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MAPPING CIRCULARITY PARAMETERS: A LITERATURE REVIEW OF POLICY PLANNING IN THE BUILT ENVIRONMENT

R. Deshmukh[1], A. Garud[2], V. Anagal[3], S. Karve[4], M. Siriwardena[5] and A. Manewa[6]

ABSTRACT

The construction industry is amongst the major consumers of natural resources, resulting in an exponential increase in overall waste generation, especially construction waste. The current approach to design in the construction industry is linear, involving take, make, dispose strategy, which has led to a significant depletion of resources and in turn to environmental degradation. The need for human shelter will remain inevitable; thus, there is an urgent need to integrate a circular economy approach within design and construction practices, which gives back to the environment it takes from. This change from linearity to circularity is a complex process, influenced by several factors. Government policies can be highly influential for this change from linear to circular approach in design, construction and management of the built environment. In the process of change, these policies need to be assessed and checked for every part that supports the circular economy principles. This systematic literature review critically examines the role of existing government policies in supporting circular economy principles and identifies key regulatory gaps that restrict their implementation. The primary gap lies in the implementation process. The suggestive nature of the frameworks hinders the implementation of such policies on a larger scale. Through the existing literature, 10 circular economy parameters were identified across 3 different construction phases, with the help of which key government policies will be analysed in the future. This study will identify the existing gap within the legal framework barring circular economy implementation in the construction sector.

Keywords: *Built Environment; Circular Economy; Policies; PRISMA; Systematic Literature Review.*

1. INTRODUCTION

The construction industry is low in resource efficiency worldwide (Shooshtarian et al., 2022). This has led to high levels of construction and demolition waste, high greenhouse gas emissions, air and water pollution, and resource depletion. Circular economy approach refers to giving back to the environment from which it takes, hence, closing the loop. This is a significant shift from the regular linear approach to design, which involved

[1] Student, Dr. B.N. College of Architecture, India, rheaadeshmukh@gmail.com
[2] Assistant Professor, Dr. B.N. College of Architecture, India, amruta.garud@bnca.ac.in
[3] Associate Professor, Dr. B.N. College of Architecture, Pune, India, vaishali.anagal@bnca.ac.in
[4] Professor, Dr. B.N. College of Architecture, India, sujata.karve@bnca.ac.in
[5] Senior Lecturer, Liverpool John Moores University, Liverpool, UK, M.L.Siriwardena@ljmu.ac.uk
[6] Senior Lecturer, Liverpool John Moores University, Liverpool, UK, R.M.Manewa@ljmu.ac.uk

a take, make, dispose strategy. The construction industry produces substantial waste, which demands a more circular approach in the design stage. In response to the growing environmental crisis, several international organizations and national governments have introduced policy frameworks aimed at promoting circular economy principles in the built environment.

Arora and Mishra (2019) notes that the 2030 Agenda for Sustainable Development outlines the need for economic security and environmental sustainability, but the only three countries that have managed to achieve one-third of the Sustainable Development Goals are Sweden, Denmark and Finland. The need for the world to come together and act upon these goals is inevitable. All countries need to have their own policy frameworks for this overarched goal to be attained. "*The Paris Agreement is a legally binding international treaty on climate change, adopted by 196 countries at the UN Climate Change Conference (COP21) in Paris, France*." (United Nations Framework Convention on Climate Change, 2018) According to this Agreement, countries must work on a five-year action plan. They are required to submit their national climate action plans in order to hold them accountable. The United States of America is the second-largest contributor to greenhouse gas emissions but has exited the Paris Agreement recently. The EU Waste Framework Directive and Circular Economy Action Plan 2020 set ambitious targets for waste reduction, recycling, and resource efficiency, promoting sustainable production, eco-design, and circular business models. This comprehensive framework aims to accelerate the circular economy transition, reduce environmental impact, and drive sustainable growth (Bragança et al., 2025).

However, all these frameworks and action plans seem to be in place on an international level and how they percolate down to the grassroot level has not been linked in the current available literature. Thus, an in-depth analysis of current regulations and the identification of potential areas for regulatory frameworks on various levels of governance is necessary to support the shift from a linear to a circular economy. A thorough analysis of the policy literature can be used to evaluate the efficiency of the laws in place, identify best practices from nations that have effectively used the concepts of the circular economy, and suggest changes that would improve compliance. The research paper aims at critically analysing how government regulations support the circular economy's principles in the building sector through thorough a systematic literature review. It analyses important policy provisions, assesses their effects, and identifies the obstacles to their implementation through a methodical literature study. This study also offers insights into policy actions that can accelerate the transition by examining national and international policy frameworks.

2. METHODOLOGY

This study uses a systematic literature review (SLR) to provide an overview of existing research on circular economy principles in the built environment and their integration into policy frameworks. The SLR follows a structured approach to evaluate and synthesize relevant literature, aiming to highlight key findings and research gaps in the field (Turner et al., 2025).

2.1 DATA COLLECTION

The literature search was conducted using Scopus, a widely recognized database for peer-reviewed research. Due to limited accessibility to databases, only one database was analysed. The search utilized the following keywords: “built environment,” "circular economy," and "policy" (TITLE-ABS-KEY (built AND environment) AND TITLE-ABS-KEY(circular AND economy) AND TITLE-ABS-KEY (policy)) AND (LIMIT-TO (LANGUAGE,"English"). The data extraction was performed on 29th of May 2025, retrieving an initial data set of 172 papers. While conducting the search by keywords, the query was specific with the use of asterisks.

2.2 SCREENING AND SELECTION

A multi-stage filtering process was applied to systematically review and filter the dataset. The first stage was Keyword Analysis, out of the 172 papers, 75 papers were excluded as they lacked direct relevance to circular economy and policy frameworks keywords. Secondly, of the remaining 97 papers, papers with abstracts not explicitly addressing both policy frameworks and the built environment were removed, resulting in the elimination of 36 papers from the dataset. Lastly, after the systematic screening, 61 papers were deemed relevant and included in the final review. The screening and selection process was done with the PRISMA Framework (Page et al., 2021) as shown in Figure 1. Due to a lack of resource availability, only one database (Scopus) was used to retrieve records.

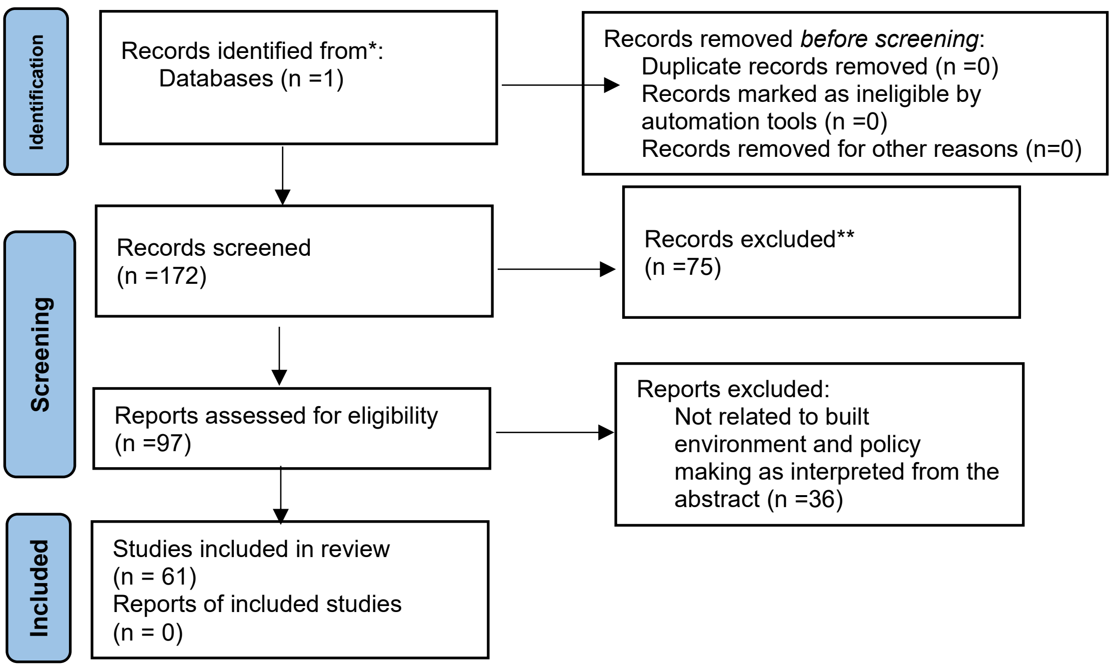

Figure 1: Screening process using PRISMA framework

This structured methodology ensures a rigorous and unbiased selection process, allowing for a comprehensive analysis of policy-driven circular economy practices in the built environment. The conclusions of these studies reveal valuable insights into existing policy frameworks and highlight challenges and opportunities for further research and study on newer policy frameworks. Table 1 highlights the country-wise distribution of publications in the given domain with their respective citations counts. The United Kingdom is leading and sustains itself regarding research output and influence on circular economy in construction, followed by high contributions from the United States of America, Australia, and The Netherlands. Hong Kong and India display fewer publications, but their strong post-screening retention suggests targeted, significant research. Emerging interest is demonstrated by India, while countries like Ghana, Sweden, and South Africa reflect developing, context-specific circular economy research environments. With regional significance, nations like Germany, Italy, and Turkey make consistent contributions.

Table 1: Country wise distribution of circular economy publications before and after screening

Country	**Before screening (n: 172)**	**After screening (n: 61)**	**Country**	**Before screening (n: 172)**	**After screening (n: 61)**
United Kingdom	31	11	Greece	5	1
Spain	13	2	Ghana	7	2
Germany	9	3	Hong Kong	6	3
Austria	8	1	Denmark	5	0
Italy	14	3	South Africa	8	1
United States	20	5	Turkey	6	3
Switzerland	7	1	Sweden	6	1
Netherlands	19	10	Australia	16	5
China	11	2	Finland	5	1
Portugal	10	3	India	6	3
Belgium	7	0			

Note: The total number of documents on addition before screening may exceed 172, as research papers addressing multiple countries have been counted under each relevant country.

2.3 KEYWORD ANALYSIS BEFORE SCREENING

Before applying the PRISMA framework, 172 papers were analysed with their keywords. For this analysis, both author and indexed keywords were used as the query was too specific. Using VOSviewer, a keyword analysis diagram was generated. **Error! R eference source not found.** is a graphical representation of trends in keyword use within the initial research database showing frequency of use, interrelation with other keywords, and the temporal pattern of usage over the years.

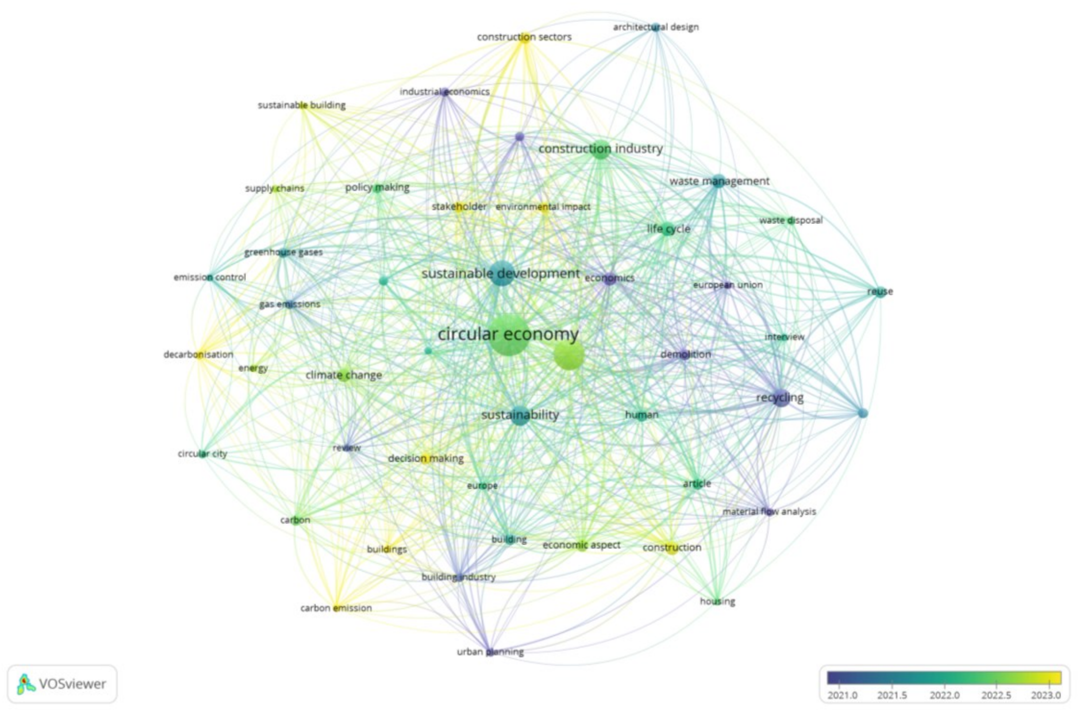

Figure 2: Keyword analysis before applying the PRISMA framework for 172 papers

There are four prominent keywords: “circular economy”, “built environment”, “sustainable development”, and “sustainability”. These are the core concepts derived from the dataset retrieved from Scopus. Keywords such as “recycling”, “reuse”, “life cycle assessment”, and “construction industry” are topics that were prominent in earlier years. In contrast, keywords such as “policy making”, “urban planning”, “climate change”, “carbon emissions”, and “decarbonisation” have emerged in recent years, indicating a growing focus on governance and system-led integration. This change indicates an emerging interest in actual applications of circular economy concepts across industries such as construction, housing, and resource management, an indication of the increasing pertinence of circular approaches to urban planning and policymaking. Furthermore, “policy making’ is linked to greenhouse emissions.

2.4 KEYWORD ANALYSIS AFTER SCREENING

Each of the 61 chosen papers was evaluated in a systematic manner to evaluate how far these parameters were included. Comparative assessment was done to identify trends, gaps, and policy implications concerning circular economy adoption. The results were synthesized to identify the prevalence and distribution of circular economy parameters in policies, the domains where policy structures strongly favour circularity, the most significant gaps in current policies and suggestions for improvement. With a systematic screening and analysis methodology, this approach guarantees a systematic and thorough assessment of the integration of circular economy principles into policy structures in the built environment.

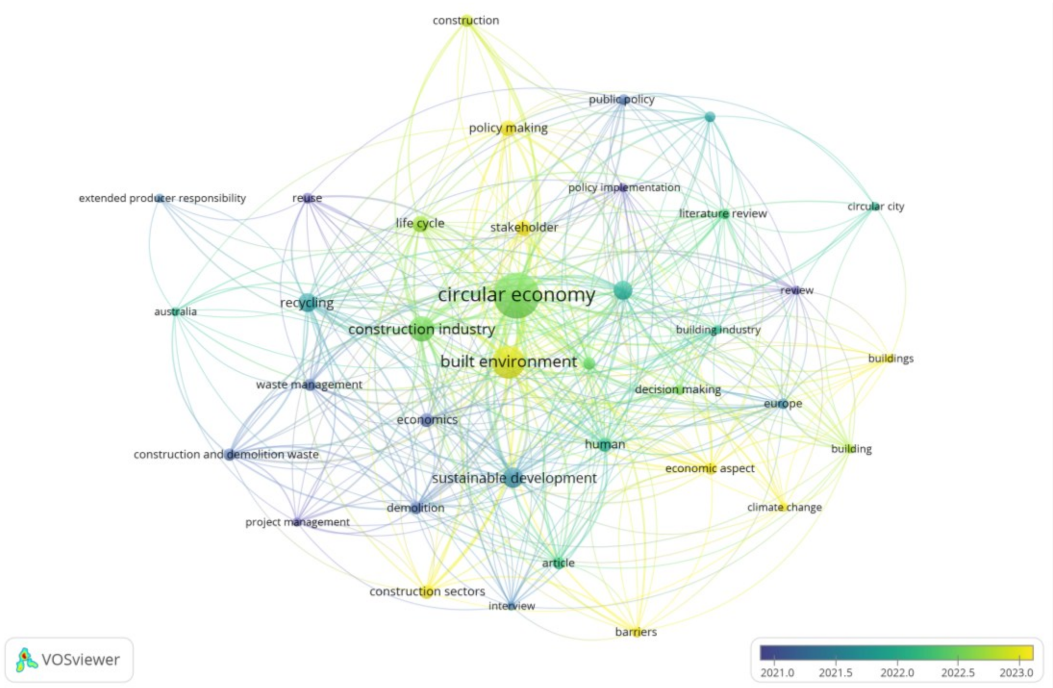

Figure 3: Keyword analysis after applying the PRISMA framework

“Sustainability”, “construction industry”, and “stakeholders” are closely linked to “circular economy” and “built environment”, highlighting the integration of environmental considerations in construction practices. Older keywords (2021-2022) include "recycling", "waste management," and "construction and demolition waste", indicating an initial focus on material recovery and environmental management practices. Keywords like "policy making” and “stakeholder” indicate that research has increasingly focused on regulatory measures and structured approaches for circular economy adoption, yet the presence of "barriers" and "economic aspect" suggests ongoing challenges in policy enforcement, financial incentives, and stakeholder engagement. The built environment and construction sector are closely linked with terms like "demolition," "reuse," and "sustainable development," emphasizing the role of materials circularity, adaptive reuse, and sustainable construction practices. The "decision-making" and "stakeholder" connections highlight the necessity of multi-stakeholder collaboration for circular economy transitions.

3. RESULTS

3.1 IDENTIFICATION OF PARAMETERS

Analysing the selected papers, numerous parameters were identified. These parameters contribute to achieving the circular economy principles at the policy level. The 10 identified parameters are as follows:

Table 2: Identification and mapping of circular economy parameters across the reviewed literature

Design for Disassembly	This strategy ensures that, post-building use, the parts of the structure can be easily modified or removed without harming the rest of the structure. The understanding that "waste does not exist " promotes the design for disassembly. (Banihashemi et al., 2024; Charef et al., 2022; Guerra & Leite, 2021; Karaca et al., 2024)
Resource Efficiency	There is a need for an integrated system to promote circular economy and resource efficiency. Several innovative technologies have emerged in recent times that can be used to monitor resource efficiency and ensure a closed-loop system. (Ababio & Lu, 2023; Adabre et al., 2024; Bos et al., 2022; Bostancı et al., 2025; David et al., 2024; Kazmi & Chakraborty, 2025; Sharma et al., 2022; Shooshtarian et al., 2022; Uddin et al., 2025; Zhang et al., 2024; Zuofa et al., 2023)
Circular Construction	To achieve this principle, the desire and willingness along with the resources to do so need to be combined. Circular construction ensures the building is designed to be disassembled or refurbished. (Andabaka, 2024; Coenen et al., 2023; Guerra & Leite, 2021; Ikiz Kaya et al., 2025; Isoaho & Valkama, 2024)
Waste Reduction	It is essential to decrease the waste generated by the construction industry to move towards a more circular economy. Resource reuse and recycling directly contributes to less waste generation. (Bolivar et al., 2025; Chartier & Pot, 2024; Gomide et al., 2024; Heurkens & Dąbrowski, 2021; Iyer-Raniga et al., 2023; Josa & Borrion, 2025; Kaewunruen et al., 2024; Lecciones et al., 2022; Marzani et al., 2025; Mhatre et al., 2023; Noll et al., 2019; Omwoma et al., 2017; Sharma et al., 2022; Stahel, 2017)
Water Circularity	Water is one such resource that is essential throughout the lifecycle of the building, from its inception to post occupancy. The current system in India does not levy any tax on water which highly impacts the way people utilize it. A more sensitive approach to water utilisation and recycling can result in significant reduction in its demand. (Almulhim & Al-Saidi, 2023; David et al., 2024; Lecciones et al., 2022; Omwoma et al., 2017; Vassi et al., 2022)
Supply Chain Circularity	Integrating circular economy principles in the supply chain ensures material efficiency, waste reduction and resource recovery throughout the lifecycle of the building. Several studies have shown that this model can enable closed-loop systems that minimise raw material extraction. (Ancapi, 2023; Zhang et al., 2024)
Renewable Energy Consumption	Incorporation of renewable energy is crucial to reduce dependency on fossil fuels and, in turn reduce emissions. Technologies like solar, wind and bioenergy promote green energy contributing to a more circular economy. (Dewagoda et al., 2022; Mhatre et al., 2023)

Embodied Carbon Minimisation	Research emphasises the importance of minimising embodied carbon by using low-carbon emitting materials, more efficient logistical planning and other construction techniques. (Bucci Ancapi et al., 2022; Gomide et al., 2024; Josa & Borrion, 2025; Kaewunruen et al., 2024; Ness, 2022; Nußholz et al., 2023)
LCA	LCA is a foundational tool to evaluate the environmental impact buildings have from their construction to their demolition. It enables designers to compare impacts of different materials and construction techniques and make the necessary decisions. (Keles et al., 2025; Rajčić et al., 2025)
Material Reuse and Recycle	Reuse and recycling of materials reduce the demand for virgin materials while also increasing the lifespan of the structure. However, there exists a conflict on whether reuse and recycling of materials is economical, taking into consideration the logistical and regulatory barriers. (Amudjie et al., 2022; Çimen, 2021; Foster & Saleh, 2021; Giorgi & Lavagna, 2024; Ikiz Kaya et al., 2025; Josa & Borrion, 2025; Lecciones et al., 2022; Marzani et al., 2025; Ranta et al., 2018; Zuofa et al., 2023).

This identification of circular economy parameters underlines the multi-dimensionality of circularity within the built environment. Each parameter symbolises a critical intervention point. The diverse literature across these parameters reflects the growing awareness of circular economy principles globally and underscores the gaps in application and integration. Notably, the constant mention of stakeholder engagement and decision-making emphasizes that successful circular economy adoption is as much a technical challenge as it is a governance and collaborative imperative, requiring active engagement across sectors, scale, and phases of development.

Table 3: Categorisation of circular economy parameters with regards to different construction phases

Construction phases	Pre-Construction	During Construction	Post-Construction
Circular Economy Parameters	Design for Disassembly Resource Efficiency	Circular Construction Waste Reduction Water Circularity Supply Chain Circularity Renewable Energy Consumption Embodied Carbon Minimisation	LCA Material Reuse and Recycle

The construction process can be categorised into mainly 3 phases: pre-construction, construction and post-construction. The pre-construction phase involves design and planning, the construction phase involves the actual realisation of the project, and the post-construction phase involves the use and end-of-life process of the structure. The 10 identified parameters can be categorised into these 3 phases. Table 2 highlights this categorisation of circular economy parameters with respect to the construction phases. On mapping literature with reference to the construction phases, as shown in Figure 4, illustrates the temporal evolution of the circular economy parameters applied across the three construction phases from 2017-2025. In the initial years, there was limited adoption of circular economy parameters, particularly in the construction phase, where efforts were mostly dispersed and restricted to practices such as waste reduction and material reuse and recycle. The distribution highlights a gradual increase in circular economy strategy adoption post 2022 during the construction phase, including a more systematic adoption of strategies. In contrast, the post-construction phase has experienced a steep and accelerated increase in strategies, particularly post 2022. This increase is indicative of a broader understanding of the significance of building performance throughout the different construction phases.

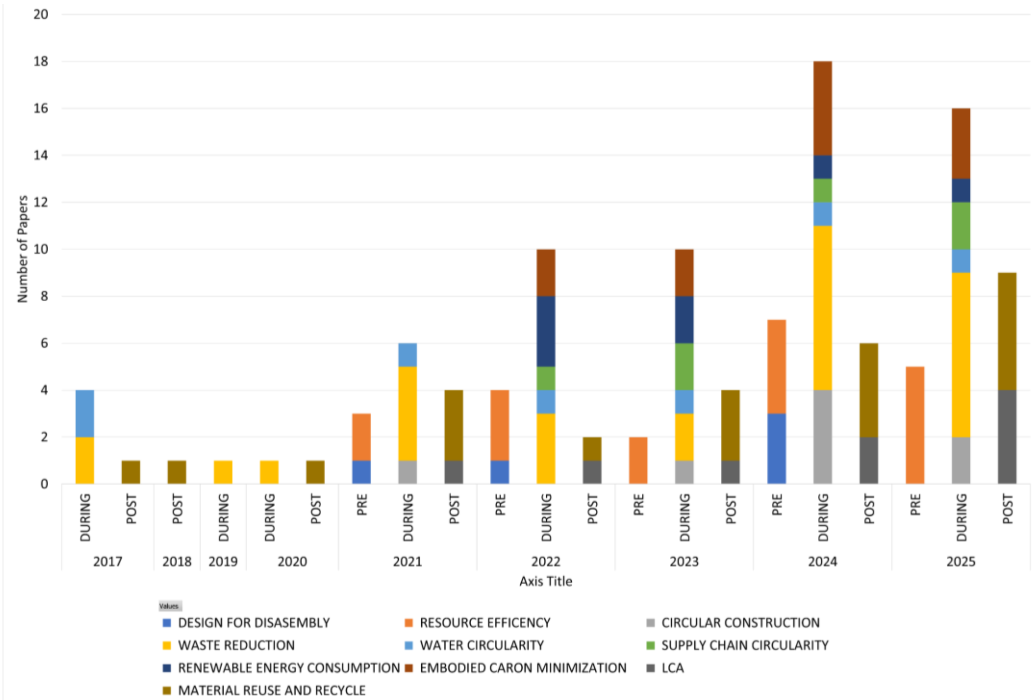

Figure 4: Temporal distribution of circular economy strategies during the different construction phases (2017-2025)

The emphasis is more towards the development of lifecycle thinking, with particular emphasis on post-occupancy evaluation, flexibility, and long-term performance. This can be observed using tools such as Building Information Modelling (BIM) for lifecycle monitoring, post occupancy feedback systems and the incorporation of maintenance plans that are aligned with circular economy principles. The trend points to policy and industry practices increasingly shifting away from traditional linear "design-build-dispose" paradigms towards regenerative, holistic, and feedback-informed design approaches that cover the whole lifecycle of the built environment.

3.2 DISCUSSION

Based on the analysis above, resource efficiency, circular design, waste reduction, material reuse and recycling are the factors that are most frequently addressed, and they represent the fundamental ideas of circular economy in the built environment. Water circularity and renewable energy use are both moderately represented, suggesting that efforts to incorporate sustainable resource management are still underway. Life cycle assessment (LCA), supply chain circularity, and embodied carbon minimisation are less common, indicating a lack of attention in policy towards long-term environmental effect assessment. There is a need for more research on modular building techniques and adaptive reuse because the design for disassembly and circular construction are the least addressed. Overall, the results indicate that although research and policy initiatives recognise circular economy principles, some elements, especially long-term sustainability strategies— sector is Extended Producer Responsibility (EPR) as suggested by Shooshtarian et al. (2021) need more attention and policy integration. An effective market-based policy strategy that can greatly support circular economy in the building

According to Evertsen and Knotten, (2024), one of the most important methods for developing a closed loop constructed environment is to shut the loop by recycling and reusing materials. Greater London's circular built environment policies have improved construction efficiency but fall short of achieving a fully circular city. While they address resource depletion and waste, they lack focus on building reuse, community involvement, and systemic urban transformation, which are essential for a truly resilient and resource-efficient future (Bucci Ancapi et al., 2024). The policy framework for a circular built environment typically follows a top-down approach, where policymakers set guidelines that practitioners, such as developers and contractors, are expected to implement. Contrary to this In Norway, the national authorities establish overarching regulations while allowing local governments the flexibility to make region-specific decisions (Evertsen & Knotten, 2024).

In case of developing countries like India, integration of the policy framework in circular economy principles through various initiatives is required. While some of the flagship policies by the government, such as SMART city mission encourage green buildings, smart energy, and water efficiency systems to support long-term sustainability, the 2070 net-zero objective of the Indian government marks the turning point in India's climate policy. To achieve this net-zero aim, the integration of circular economy principles at the design phase is highly recommended. Even though they are effective in promoting low-carbon technology to a considerable degree, policies lacking a long-term mitigation aim would not be able to meet India's climate ambitions to meet the objectives of the Paris Agreement (Chaturvedi et al., 2024).

Based on the review findings, circular parameters such as Design for disassembly in the pre-construction phase become the most essential and urgent parameter that must be integrated in the regulatory and assessment frameworks in the built environment, followed by systematic phase wise integration of the other parameters, providing foundation for future targeted studies.

4. CONCLUSIONS

The primary research gap lies in the lack of mandatory enforcement of circular economy principles in the current policies. Existing literature highlights the importance of circular economy principles but does not guarantee their enforcement. There is also insufficient research on policy barriers, incentives, and the role of different stakeholders in ensuring the adoption of circular economy E principles across the construction industry in India. A major setback in the enforcement of these policies includes people's participation which needs to be included in the current policies. The lack of public awareness and involvement, together with the lack of defined financing sources and incentives to encourage companies and developers to embrace circular processes, are significant obstacles to compliance. Additionally, overlapping jurisdictional regulations and fragmented rules lead to bureaucratic obstacles that slow down implementation and lessen the impact of policies. For the construction industry to close these gaps, a thorough regulatory framework with legally binding requirements, clear enforcement procedures, stakeholder engagement plans, and a planned adoption roadmap for the circular economy is needed. Building further on the identified research gap, this research will extend to analysing multiple national and state level policy frameworks. The 10 identified circular economy parameters would be crucial in analysing the policies and further identifying the gaps in the implementation of the same.

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