

A BIBLIOMETRIC STUDY OF ADOPTION OF GREEN BUILDING CONCEPTS IN SHOPPING CENTRES

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Abstract. The adoption of green building concepts in shopping centres has emerged as an important strategy for enhancing environmental sustainability, energy efficiency, and consumer well-being. Despite the growth of green building research, studies focusing specifically on retail environments remain limited. This study employed a bibliometric approach to examine the evolution, trends, and intellectual structure of research on green building adoption in shopping centres from 2000 to 2025. Using the Dimensions AI database, 26 publications were identified and analysed through citation analysis, co-citation networks, journal co-citation, and bibliographic coupling. The findings reveal that research in this field is fragmented and episodic, with three main thematic clusters: managerial and policy adoption, building performance and thermal comfort, and energy-efficient systems. Influential works primarily focus on certification frameworks and energy efficiency, while retail-specific challenges remain underexplored. Geographic analysis indicates limited international collaboration, with most contributions concentrated in a few countries. The study highlights gaps in the literature and underscores the need for sector-specific frameworks, cross-country studies, and targeted policies to promote sustainable practices in shopping centres. These insights provide a foundation for guiding future research, policy-making, and practical implementation of green building strategies in the retail sector.

Keywords: *Bibliometric analysis, energy efficiency, green buildings, shopping centres, sustainability.*

INTRODUCTION

Green building practices have emerged as critical strategies for reducing the environmental impact of the construction and property sectors, particularly in urban commercial developments such as shopping centres. These practices aim to improve energy efficiency, reduce greenhouse gas emissions, enhance occupant comfort, and promote sustainable resource use (Kibert, 2016; Zhao et al., 2019). Shopping centres, as high-consumption and high-traffic facilities, offer a unique context for examining the adoption of green building concepts, given their potential influence on sustainability practices across urban environments.

Despite the growing attention to sustainable construction globally, the literature suggests that adoption rates of green building practices in shopping centres remain uneven, with barriers including cost, technical expertise, and policy support (Fuerst & McAllister, 2011; Darko & Chan, 2017). Moreover, there is limited synthesis of the body of research on this topic, particularly in terms of global trends, key contributing authors, influential publications, and country-level research contributions.

To address these gaps, this study employed a bibliometric analysis approach to systematically map the research landscape on green building adoption in shopping centres. By analysing publication patterns, citation networks, co-authorship links, and keyword occurrences, the study aimed to identify research trends, influential works, and potential areas for further investigation. This approach enables a quantitative assessment of the intellectual structure of the field and provides insights into its evolution from 2000 to 2025.

Research on green building adoption in shopping centres encompasses multiple dimensions, including environmental performance, energy efficiency, indoor environmental quality, and sustainability certification systems such as LEED, BREEAM, and Green Globes (Ascione et al., 2022). Studies indicate that sustainable design strategies, such as energy-efficient HVAC systems, thermal insulation, and intelligent building technologies, are central to reducing operational energy consumption and improving occupant comfort (Ascione et al., 2022).

While numerous case studies have examined the implementation of these strategies in office buildings, residential complexes, and industrial facilities (Canbay et al., 2004; Perez-Lombard et al., 2008), research specifically focusing on shopping centres is relatively limited. Wei et al. (2015) highlighted the global diversity of green building certification systems, emphasising that adoption is influenced by national policy frameworks, market incentives, and technological availability. Similarly, Fuerst and McAllister (2011) found that financial and operational considerations strongly affected the adoption of green practices, including the cost of materials and long-term return on investment.

Bibliometric approaches are increasingly recognised as valuable for systematically analysing research trends, identifying influential authors and publications, and mapping intellectual structures in a field (Cobo et al., 2011; Donthu et al., 2021). By applying citation analysis, co-citation analysis, and bibliographic coupling, researchers can reveal the evolution of knowledge, collaboration networks, and thematic clusters in a specific domain (Boyack & Klavans, 2010). Given the fragmented and dispersed nature of research on green building adoption in shopping centres, a bibliometric review provides a structured and comprehensive overview that can inform both scholars and practitioners, highlighting gaps, emerging trends, and potential areas for further investigation.

1. METHODOLOGY

The study adopted a bibliometric research design, which integrates quantitative techniques to evaluate patterns, structures, and developments in scholarly literature. According to Creswell and Plano Clark (2007), robust research design entails

combining qualitative and quantitative approaches to maximise explanatory power, while bibliometric analysis specifically allows for systematic mapping of research activity across disciplines. By examining publication type, title, keywords, authorship, institutional affiliations, and geographic distribution, bibliometrics provides insights into knowledge development, emerging themes, and future research trajectories.

The study population comprised relevant publications on green building adoption in shopping centres between 2000 and 2025. In line with Chain et al. (2019), a census approach was applied, ensuring comprehensive coverage of available material rather than a sampled subset. This approach enabled more representative insights into global research patterns. Twenty-six publications were identified and formed the analytical dataset.

Data were collected using the Dimensions AI database, a platform offering extensive bibliographic records and analytic functionalities across multiple disciplines. A structured search query was designed, incorporating Boolean operators and quotation marks to refine results and improve accuracy (Ho et al., 2016). The final retrieval string was:

("sustainable construction" OR "green building practices") AND
(shopping malls OR retail centres) AND NOT (cities OR neighbourhoods
OR heritage buildings).

Filters were applied to restrict the dataset to journal articles, book chapters, and conference proceedings within the categories "Built Environment and Design" and the Sustainable Development Goals "Affordable and Clean Energy" and "Sustainable Cities and Communities."

To prepare the dataset, records were exported into Microsoft Excel and CSV formats. The Excel file was cleaned to remove duplicates and standardise formatting, while the CSV file was directly analysed using VOSviewer software, which automatically generated bibliometric indicators including co-authorship, citation counts, and total link strength. Operational variables included authorship, publication year, citation count, publication outlet, and bibliometric linkage strength.

Since the data collected included many aspects that could not be analysed by the human eye, domain analysis was used in this study to improve analysis. Domain analysis involved identifying and defining the relationships between key concepts, topics, and themes that were commonly addressed within a specific research field to provide a structured understanding of the intellectual structure and content of a particular research area. VOSviewer software tool was utilised for analysis and creating bibliometric maps based on network data used to construct networks of academic publications, academic journals, researchers, research organisations and countries. Items in these networks were connected by using bibliometric analysis techniques such as co-authorship analysis, co-occurrence analysis, citation analysis, bibliographic coupling, or co-citation links as they were suitable for bibliometric research on various topics and fields (Cobo et al., 2011; Song et al., 2016).

This study used citation analysis, co-citation and bibliographic coupling analysis as the bibliometric analysis techniques. Citation analysis and total link strength were used for the description of maps and networks. A high link strength

suggested a strong standing point for articles and journals in a field of research (Cobo et al., 2011; Kleminski et al., 2022). Each journal, document or author was represented by a node, and the lines connecting them (edges) indicated how closely related they were based on co-citation frequency. Journals that frequently got cited were grouped closer together in the network visualisation (clusters).

2. RESULTS

Figure 1 indicates that the earliest record published was in 2007, and not 2000 as the study initially intended. The number of articles showed a steady growth, increasing from 2 in 2015 to 5 in 2016. However, a significant decline was observed in 2017, followed by a gradual peak from 2018 onwards. Although a slight decline was seen in 2023, it was immediately followed up by a peak in 2024. This concludes that 2017 was the year the nature of research in this field was at its prime. Figure 1 is a summary of publications from 2000 and 2024.

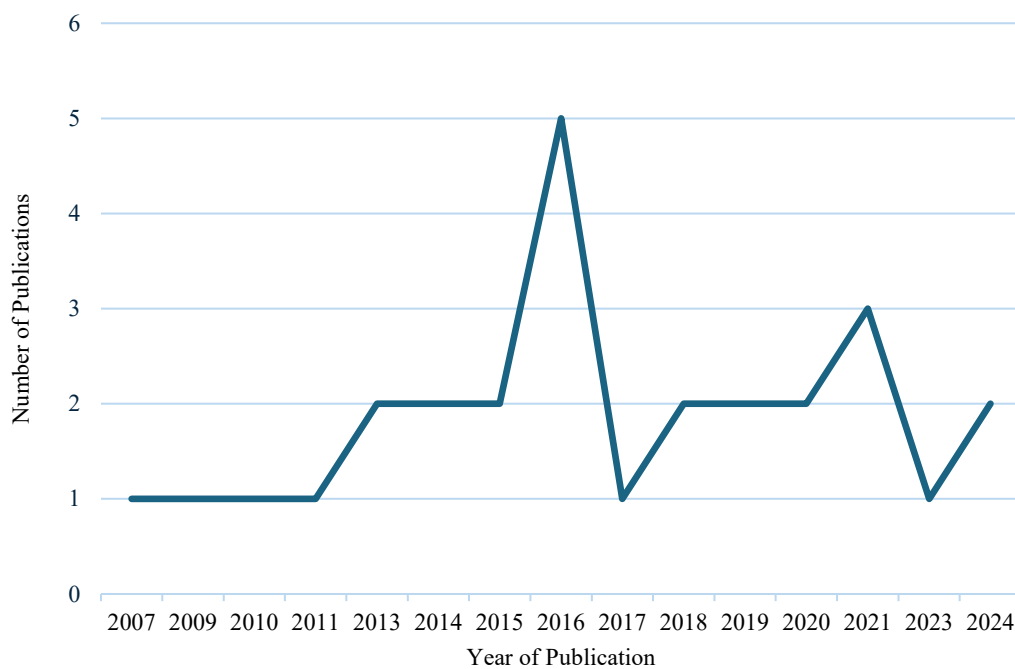


Fig. 1. Publications of green building research in shopping centres from 2000 to 2025. Source: Research findings.

2.1. Document Citation Patterns

A document citation network in bibliometric research is a visual representation of the links between documents based on how frequently they were cited by other documents (Cobo et al., 2011). Researchers can learn about the knowledge flows and evolution of research subjects in certain areas of study by evaluating co-citation patterns (Boyack & Klavans, 2010). By utilising document citation, a framework of how the study of green building adoption in shopping malls has changed over

time in terms of citation patterns was established. Alongside the evolution of this area of research, the challenges encountered in this adoption were determined based on documents that received the highest citation counts.

Since the timeline of this study was from 2000 to 2025, Fig. 2 indicated different documents and the year they were published. It was apparent that there were no published records until 2011, as shown in Fig. 2. The most recent publication was in 2025 by Ramkumar et al. (2025), but even so, it received the lowest number of citations of 2. Wei et al. (2015) had the largest node, and a citation count of 204 citations, followed by Fasiuddin & Budaiwi (2011) with 63 citations. Publication by Deribbble & Reeder (2015) was the third most cited document with 50 citations. These articles were therefore used to determine the challenges encountered in shopping malls when adopting green building concepts.

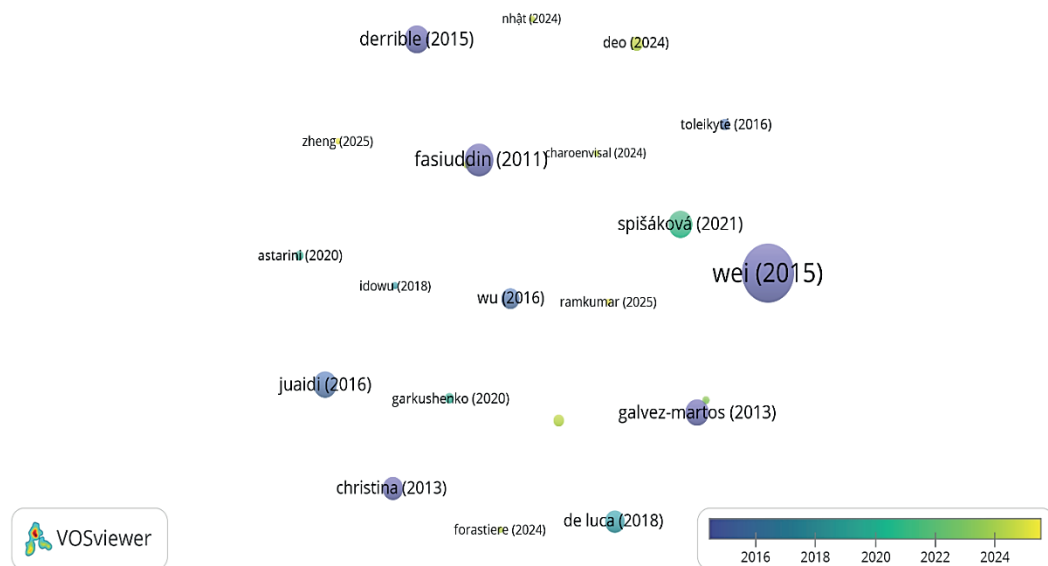


Fig. 2. Document co-citation analysis network.

Source: Research findings.

Wei et al. (2015) discussed the different green building certifications used by 30 different countries to assess the extent to which indoor air quality is considered part of the green building initiative, and this article received 204 citations in total, with 47 citations being recent, as indicated in the publication metrics on the Dimensions website. Li et al. (2016) stated that green building adoption research is low. However, the number of citations received in an article by Wei et al. (2015) showed that this area of research is growing though at a slow pace since not that many articles received high citation counts apart from Fasiuddin et al. (2011) with 63 citations where they discussed a need for a smart energy conservation strategy to efficiently operate heating, ventilating and air-conditioning systems (HVAC) while also maintaining the proper thermal comfort. Ramkumar et al. (2025) also expressed the same concerns as Fasiuddin et al. (2011), although their article had received only two citations at the time this article was written. Deribbble et al. (2015), being the third most cited document with 50 citations and 13 being recent,

Although Newman (2006) discussed that green building adoption was relatively new in shopping malls and only one article was published in 2007, the number of records collected in this study proved otherwise. The equilibrium of different publications either journal articles to conference proceedings is not reached, then the assumption can be that the topic is less relevant. Therefore, with the number of records being 16 journal articles, four conference proceedings and four book chapters, the assumption by Lebon et al. (2008) was proved to be correct.

2.2. Journal Co-citation Networks

The cluster consisting of ‘energy and buildings’ had the largest node, and it was also the biggest cluster as it was connected to other journals such as ‘energy conversion and management’, ‘sustainability’ and energy reports. The next node which formed the largest cluster was ‘energy’ and it had connections with ‘journal

of cleaner production' and others such as 'journal of business research and' 'renewable and sustainable energy reviews. Table 1 is a summary of journal link strength and citations.

Table 1. Journal Link Strength and Citations

ID	Journal	Total Link Strength	Citations
67	Energy and Buildings	1273	87
153	Journal of Cleaner Production	332	21
65	Energy	464	20
22	Applied Energy	415	19
74	Energy Policy	339	16
223	Renewable and Sustainable Energy Reviews	373	15
64	Energies	251	13
-40	Building and Environment	185	11
148	Journal of Building Engineering	252	11
163	Journal of Environmental Psychology	101	11
75	Energy Procedia	230	10
183	Journal of Retailing and Consumer Services	109	9
236	Sustainability	131	9
69	Energy Conversion and Management	200	8
152	Journal of Business Research	109	8
227	Resources, Conservation and Recycling	51	8
41	Building Research & Information	81	6
76	Energy Reports	149	6
78	Environment and Behavior	52	6
26	Applied Thermal Engineering	84	5
43	Buildings	92	5
182	Journal of Retailing	61	5
191	Leukos, the journal of the Illuminating Engineering Society of North America	112	5
Total			314

Source: Research findings.

The total link strength for this network was 2723 links, with 'Energy and Buildings' having the highest link strength of 1273 links. The top five journals with the highest citations included 'Energy and Buildings' with 87 citations, followed by 'Journal of Cleaner Production' with 21 citations, 'Energy' with 20 citations, which was directly followed by 'Applied Energy' with a citation count of 19. 'Renewable and Sustainable Energy Reviews' followed with 15 citations. The journals with the lowest citation count were 'Journal of Retailing', 'Buildings', 'Applied Thermal Engineering' and lastly 'Leukos, the journal of the Illuminating Engineering Society of North America', all with five citations. It was deduced that 'Energy and

Buildings' has made a significant contribution as it had both the highest citation count and total link strength in the network.

2.3. Geographic Distribution

Kleminski et al. (2022) define bibliographic coupling of countries as an evaluation of the relationships between countries based on shared citations in academic publications. This strategy involved identifying influential papers, authors, institutions, and countries by examining citations and publications from various geographical regions. Figure 4 illustrates the four countries that have published articles related to green buildings and shopping centres, showcasing the diversity of international collaboration in this field. Although the census of this study included 26 publications, the visual map showed that Spain has the highest density, with two published articles. The remaining countries, the United Kingdom, Saudi Arabia, and Canada, each had one published article.

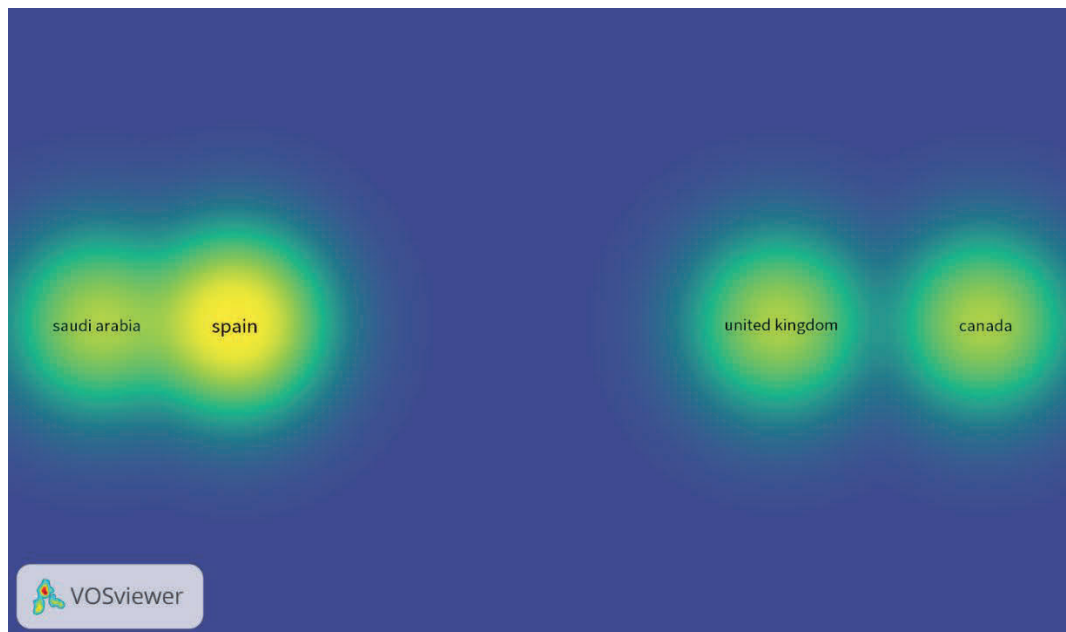


Fig. 4. Bibliographic coupling of countries – Density Visualisation Map.
Source: Research findings.

The map highlighted the connections between four countries, with Spain being linked to all three, which indicated a significant role in the global discussion on green building and shopping centres. Although that was the case, articles by Hinnells et al. (2008) and Darko & Chan (2017) revealed that green building adoption was examined in Malaysia, the United States of America and Indonesia. Therefore, it was concluded that more collaborations in this field were needed for the purposes of creating a concrete research base and adding to the body of existing research.

3. DISCUSSION

This study set out to examine the evolution and intellectual structure of research on the adoption of green building concepts in shopping centres through bibliometric analysis. By mapping 26 publications indexed in the Dimensions AI database between 2000 and 2025, it provided insights into research trends, influential works, and gaps in the literature.

The findings suggest that research on green building adoption in shopping centres remains fragmented and relatively underdeveloped compared to the broader green building discourse. Publication output peaked in 2016 and again in 2021 but has otherwise fluctuated, indicating episodic rather than sustained scholarly attention. This aligns with Newman (2006), who noted that retail environments were slower to adopt sustainability practices compared to office and institutional buildings.

The co-citation analysis revealed three primary research clusters: managerial and policy dimensions (Wei et al., 2015), building performance, thermal comfort, and energy efficiency in HVAC systems (Fasiuddin & Budaiwi, 2011; Ramkumar et al., 2025), and lastly, the cost of implementing green concepts and their financial, economic, and environmental effects (Derrible & Reeder, 2015).

These clusters confirm the centrality of operational efficiency and comfort to green retail design, echoing previous observations that shopping centres are energy-intensive assets requiring tailored interventions (Fuerst & McAllister, 2011; Darko & Chan, 2017). Notably, however, relatively few works directly addressed retail-specific challenges such as tenant coordination, consumer expectations, and retail supply chains, which were emphasised in broader sustainability literature (Grimmer, 2022).

Highly cited works such as Wei et al. (2015) highlight the importance of certification frameworks and international benchmarking in shaping adoption trends. Their influence underscores the role of institutional structures in legitimising green practices (Li et al., 2016). Yet, while certification systems provide credibility, the lack of shopping centre-specific guidelines may limit applicability in retail contexts.

The bibliographic coupling analysis revealed contributions from only four countries (Spain, the UK, Saudi Arabia, and Norway) suggesting limited geographic diversity. While other studies confirm activity in the USA, Malaysia, and Indonesia (Hinnells et al., 2008; Johari et al., 2010; Darko & Chan, 2017), the lack of international collaboration suggests that research on green retail buildings is still confined to niche academic networks. Broader comparative studies would enable cross-country learning and transfer of best practices.

From a theoretical standpoint, these findings highlight that the adoption of green building concepts in shopping centres has not yet achieved the critical mass of research required to form a cohesive subfield. Practically, the results underscore the need for tailored frameworks that address the operational and consumer-specific challenges of retail spaces, rather than extrapolating from office-based studies. For policymakers, the limited geographic scope suggests an urgent need for incentives,

regulations, and collaborative initiatives that stimulate research and adoption in emerging economies where retail growth is most pronounced.

This study was limited by its reliance on a single database (Dimensions AI), which may not have captured all relevant publications. The relatively small dataset of 24 records also constrains the generalisability of findings. Future research should expand the scope by incorporating multiple databases such as Scopus and Web of Science, and by applying mixed bibliometric and content analysis methods to capture deeper insights. In addition, comparative case studies of green shopping centres across regions would enrich understanding of context-specific drivers and barriers.

CONCLUSION

This bibliometric study examined the adoption of green building concepts in shopping centres, drawing on 26 publications indexed in Dimensions AI between 2000 and 2025. The findings show that research in this area is emerging but fragmented, characterised by episodic growth and limited geographic representation. Co-citation networks revealed three dominant themes, managerial and policy adoption, technical aspects of building performance, and energy efficiency in HVAC systems, yet relatively few studies have directly addressed the retail-specific challenges of green building adoption.

The analysis highlights that influential works in the field often focus on certification frameworks and energy-efficient technologies in non-retail contexts, underscoring the peripheral position of shopping centres within broader sustainability research. Furthermore, the concentration of contributions from a handful of countries points to the absence of widespread international collaboration.

Overall, the study underscores the need for more sector-specific research that accounts for the operational complexity, consumer dynamics, and energy demands unique to shopping centres. Policymakers and practitioners should encourage the development of targeted frameworks and incentives to accelerate adoption in this under-researched domain. Future work should build on these findings through cross-country comparative studies, integration of multiple bibliographic databases, and mixed method approaches that combine bibliometric mapping with qualitative insights.

By identifying the intellectual structure, gaps, and opportunities within this field, the study provides a foundation for advancing scholarship and guiding practice in the sustainable transformation of shopping centres.

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