mobility systems, and managing circular supply chains are key areas of research and innovation.

The Indian automotive industry has experienced substantial growth over the past twenty years, driven by rising domestic demand, rapid urbanisation, and government initiatives. The sector contributes around 7.1% to India's Gross Domestic Product (GDP) [5]. It is the world's third-largest automobile market by sales and the fourth-largest by production, supporting nearly 35 million jobs [5]. However, this expansion has also increased environmental challenges related to resource use, emissions, and waste. Therefore, policymakers and industry leaders are concentrating on sustainability frameworks that align with broader ESG principles and the United Nations (UN) SDGs [6-9]. Initiatives such as the National Manufacturing Policy [10], the Automotive Mission Plan [11], and the National Electric Mobility Mission Plan [12] have been gradually shaping the sustainability trajectory of the Indian automotive industry. Furthermore, India's dedication to global sustainability agendas has further strengthened the significance of circular economic models.

Academic interest in CE practices within the Indian automotive industry has grown considerably. Scholars have explored topics such as sustainable manufacturing, green supply chain management, remanufacturing strategies, life-cycle assessment, and circular business models. [13-19]. Despite the increasing body of literature, a gap in temporal mapping continues to exist. There is still a limited systematic understanding of how research on the CE has progressed within the Indian automotive sector and how these developments align with key sustainability policy milestones. Analysing the evolution of research can provide valuable insights into the connection between policy initiatives, industrial change, and academic investigation. This review examines how CE scholarship in the Indian automotive industry has developed and whether its progression can be divided into publication phases that align temporally with major ESG and SD milestones in India. Therefore, the study focuses on the following research question:

RQ1: How has CE scholarship in the Indian automotive industry evolved, and how do identifiable publication phases correspond temporally with major ESG and SD milestones in India?

With the following sub-questions:

SRQ1: What are the temporal trends in the publication volume of CE research in the Indian automotive industry?

SRQ2: Can distinct developmental phases or inflexion points in research intensity be identified?

SRQ3: How do these phases align with broader SD and ESG reporting eras in India?

METHODOLOGY

This study applies a bibliometric review to explore the development of research on the CE in the Indian automotive industry. This

enables a systematic evaluation of academic work using quantitative methods to detect trends in publications and thematic progress, thus filling the ongoing gap in temporal mapping [20].

Scopus and WoS Core Collection databases were used to search for relevant literature. These databases were selected due to their comprehensive coverage of peer-reviewed journals across various research disciplines [21]. These research fields include engineering, environmental science and management, and sustainability studies, making it suitable for analysing research in the CE within the automotive industry [22].

To gather relevant literature, a structured search strategy was crafted using a combination of keywords related to the study. Keywords included "Circular Economy", "Indian Automotive Industry", and "Indian Automotive Sector". Boolean operators were employed to combine these search terms, ensuring comprehensive coverage in locating publications related to CE practices in the Indian automotive industry. The search was executed across titles, abstracts, and author keywords to ensure relevance to the research topic.

Following the initial search, the dataset was refined through a screening process that included only peer-reviewed journal articles and conference papers published in English. This screening employs a four-stage framework for reviewing studies. During Stage 1 or identification, publications are retrieved based on the predefined search query. During Stage 2 or screening, duplicate records are eliminated. During Stage 3 or eligibility, titles, abstracts, and keywords are assessed to determine relevance. During Stage 4 or inclusion, final selections of publications are incorporated into the bibliometric dataset.

The filtering process produced a refined collection of publications that forms the basis for the bibliometric analysis. The bibliometric analysis concentrates on several key aspects of scholarly activity. During the publication trend analysis, annual publication counts are examined to identify growth within the literature. This allows for the identification of distinct research phases and provides insight into the temporal development [23, 24]. During the citation analysis, highly influential publications within the dataset are identified. These papers often represent foundational contributions that shape the direction of research within the field [25]. During the keyword co-occurrence analysis, the frequency and co-occurrence of keywords within the dataset are examined to identify dominant research themes and emerging topics. This process helps reveal how the focus of the study has evolved over time [26, 27]. During the policy-research temporal mapping, the publication phases are aligned with key ESG initiatives and SD milestones. The study offers insights into the connection between policy progression and academic research trajectories [28-30].

RESULTS

Screening Process

The literature search was conducted on 14 March 2026. The WoS Core Collection search yielded 22 results, and the Scopus search yielded 45 results. Before beginning the screening process, the total number of papers to be considered after the database search was 67. According to the methodology, only peer-reviewed journal articles and conference papers published in English were selected for analysis. This reduced the number of results from WoS Core Collection to 19 papers and from Scopus to 34 papers. Figure 1 illustrates the screening process in a flow diagram, and Table 1 displays the 30 eligible papers for this study.

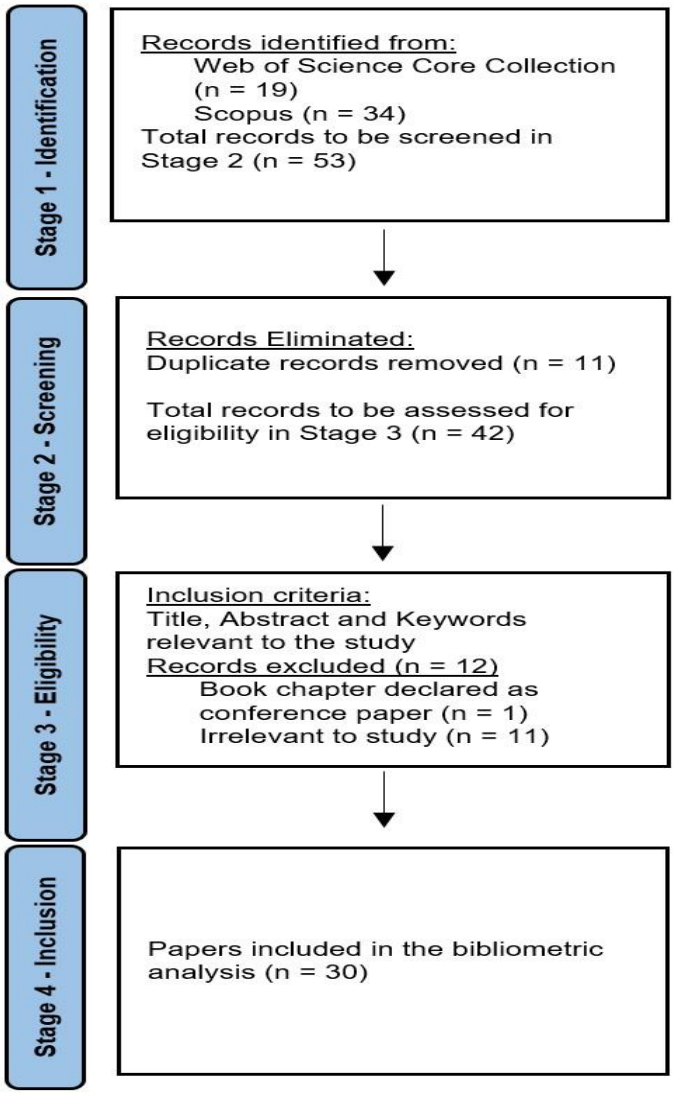

Figure 1 - Four - Stage Screening Process

Table 1 - Eligible Papers

Research Ref. No.	Title	Journal Outlet	Authors	Pub. Year	DOI
1	Impact of circular economy adoption on sustainable business performance in Indian automobile manufacturing firms using a DEMATEL, PLS-SEM, and ANN framework	Discover Sustainability	Potharaju et al.	2026	10.1007/s43621-026-02698-9
2	Unveiling the impact of revenue and inventory on	Discover Sustainability	Kanoujiya et al.	2026	10.1007/s43621-025-02322-2

	circular economy using profitability and competition as moderators in Indian automobile firms				
3	Does Circular Economy Effect the Valuation of the Indian Automobile Firms?	Circular Economy and Sustainability	Tejasmayee et al.	2026	10.1007/s43615-026-00717-5
4	Circular Economy Barriers in the Automotive Industries in Rajasthan, India: Modeling through – SEM	Circular Economy and Sustainability	Sharma	2026	10.1007/s43615-026-00840-3
5	Advancing Circular Economy in India's Automotive Sector: Challenges and Sustainable Solutions	SAE Technical Papers	Kumar	2026	10.4271/2026-26-0238
6	Circularity and LCA: Enhancing Sustainability in the Indian Electric Vehicle Sector	SAE Technical Papers	Haregaonkar et al.	2026	10.4271/2026-26-0239
7	An Integrative Frame Work for Circular Manufacturing System in Indian Industry	Circular Economy and Sustainability	Nagaraja & Suresh	2025	10.1007/s43615-025-00696-z
8	Projection of end-of-life electric vehicle batteries in India considering net-zero targets: a step towards circularity	Environmental Research Letters	Bhattacharya et al.	2025	10.1088/1748-9326/ae03d9
9	A global review of end-of-life vehicle management: India as a model for circular economy in	Journal of Environmental Management	Aggrawal et al.	2025	10.1016/j.jenvman.2025.127386

	automotive sector				
10	Analysis of Barriers to Introducing Circular Economy Practices in the Automotive Industry within Rajasthan, India	Circular Economy and Sustainability	Sharma & Nair	2025	10.1007/s43615-025-00556-w
11	An investigation into the comprehensive effects of Lean Six Sigma and Industry 4.0 on creating a circular economy	International Journal of Advanced Operations Management	Shrivastava & Mishra	2025	10.1504/IJAOM.2025.150029
12	Assessing the key enablers for circular economy adoption for industrial symbiosis: Evidence from an Indian automotive component manufacturing industry	Environment Development and Sustainability	Suman & Rajak	2025	10.1007/s10668-024-05920-8
13	From waste to wealth: the influence of circular economy on the operational dynamics of Indian automotive firms	International Journal of Productivity and Performance Management	Tejasmayee et al.	2025	10.1108/IJPPM-10-2024-0701
14	Assessing Economic Impacts: Circular Economy Adoption in the Indian Automotive Industry	CISCT Conference Proceedings	Tejasmayee et al.	2024	10.1109/CISCT62494.2024.11134222
15	Multi-objective artificial bee colony algorithm for reducing carbon emission and maximizing profit in a	Environment Development and Sustainability	Sakthivel et al.	2024	10.1007/s10668-024-05233-w

	circular supply chain network				
16	Indian automotive supply chains: barriers to circular economy for sustainable development	Management Decision	Gopan & Balaji	2023	10.1108/MD-03-2023-0435
17	Sustainable development-oriented regulatory and competitive pressures to shift toward a circular economy: The role of environmental orientation and Industry 4.0 technologies	Business Strategy and the Environment	Al-Swidi et al.	2023	10.1002/bse.3393
18	Development of a micro-level circular economy performance measurement framework for automobile maintenance garages	Journal of Cleaner Production	James et al.	2023	10.1016/j.jclepro.2023.138025
19	Automotive industry and industry 4.0-Circular economy nexus through the consumers' and manufacturers' perspectives: A case study	Renewable and Sustainable Energy Reviews	Rizvi et al.	2023	10.1016/j.rser.2023.113517
20	Antecedents of digital supply chains for a circular economy: a sustainability perspective	Industrial Management & Data Systems	Dwivedi et al.	2023	10.1108/IMDS-05-2022-0273
21	Analysis of Barriers to Closed-Loop Supply Chain: A Case of the Indian Automotive Industry	IEEE Transactions on Engineering Management	Bhatia et al.	2022	10.1109/TEM.2020.2998794
22	Development,	Sustainability	Harun et al.	2022	10.3390/su142215441

	Critical Evaluation, and Proposed Framework: End-of-Life Vehicle Recycling in India				
23	Sustainable supply chain management of automotive sector in context to the circular economy: A strategic framework	Business Strategy and the Environment	Sonar et al.	2022	10.1002/bse.3112
24	Adoption of additive manufacturing for sustainable operations in the era of circular economy: Self-assessment framework with case illustration	Computers & Industrial Engineering	Priyadarshini et al.	2022	10.1016/j.cie.2022.108514
25	Circularity issues and blockchain technology in the auto industry	Energy Sources	Rizvi et al.	2022	10.1080/15567036.2022.2107119
26	Supplier evaluation in the context of circular economy: A forward step for resilient business and environment concern	Business Strategy and the Environment	Haleem et al.	2021	10.1002/bse.2736
27	Analysing the roadblocks of circular economy adoption in the automobile sector: Reducing waste and environmental perspectives	Business Strategy and the Environment	Agrawal et al.	2021	10.1002/bse.2669
28	Investigating drivers of circular supply chain with product-service system in	Journal of Cleaner Production	Nag et al.	2021	10.1016/j.jclepro.2021.128629

	automotive firms of an emerging economy				
29	Recovery of resources from end-of-life passenger cars in the informal sector in India	Sustainable Production and Consumption	Sharma & Pandey	2020	10.1016/j.spc.2020.06.005
30	An Institutional Framework to Address End-of-Life Vehicle Recycling Problem in India	SAE Technical Papers	Venkatesan & Annamalai	2017	10.4271/2017-26-0179

Publication Trend Analysis

The publication trend indicates a clear increase in research on the CE within the Indian automotive sector over the past decade. Very limited output is observed before 2020, followed by a noticeable rise from 2021 onwards. The peak research activity occurs between 2022 and 2026, with 25 of the 30 eligible papers published during this period. This pattern suggests that research on the CE in the Indian automotive sector has progressed from an emerging topic to a rapidly expanding field. Table 2 presents the publication trend over time for the 30 eligible papers, and Figure 4 displays the publication trend chart, illustrating growth across the decade.

Table 2 - Publication Trend

Year	2017	2020	2021	2022	2023	2024	2025	2026
Number of Publications	1	1	3	5	5	2	7	6

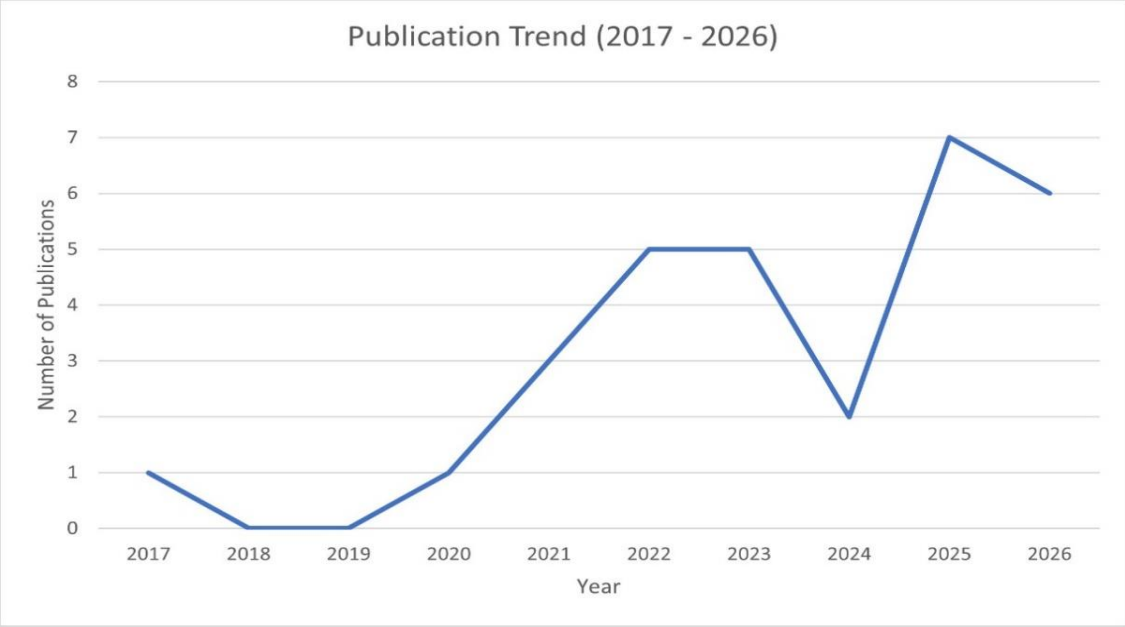

Figure 2 - Publication Trend Chart

The trend indicates that publication activity on the CE in the Indian automotive sector has progressed through three phases. The foundations phase, between 2017 and 2020, with 2 publications, mainly concentrated on End-of-Life (EoL) recycling and resource

recovery (Research References 29 + 30). The expansion phase, between 2021 and 2023, with 13 publications, broadened the research scope to include more advanced topics such as circular supply chains, barriers and obstacles to adoption, supplier evaluation, Industry 4.0, blockchain, and performance measurement frameworks (Research References 16 – 28). The acceleration phase, from 2024 onwards, with 15 publications, demonstrates increased methodological sophistication, shifting towards empirical validation, modelling, optimisation, and industry-specific applications (Research References 1 – 15).

The distribution of publication outlets indicates that research on the CE in the automotive sector is published across sustainability, engineering, and management journals. However, some outlets are more prominent, including Business Strategy and the Environment, Circular Economy and Sustainability, Journal of Cleaner Production, Environmental Development and Sustainability, Discovery Sustainability, and SAE Technical Papers. This emphasises the interdisciplinary nature of circular economy research. Table 3 displays the most active publication outlets, which appear more than once.

Table 3 - Featured Outlets

Outlet	Count
Business Strategy and the Environment	4
Circular Economy and Sustainability	4
SAE Technical Papers	3
Journal of Cleaner Production	2
Environmental Development and Sustainability	2
Discovery Sustainability	2

This suggests that the literature primarily concentrates on sustainability and environmental journals and conference papers.

Citation Analysis

Since Scopus and WoS are databases that are generally not accessible to everyone and do not include all papers, Google Scholar was used as a common platform for citation analysis. Table 4 displays the five most cited papers from the thirty eligible papers.

Table 4 - Top Five Cited Papers

Rank	Title	Journal Outlet	Pub. Year	Google Scholar Citations
1	Analysing the roadblocks of circular economy adoption in the automobile sector: Reducing waste and environmental perspectives	Business Strategy and the Environment	2021	133
2	Investigating drivers of circular supply chain with product-service system in automotive firms of an emerging economy	Journal of Cleaner Production	2021	110
3	Sustainable development-oriented regulatory and competitive pressures to shift toward a circular economy: The role of environmental orientation and Industry 4.0 technologies	Business Strategy and the Environment	2023	101
4	Supplier evaluation in the context of circular economy: A forward step for resilient business and environment concern	Business Strategy and the Environment	2021	72
5	Sustainable supply chain management of automotive sector in context to the circular economy: A strategic framework	Business Strategy and the Environment	2022	62

The most-cited papers appeared in leading sustainability journals such as Business Strategy and the Environment and the Journal of Cleaner Production. All three most-cited articles have over 100 Google Scholar citations. Analysing the roadblocks of circular economy adoption in the automobile sector: Reducing waste and environmental perspectives by Agrawal et al. (2021) conducts an empirical analysis of barriers to the CE adoption in the Indian automotive industry. It sits at the intersection of several high-demand research areas, focusing on the CE and sustainability trend in academia and the automotive sector, and tackles the barriers to adopting CE practices in the Indian automotive industry. Investigating drivers of circular supply chain with product-service system in automotive firms of an emerging economy by Nag et al. (2021) focuses on Indian automotive firms transitioning to circular supply chains. The paper combines three major themes: CE or CE supply chain, product-service systems, and sustainability in the automotive industry. The paper analyses key drivers of circular supply chains, making it a reference model for further empirical and modelling work. Sustainable development-oriented regulatory and competitive pressures to shift towards a circular economy: The role of environmental orientation and Industry 4.0 technologies by Al-Swidi et al. (2023) presents an empirical analysis based on Indian automotive and auto-component firms. It addresses a key research gap and examines how regulatory and competitive pressures specifically drive firms to adopt Industry 4.0 technologies and transition towards a CE. All three top-cited articles discuss themes that were trending and had significant research gaps.

Keyword Co-occurrence Analysis

Author-provided keywords were extracted from each paper. Two of the three SAE Technical Papers publications did not provide keywords; they were omitted, even though the title or abstract made them eligible. Before analysis, the keywords were cleaned and standardised to ensure consistency. For example, synonymous or abbreviated terms such as CE and Circular Economy were unified. After data cleaning, the keyword analysis determined the frequency of keyword occurrences and the co-occurrence relationships between keywords within the same publication. Table 5 presents the five most frequently occurring keywords within the 28 eligible papers.

Table 5 - Top Five Keyword Occurrences

Keywords	Occurrences
Circular Economy	24
Sustainability	6
Automotive Industry	5
Barriers	5
End-of-life	5

The results indicate that the CE is the dominant concept in the analysis, appearing in most publications. In the remaining four eligible papers, the CE was also conceptually evident. The co-occurrence analysis revealed strong relationships among keywords. Table 6 shows the keyword pairings among the five most frequently appearing keywords within the 28 eligible papers.

Table 6 - Keyword Pairing Top Five Keywords

Keyword Pair	Co-Occurrences
Circular Economy and Sustainability	6
Circular Economy and Automotive Industry	5
Circular Economy and Barriers	4
Circular Economy and End-of-Life	3

The findings show that the CE is strongly connected to sustainability and the automotive sector.

Policy-Research Temporal Mapping

As outlined in the publication trend analysis, three phases were identifiable. The foundations phase from 2017 to 2020 primarily concentrates on EoL recycling and resource recovery. The expansion phase from 2021 to 2023 broadens the research scope to include more advanced topics and performance measurement frameworks. The acceleration phase from 2024 onwards demonstrates increased methodological sophistication, with a shift towards empirical validation, modelling, optimisation, and industry-specific applications. These phases will now be mapped against key ESG initiatives and SD milestones in the Indian automotive industry to provide insights into the relationship between policy development and academic research. The period from 2017 to 2026 falls within two important sustainability eras in India. Firstly, the SDGs alignment era from 2016 to 2020. Secondly, the ESG era from 2021 to the present. The ESG era is again divided into the BRSR (2021–2023) and BRSR Core (2024–2026) phases.

In 2015, during the SDGs alignment era, as part of the 2030 Agenda for SD, the UN established seventeen interconnected objectives known as the SDGs, which aim to guide international efforts towards achieving SD by 2030 and to address global challenges such as poverty, inequality, hunger, gender equality, peace, and justice [31, 32]. India officially adopted the SDGs in September 2015 [33]. The main SDG for the CE is SDG 12, which emphasises responsible consumption and production. It directly aims to minimise waste, promote the sustainable management of natural resources, and ensure sound handling of chemicals and waste [34]. The Government of India established the National Institution for Transforming India (NITI) Aayog in 2015, which functions as a public policy think tank [35]. The agency is responsible for stimulating economic growth and promoting cooperative federalism [36]. By 2017, it had started promoting resource efficiency and initiating discussions in sectors such as automotive, metals, and manufacturing within the CE [37]. During this era, two main pillars of government policy were introduced. Firstly, the Faster Adoption and Manufacturing of (Hybrid and) Electric Vehicles Scheme (FAME I) was launched in India to decrease reliance on fossil fuels and reduce urban air pollution [38]. Secondly, the shift from Bharat Stage IV to Bharat Stage VI, bypassing Bharat Stage V [39]. This policy compelled automobile manufacturers to implement advanced engine technologies and exhaust after-treatment systems, and required oil refineries to supply cleaner fuel, which was rolled out nationwide in 2017 [40]. Other examples of sustainability policies, not necessarily related to the CE, implemented during this period included the introduction of the Corporate Average Fuel Economy (CAFE) standards for the financial year 2017–2018 [41]. In 2019, the FAME I was updated to FAME II, introducing extensive subsidies for electric vehicles and improvements to infrastructure and public transport electrification [42]. Targeting 2020, the National Electric Mobility Mission was launched to create a roadmap to accelerate the adoption of electric vehicles and encourage the shift to electrified mobility [43]. In 2017, the first eligible conference paper from this study was published, focusing on automotive recycling of ELVs in India. The only other eligible paper from this study was published in 2020 and examined material recovery and circular resource loops in Indian automotive ELV.

The ESG era signifies a fundamental shift in ESG reporting and introduced the BRSR along with assurance requirements [44]. ESG have evolved from a compliance exercise into a strategic governance tool that shapes decarbonisation, supply chain management, and corporate accountability [45]. The BRSR is a mandatory framework

introduced in 2021 by the Securities and Exchange Board of India (SEBI) for the top 1000 listed companies to disclose their ESG performance, replacing the old Business Responsibility Report to ensure greater transparency, accountability, and standardisation in sustainability reporting [46]. In 2023, the BRSR Core was introduced as a part of the larger BRSR framework, including specific key performance indicators with the aim of providing standardised assurance-ready metrics [47]. During this period, the Government of India implemented several significant automotive regulations and policies related to the CE. The most notable is the National Vehicle Scrappage Policy from 2021. This policy seeks to shift from a take-make-dispose approach to a circular one by replacing old, polluting, and unfit vehicles with newer, cleaner, and more fuel-efficient alternatives [48]. The Mandatory Automated Fitness Testing, as required by the Vehicle Scrappage Policy, mandates that all heavy commercial vehicles over 15 years old undergo a fitness test at Automated Testing Stations to determine whether they are fit for use or need to be recycled [49]. The Ministry of Environment, Forest and Climate Change implemented the Battery Waste Management rules in 2022, establishing Extended Producer Responsibility (EPR) for pre-consumer waste, requiring the display of EPR registration numbers, and enabling electronic trading platforms for EPR certificates [50]. Other examples of sustainability policies introduced during this period, which do not necessarily relate to the CE, included the 2022 update to the CAFE norms, setting more stringent fuel-efficiency targets for passenger vehicles [51]. In 2023, the Government of India launched the National Green Hydrogen Mission to promote green hydrogen production and develop fuel-cell vehicle ecosystems [52]. The Prime Minister E-Drive Reform is a post-FAME II transition policy aimed at ensuring fiscal sustainability for electric vehicle subsidies [53]. Under development in 2025, the CAFE standards were further revised to promote electrification and hybridisation [54]. By 2026, the Zero-Emissions Mobility and Net-Zero Alignment policies had been implemented to assist India in reaching its net-zero targets by 2070 [55]. During the first phase of this period (2021–2023), 13 of the 30 eligible papers were published. In the second phase (2024–2026), 15 of the 30 eligible papers were published. Figure 3 shows the timeline of the policy.

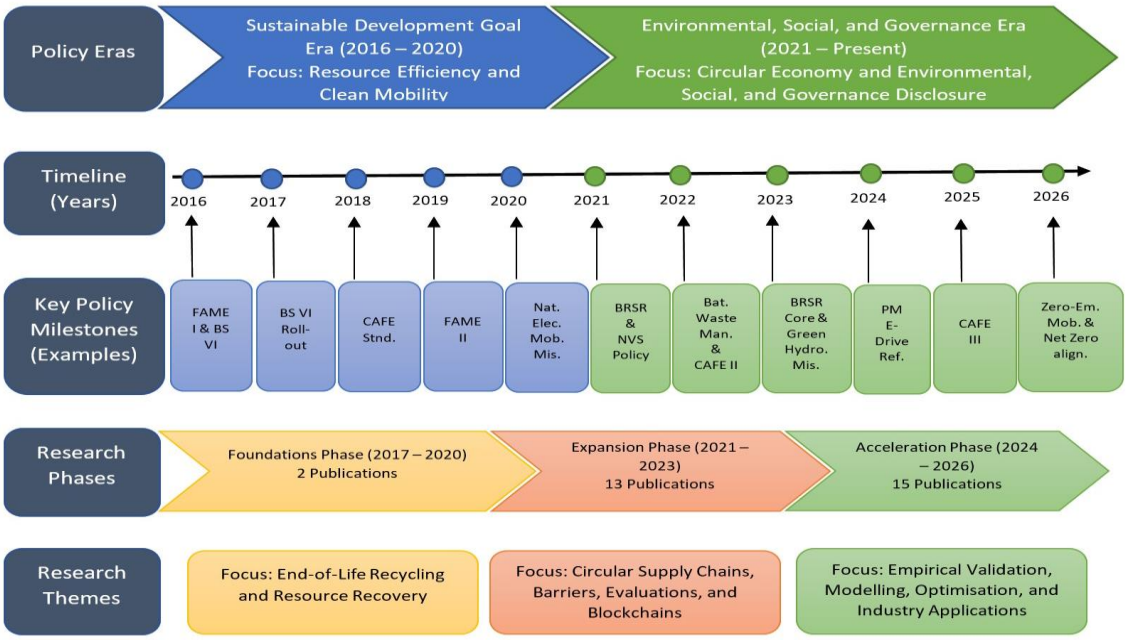

Figure 3 - Temporal Mapping of Policy and Research Phases

DISCUSSION

This study aimed to examine how the scholarship on the CE has developed over time and whether identifiable publication phases correspond with key milestones in sustainability policy. The findings reveal a clear progression in the literature, characterised by a significant rise in publications and the emergence of three distinct phases. Furthermore, the results demonstrate a strong temporal alignment between the growth of academic research and the development of sustainability policies in the Indian automotive industry, especially the shift from the SDGs era to the ESG reporting era. The year 2021 was identified as a turning point, marked by significant policy milestones, particularly concerning the National Scrappage Policy and the implications of the BRSR framework. The main research question (RQ1) and the subsequent sub-questions (SRQ1, SRQ2, and SRQ3) were addressed. The temporal trends (SRQ1) highlight a transition from limited academic engagement to rapid growth, while the identification of distinct phases (SRQ2) confirms intensified research activity. Finally, the policy mapping (SRQ3) shows that these stages are connected to broader developments in sustainability and governance.

The foundation phase (2017–2020) reflects the early stage of scholarly engagement with the CE within the Indian automotive industry context. During this period, research output was limited and mainly focused on EoL management and resource recovery. The narrow scope and low volume of publications suggest that the CE was still an emerging concept, with the NITI Aayog promoting it in 2016. The expansion phase (2021–2023) marks a notable shift in both the quantity and scope of research. During this period, the introduction of ESG frameworks, particularly the BRSR, enhanced corporate responsibility and standardised sustainability reporting. The increasing number of publications reflects growing academic and industry interest, with topics such as circular supply chains, barriers, Industry 4.0, and performance measurement frameworks broadening research scope. The acceleration phase (2024–2026) shows further development of the field, characterised by a rapid increase in publications. This phase coincides with the introduction of the BRSR Core framework. Research focused on empirical validation, advanced modelling techniques, optimisation, and industry-specific applications. This development indicates that CE practices are becoming more deeply embedded within the industry.

The temporal mapping reveals that periods of heightened policy intervention closely correspond with increases in research activity. This demonstrates a co-evolutionary relationship where policy frameworks act as catalysts for academic research, while scholarly outputs bolster sustainability initiatives. The shift from the SDGs era to the ESG period seems particularly influential in boosting research intensity.

CONCLUSION

This study explores the development of CE research within the Indian automotive industry using a bibliometric approach combined with policy-research temporal mapping. By analysing publication patterns, citation trends, keyword co-occurrence, and policy consistency, it provides a comprehensive overview of how the field has evolved over time.

Several limitations can be recognised. Firstly, using the Scopus and WoS Core Collection databases may have excluded relevant publications not indexed in these sources, thus missing regional Indian journals. Secondly, the relatively small sample of only 30 eligible papers limits the generalisability of the results. Thirdly, reliance on keyword-based search strategies might result in the omission of relevant studies that use different terminology. Finally, although bibliometric analysis provides valuable quantitative insights, it does not fully reflect the qualitative depth of

the literature. Future research could expand the dataset by including additional databases and adopting a mixed-method approach to gain a more comprehensive understanding of the development of a CE within the Indian automotive sector.

In addressing the research questions, the study confirms that the scholarship on the CE has evolved from a limited, emerging field to a well-established discipline. A key contribution is identifying a strong alignment between policy and research. The temporal mapping shows that periods of intensive policy interventions correspond with increased research activity, systematically illustrating the relationship between policy development and academic output. For academics, this temporal mapping gap offers a clear timeline of how research themes have shifted in response to national policy. For practitioners and policymakers, the results highlight that circular supply chains and Industry 4.0 are increasingly important for regulatory compliance in India, and that structured sustainability frameworks can promote knowledge development. For stakeholders, the growing focus on empirical and performance-based research emphasises the importance of measurable, data-driven approaches to the CE.

In conclusion, research on the CE in the Indian automotive industry has matured, characterised by increasing methodological sophistication and stronger integration with policy and industry practices. Its development is closely linked to national sustainability initiatives, such as the National Vehicle Scrappage Policy and the BRSR framework, as well as global initiatives, such as the SDGs and the ESG framework. This suggests that ongoing alignment between policy and research will remain crucial for the CE in the Indian automotive sector.

Declaration by Authors

Acknowledgement: None

Source of Funding: None

Conflict of Interest: No conflicts of interest declared.

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How to cite this article: Roland Frank Doelp. Temporal evolution of circular economy research in the Indian automotive industry: a bibliometric review. *International Journal of Research and Review*. 2026; 13(4): 119-136. DOI: *https://doi.org/10.52403/ijrr.20260413*

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