Bagh-e Nazar
DOI:10.22034/bagh.2026.578916.6008

Bagh-e Nazar, *23*(162), 97-116 / 2026
Persian translation of this paper entitled:
تحلیل علم‌سنجی بر رویکردهای حل مسئله در مدیریت انرژی ساختمان
is also published in this issue of journal.

Review Article

Bibliometric Analysis of Problem-Solving Approaches in Building Energy Management

Parisa Javid[1], Masoumeh Yavari[2]*, Pouya Fotovatian[3] , Mohammad Najafi[4], Mohammad Javid [5]

1- Department of Architecture, Faculty of Art and Architecture, ST.C, Islamic Azad University, Tehran, Iran
2- Department of Architecture, Faculty of Art and Architecture, Khatam University, Tehran, Iran
3-Department of Architecture, Faculty of Art and Architecture, Cha.C, Islamic Azad University, Chalous, Iran
4- Department of Architecture, Faculty of Art and Architecture, Khatam University, Tehran, Iran
5- Department of Architecture, Faculty of Art and Architecture, YI. C, Islamic Azad University, Tehran, Iran

Received: 15/04/2026 Accepted: 07/07/2026 Available online:22/11/2026

Abstract

Problem statement: Buildings account for approximately one-third of global primary energy consumption. Addressing this challenge has made building energy management a key strategy for improving energy efficiency and reducing consumption. This study presents a bibliometric analysis of building energy management research, with a particular focus on problem-solving approaches in the built environment.

Research objective: This study aims to present findings on energy consumption management, with an emphasis on problem-solving approaches in buildings. Additionally, it seeks to identify emerging trends and recent research directions in this domain.

Research method: The keyword "building energy management" was retrieved from the Scopus database, yielding an initial dataset of 1,098 publications between 2019 and 2025. The PRISMA framework was employed for data collection and screening. After removing irrelevant records and applying inclusion criteria, 336 articles were selected for comprehensive analysis. Bibliometric assessment was carried out using co-occurrence, co-authorship, and co-citation analyses. The scientific network mapping was conducted using VOSviewer and the Bibliometrix package within the RStudio environment, and the main thematic expressions in the field were identified through graphical visualization.

Conclusion: The results reveal that energy management is strongly linked to concepts such as building thermal performance, sustainability, smart buildings, energy consumption, thermal comfort, natural ventilation, and visual comfort. The publication trend in this field has increased in recent years. China and the United States demonstrate the highest level of collaboration in scientific output. Furthermore, emerging topics such as smart buildings, deep learning, and artificial Intelligence have become increasingly prominent in recent research.

Keywords: *Building Energy Management; Sustainability; Smart Buildings; Systematic Review; Bibliometric Analysis*

Introduction

Globally, the escalating energy demand in the building sector presents a complex challenge. Buildings account for over one-third of global primary energy consumption (Magoni & Adami, 2020), consuming approximately 40% of the world's energy and generating 30% of global carbon dioxide (CO_2)

*Corresponding Author: 09126727929, ma.yavari@khatam.ac.ir

emissions (Anika et al., 2022). Examining emissions across selected countries reveals that the United States, as one of the largest emitters (Nurdiawati & Urban, 2021), accounts for approximately 40%- 48% of global emissions (Möslinger et al., 2023). Consequently, enhancing energy conservation and minimizing waste in buildings are critical imperatives. These measures preserve finite fossil fuel resources, reduce energy costs for consumers and businesses, and improve the long-term sustainability of the built environment. This study aims to present recent advancements in building energy management. Providing a comprehensive review of problem-solving approaches in this domain can clarify their efficiency and application in architectural design while highlighting key considerations for future research. Furthermore, this study seeks to identify and analyze the concepts and problem-solving methodologies within building energy management. Employing a systematic approach, this research establishes a conceptual framework for problem-solving methods in building energy management, which is essential for achieving energy-reduction targets. Consequently, this study addresses the following research questions:

-What are the key indicators influencing problem-solving approaches in global building energy management?

-What are the performance trends of emerging articles and journals regarding indicators that influence building energy management?

-What are the collaboration patterns among countries and researchers based on the geographical and chronological distribution of studies in building energy management?

-How are the relationships between key concepts in the field of building energy management defined and structured?

To address these questions, the indicators that influence problem-solving approaches in the building sector must first be defined based on international and domestic literature. Subsequently, a bibliometric analysis is conducted to map the intellectual structure of the existing literature. Quantitative methods, including co-authorship and document co-citation analyses, are applied to examine the academic network.

Although numerous studies on building energy management have been published recently, the majority focus on technical solutions, optimization models, smart technologies, and energy performance analysis. Few studies investigate the intellectual structure and evolutionary trends of this domain from a bibliometric perspective. Furthermore, previous reviews have often concentrated on specific subfields, failing to provide a comprehensive analysis of problem-solving approaches in building energy management, particularly regarding conceptual networks, scientific collaboration patterns, and citation relationships. Additionally, recent advancements, especially those integrating smart building technologies, machine learning, and artificial Intelligence, have not been systematically analyzed in prior reviews. This study addresses these gaps by presenting a comprehensive bibliometric analysis of the building energy management literature. By utilizing co-word, co-authorship, and co-citation analyses, this research maps the conceptual framework, identifies emerging trends, and highlights the principal contributors in this field. The significance of this study lies in its integrated perspective on problem-solving approaches that combine thematic trends, scientific networks, and recent research developments.

Theoretical Framework

Buildings are designed and constructed primarily to accommodate human activities. Given that individuals spend approximately 90% of their time indoors, integrating building energy management systems (BEMS) equipped with intelligent control systems is crucial (Wieser et al., 2020). The primary objective of these systems is to maintain the thermal and environmental comfort standards expected by occupants while reducing energy consumption by adapting to energy price fluctuations during building operations (Luther et al., 2020). Furthermore, due to technical and environmental constraints, the share of renewable energy sources in buildings can be restricted (Kuusk et al., 2020). Under such

circumstances, building energy management plays a vital role in accelerating the transition toward a low-carbon economy and long-term sustainability (Zhang & Zhang, 2024). Currently, the building sector accounts for approximately 40% of global energy consumption. Consequently, energy management systems are essential for monitoring, controlling, and optimizing energy consumption in real time, thereby facilitating energy efficiency management (Harputlugil & de Wilde, 2021; Javid et al., 2025b; Nikghadam, 2025). These systems enable the integration and management of diverse building components—such as heating, ventilation, and air conditioning (HVAC), lighting, and security—to minimize energy consumption, maintain occupant comfort, and ensure indoor environmental quality (Mariano-Hernández et al., 2021). Over time, building energy management systems have integrated advanced methodologies leveraging the Internet of Things (IoT) and automation. This integration has enhanced system functionality, enabling dynamic adjustment of energy consumption in response to changing environmental conditions (Nikghadam, 2025; Uzair & Ali Abbas Kazmi, 2023). During the building design phase, energy management technologies are widely used to optimize design strategies for thermal comfort, a methodology known as "performance-based design." Another key application of building energy management is enhancing building energy resilience by integrating energy system simulations with local grids to balance energy supply and demand at the urban scale. Concurrently, the integration of renewable energy sources into building energy management systems has attracted significant academic attention (Javid et al., 2026; Jin et al., 2024). Traditional energy management frameworks often lack the flexibility to efficiently integrate the intermittent outputs of photovoltaic systems and wind turbines (Ma & Liu, 2026). Moreover, many renewable energy integration strategies are primarily driven by economic incentives (Duraković, 2026), frequently neglecting occupant-centric performance criteria and long-term sustainability metrics.

Literature Review

Over the past decade, various strategies have been implemented to improve energy efficiency in buildings. These initiatives have led to new research developments that summarize key findings regarding energy consumption management across different building sectors. Table 1 presents the details of selected publications, outlining their methodologies and problem-solving approaches.

A critical review of the literature on building energy management reveals that this field has evolved through a multifaceted approach, drawing on diverse simulation tools, experimental configurations, and intelligent building systems. The ultimate objective of these studies is to establish problem-solving frameworks that minimize energy consumption, enhance occupant comfort, and promote environmental sustainability. As shown in the chronological evolution of the literature, building energy management has shifted from localized optimization strategies to integrated, smart, and occupant-centric solutions. Despite these advancements, significant research challenges remain. Specifically, the integration of intermittent renewable energy sources, the optimization of multi-dimensional comfort indices (such as thermal, visual, and indoor air quality), and the development of scalable urban-level energy models require deeper interdisciplinary research using advanced simulation platforms and machine learning techniques. A key scientific gap in this domain is the scarcity of systematic reviews that analyze and categorize these problem-solving methodologies. Although empirical studies have proliferated in recent years—as shown by the studies from 2020 to 2026 compiled in Table 1 few reviews systematically map this academic landscape. Existing reviews often fail to analyze the underlying intellectual structures, co-citation networks, and emerging algorithmic trends (such as deep learning and reinforcement learning) in a structured manner. This lack of comprehensive

Table 1. Literature Review of Selected Studies on Building Energy Management. Source: Authors.

References	Approach	Location / Case Study	Research Methodology	Design Parameter / Technology
Zhao et al. (2026)	Thermal Performance	Zhongshan, China	Simulation	Passive strategies
Xu et al. (2026)	Thermal Performance, Energy Consumption	Qingdao, China	Experimental	Passive and active strategies
Poosapadi et al. (2026)	Sustainability, Energy Consumption	—	Machine learning	Smart building systems
Pajek et al. (2026)	Energy Consumption, Sustainability	Ljubljana, Slovenia	Simulation (EnergyPlus)	Passive strategies
Mousavi Motlagh et al. (2026)	Thermal Comfort, Energy Consumption	Bunnik, Breda, and Amsterdam, Netherlands	Experimental	Passive strategies
Ma & Liu (2026)	Thermal Comfort, Energy Consumption	Wuhan, China	Simulation	Internet of Things (IoT)
Vittori et al. (2025)	Smart Buildings	Jönköping, Sweden	Experimental	Internet of Things (IoT)
Javid et al. (2025a)	Thermal Comfort, Visual Comfort	Yazd, Iran	Simulation (Ladybug Tools)	Passive systems
Hou et al. (2025)	Natural Ventilation	Wuhan, China	Mathematical simulation & Deep learning	Smart building systems
Nikghadam et al. (2025a)	Thermal Comfort	Tabriz and Yazd, Iran	Simulation (Ladybug Tools)	Passive systems
Cai et al. (2025)	Sustainability, Energy Consumption	—	Machine learning	Smart building systems
Habib et al. (2025)	Thermal Performance, Energy Consumption	Sweden	Mathematical modeling	Smart building systems
Yu et al. (2024)	Natural Ventilation	Macao, China	Simulation	Smart building systems
Chikurtev et al. (2023)	Thermal Performance, Energy Consumption	Bulgaria	Simulation (MATLAB)	Smart building systems
Dagdougui et al. (2020)	Smart Buildings	Rabat, Morocco	Simulation	Smart building systems

synthesis underscores the need for a systematic bibliometric study to identify gaps, develop a cohesive conceptual framework, and guide future research trajectories.

Research Method

This article seeks to present a clear picture of advanced developments and potential opportunities in building energy management and to serve as a strong guide and reference for current and future researchers in the field and its applications. Various approaches may be employed to analyze a body of documents related to a journal, a specific topic, or a country. One of the most widely used approaches in this context is bibliometric analysis, which has been extensively applied to examine and analyze large volumes of scientific data (Çelik & Şekeroğlu, 2023). Bibliometric methods assist researchers in identifying emerging trends in articles and journals (Nikghadam et al., 2025b; Wang et al., 2025). This method is particularly useful for collecting a corpus of documents and providing an overview of leading research trends (Wu et al., 2024). Among the available tools, VOSviewer is frequently used to examine relationships among publications from different databases and to classify keywords (Tang et al., 2024). Most of the articles included in this study belong to the past six years, reflecting recent challenges and issues related to problem-solving approaches in building energy management. Table 2 presents the types of analyses that can be extracted using bibliometric data visualization software. The research procedure is summarized as follows:

Step 1: In this study, problem-solving approaches in building energy consumption management were identified and extracted from domestic and international documentaries and library sources.

Step 2: A bibliometric analysis was conducted to uncover the intellectual structure of the existing

Table 2. Analytical Outputs Extractable from Bibliometric Visualization Software. Source: Wu et al., 2025.

Title	Description
Item	Topics or elements investigated in the research.
Link	The connection is established between two items.
Link Strength	A positive numerical value indicating the strength of the relationship between two items; a higher value means a stronger link.
Network	A structure formed by items and links together.
Cluster	A group of items that are located close to each other on the map and are related to one another.
Network Visualization	A visual representation of relationships between items and links.
Overlay Visualization	A visualization similar to network mapping, but with different item coloring based on additional attributes such as time or citation impact.
Density Visualization	A view useful for understanding the map's overall structure and for focusing on the most prominent areas.
Co-occurrence	Extraction of article keywords to identify the main topics and research trends in the field.
Co-citation	Two scientific documents that are cited together by a later article indicate a similarity between them.
Bibliographic Coupling	Two documents that cite similar references in their reference lists and therefore share common topics.
Co-authorship	Collaboration between multiple authors in producing scientific works.
All Keywords	Includes author keywords and automatically extracted keywords from scientific databases.

literature on problem-solving approaches in building energy management. This quantitative analysis examined keyword co-occurrence, co-authorship, and co-citation relationships within bibliographic documents. For the search process and data extraction, the Scopus database was used. VOSviewer software and the Biblioshiny library in RStudio were used to generate keyword co-occurrence maps and clarify the field's thematic structure.

The software extracted publications from the Scopus database and generated various maps, including network, overlay, and density visualizations. This study employs a literature review methodology, drawing on both quantitative and qualitative data. Fig. 1 illustrates the research steps and outlines the procedures followed for selecting keywords and sources from the database.

This study presents a literature review on problem-solving approaches for building energy consumption management. To this end, the search strategy was limited to studies that directly addressed concepts such as energy management, energy consumption reduction, and energy efficiency improvement in the building context. Accordingly, a range of keywords was used, including energy management system, energy management in buildings, building energy management, energy consumption reduction, and energy efficiency, to achieve broader coverage of relevant studies. Using certain terms as exact phrases within quotation marks enabled restricting the search results to studies that explicitly employed these concepts in the context of building energy management. The term energy efficiency was also used to identify studies focusing on technologies, methods, and strategies for optimizing energy consumption. Subsequently, to enhance the dataset's validity and consistency, priority was given to peer-reviewed articles published in indexed scientific journals. This approach helped exclude other topics within the broader field of smart buildings, such as communication systems, security, industrial network integration, and related areas. Finally, the search was limited to journal review articles to identify sources with greater scientific rigor and reliability. For screening the collected data, the 27-item PRISMA checklist was used. Based on this checklist, relevant sources were first identified. The studies were evaluated against inclusion and exclusion criteria, and the final set of eligible sources for deeper analysis was determined. Since this analysis required complete documentation, the scope of source types was limited to articles, conference papers, book chapters, reviews, and books. This stage was considered the first data screening phase (n = 1,042). In addition, since Scopus allows direct reading of article abstracts, irrelevant records were removed through abstract screening (n = 72). Commercial journals were also largely excluded from the review. After the identification stage, 968 articles were transferred to the next phase.

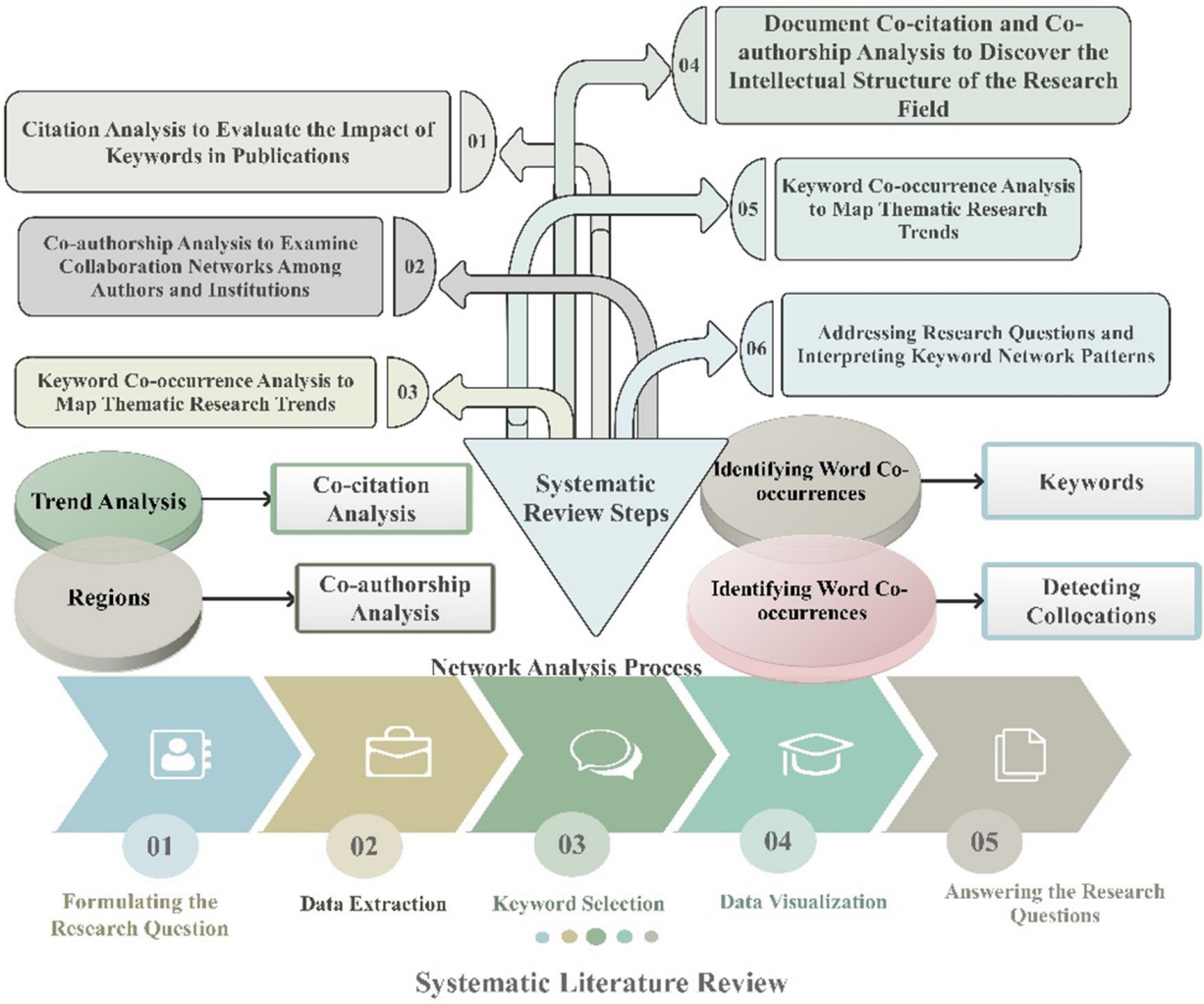


Fig. 1. The Research Process in a Systematic Manner. Source: Authors.

At this stage, 5 articles were excluded because they were scheduled for future publication and could not yet be cited, leaving 963 articles for the next screening step. After reviewing all records, some semantic ambiguities remained in the search terms. For example, the term energy consumption may refer to energy-saving optimization, but it may also appear as a keyword in related phrases, such as energy management systems. Similarly, the term sustainable architecture in the database may refer to zero-carbon architecture, although other related articles were also retrieved. Ultimately, titles and abstracts were carefully reviewed to ensure the data were valid and relevant; irrelevant records were removed to complete the final data-cleaning and processing phase (n = 935). The time span was set from 2019 to the end of 2025. Extending the period to 2025 enhances the study's timeliness and novelty, providing insight into the latest research developments. In the next stage, 18 articles were excluded for not aligning with the research topic. During the eligibility assessment stage, 954 articles were initially examined, and 456 were removed based on three criteria: topic mismatch, duplicate content, and irrelevance. Finally, in the PRISMA "included" stage, 456 articles underwent final review; of these, 153 were excluded because their available abstracts did not adequately address the research questions, and 336 were ultimately selected for detailed analysis. A better understanding of theories, methods, and emerging trends helps this study reveal new topics and research directions. The final number of retrieved documents was 336.

In the third stage, VOSviewer and the Biblioshiny package were used for bibliometric analysis, providing the foundation for the subsequent qualitative analysis.

The PRISMA stages are shown in Fig. 2. These articles exhibited an annual growth rate of 11.1% and reached a publication peak in 2022, with an R-index of 0.269 and an average citation count of 3. 4 citations per article. The frequency and co-occurrence analysis of extracted keywords provides useful information about the field of energy consumption management and its thematic classification. Based on software-generated data and content analysis, thematic approaches, emerging studies, co-occurrence patterns, and relationships among problem-solving approaches in building energy management were identified at both general and architecture-specific levels in the key literature. The findings of this systematic review are presented comprehensively in the following section.

Findings and Discussion

To address the research questions, the first part of the analysis examines frequency-based indicators from several perspectives, including temporal distribution, geographical dispersion of research, annual citation counts, and the journals that publish the research. In the next stage, a systematic content analysis is conducted to investigate problem-solving approaches, their semantic relationships, and keywords through bibliometric visualization. According to Fig. 3, the temporal distribution of the keyword "building energy management" was examined from 2019 to 2025. The findings indicate that the peak in citation activity for this keyword occurred in 2022, while its upward trend has continued in recent years.

Fig. 4 illustrates the geographical distribution of citations. The results show that China ranks first in the production of articles on building energy management. Over the past six years, a total of 117 articles have been published in this country. The United States ranks

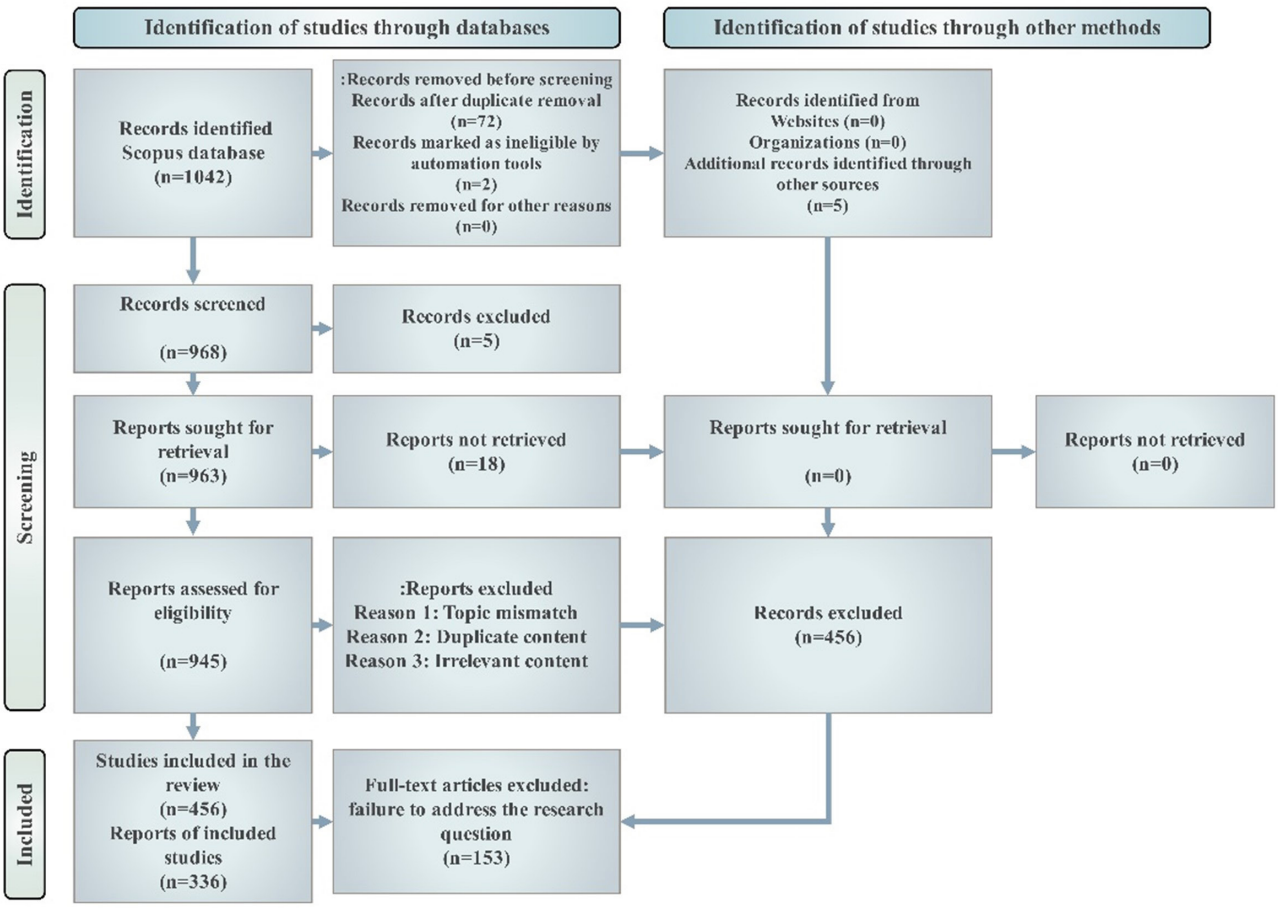


Fig. 2. Research Process Based on the PRISMA Framework. Source: Authors.

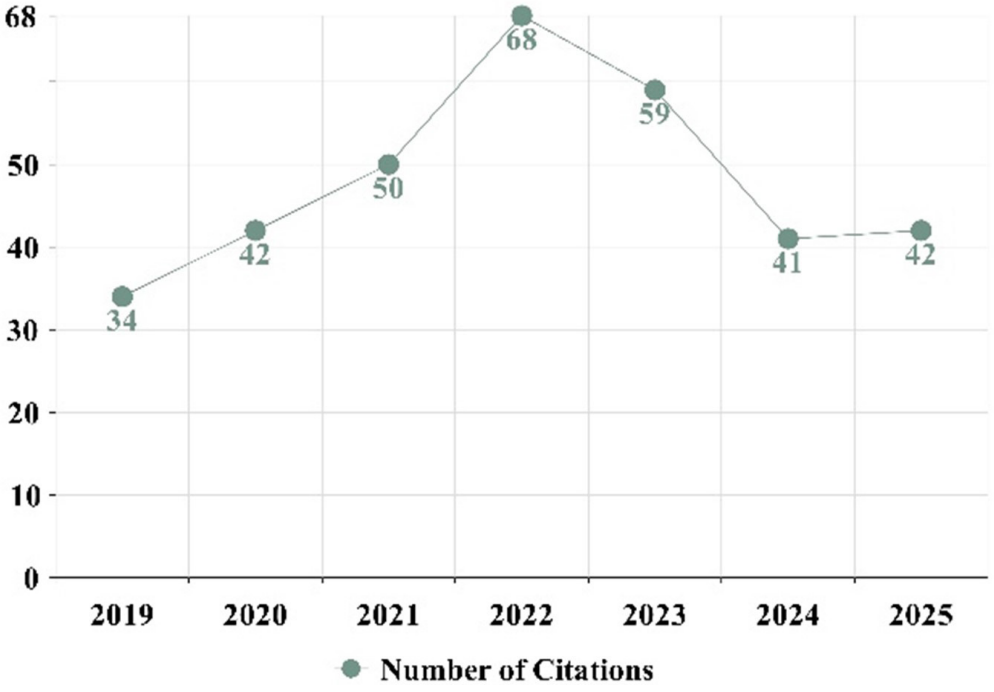


Fig. 3. Temporal Distribution of Citations. Source: Authors.

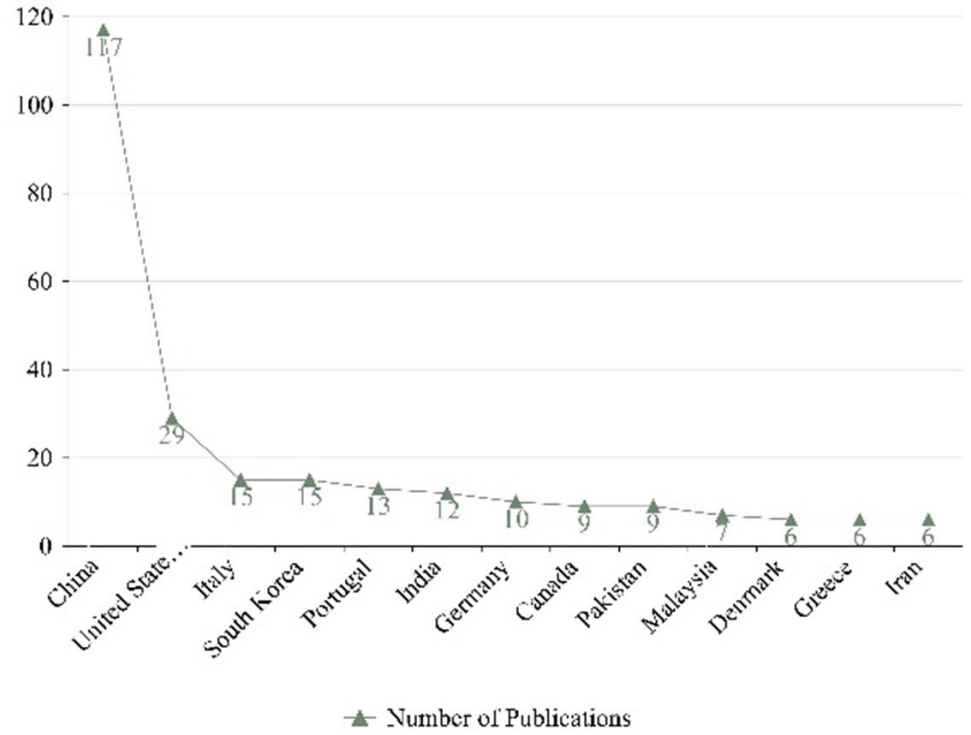


Fig. 4. Spatial Distribution of Citations. Source: Authors.

second, with 29 articles published during the same period. Iran ranks 15th, with 6 articles published in the Scopus database over the last six years in the field of building energy management. The geographical distribution of articles is presented in Table 3 and Fig. 5.

Fig. 6. presents the journals that publish articles in the field of building energy management, based on

Table 3. Citation Distribution by Country. Source: Authors.

Country	Articles	Total Citations	Average Article Citations	Single-Country Publications (SCP)
China	117	176	6.1	118
United States	29	167	1.4	29
Italy	15	71	4.7	15
South Korea	15	55	3.7	15
Portugal	13	47	23.5	13
India	12	45	7.5	12
Germany	10	33	11.0	10
Canada	9	32	3.2	9
Pakistan	9	30	15.0	9
Malaysia	7	22	1.8	7
Denmark	6	21	1.6	7
Greece	6	18	6.0	6
Iran	6	17	17.0	6

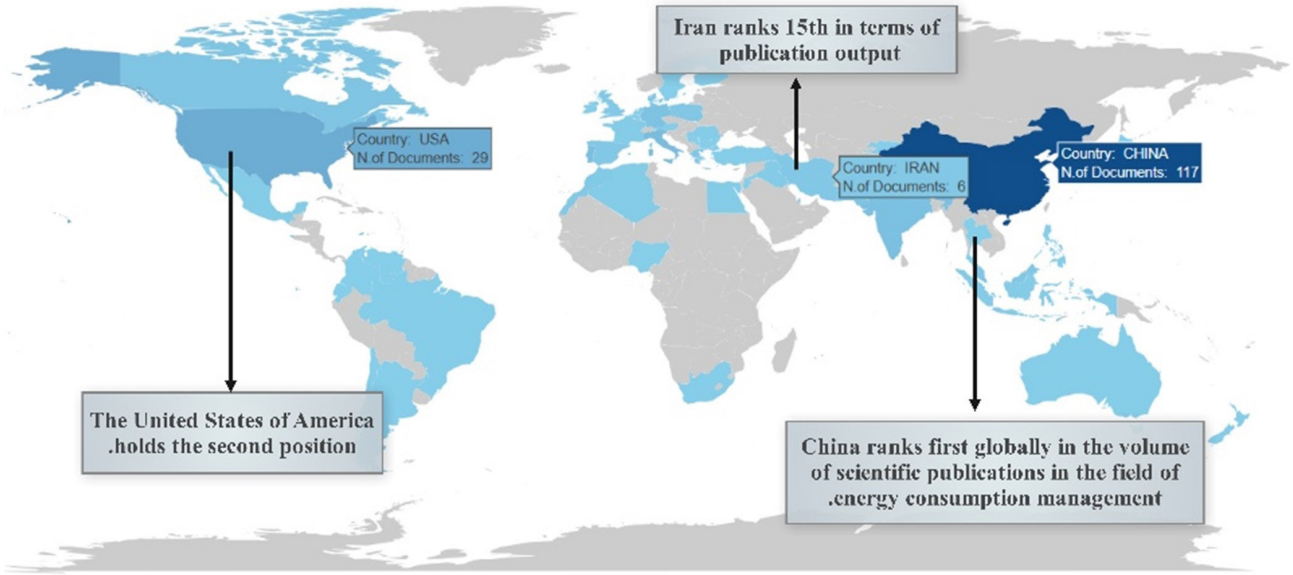


Fig. 5. Geographical Ranking Distribution. Source: Authors.

Scopus database metrics. Energy accounts for the largest share, with 51 articles, followed by Building and Environment with 42, IEEE Access with 38, and Applied Energy with 31. These publications represent the most prominent venues in the Scopus database for research on building energy management.

- **Identification of building energy management approaches**

In bibliometric analysis, co-occurrence mapping serves as a quantitative measure of relationships and conceptual overlap among key terms. While the preceding sections examined the contributions of influential countries, institutions, sources, and authors, the thematic core and conceptual framework of the literature—as expressed through keywords—require detailed analysis. Keyword co-occurrence analysis effectively reveals the research focus, thematic domains, and evolution of core topics within the field. As illustrated in Fig. 7, the core concepts in the domain of building energy management were identified by extracting keywords from the selected documents with VOSviewer. This co-occurrence analysis was executed to map the relationships between theoretical concepts and problem-solving approaches in building energy management. The analysis is based on the frequency of keyword occurrence and their relative proximity across different academic publications.

As shown in Table 4 and Fig. 8, the keyword frequency indicates that "energy management,"

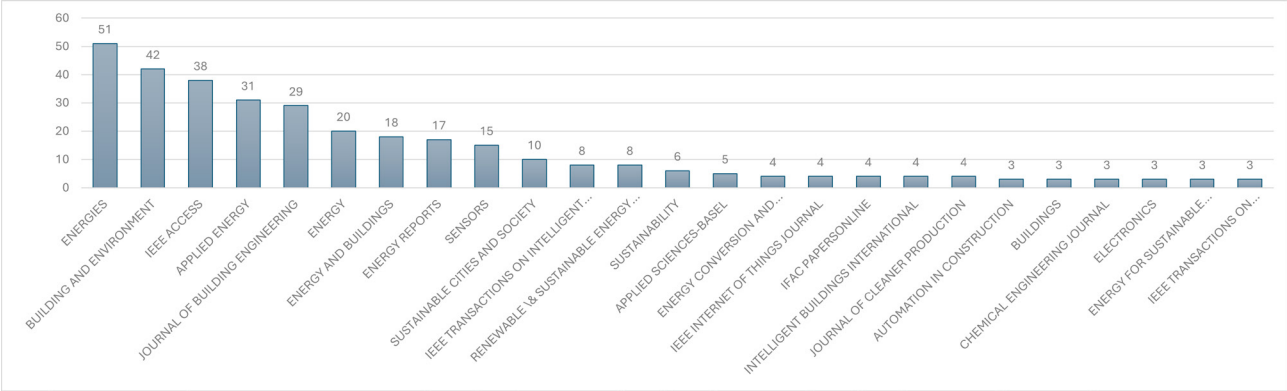


Fig. 6. Publishing Journals of Selected Documents. Source: Authors.

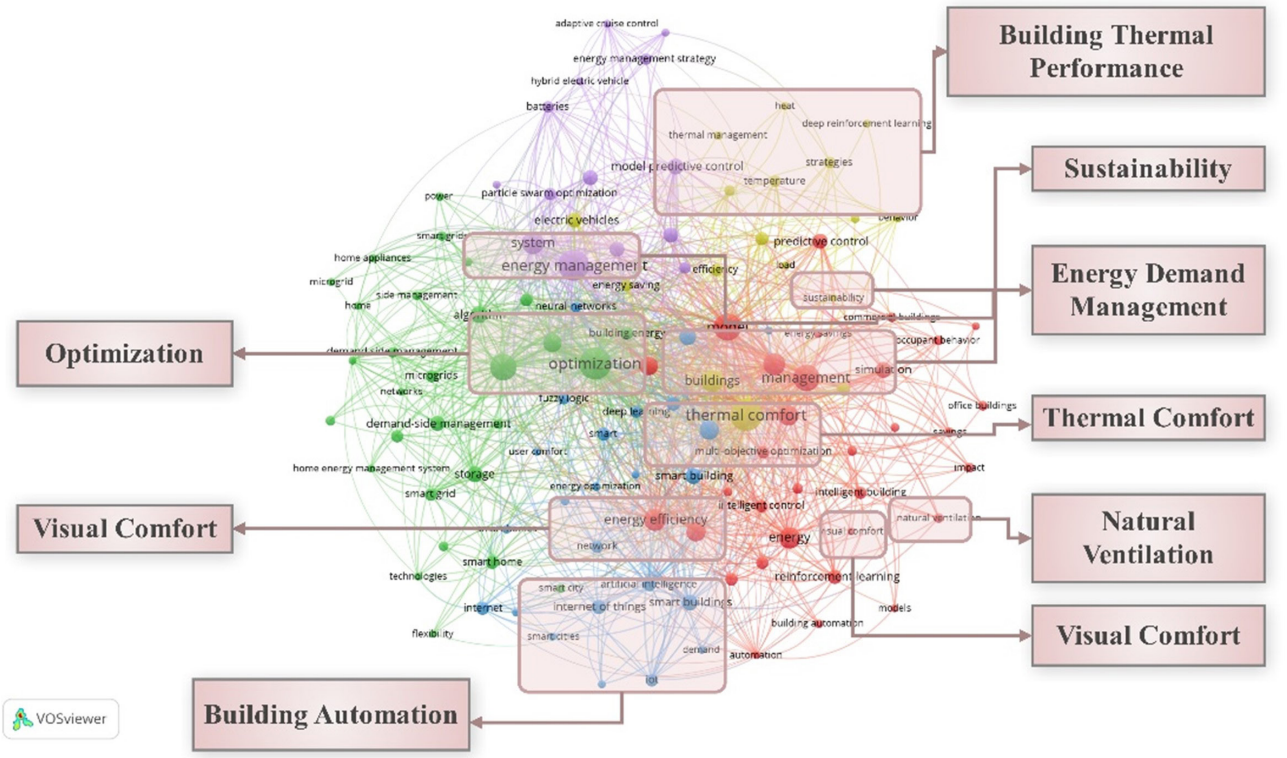


Fig. 7. Core Concepts in the Field of Building Energy Management. Source: Authors.

with 45 occurrences, is the central research focus. It is followed by "building thermal performance" (28 occurrences) and "energy consumption" and "optimization" (each with 27 occurrences). In addition, terms such as "thermal comfort," "natural ventilation," "sustainability," "visual comfort," and "building Intelligence" occupy the central core of the conceptual network in this field. The high concentration of these keywords suggests that building energy management is no longer limited to reducing energy consumption alone; rather, it has evolved into a multidimensional issue that is simultaneously associated with thermal performance, indoor environmental quality, occupant comfort, sustainable design, and the reduction of environmental impacts. Therefore, the frequency of these keywords indicates that research in this area is moving beyond a purely technical perspective toward more integrated approaches that seek to balance energy efficiency, comfort, and sustainability.

On the other hand, the presence and growth of terms such as "machine learning," "Internet of Things," "smart building," "predictive control," "energy

Table 4. Keyword Frequency Distribution. Source: Authors.

Frequency	Keyword	Frequency	Keyword	Frequency	Keyword	Frequency	Keyword
8	Climatic Strategies	10	Energy Simulation	15	Smart Building	45	Energy Management
8	Occupant Behavior	9	Lighting	15	Model Predictive Control	28	Building Thermal Performance
8	Renewable Energy	9	Glare	13	Carbon Reduction	27	Energy Consumption
7	Green Buildings	9	Life-Cycle Extension	13	Office Buildings	27	Optimization
7	Design Strategy	9	Thermal Comfort	12	Energy Storage	21	Thermal Comfort
7	Smart Façade	9	Multi-Objective Optimization	11	Environmental Air Quality	19	Natural Ventilation
7	Smart City	8	Humidity Comfort	11	Adaptive Building	18	Sustainability
7	Heat Control	8	Thermal Management Strategy	11	Energy Simulation	17	Visual Comfort
6	Average Occupant Satisfaction	8	Indoor Temperature Control	11	Genetic Algorithm	15	Building Intelligence
-	-	8	Heating System	10	Artificial Intelligence	15	Machine Learning
-	-	8	Energy Demand	10	Daylighting	15	Internet of Thing

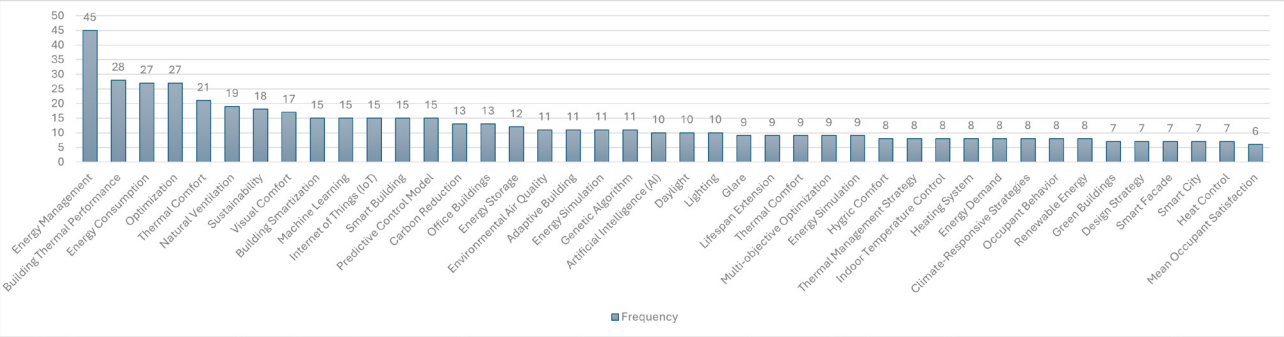


Fig. 8. Frequency of Keyword Occurrence. Source: Authors.

simulation," and "genetic algorithm" indicate a shift in research toward data-driven and intelligent approaches. In particular, the growth of machine learning since 2023 can be attributed to advances in sensors, smart building management systems, access to real-world energy consumption data, and artificial Intelligence algorithms. These technologies have enabled energy consumption prediction, intelligent control of heating, cooling, and ventilation systems, analysis of occupant behavior, and optimization of building performance. Accordingly, the clustering results presented in Table 5 show that problem-solving approaches in building energy management are evolving from traditional consumption-reduction methods toward smart, predictive, adaptive, and sustainable solutions.

Cluster 1 (Building Thermal Performance): Centered around the core node of building thermal performance, this cluster comprises 32 keywords (accounting for approximately 22% of the total keywords), with 105 occurrences and a link strength of 20. The primary constituents of this cluster include heating system, indoor temperature control, thermal management strategy, and heat control.

Cluster 2 (Energy Consumption): Anchored by the core node of energy consumption, this cluster consists of 29 items (representing 20% of the total dataset), characterized by 78 occurrences and a link strength

Table 5. Clustering of Core Keywords. Source: Authors.

Cluster	Cluster Name	Occurrences	Link Strength	Cluster	Cluster Name	Occurrences	Link Strength
Cluster 1	Building Thermal Performance	105	20	Cluster 5	Natural Ventilation	40	7
Cluster 2	Energy Consumption	78	12	Cluster 6	Sustainability	32	7
Cluster 3	Optimization	53	8	Cluster 7	Visual Comfort	31	6
Cluster 4	Thermal Comfort	44	10	Cluster 8	Building Intelligence	29	5

of 12. The key thematic elements associated with this cluster include cost reduction, energy storage, office buildings, carbon reduction, and life-cycle extension.

Cluster 3 (Optimization): Centered on optimization, this cluster contains 19 items (constituting 13.1% of the total keywords), with 53 occurrences and a link strength of 8. The cluster is prominently defined by keywords such as genetic algorithms, machine learning, energy simulation, and multi-objective optimization.

Cluster 4 (Thermal Comfort): With thermal comfort acting as the central node, this cluster encompasses 18 items (representing 12.4% of the total keywords), exhibiting 44 occurrences and a link strength of 10. The prominent keywords within this domain include average occupant satisfaction, occupant behavior, humidity comfort, and temperature comfort.

Cluster 5 (Natural Ventilation): Led by the core concept of natural ventilation, this cluster comprises 15 items (representing 10.3% of the total keywords), showing 40 occurrences and a link strength of 7. It is characterized by terms such as adaptive building, HVAC systems, CFD (Computational Fluid Dynamics), and environmental air quality.

Cluster 6 (Sustainability): Anchored by sustainability, this cluster consists of 12 items (accounting for 8.2% of the total keywords), with 32 occurrences and a link strength of 7. The primary thematic keywords include climatic strategies, energy demand, design strategy, green buildings, and renewable energy.

Cluster 7 (Visual Comfort): Centered on visual comfort, this cluster contains 11 items (representing 7.5% of the total keywords), displaying 31 occurrences and a link strength of 6. The cluster specifically groups keywords such as glare, daylighting, lighting, and solar radiation.

As illustrated in Fig. 9, the co-occurrence network highlights the overlapping relationships among key concepts, specifically energy management, building thermal performance, energy consumption, optimization, thermal comfort, natural ventilation, sustainability, visual comfort, and building Intelligence. Based on the temporal co-occurrence analysis of these keywords, the detailed findings are presented systematically below.

Cluster 8 (Building Intelligence): Centered around the core node of building Intelligence (or smart buildings), this cluster comprises 9 items (accounting for 6.5% of the total keyword set), with 29 occurrences and a link strength of 5. The primary constituents of this cluster include smart cities, the Internet of Things (IoT), smart façades, and artificial Intelligence (AI).

Following this thematic division, the relationships among these approaches are examined using link counts and keyword co-occurrence patterns. This structural correlation is visualized in Fig. 10, which illustrates the comprehensive co-occurrence network of building energy management keywords. The clustering results indicate that eight principal clusters have formed around building thermal performance, energy consumption, optimization, thermal comfort, natural ventilation, sustainability, visual comfort, and building Intelligence. The strong concentration of the first and second clusters on thermal performance and energy consumption suggests that a substantial proportion of the literature remains shaped by the growing challenges posed by rising energy demand,

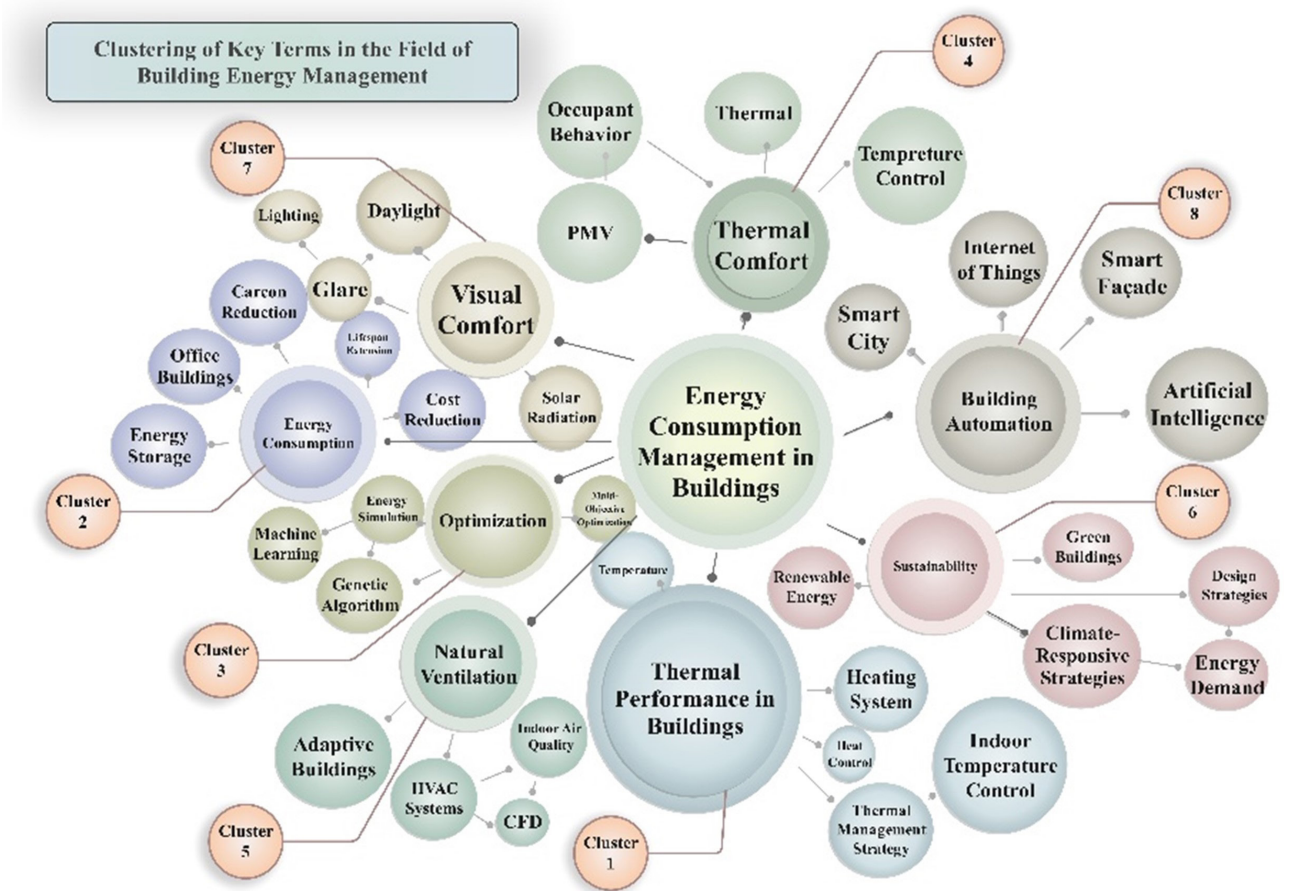


Fig. 9. Clustering Networks of Building Energy Management. Source: Authors.

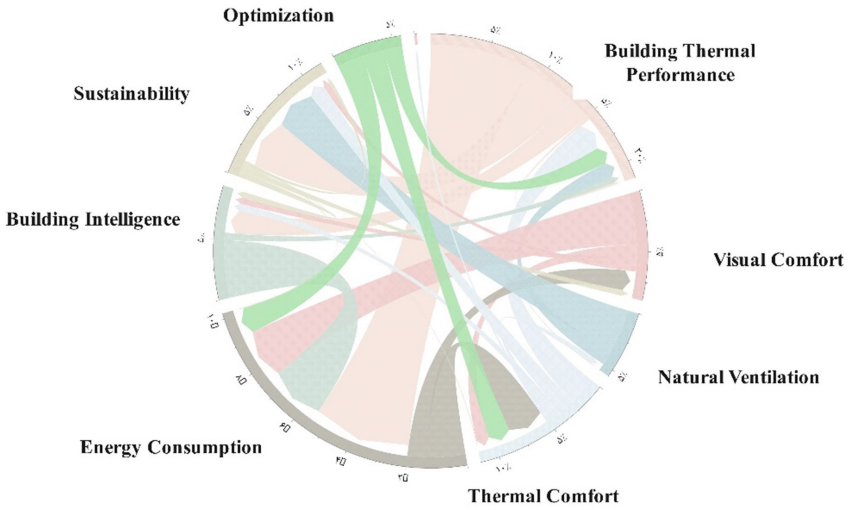


Fig. 10. Co-occurrence Network of Keywords in Building Energy Management. Source: Authors.

operational costs, and the imperative to reduce carbon emissions in buildings. Accordingly, concepts such as indoor temperature control, heating systems, energy storage, cost reduction, and carbon reduction occupy central positions within these clusters. The emergence of this trend may be attributed to intensifying environmental pressures, energy-reduction policies, mandatory low-energy building design requirements, and a simultaneous emphasis on indoor environmental quality. Moreover, the presence of clusters related to

thermal comfort, natural ventilation, sustainability, and visual comfort demonstrates that building energy management is no longer confined solely to reducing energy consumption.

Rather, it has evolved toward a multidimensional approach in which occupant comfort, indoor air quality, daylighting, climate-responsive strategies, green buildings, and the use of renewable energy sources also play essential roles. On the other hand, the optimization and building of Intelligence clusters reflect a shift in the research trajectory from traditional, static methods toward computational, data-driven, and intelligent approaches. The inclusion of keywords such as genetic algorithm, machine learning, energy simulation, multi-objective optimization, Internet of Things (IoT), smart façade, and artificial Intelligence within these clusters indicates that advances have strongly influenced recent scientific developments in this field in digital technologies, smart sensors, building management systems, big data, and predictive algorithms. These technologies have enabled real-time monitoring of energy consumption, prediction of occupant behavior, intelligent control of HVAC systems, evaluation of design scenarios, and simultaneous optimization of energy use and comfort. Therefore, the clustering pattern reveals that problem-solving approaches in building energy management have shifted from an exclusive focus on consumption control and thermal performance toward intelligent, predictive, adaptive, and sustainable solutions. This transformation has emerged from the intersection of the energy crisis, environmental requirements, and the rapid development of artificial Intelligence and Internet of Things technologies in the building industry. In the present study, the co-occurrence of two items was examined using all keywords, citations, bibliographic coupling pairs, and co-authorship relationships across 145 keyword items, based on their occurrence in the extracted scientific documents. Table 6 presents the number of central cores for each cluster during the 2019–2025 period, categorized by frequency of occurrence in the reviewed articles.

On the other hand, the results indicate that concepts such as building Intelligence, sustainability, and visual comfort, although ranked lower in terms of co-occurrence frequency, exhibit relatively high density values. For instance, building Intelligence, with a centrality of 3. 19 and a density of 69.74; sustainability, with a centrality of 7. 35 and a density of 80.36; and visual comfort, with a centrality of 5. 04 and a density of 81.26, reflect the emergence of coherent and specialized subfields within the building energy management literature. The development of these concepts may be interpreted in relation to recent scientific and technological advances, including the evolution of smart building management systems, the Internet of Things, environmental sensors, energy modeling and simulation, predictive control, and machine learning algorithms. These technologies have enabled real-time monitoring, energy consumption forecasting, intelligent equipment control, lighting optimization, and the simultaneous enhancement of comfort and energy efficiency.

Accordingly, the patterns of centrality, density,

Table 6. Annual Frequency of Cluster Occurrences. Source: Authors.

Year	Building Energy Consumption Management	Building Thermal Performance	Energy Consumption	Optimization	Thermal Comfort	Natural Ventilation	Sustainability	Visual Comfort	Building Intelligence
2019	2	1	1	1	0	0	1	0	2
2020	4	3	3	4	1	3	3	1	5
2021	7	10	7	6	4	4	5	5	8
2022	17	16	13	13	9	7	9	11	11
2023	27	22	20	18	13	8	14	15	13
2024	36	25	24	23	19	15	16	17	13
2025	45	28	27	27	21	19	17	17	15

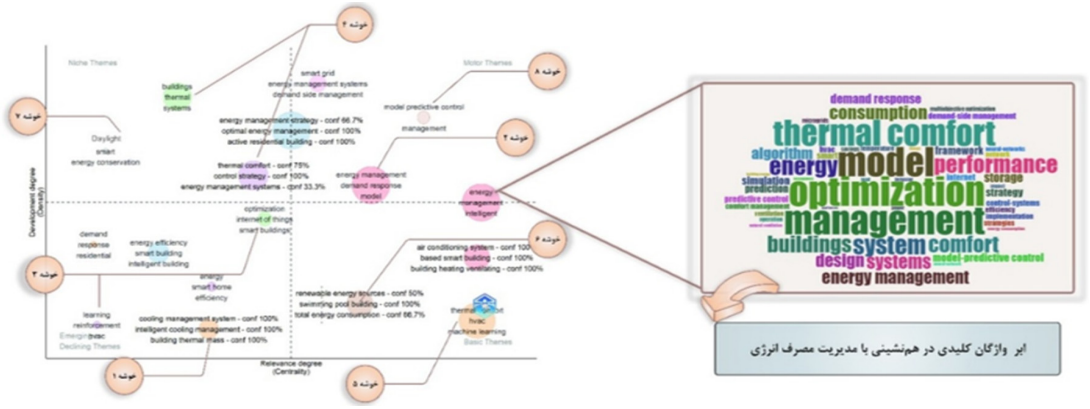


Fig. 11. Keyword Word Cloud and the Degree of Cluster Development and Relevance. Source: Authors.

and keyword overlap suggest that building energy management has gradually evolved from a purely technical, consumption-oriented approach into an interdisciplinary, data-driven field, in which climate-responsive design, occupant comfort, sustainability, and smart technologies play a decisive role in shaping future research directions. Based on the results presented in Table 7, the keyword "building thermal performance", with a centrality distance of 6.31, a density of 69.55, and 221 co-occurrences, was ranked fifth.

Fig. 12 identifies the trending keywords for each year. In this visualization, the size of the circles represents the weight of the keywords; in other words, the larger the circle, the more frequently the keyword appeared in publications during that year. The blue circles indicate the stronger prominence of each keyword. For example, machine learning appears more frequently from 2023 to 2025, peaking in 2025. Keywords such as energy simulation, genetic algorithm, and sustainability were more prominent from 2019 to 2023, but their prominence has now declined somewhat in the field of building energy consumption management. Artificial Intelligence, energy consumption management, and climate-responsive strategies are also categorized among the more recent research directions in this field. Fig. 13 presents the emerging approaches in data visualization. In the density view, node size is determined by the item's weight. The greater the weight, the larger the label. The color of each item is also determined according to the cluster to which it belongs. The lines between items represent links, and the distance between two items indicates the strength of their relationship; the shorter the distance, the stronger the relationship. This implies that the two items have appeared together more frequently in the same publications and therefore have a higher probability of co-occurrence. The network visualization used in this study was generated from co-occurrence links between items. The color of each item is determined by the average publication-year score and is graded over the period from 2019 to 2025. The color bar in the upper-right corner of the map displays the keyword spectrum by average year of publication. For example, keywords shown in green relate to optimization and building performance system management patterns, and their publication dates are 2021 and later. In other words, these keywords have attracted greater attention in recent years from publications and researchers in machine learning and artificial Intelligence. They are increasingly being examined using AI-based methods and algorithms. The yellow color indicates managerial items and those related to energy demand, corresponding to the years 2022 to 2024. Items such as smart cities and smart homes are associated with the period before 2019 and are therefore older than the other items investigated. Overall, research on optimizing building performance, user satisfaction, and comfort has continued to attract scholarly attention in recent years and may help advance the field.

The size of the circles (keywords) represents the weight of each item. The list of emerging approaches, identified in yellow, includes the following: deep learning, thermal management, energy management strategy, swarm Intelligence algorithm optimization, occupant behavior,

Table 7. Cluster Density and Number of Co-occurrences. Source: Authors.

No.	Cluster Name	Centrality Distance	Density	Density Rank	Number of Co-occurrences
Cluster 1	Building Thermal Performance	6.31	69.55	5	221
Cluster 2	Energy Consumption	3.71	57.84	3	136
Cluster 3	Optimization	4.60	67.37	4	98
Cluster 4	Thermal Comfort	3.94	54.62	2	112
Cluster 5	Natural Ventilation	8.31	53.13	1	78
Cluster 6	Sustainability	7.35	80.36	7	64
Cluster 7	Visual Comfort	5.04	81.26	8	57
Cluster 8	Building Intelligence	3.19	69.74	6	70

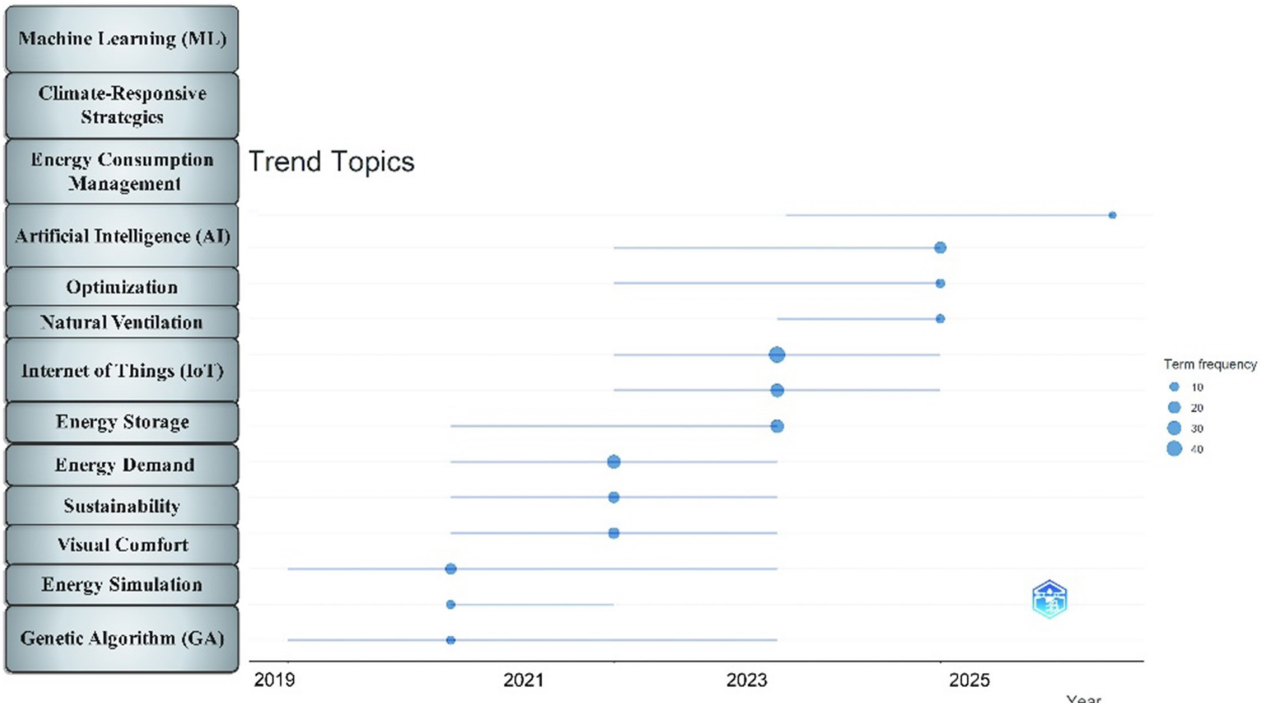


Fig. 12. Trending Keywords Over Time. Source: Authors.

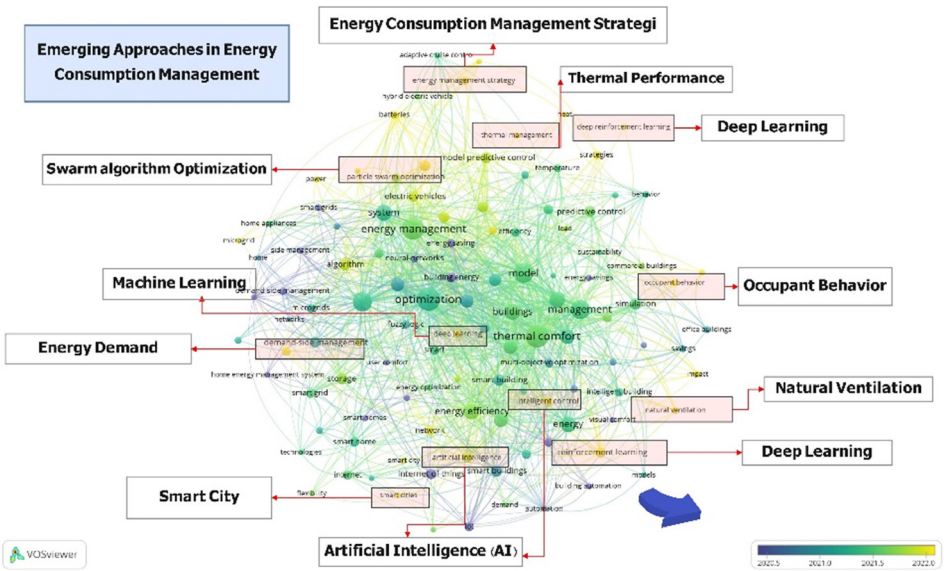


Fig. 13. Emerging Keywords in Energy Consumption Management. Source: Authors.

natural ventilation, artificial Intelligence, smart city, and energy demand management. Challenges threatening the field of energy management have increased the importance of optimization and supply-and-demand balancing in consumption management.

Conclusion

This study conducted a bibliometric analysis of problem-solving approaches in building energy management to map the intellectual structure, emerging trends, and conceptual links in this field. The necessity of this investigation stems from the fact that most previous works—ranging from systematic reviews to thematic studies—have primarily focused on isolated aspects such as energy consumption, thermal performance, thermal comfort, HVAC systems, optimization, or smart technologies. Consequently, they have rarely provided a comprehensive overview of the intellectual structure, conceptual networks, evolutionary pathways of topics, and the strategic positioning of problem-solving approaches in building energy management. Therefore, the primary gap in existing literature is the lack of an integrated, bibliometric data-driven analysis to explain the interconnections among concepts, research clusters, and emerging trends in this domain. The current study distinguishes itself from previous reviews in its methodology: rather than merely introducing technologies or categorizing energy management solutions, it investigated the field's scientific and conceptual structure through keyword co-occurrence, co-authorship, and co-citation analyses. To this end, bibliographic data extracted from the Scopus database for the period 2019 to 2025 were screened using the PRISMA framework and subsequently analyzed with VOSviewer and Bibliometrix. This methodology enabled the identification of core research themes, relationships among concepts, scientific networks, and emerging trends. The findings revealed that the building energy management literature is structured around eight primary thematic axes: building thermal performance, energy consumption, optimization, thermal comfort, natural ventilation, sustainability, visual comfort, and building Intelligence. Thermal performance and energy consumption remain core domains of this field due to their direct relationship to reducing energy use, controlling thermal loads, and mitigating carbon emissions. Conversely, the growth of concepts such as optimization, machine learning, the Internet of Things, and building Intelligence indicates a paradigm shift from traditional, static frameworks toward data-driven, intelligent, and predictive approaches. Furthermore, centrality and density analysis demonstrated that concepts such as natural ventilation, sustainability, thermal comfort, and building Intelligence are critical not

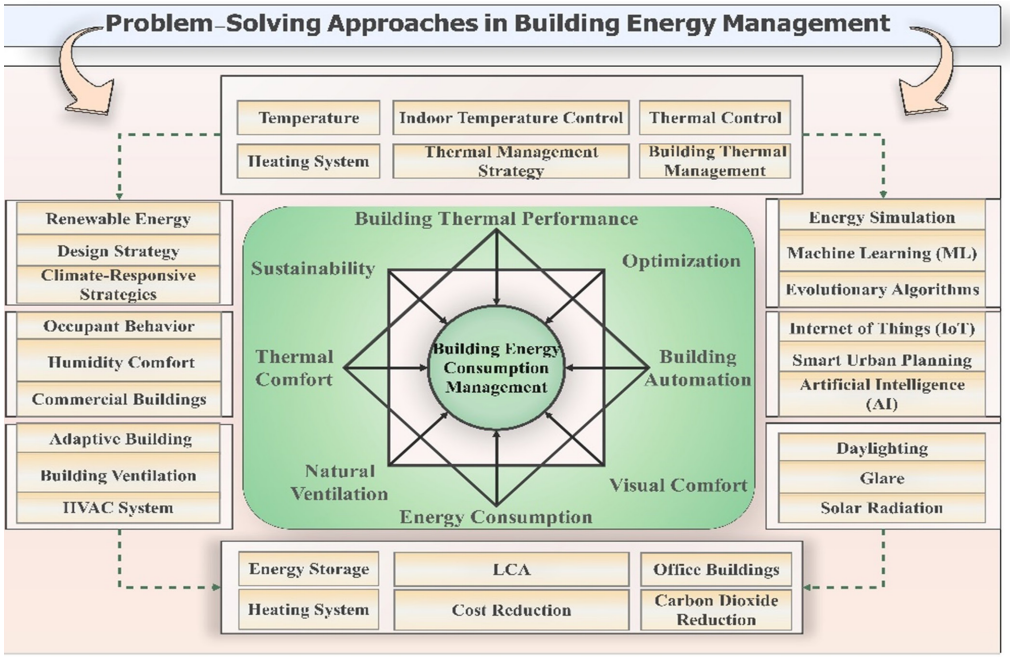


Fig. 14. Problem-Solving Approaches in Building Energy Management. Source: Authors.

Table 8. Dominant Approaches in Domestic and International Research. Source: Authors.

Category	Dominant Keywords	Dominant Approach
International Publications	Internet of Things (IoT), Machine Learning, Multi-Objective Optimization, Visual Comfort, Intelligence, Technological, and Data-Driven	Domestic Publications
Local Publications	Energy Consumption, Thermal Performance, Natural Ventilation, Thermal Comfort, Sustainability	Climate-Responsive and Passive

only in terms of publication frequency but also in linking disparate clusters and shaping future research pathways. This finding indicates that building energy management has gradually evolved from a strictly technical problem into an interdisciplinary domain in which energy efficiency, occupant comfort, climate-responsive design, sustainability, and smart technologies are addressed simultaneously. Based on these findings, it can be argued that problem-solving approaches in building energy management are evolving along three primary pathways:

The Technical and Functional Pathway: Focuses on reducing energy consumption, enhancing thermal performance, and optimizing building systems. The Human and Environmental Pathway: Integrates thermal comfort, visual comfort, indoor air quality, and occupant behavior into the energy management framework. The Smart and Data-Driven Pathway: Relies on artificial Intelligence, the Internet of Things, machine learning, predictive control, and smart building paradigms.

The convergence of these three pathways demonstrates that the future of building energy management is moving toward integrated, multi-objective, adaptive, and data-driven approaches. From a practical standpoint, the outcomes of this study can benefit researchers, designers, policymakers, and building energy managers. Researchers can leverage the identified clusters and keywords to select future research directions. Designers and engineers can develop more comprehensive solutions to minimize energy consumption by understanding the linkages between thermal performance, user comfort, and smart technologies. Similarly, policymakers can utilize these emerging trends to align incentive programs and building standards with the development of smart, sustainable, and low-energy buildings. In summary, the innovation of this research lies in providing a networked, analytical visualization of problem-solving approaches for building energy management. The study demonstrated that the future of research in this domain lies in integrating climate-responsive and passive strategies with smart technologies, real-world building data, predictive control, and artificial Intelligence algorithms. Nonetheless, limiting the data to the Scopus database and the 2019–2025 timeframe constitutes a limitation of this study. Consequently, future studies are recommended to incorporate databases such as Web of Science and to use mixed methods that combine bibliometrics with qualitative content analysis. Ultimately, the primary novelty of this research lies in moving beyond descriptive and theme-oriented reviews to present a network-based, analytical mapping of the building energy management knowledge structure. The study demonstrated that building energy management is no longer limited to consumption reduction or thermal performance improvement; rather, it has evolved into an interdisciplinary field in which sustainability, occupant comfort, climate-responsive design, optimization, Intelligence, and data-driven technologies simultaneously shape problem-solving methodologies. Therefore, conducting this novel bibliometric study was essential to identify knowledge gaps, emerging trends, conceptual links, and future research paths that have not been comprehensively and synthetically addressed in many previous systematic reviews and studies.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References List

- Anika, O. C., Nnabuife, S. G., Bello, A., Okoroafor, E. R., Kuang, B., & Villa, R. (2022). Prospects of low and zero-carbon renewable fuels in 1.5-degree net zero emission actualisation by 2050: A critical review. *Carbon Capture Science and Technology, 5*, Article 100072. https://doi.org/10.1016/j.ccst.2022.100072
- Cai, H., Zhang, W., Yuan, Q., Salameh, A. A., Alahmari, S.,

& Ferrara, M. (2025). Cost-effective intelligent building: Energy management system using machine learning and multi-criteria decision support. *Energy Economics, 142*, Article 108184. https://doi.org/10.1016/j.eneco.2025.108184

• Çelik, K. T., & Sekeroglu, A. (2023). The importance of geographical information systems in urban and landscape planning: A bibliometric analysis. *Megaron, 18*(4), 499–519. https://doi.org/10.14744/megaron.2023.70962

• Chikurtev, D., Yosifova, V., Haralampieva, M., & Petrov, R. (2023). Development and evaluation of an energy-efficient intelligent infrared heating system for industrial buildings. *Journal of Energy Systems, 7*(3), 277–289. https://doi.org/10.30521/jes.1198583

• Dagdougui, Y., Ouammi, A., & Benchrifa, R. (2020). Energy management-based predictive controller for a smart building powered by renewable energy. *Sustainability (Switzerland), 12*(10), Article 4264. https://doi.org/10.3390/su12104264

• Duraković, B. (2026). *Building Management Systems. In Advancing Zero Energy Buildings: Pathways to Sustainable Development and Global Impact* (pp. 65–76). Springer Nature Switzerland. https://doi.org/10.1007/978-3-032-16601-2_4

• Habib, M., Palomba, V., Frazzica, A., & Wang, Q. (2025). Optimizing hybrid thermal energy storage in building management systems using data-driven model predictive control. *ENERGY REPORTS, 14*, 2092–2109. https://doi.org/https://doi.org/10.1016/j.egyr.2025.08.033

• Harputlugil, T., & de Wilde, P. (2021). The interaction between humans and buildings for energy efficiency: A critical review [Review]. *Energy Research and Social Science, 71*, Article 101828. https://doi.org/10.1016/j.erss.2020.101828

• Hou, H., He, Z., Xiang, M., Lu, Y., Yang, J., Huang, L., & Xie, C. (2025). Interval Multi-Objective Optimization for Low-Carbon Building Energy Management System Upon Deep Reinforcement Learning. IEEE Transactions on Industry *Applications, 61*(2), 2193–2202. https://doi.org/10.1109/TIA.2025.3531821

• Javid, P., Nikghadam, N., Karimpour, A., & Sabernejad, J. (2025a). Design Optimization of Atrium Skylights for Enhanced Office Building Performance Using NSGA-II: Case Study in Yazd, Iran. *JOURNAL OF DAYLIGHTING, 12*(2), 520–547. https://doi.org/10.15627/jd.2025.31

• Javid, P., Nikghadam, N., Karimpour, A., & Sabernejad, J. (2025b). Optimizing Channel Configurations to Enhance Thermal Comfort in Connected Enclosed Atrium (Case Studies: Yazd and Tabriz). *International Journal of Architecture and Urban Development, 15*(2), 31–50. https://doi.org/10.71711/ijaud.2025.1214474

• Javid, P., Nikghadam, N., Karimpour, A., & Sabernejad, J. (2026). Optimal Atrium Configuration in Office for Thermal Comfort Enhancement (Case Study: Yazd and Tabriz Cities) [Research Paper]. *International Journal of Architectural Engineering & Urban Planning, 36*(2). https://doi.org/10.22068/ijaup.942

• Jin, X., Ahmed, Z., Pata, U. K., Kartal, M. T., & Erdogan, S. (2024). Do investments in green energy, energy efficiency, and nuclear energy R&D improve the load capacity factor? An augmented ARDL approach. *Geoscience Frontiers, 15*(4), 101646. https://doi.org/https://doi.org/10.1016/j.gsf.2023.101646

• Kuusk, K., Naumann, J., Gritzki, A., Felsmann, C., De Carli, M., Tonon, M., & Kurnitski, J. (2020, Sep 06–09). Nearly zero energy renovation concepts for apartment buildings.*E3S Web of Conferences* [12th nordic symposium on building physics (nsb 2020)]. 12th Nordic Symposium on Building Physics (NSB), Tallinn, ESTONIA.

• Luther, M., Tokede, O., & Liu, C. L. (2020). Applying a comfort model to building performance analysis. *Architectural Science Review, 63*(6), 481–493. https://doi.org/10.1080/00038628.2020.1742645

• Ma, W., & Liu, T. (2026). Adaptive smart energy management in buildings: A deep reinforcement learning and IoT framework for energy efficiency and thermal comfort. *Energy and Buildings, 351*, 116659. https://doi.org/https://doi.org/10.1016/j.enbuild.2025.116659

• Magoni, M., & Adami, R. (2020). The decision-making steps for the construction of Renewable Energy Plants: an analysis of the conflict factors of the Italian authorisation procedures. *Italian Journal of Planning Practice, 10*(1), 106–124.

• Mariano-Hernández, D., Hernández-Callejo, L., Zorita-Lamadrid, A., Duque-Pérez, O., & Santos García, F. (2021). A review of strategies for building energy management system: Model predictive control, demand side management, optimization, and fault detect & diagnosis. *JOURNAL OF BUILDING ENGINEERING, 33*, Article 101692. https://doi.org/10.1016/j.jobe.2020.101692

• Möslinger, M., Ulpiani, G., & Vetters, N. (2023). Circular economy and waste management to empower a climate-neutral urban future . *JOURNAL OF CLEANER PRODUCTION, 421*, Article 138454. https://doi.org/10.1016/j.jclepro.2023.138454

• Mousavi Motlagh, F., Hoes, P.-J., & Hensen, J. (2026). Unlocking zero-cost flexibility in office buildings with adaptive comfort heating strategy and thermal mass utilization. *Energy and Buildings, 357*, 117126. https://doi.org/https://doi.org/10.1016/j.enbuild.2026.117126

• Nikghadam, N., Javid, P., Karimpour, A., & Sabernejad, J. (2025a). *Optimal Skylight-to-Roof Ratio in Central Atriums for Thermal Comfort based on solar-induced ventilation: Case Studies from Yazd and Tabriz.* Iranica Journal of Energy & Environment. https://doi.org/10.5829/ijee.2026.17.02.09

• Nikghadam, N., Javid, P., Karimpour, A., & Sabernejad, J. (2025b). A Systematic Bibliometric Analysis of Energy Optimization Methods in Buildings. *The Monthly Scientific Journal of Bagh-e Nazar, 22*(142), 41–56. https://doi.org/https://doi.org/10.22034/bagh.2025.490974.5717

• Nikghadam, N., Javid, P., Karimpour, A., & Sabernejad, J. (2026). Bibliometric Study of Energy Simulation Tools in Building

Performance Optimization: A Review of Recent Research. *Hoviatshahr, 20*(1), 129–148. https://doi.org/10.71793/hoviatshahr.2026.1218927

- Nikghadam, N., Javid, Parisa , Karimpour, Alireza, Sabernejad, Jaleh. (2025). Optimization of the Direction and Number of Atrium Openings in a Centralized Model for Improving Thermal Comfort in Office Buildings in Hot and Dry Climates (Case Study of Yazd City). *Space Ontology International Journal, 14*(3), 43–61. https://doi.org/10.71879/soij.2025.1206995
- Nurdiawati, A., & Urban, F. (2021). Towards deep decarbonisation of energy-intensive industries: A review of current status, technologies and policies. *ENERGIES, 14*(9), 2408.
- Pajek, L., Božiček, D., Potočnik, J., & Košir, M. (2026). Impact of passive energy efficiency measures on embodied and operational GWP: A parametric study of detached houses under evolving grid and climate conditions. *ENERGY AND BUILDINGS, 359*, 117308. https://doi.org/https://doi.org/10.1016/j.enbuild.2026.117308
- Poosapadi, D., Devi, G. M., Padmapriya, G., Srinivasan, K., Logeshwaran, T., Juli Amala Rani, J., Kumar, C. R., Rajesh kumar, E., & Khan, M. A. (2026). Energy Efficient Smart Control Strategies: Applying Machine Learning to Enhance Efficiency in Eco-Friendly Building Management for Renewable Energy Systems. *Sustainable Computing: Informatics and Systems, 50*, 101315. https://doi.org/https://doi.org/10.1016/j.suscom.2026.101315
- Tang, S. C., Xiao, R., & Cai, X. Y. (2024). Media façades research agenda: a bibliometric analysis from 2003 to 2022 [Review; Early Access]. *Architectural Science Review, 16*. https://doi.org/10.1080/00038628.2024.2305886
- Uzair, M., & Ali Abbas Kazmi, S. (2023). A multi-criteria decision model to support sustainable building energy management system with intelligent automation. *ENERGY AND BUILDINGS, 301*, Article 113687. https://doi.org/10.1016/j.enbuild.2023.113687
- Vittori, F., Tan, C. F., Pisello, A. L., Chong, A., Piselli, C., & Miller, C. (2025). BIM-to-BRICK: Using graph modeling for IoT/BMS and spatial semantic data interoperability within digital data models of buildings. *ENERGY AND BUILDINGS, 348*, 116368. https://doi.org/https://doi.org/10.1016/j.enbuild.2025.116368
- Wang, G. Y. X., Zhu, P. C., Yao, S., Yuan, J. Y., & Hu, T. H. (2024). Occupant behavior model and its involvement in building optimization design: a review [Early Access]. *Journal of Asian Architecture and Building Engineering, 17*. https://doi.org/10.1080/13467581.2024.2358195
- Wieser, M., Onnis, S., & Meli, G. (2020). Thermal performance of light earth enclosures. Possibilities of its application in the Peruvian territory. *Revista De Arquitectura, 22*(1), 164–174. https://doi.org/10.14718/RevArq.2020.2633
- Wu, T. J., Wu, J. X., Yang, Y. X., & Dong, W. (2024). A bibliometric review of perceptions of the built environment supported by multi-source data [Early Access]. *Journal of Asian Architecture and Building Engineering, 16*. https://doi.org/10.1080/13467581.2024.2349746
- Xu, C., Tian, X., Yang, R., Song, S., Han, F., Kong, D., & Zhang, Y. (2026). Performance evaluation of building-integrated photovoltaic windows with triple-glazing: Summer assessment in cold climate. *Energy and Buildings, 358,* 117247. https://doi.org/https://doi.org/10.1016/j.enbuild.2026.117247
- Yu, P., Zhang, H., Song, Y., Hui, H., & Chen, G. (2024). District Cooling System Control for Providing Operating Reserve Based on Safe Deep Reinforcement Learning. *IEEE Transactions on Power Systems, 39*(1), 40–52. https://doi.org/10.1109/TPWRS.2023.3237888
- Zhang, X. C., & Zhang, X. Q. (2024). Low-carbon design optimization of reinforced concrete building structures using genetic algorithm [; Early Access]. *Journal of Asian Architecture and Building Engineering, 15*. https://doi.org/10.1080/13467581.2023.2278466
- Zhao, Q., Zhang, N., Zhang, Z., Zeng, Y., Shady, A., & Yuan, Y. (2026). Scalable epoxy-based radiative cooling coatings with ternary filler synergy for efficiency and low-cost building thermal management [Article]. *Energy and Buildings, 358*, Article 117236. https://doi.org/10.1016/j.enbuild.2026.117236

COPYRIGHTS
Copyright for this article is retained by the author(s), with publication rights granted to the Bagh-e Nazar Journal. This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution License (https://creativecommons.org/licenses/by/4.0/).

HOW TO CITE THIS ARTICLE
Javid, P., Yavari, M., Fotovatian, P., Najafi, M., & Javid, M. (2026). Bibliometric Analysis of Problem-Solving Approaches in Building Energy Management. *Bagh-e Nazar*, *23*(162), 97-116.

DOI: 10.22034/bagh.2026.578916.6008
URL: https://www.bagh-sj.com/article_247150.html?lang=en