sustainability

Review

Comprehensive Analysis of Influencing Factors on Building Energy Performance and Strategic Insights for Sustainable Development: A Systematic Literature Review

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Abstract: A prerequisite for decreasing the intensification of energy in buildings is to evaluate and understand the influencing factors of building energy performance (BEP). These factors include building envelope features and outdoor climactic conditions, among others. Based on the importance of the influencing factors in the development of the building energy prediction model, various researchers are continuously employing different types of factors based on their popularity in academic literature, without a proper investigation of the most relevant factors, which, in some cases, potentially leads to poor model performance. However, this can be due to the absence of an adequate comprehensive analysis or review of all factors influencing BEP ubiquitously. Therefore, this paper conducts a holistic and comprehensive review of studies that have explored the various factors influencing energy use in residential and commercial buildings. In total, 74 research articles were systematically selected from the Scopus, ScienceDirect, and Institute of Electrical Electronics Engineers (IEEE) databases. Subsequently, by means of a systematic and bibliometric analysis, this paper comprehensively analyzed several important factors influencing BEP. The results reveals the important factors (such as windows and roofs) and engendered or shed light on the application of some energy-efficient strategies such as the utilization of a green roof and photovoltaic (PV) window, among others.

Keywords: energy efficiency; building energy performance; influencing factors; sustainability; review; energy-efficient strategies

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1. Introduction

Energy efficiency is considered a viable solution to the ubiquitous problem of high energy consumption around the world, consequently leading to a significant increase in carbon footprint, which is ecologically detrimental [1,2]. Based on the global pressing need to decrease energy usage and greenhouse gas (GHG) emission, researchers have recommended energy efficiency as the most cost-effective approach of tackling energy security and economic problems [3,4]. There are various energy-consuming sectors, ranging from the industrial to transport sector [5]. However, the building sector is considered one of the largest energy consumers in the world [5–7]. This is due to the fact that people spend over 65% of their time in buildings [8], thus eliciting over one-third of the total energy consumption [9,10].

Building energy efficiency is receiving increasing attention from researchers and various approaches have been explored to advance energy efficiency in buildings such as the integration of renewable energy sources [11,12], and retrofitting [13,14], among others. One of the most efficient approaches is the estimation and optimization of building energy performance (BEP). However, there are various factors influencing building energy performance such as the building envelope [15,16], climate [17–19], and occupant behavior [6,20] among others [6,21]. It remains a prerequisite that the enhancement of energy efficiency in the building sector is predicated on the ability to clearly comprehend current factors affecting energy consumption [16]. According to the International Energy Agency (IEA), energy performance in buildings is influenced by technical or physical factors (i.e., climate, building envelope, and equipment) and human factors (i.e., operation and maintenance, interior conditions, and occupant behavior) [22]. Subsequently, many studies have underlined these factors as important elements for understanding energy usage in buildings [5,9,13,23,24]. However, it is a growing consensus that operation and maintenance configurations are key drivers of BEP [6]. Several studies stipulated that physical factors such as the building envelope constitute the most significant effect on BEP [17,25–27]. Moreover, numerous studies have explored the effect of climate change on BEP, such as the effect of changes in temperature [18,21,28,29]. The International Energy Agency stipulated that, due to the increase in temperatures during summer, the demand for cooling in buildings escalated abruptly, leading to a significant increase in energy consumption [30].

According to [31], irrespective of the method employed to improve building energy efficiency, whether applying an energy policy regulation, developing building energy prediction model (BEPM), or creating a green certification program, an essential prerequisite is the comprehension of the factors influencing energy consumed in the building stock. BEPM is measured as the most promising solution for improving energy efficiency [32–34]. Researchers have developed various building energy prediction models (BEPM) using several factors such as the building envelope (i.e., wall and roof), among others [7,32,35]. However, these studies do not provide a solid justification for the factor selected in developing the model. Typically, most studies tend to employ factors based on their popularity in the literature and it is well-known that the presence of irrelevant factors could engender noise [36–38]. This arbitrary selection could potentially be the reason for the failure to develop BEPM with optimal performance. Nevertheless, there is an absence of an adequate comprehensive analysis or review of all factors influencing BEP that enable model developers to easily identify the most relevant features in the context of the type of building. This is considering the idea that it is a possibility that the most relevant factors differ dependent on the type of building (i.e., commercial and residential buildings). For example, we employed some factors such as the wall, weather, and occupancy data for predicting the annual energy consumption for residential buildings. We used an artificial neural network (ANN), a support vector machine (SVM), and linear regression (LR) to develop the BEPM and did not achieve optimal performance. The highest performance value was a mean absolute error of 0.44. Likewise, [39] utilized ANN and SVM for the building energy prediction of a commercial building and achieved a mean absolute error score of 11.26. Although it is noted that other aspects such as data size and temporal granularity, among others, could have an effect on the performance, the use of an irrelevant factor could generate noise and potentially lead to poor performance.

Based on the existing literature, it is evident that researchers do not conduct a rigorous review of the literature to identify the most relevant factors; rather, they arbitrarily select factors without a solid justification. However, considering it is common knowledge that the factors selected (e.g., wall and window) could potentially affect energy consumption, there is not much scrutiny around the need to provide justifications for the factors selected from researchers. In the literature, several studies have further explored specific factors based on their popularity. For example, in recent years, there has been increasing research on several components of the building envelope that can significantly improve building energy efficiency [6]. Reference [25] stated that the better insulation of windows, walls, and roofs, among others, can contribute to the efficient usage of energy. Nevertheless, a few studies (e.g., [31,40]) still emphasized the importance of operation and maintenance. For example, [31] concluded that air conditioner (AC) cleanliness and proper housekeeping are critical factors to ensure energy savings. Furthermore, [41] conveyed that harmonics are one of the most significant power quality issues in system operations, primarily caused by the widespread integration of power electronic loads. Regarding performance and energy efficiency, other design factors such as windows are identified as the weakest component of the building envelope, accountable for a significant amount of heat transmittance and thermal bridging in buildings [9].

In the field of building energy efficiency, thermal building insulation is the most researched area, as insulation materials have been identified as a successful method to minimize energy use and, therefore, aid the achievement of sustainable buildings [5,42]. Reference [43] stated that a building formation with fixed envelope properties have been acknowledged as a factor affecting the heating and cooling loads in residential buildings in certain cities such as Rome and Hong Kong. Depending on the weather conditions in various cities and the appropriate optimization of the building envelope, factors such as windows can save over 25% of the total heating load [9]. Despite the highlighted increase in building insulation, [44] argues that changing the orientation of the building will impact the building energy performance better than an increase or decrease in wall insulation. This could be said to be location-dependent considering the external wall insulation of buildings in cold areas in China has achieved remarkable energy savings [24].

Apart from a few studies [9,45], most studies are concerned with understanding how these factors affect existing buildings and this can be subject to the fact that most of the existing buildings were constructed before energy efficiency in buildings was a concern, and many of these buildings will remain functional beyond 2050 [13]. However, few studies emphasized the importance of considering energy efficiency at the early design stage of buildings [46], as the decisions made in the early design stage of buildings (i.e., building components selection, and orientation, among others) can tremendously reduce or increase the building energy consumption [44].

Several studies conducted an evaluation of specific factors based on their popularity or domain knowledge. Some studies (such as [8,47]) focused on a review of occupant behavior while some studies [48,49] focused on the building envelope and environmental factors based on their popularity in research. The importance of understanding all the factors influencing energy consumption cannot be overemphasized. This is because, regardless of the method selected to improve building energy efficiency, there is a need to conduct a comprehensive evaluation of building-energy-influencing factors which can be useful in the consideration of retrofitting existing building at the early design stage of buildings. This will especially aid developers in making an appropriate selection of factors for the development of estimation models or BEPM. Thus, this study delivers a holistic, structured, and comprehensive review of studies that have explored the relevance of various factors affecting energy use in buildings, with the aim to produce more insights for selecting the most important factors for the development of estimation models and, likewise, provide more knowledge for the appropriate selection of factors to optimize when constructing energy-efficient building designs. Although there is not a clear consensus in all cases of these studies in the literature, in those unique cases, inference and statistical analysis will be employed to deduce the most relevant factors for developing energy prediction models for different types of buildings. The objectives essential for achieving this aim are listed below:

1. To identify the factors that significantly affect BEP, by means of a systematic review of literature;
2. To examine the summary of outcomes of the systematic review and classify the acknowledged factors in order to determine which is the most important.

Contribution of Study

This study will convey a plausible contribution to knowledge by presenting BEP factors needed to develop a high-performing BEPM, as the inclusion of irrelevant factors can easily engender a poor BEPM. This will significantly improve the BEPM development process more efficiently. Understanding the influencing factors of building energy performance (BEP) is crucial for developers of energy prediction models. By identifying and comprehensively analyzing these factors, developers can refine their models to accurately predict energy consumption in residential and commercial buildings. Incorporating factors such as building envelope features and outdoor climactic conditions allows for more precise predictions, improving the overall performance of energy prediction models. Additionally, insights into the most relevant factors enable developers to prioritize their focus and allocate resources efficiently, ultimately leading to the creation of more effective and reliable models for optimizing energy efficiency in buildings. Furthermore, the findings provide valuable insights for developing optimal energy efficiency measures in buildings, thereby contributing to sustainable development efforts aimed at reducing energy consumption and environmental impact in the built environment.

The extent of this study is limited to the identification of the most important factors for BEPM development. The scope of this study is structured as follows: The next section explains the systematic review methodology utilized in this study. Subsequently, a bibliometric analysis is conducted, and the results and findings described in the next section. This next section is named result and discussion, explaining the steps conducted in analyzing the data from the systematic review. Section 6 conveys the theoretical and practical implication, while the next section concludes the work.

2. Methodology

This study employed a systematic review method to identify the most important factors needed to develop high-performing BEPM. While some factors have been recognized as noncrucial factors of energy usage in buildings [43], there are still so many factors that have been considered to affect energy consumption. As a result, the most prevalent factors, as noted by [22], in an empirical analysis of BEP, were classified as technical factors (i.e., climate and building envelope) and human factors (i.e., interior conditions and occupant behavior). This review covered the most prevalent and popular factors, namely, the building envelope (building floor area, [43,50], window [44,51,52], roof [17,53], wall [13,23,24], and orientation [44,54]), climate conditions [10,42,55], and occupancy [6,20,56].

Among these factors, occupancy is considered to be the most important factor for improving BEP [56]. As stated by [40], "Buildings do not consume energy, people do". However, other studies argue that climate condition such as temperature is more important, as it influences the energy used by occupants/people [17,57]. This study conducts a systematic review of the aforementioned factors and a bibliometric analysis of factors that improve BEP. Primarily, each factor is accumulated using a systematic literature review and classified or ranked based on its occurrence or frequency of usage.

Systematic review is an academically accepted approach for engendering valid and reliable contribution as it reduces bias, hence its popularity in diverse important research fields around the world [58]. A systematic literature review should follow a specific process to elicit repeatability, transparency, and rigour. Bibliometric analysis is a well-known and reliable method of analysis for evaluating the development and quality of research produced [59].

This study explored three different databases, namely, Scopus, ScienceDirect, and Institute of Electrical and Electronics Engineers (IEEE), for research articles relevant for identifying the factors affecting BEP. Although other databases were also considered such as Engineering Village (EV), Web of Science, and Google Scholar, among others, based on their popularity and recognition for publishing high-quality journal articles, they were not explored due to inaccessibility restrictions, and others (Google Scholar) due to their elicitation of infinite outcomes with varying levels of accuracy from expected results as corroborated by [60]. The databases employed have been considered suitable and sufficient for a systematic review based on their high indexing rate and extensive publication coverage [61,62]. These databases were also selected because they are mutual amongst Q1 energy journals such as Journal of Building Engineering and Energy for Sustainable Development, among others, and the utilization of these three database eliminates database and geographic bias as they cover articles from various countries worldwide, and, consequently, ensure high reliability and quality [58] (see Figure 1).

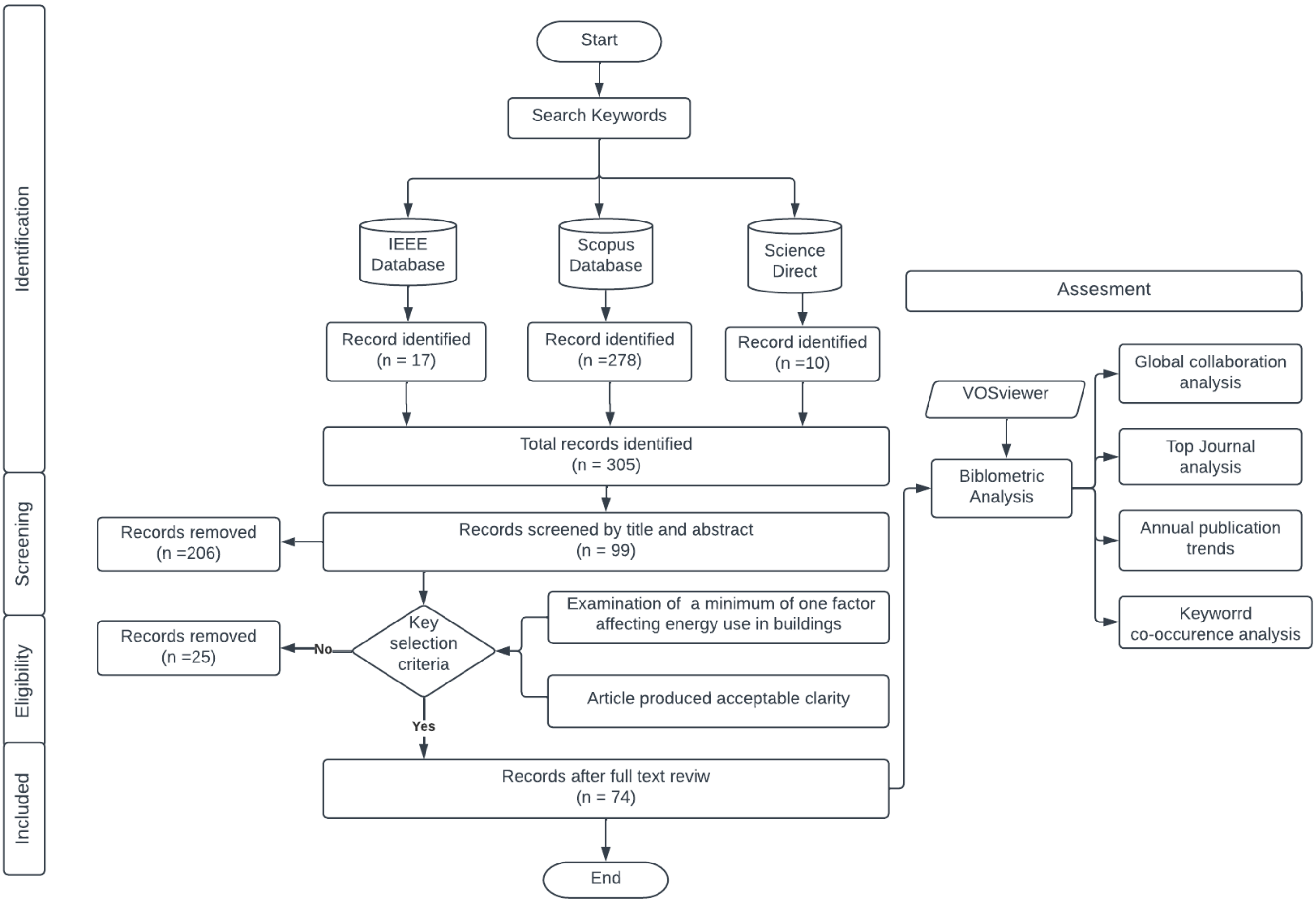


Figure 1. Framework of the key phases of the methodology.

The terms and keywords used for the databases were carefully selected based on review of other energy-related papers [53,55]. These terms and keywords searched across the three databases (i.e., Scopus, ScienceDirect, and IEEE) are "building energy consumption" or "building energy performance" or "building energy savings", "factors", or "drivers" as displayed in Table 1.

Table 1. Database, terms/keywords, and research articles' search outcome.

Databases	Query String	Results
Scopus	TITLE-ABS-KEY (("building energy consumption" OR "building energy performance" OR "building energy savings") AND ("factors" OR "drivers")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (SUBJAREA, "ENER")) AND (LIMIT-TO (LANGUAGE, "English")	278
ScienceDirect	TITLE-ABS-KEY (("building energy consumption" OR "building energy performance" OR "building energy savings") AND ("factors" OR "drivers")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (SUBJAREA, "ENER")) AND (LIMIT-TO (LANGUAGE, "English"))	10
IEEE	("Abstract":"building energy savings") OR ("Abstract": "building energy consumption") OR ("Abstract":"building energy performance") AND ("Abstract":"drivers") AND ("Abstract":"factors") Filters Applied: Journals	17
Results identified after full-text review		74

There were no restrictions in the search centred on language, and document year, as this study considered all research articles from inception that focused on relevant factors affecting BEP, and all articles generated from the search were written in English. The search results produced articles from 2000 to 2022. The titles and abstracts of the search results were examined to confirm the suitability of the articles for this study. One of the inclusion criteria for selection was that the BEP study must be centred solely, or mainly on a factor or factors affecting BEP. Other criteria include the following; The article must be comprehensive and produce acceptable clarity (i.e., proper elucidation of methodology and conclusions). The abstract and titles of each article were typically sufficient enough to determine the studies that were most suitable for this study, or else introductions and/or conclusions of the article was examined. In unique cases, the full text of the article was examined.

To enhance the validity of this study, one exclusion criteria was the restriction of the results to only journal articles, mainly because they are measured as more credible [58]. Another example of exclusion criteria is the dismissal of non-English articles, due to the lack of wherewithal to cover interpretation cost. Therefore, five non-English articles were removed from the search records. One example of the articles removed due to language constraint is [63] which is scripted in Chinese. Moreover, 36 review articles were also removed as they primarily comprised factors identified from other research articles. Furthermore, the search result generated articles that were not within the scope of this study, articles from diverse subject areas such as chemical engineering [64], econometrics, and finance [65,66], among others. The occurrence of those articles could be due to the use of certain terms/keywords in search query (i.e., "energy savings", "drivers", etc.) in abstract or title of article, Thus, the subject area was limited to energy-related areas only. After the application of inclusion and the exclusion criteria, the final result totalled 74 articles which were reviewed in this study. Thereafter, the bibliographic data of the relevant articles were exported from all databases (Scopus, Science, and IEEE) for analysis, before further amalgamation of the data for this study.

3. Bibliometric Analysis

A bibliometric analysis was implemented to understand and assess knowledge areas. Therefore, as necessary, various tools were explored and the most appropriate tool was selected [67]. There are various bibliometric analysis tools such as VOSviewer® 1.6.20 [68], CiteSpace® 6.3.1 [69], and Gephi® 0.10.1 [70]. However, VOSviewer® is the most generally exploited in academic research [48,61,71] and it is recognized for its user-friendliness and noted as among the best tools for bibliometric analysis [72,73], Therefore, it was selected and utilized in this study. VOSviewer® is a tool that provides the essential features needed for science mapping and the analysis of bibliometric networks [67]. In this study, the bibliometric analysis was implemented for a publication trend analysis, keyword occurrence analysis, and geographical/co-authorship and citation analysis.

Generally, the number of publications analyzing relevant factors in the BEP field from 2000 to 2022 shows an increase in certain years as displayed in Figure 2. The first 13 years (2000–2013) can be said to have received no significant attention or development. However, it is noted that the first few publications within these years were from east Asia (i.e., China [13,74], and South Korea [52]), except [75] which originated from Cyprus. This early investigation in China is most likely due to the extreme energy consumption in buildings there [76]. The stable and slow growth in publications across other countries such as the United States [20,43,77], and Brazil [78,79], among others, started from the year 2014. This phenomenon could be subject to the availability of prominent worldwide climate reports, such as the Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Synthesis Report, presenting the imminent need for a reduction in greenhouse gas emission from buildings, stating the pervasive impacts and the need to build a more sustainable future for posterity [80].

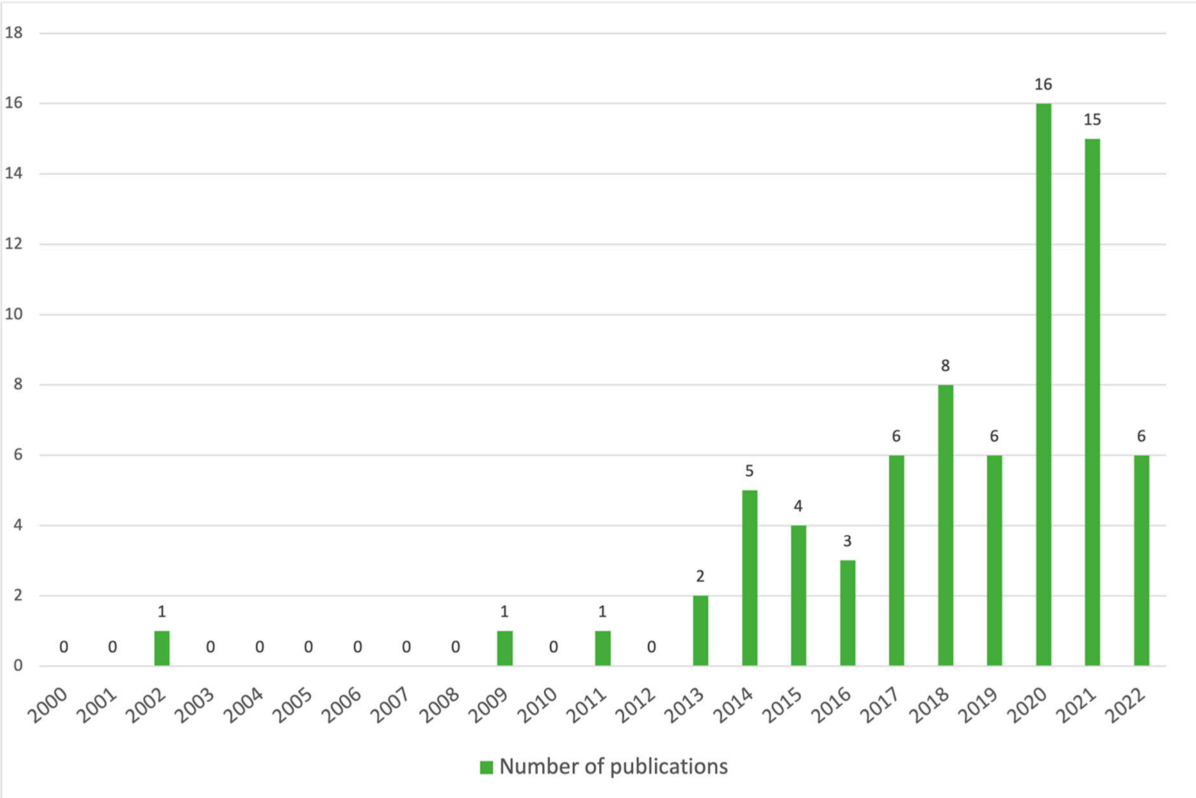
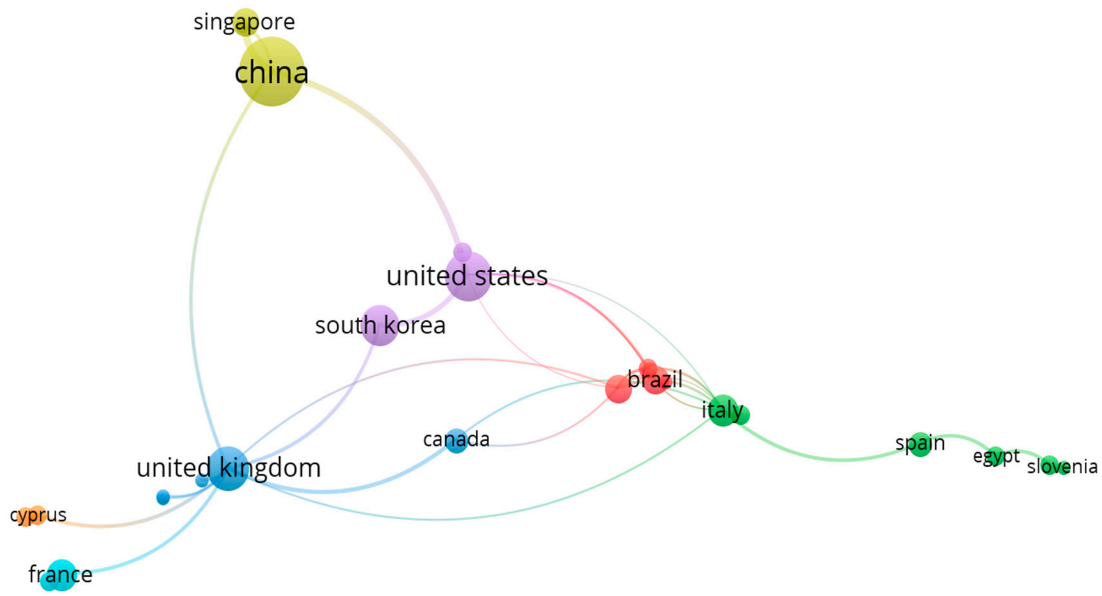


Figure 2. Proportion of annual publication on BEP factors.

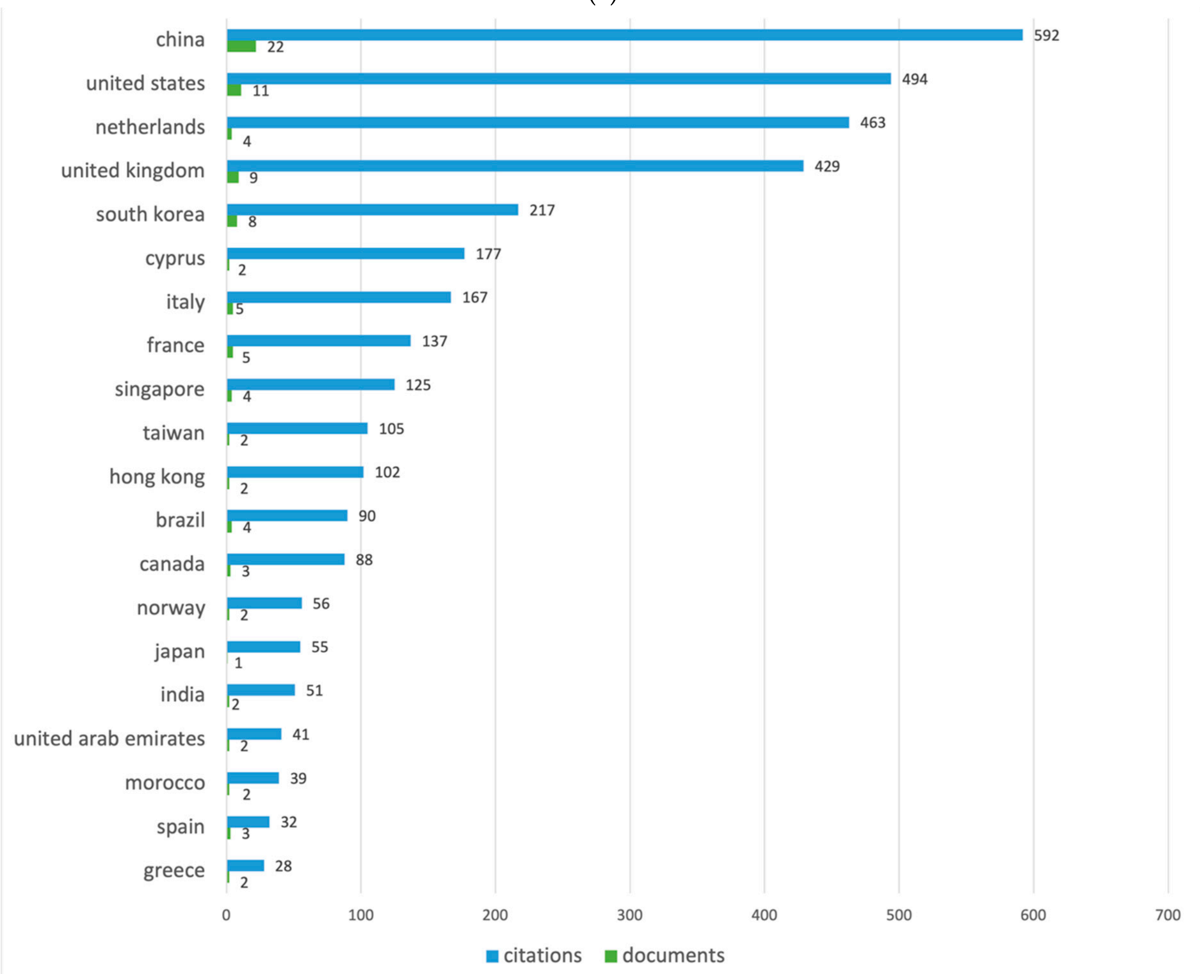
Figure 3 shows a global collaboration of the different countries conducting research on the factors affecting BEP. Figure 3b displays the proportion of publications by the country of publication. China had 22 papers related to this field of study, accounting for 29.73% of all interrelated publications, trailed by the United States with 11 publications (14.87%). However, the average citation values for articles published in China and the United States do not differ significantly, considering the United States produced half as many papers as China. The average citation values of China and United States are 592 and 494, respectively. The total number of citations is arguably the best indicator of quality [81,82]; in this regard, China is currently leading in the quality of research published in relation to the factors affecting BEP.

These occurrences from China and the United States could be due to certain projections; for example, China is estimated to account for one-fourth of the building electricity consumption in buildings in the world by the year 2040 [83], while the United States is projected to be responsible for beyond 1.3% of total energy yearly [84]. Other countries such as the Netherlands and the United Kingdom (UK), and South Korea also conducted good quality research. Nevertheless, all countries have a rising quantity of citations which denotes quality contributions to the academic literature. The articles used in this study only originated from the countries in Figure 3a and3b below.

The examination of certain keywords is often supported for connecting key research areas in the academic literature [85]. The keyword occurrence map was visualized using VOSviewer. VOSviewer generates a bibliographic map centred on distance, where the relational strength is denoted by the distance between two keywords, and a short distance signifies a more solid relationship [86]. The label size signifies the degree of the keywords in pertinent studies. The articles produced 876 keywords gathered by utilizing fractional counting. The minimum number of occurrences for each keyword was set at 5; therefore, only 37 met the threshold as displayed in Figure 4.



(**a**)



(**b**)

Figure 3. (**a**) Global collaboration network; (**b**) proportion of publications by country.

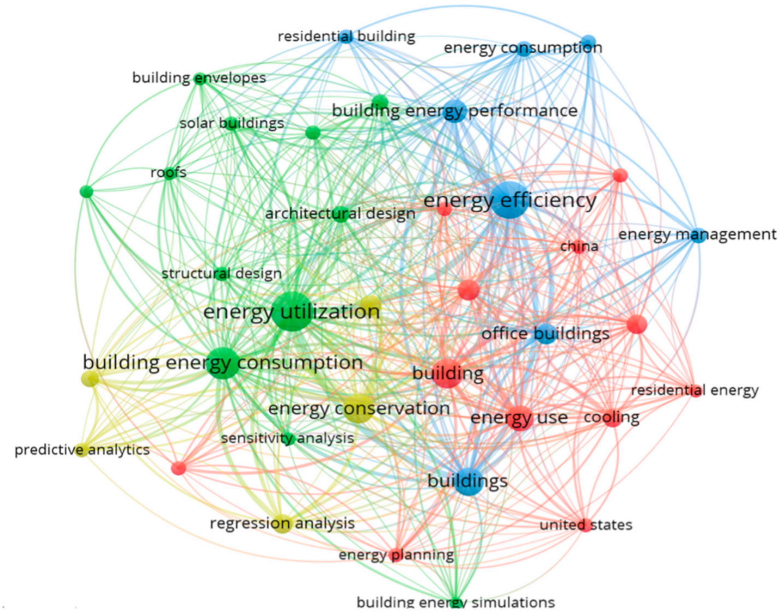


Figure 4. Keywords occurrence bibliographic map.

Based on the highest to lowest number of occurrences, the top 20 keywords were selected and visualized in Figure 5. This result shows that certain fields in the research or keywords are receiving significant attention, while some are not receiving as much. For example, "Energy utilization", "Energy efficiency", "Building energy consumption", "Energy conservation", "Building", and "Energy use", among others, have been abundant in BEP research, and this also substantiates the increase in research on improving building energy efficiency. Walls and architectural design were also noted to be in the top 20 keywords, which shows that these features are receiving attention with respect to improving BEP.

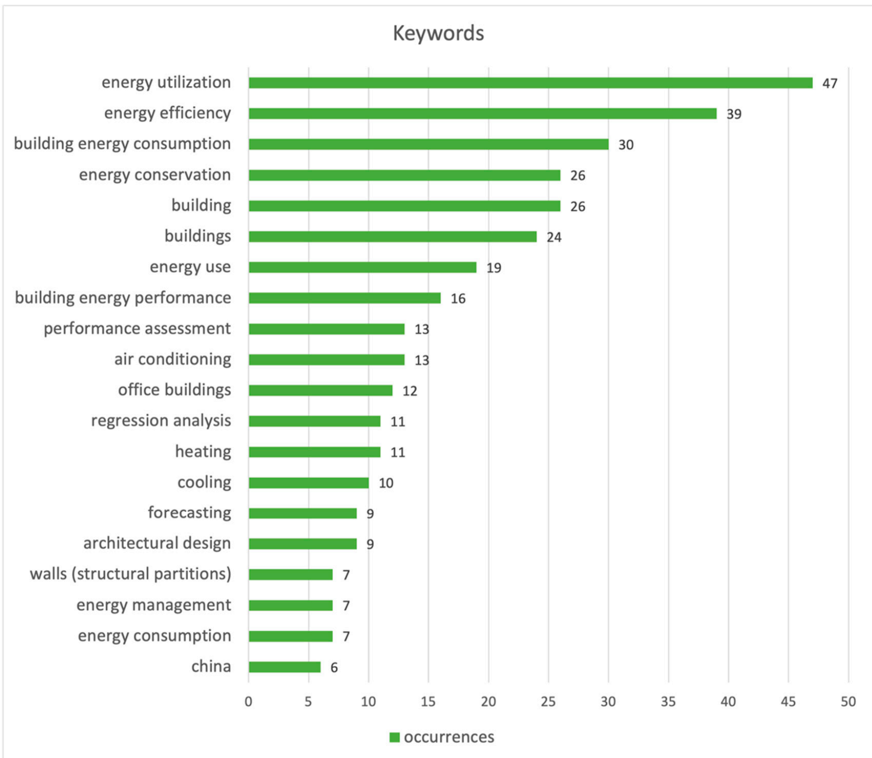


Figure 5. Top 20 keywords and number of occurrences.

4. The Factors

In this study, we examined the influence of various popular and prevalent factors of BEP. Numerous studies have explored various factors [46,87,88]; however, seven of the most explored factors affecting BEP were reviewed. These factors include the building floor area, windows, roof, wall, weather, occupancy, and building orientation. A short description of these factors is detailed in Table 2 below:

Table 2. Description of nine popular and prevalent factors of BEP.

	Factors	Description	References
1	Building floor	Building floor area can be defined as the overall footprint range of the buildings inside the buffer zone, multiplied by the relevant quantity of floor levels [89]. This factor includes the review of building floor and other related building floor factors that influence BEP such as number of floors and floor usage.	[23,26,28,35,43]
2	Windows	Window is a part of a building envelope that opens in the side of a building, which aids the interaction between the exterior and interior environment. [90] This factor includes the review of windows and other related window factors that influence BEP such as window glazing, and insulation, among others.	[27,44,52,91,92]
3	Roof	Building roof is known as the body of the building, which is continually influenced by atmospheric agents during the day. The importance of roof has been amplified owing to its large area and energy waste from the roof [93].	[17,88,94,95]
4	Wall	The wall of a building is the central interface between the building interior and exterior, which is also the main channel for the heat exchange between the building interior and exterior. Thus, the reduction in wall energy use is one of the key means to decrease the energy consumption of the traditional building [96]. This factor includes the review of wall and other related wall factors that influence BEP such as walls' solar absorptivity, wall insulation, and thickness, among others.	[44,52,92,95]
5	Weather	Weather is defined as the condition of the atmosphere, to the degree that it is hot or cold, wet or dry, and so on. Generally, weather represents the day-to-day temperature and precipitation activity [97].	[18,25,46,87]
6	Occupancy	Building occupancy is the foundation for operations and management of a building. With the growing prerequisite for building energy conservation, occupancy forecasting has become an essential input for simulations [98].	[20,28,43,87]
7	Building Orientation	Building orientation is the alignment of a building in relation to seasonal difference in the sun path, as well as dominant wind pattern. The effect of building orientation varies from thermal comfort to ventilation, and energy usage [99].	[9,23,44–54]

5. Result and Discussion

This section reveals the results, findings, and discussions of the systemic literature review. The results are displayed in the form of tables and statistical illustrations. The factors affecting BEP were selected from the systematically reviewed articles; each factor was explored by at least one of the reviewed articles. For comparison, the frequency of application of each factor was visualized in Figure 6. Considering a large majority of the review studies did not develop a BEPM, except [87,100,101], therefore accuracy based on the factors utilized was not studied. The plot in Figure 6 displays the actual frequency based on the number of application (green bar), while the second bar (blue bar) was calculated based on the consideration of the most used factor as 100% of the frequency of application (i.e., if actual frequency is 2, and most used factor is 4, this will be 50% frequency). Subsequent discussions were based on the second bar in the interest of simplicity.

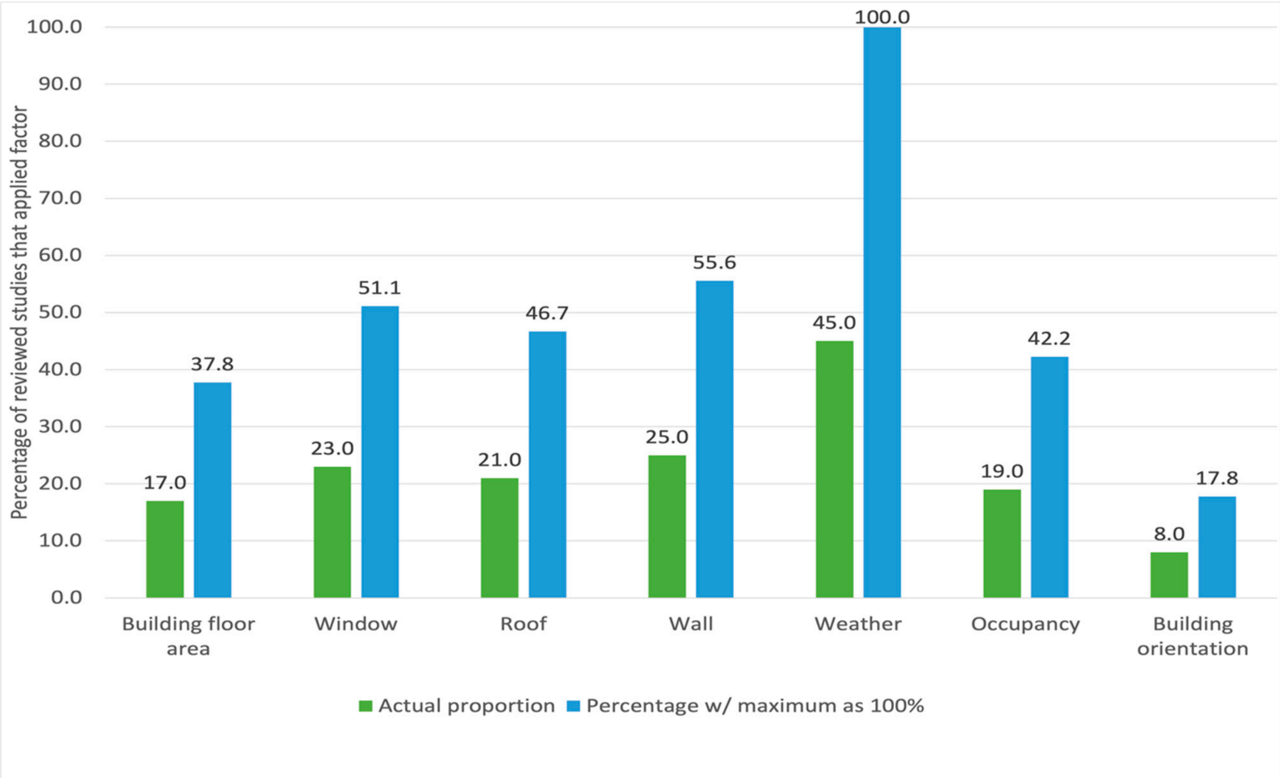


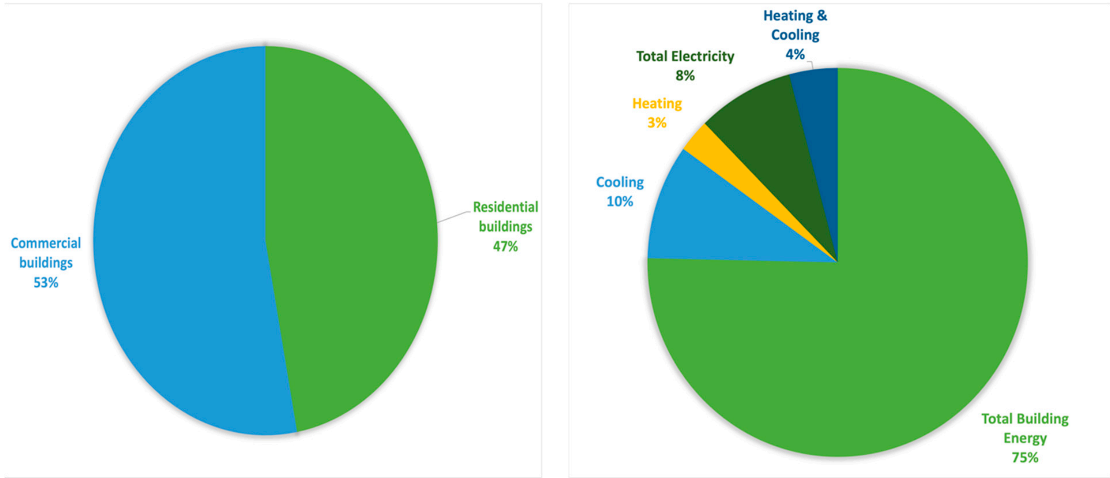
Figure 6. Frequency of application of factor in study.

Table 3 shows the ranking of the factors based on the bar plots in Figure 6. According to the second bars (blue bars) in the plot, there were only three factors out of seven that had a beyond 50% frequency of application and are measured as the most essential based on the simple evaluation. These factors include the weather, wall, and windows. Of the seven factors, It should be noted that only the roof factor (46.7%) and occupancy (42.2%) are relatively close to the 50% value. Additionally, it was evident that the construction year factor achieved a low frequency rating considering only two studies applied the factor. Thus, it was exempted from the ranking in Table 3.

Table 3. Factors and associated ranking.

Factor	Above 50%	Ranking
Weather	Yes	1
Wall	Yes	2
Windows	Yes	3
Roof	No	4
Occupancy	No	5
Building floor area	No	6
Building orientation	No	7

Figure 7a indicates only 47% of the reviewed articles focused on investigating the factors affecting BEP in residential buildings, while 53% of the reviewed articles centred on commercial buildings. Regarding energy types, a substantial fraction of the reviewed articles focused on analyzing the total building energy, which is a total of 75%, while 10%, 8%, 4%, and 3% of the reviewed articles focused on the cooling, total electricity, heating, and cooling and heating, respectively.



(**a**) (**b**)

Figure 7. Percentage of reviewed articles based on (**a**) building types, and (**b**) energy types.

Given that the most relevant factors could differ depending on the type of building (i.e., commercial and residential buildings), Figure 8 shows the frequency of application of all factors for residential and commercial buildings. For residential buildings, according to the second bars (blue bars) in the plot, there were only two factors out of eight that had a beyond 50% frequency of application and are measured as the most essential based on the simple evaluation. These factors include the weather and wall. However, of the eight factors, the roof and window elicited the same value of 47.4%, which is relatively close to the 50% value. The relatively small margin could suggest that the roof and window are also very essential in relation to BEP for residential buildings. On the other hand, the commercial buildings plot shows four factors out of eight had a beyond 50% frequency, namely, the weather, wall, window, and building floor area. The occupancy factor appears to be the closest to 50% frequency. Contrarily, the result implies that the building floor area and occupancy are presumably more essential in commercial than residential buildings. The weather, on the other hand, remained the highest and most essential factor for both buildings and several studies have stipulated that weather factors are one of the most relevant factors that strongly affect energy performance [17,19,23]. It is well-noted that the result is not enough to draw a conclusion; therefore, the advantages and drawbacks highlighted in the reviewed studies are further used to corroborate, justify, and invalidate their importance. The extent of the entire group of reviewed articles is shown in Table 4, based on the factors explored.

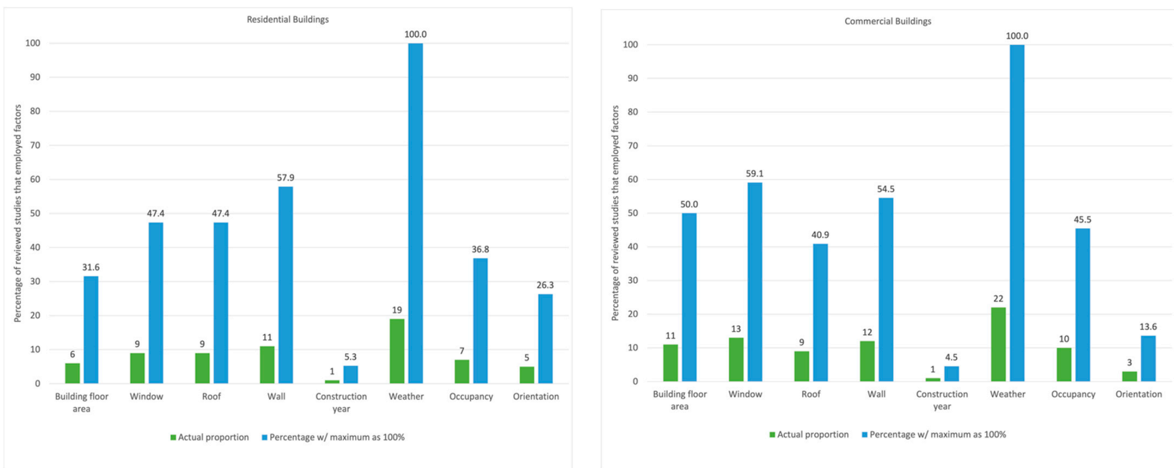


Figure 8. Frequency of application of factors for commercial and residential buildings.

Table 4. Data properties, purpose, and factors explored in reviewed studies.

S/N	Reference	Purpose of Study	Building Type	Energy Type	Building Floor Area	Window	Roof	Wall	Construction Year	Weather	Occupancy	Orientation
1	[31]	Empirical analysis of drivers of energy use	Residential	TBE	✓	✓			✓			
2	[46]	Analysis of the impact of meteorological year	NCS	TBE						✓		
3	[25]	Analysis of factors influencing energy consumption	Residential	TE						✓		
4	[87]	Proposed method for building energy prediction	Residential	TBE						✓	✓	
5	[20]	Analysis of the impact of occupancy profiles	Residential	TBE							✓	
6	[88]	Parameter ranking of its influence on BEP	NCS	TE			✓	✓			✓	
7	[17]	Analysis of building energy use and indoor thermal conditions	Commercial	TBE			✓	✓				
8	[18]	Analysis of factors affecting BEP	Commercial	TBE						✓		
9	[44]	Estimation of the energy efficiency of designs	Residential	Heating		✓		✓				✓
10	[26]	Determined the change in heat loss in buildings	Residential	Heating	✓							
11	[43]	Studied the influence of climate on BEP	Commercial	TBE	✓					✓	✓	
12	[19]	Demonstrated the importance of accurate meteorological data	Residential	TBE						✓		
13	[102]	Identified factors affecting BEP	NCS	TBE							✓	
14	[77]	Investigated the net energy consumption	Residential	H&C						✓		
15	[94]	Studied extensive and intensive green roofs	Residential	Cooling			✓			✓		
16	[52]	Investigated the behavioral and physical parameters influencing BEP	Residential	Cooling		✓		✓		✓	✓	
17	[28]	Examined the effect of scale factors	Commercial	TBE	✓					✓	✓	
18	[57]	Studied the factors influencing air conditioning energy use	Commercial	Cooling						✓		
19	[103]	Analyzed occupant behavior patterns	Commercial	TBE						✓		
20	[29]	Explored effect of weather features on building energy use	Residential	Gas						✓		
21	[104]	Examined window operating behavior	Commercial	TBE		✓				✓		
22	[27]	Analysis of photovoltaic (PV) windows	Commercial	TBE		✓						
23	[95]	Analyzed impact of cooling materials on BEP	Residential	TBE			✓	✓				

Table 4. *Cont.*

S/N	Reference	Purpose of Study	Building Type	Energy Type	Building Floor Area	Window	Roof	Wall	Construction Year	Weather	Occupancy	Orientation
24	[91]	Analysis of ohotovoltaic (PV) windows	Commercial	TBE		✓				✓		
25	[105]	Demonstrated roles of social-psych features which influence BEP	Commercial	H&C							✓	
26	[106]	Benchmarked daily electricity use of a building	Commercial	TE						✓	✓	
27	[107]	Proposed methodology to optimize the daylight potential	Residential	TBE						✓		
28	[92]	Addressed the research gaps to decompose building energy factor structure	Commercial	TBE		✓		✓				
29	[7]	Investigated two stochastic models	Residential	TE		✓						
30	[100]	Examined accuracy and generalization of deep highway networks	Commercial	TBE						✓		
31	[101]	Comparison of ML models	Residential	TE						✓		
32	[79]	Evaluated the capabilities of artificial neural network (ANN)	Commercial	TBE			✓	✓				
33	[108]	Identified factors of the dynamic energy performance gap	Commercial	TBE	✓	✓	✓	✓				
34	[23]	Examined the effects of four fundamental facade properties	Commercial	TBE	✓	✓	✓					✓
35	[54]	Examined the effect of geometrical factors	Residential	TBE	✓	✓	✓	✓		✓		✓
36	[24]	Examined effects of building external wall's insulation thickness	Commercial	TBE				✓		✓		
37	[109]	Developed a support vector machine (SVM) method to predict energy consumption	Residential	TBE						✓		
38	[53]	Studied the materials and compositions used in building envelopes	Residential	TBE			✓	✓				
39	[110]	Examined the effects of various environmental features on the cooling performance	NCS	Cooling			✓			✓		
40	[111]	Calculated embodied and operating energy	Residential	TBE	✓							
41	[10]	Examined building materials and ventilation system	Commercial	Cooling				✓				
42	[9]	Examined the influence of window-to-wall ratio on energy load	Commercial	TBE			✓	✓		✓		✓

Table 4. *Cont.*

S/N	Reference	Purpose of Study	Building Type	Energy Type	Building Floor Area	Window	Roof	Wall	Construction Year	Weather	Occupancy	Orientation
43	[112]	Analyzed outdoor and indoor data collected from buildings	Commercial	H&C	✓					✓	✓	
44	[113]	Proposed a data cube model	Commercial	TBE		✓	✓	✓		✓		
45	[45]	Developed understanding of how energy is consumed	Residential	TBE						✓	✓	
46	[24]	Examined variables that can be applied during building design	Residential	TBE		✓	✓	✓				
47	[78]	Proposed a method to integrate thermal satisfaction into energy benchmarking	Commercial	TBE	✓						✓	
48	[56]	Investigated the importance of various environmental factors	Commercial	TBE	✓	✓	✓	✓		✓		
49	[114]	Proposed window configurations for energy efficiency	Residential	TBE	✓						✓	
50	[16]	Proposed a data-driven approach	Commercial	TBE	✓	✓						
51	[115]	Proposed a data-driven approach	Commercial	TE						✓	✓	
52	[116]	Factor analysis	Residential	TBE						✓	✓	
53	[74]	Selected factors to analyze energy utilization indicators (EUIs)	Commercial	TBE	✓	✓		✓	✓	✓	✓	✓
54	[117]	Examined the issues that require a solution for application of BEPS tools	Commercial	TBE						✓		
55	[118]	Proposed a novel technique for building-energy-estimating learning models	Commercial	TBE						✓		
56	[75]	Examined measures to reduce the thermal load.	Residential	Cooling		✓	✓	✓				✓
57	[21]	Extrapolated a set of simple correlations of heating energy demand for office buildings	Commercial	TBE		✓		✓				
58	[51]	Studied the influence of building envelope parameters on BEP	Residential	TBE		✓	✓	✓				
59	[43]	Studied the influencing factors of thermal behavior of the roofs	Residential	TBE			✓			✓		
60	[5]	Investigated outdoor wall layer on the BEP	NCS	TBE			✓	✓		✓		
61	[6]	Presented key issues and drivers affecting the energy behavior	Residential	TBE		✓				✓	✓	✓

Table 4. *Cont.*

S/N	Reference	Purpose of Study	Building Type	Energy Type	Building Floor Area	Window	Roof	Wall	Construction Year	Weather	Occupancy	Orientation
62	[119]	Evaluated how temperature affects thermal conductivity of materials in building components	Residential	TBE				✓				
63	[120]	Calculated weight coefficients of each subfactor	Commercial	TBE				✓				
64	[121]	Explored the energy efficiency and optimized the architectural design	Residential	TBE				✓		✓		✓
65	[122]	Examined main factors causing overheating	Commercial	TBE	✓	✓				✓		
66	[96]	Triple-glazed window filled with PCM (TW + PCM) was proposed	NCS	TBE		✓				✓		
67	[13]	Investigated the building walls in cooling-dominant cities	Commercial	Cooling		✓	✓					
68	[42]	A sensitivity analysis was undertaken to assess the key factors affecting BEP	Commercial	TBE						✓	✓	
69	[123]	Investigated phase change material, and green and cool roofs	Commercial	TBE			✓			✓		
70	[40]	Investigated the interaction effects of occupant-behavior-related factors	Commercial	TBE						✓	✓	
71	[124]	Developed understanding of the most important factors affecting BEP	Residential	TBE						✓		
72	[125]	Investigated key influencing factors of BEP	Commercial	TBE	✓							
73	[55]	Identified the parameters affecting BEP	Residential	TBE	✓		✓	✓		✓		
74	[126]	Examined weather data	Residential	TBE						✓		

Acronyms—TBE: Total Building Energy, TE: Total Electricity, H&C: Heating and Cooling. NCS: Not clearly stated, ✓: factor explored in study and BEP: Building Energy Performance.

By understanding how heat is transferred through a building, it is possible to identify areas where energy losses occur and implement measures to improve insulation and reduce energy consumption. Some studies estimate the building's energy consumption for heating and cooling using machine learning [35,127,128], while some utilize the mathematical thermal heat formula [129,130]. The mathematical thermal heat formula for a building is used to calculate and predict the rate of heat transfer through various components of the building envelope, such as walls, windows, roofs, and floors. The mathematical thermal heat formula for a building typically involves calculating heat transfer through various components, such as walls, windows, roofs, and floors. One common approach to modelling this heat transfer is through the use of the heat conduction equation, which describes how heat flows through a material. The formula for one-dimensional heat conduction through a material with constant thermal conductivity kk and thickness LL is [131]:

$$Q = \frac{\mathrm{K} \cdot \mathrm{A} \cdot (T_1 - T_2)}{L}$$

where:

- Q is the rate of heat transfer (in watts);
- K is the thermal conductivity of the material (in watts per meter per degree Celsius);
- A is the cross-sectional area through which heat is transferred (in square meters);
- T_1 and T_2 are the temperatures on either side of the material (in degrees Celsius);
- L is the thickness of the material (in meters).

For a building composed of multiple materials, such as walls with insulation, the overall heat transfer rate is calculated by summing the contributions from each component. This process requires considering the thermal properties (thermal conductivity, specific heat capacity, and density) and geometric characteristics (thickness, surface area, and orientation) of each component, including walls and windows. For instance, heat transfer through a window is calculated using its U-value, which represents its overall thermal conductance, and the temperature difference between the indoor and outdoor environments.

Furthermore, the reviewed articles stated the various impacts of the identified factors on BEP. Although some studies corroborated the significant effect of the identified factors on BEP, some studies stated some opposing arguments of certain factors. Therefore, each factor is further discussed based on the stipulated theories in the reviewed articles.

5.1. Impact of Building Floor

In relation to the building energy performance, it is practical to infer that large buildings are liable to use more energy in comparison to smaller buildings. However, it is worth noting that this is merely a typical pattern as it is still conceivable for a large building to be more energy-efficient than a small building, if the design and operation is conducted with this target in mind [43]. The Pearson correlation conducted by [43] shows a weak correlation between BEP and floor area with a coefficient value of 0.32, indicating no clear or solid proof that small residential buildings will use less energy than larger ones. The benchmarking of BEP considers a broad variety of different factors, including the floor area, and climate condition, among others, for commercial buildings [28]. Reference [132] found that the building floor area constitutes a large share in the space heating loads of residential buildings. The quantile regression results by [16] revealed that most drivers imposed strong diverse effects on BEP. However, in comparison with other considered factors, the floor area engendered the highest positive effect on energy consumption.

Another essential factor of BEP is the floor usage, or the manner of action or activity conducted in various building areas or spaces. For example, commercial areas such as restaurants or retail stores, or residential spaces such as luxury or flamboyant dwellings, are key factors affecting BEP levels. Intriguingly, whilst various studies have highlighted the influence of floor characteristics such as the floor area for commercial buildings [26,28,43], they did not unequivocally highlight the significance or importance of the floor usage for analyzing BEP. Nevertheless, it is noted that different building types (i.e., residential or commercial) ultimately have varying BEP levels [84]. Thus, it is not unexpected to devise the floor usage, which reveals the type of operation of the reviewed buildings, to be an influencing factor of BEP.

The geometrical features of a building such as the number of floors, and area of floor ratio, were measured and it was noted that the five-floor models of a commercial building were more susceptible to heat transmittance through the roofs [23]. Therefore, the number of floors is considered one of the most vital features that has a substantial influence on energy use [133]. It was also noted by [134] that the number of floors is the most effective factor that influences the annual heating energy demand.

5.2. Impact of Window

According to the study of the IEA, the BEP of office buildings is primarily influenced by four factors, specifically, weather features, envelope performance, occupant behavior, and equipment performance. However, one of the greatest common occupant behaviors in buildings is the window operating behavior [22]. Based on the observation and analysis of 35 buildings, it was found that a strong correlation lies between temperatures (outdoor weather temperature and indoor air temperature) and window operation [104].

In warm areas of Asia, an investigation into the relationship between energy savings and window properties inferred that windows with low U-values (e.g., triple-glazing windows) decreases energy use and, likewise, contribute to a decrease in the total cooling and heating demands [23]. Buildings encompassing windows with lower U-values exhibit better energy efficiency, and low U-values can be reached by material-based solutions such as multi-pane glazing systems and well-insulated frames which are commercially accessible. However, regardless of the level of the U-value, smaller windows have less of an impact on decreasing the annual energy demand [23].

Despite the impact of window glazing, only a few studies explicitly considered and emphasized the essentiality, and potential benefits or drawbacks [6,23,54,104]. Ghosh and Neogi (2018) stipulated that, although glazed facades are progressively being utilized in contemporary buildings to ease interior daylight accessibility and also to beautify the building architecturally, the increased application of glazed facades is engendering a greater solar gain on the internal part of the building, which is gradually becoming a major problem in hot climate regions. References [27] and [91] proposed and improved an approach of employing building-integrated photovoltaic (BIPV) windows to deliver a better thermal performance. The development of building-integrated photovoltaic (BIPV) windows is proposed to be of great significance because it does not only generate electric power, but it also decreases the heating and cooling loads in buildings simultaneously. One of the benefits of BIPV windows is that it has a great solar heat gain control ability [27]. In southwest China, [135] assessed a photovoltaic (PV) window and deduced that it could achieve an energy savings ratio of 83%, when PV windows were fitted on the south-facing façade.

In the conception of green architecture, it is noted that, in terms of performance and energy efficiency, windows are measured as the weakest component or feature of the building envelope. In buildings, they are responsible for the greatest quantity of direct solar gain and thermal bridging. Windows are responsible for about 20% of total heat loss, depending on the outdoor climatic conditions and size of the glazing. Thus, modifying the window-to-wall ratio (WWR) can engender considerable influence on energy compared to modifying the external walls' thickness [9] Therefore, it is recommended that the analysis and configuration of the WWR should be conducted at the design phase to enhance the BEP [136]. Additionally, [9] proffered that WWR should ultimately range between 30% to 35%, except in high-altitude mountains where the intensity of outdoor temperatures is low. This is estimated to bring about definitive results regarding energy consumption.

Furthermore, in residential buildings, windows are considered to be essential factors, and significant energy savings can be generated when extra procedures are implemented [75]. The study by [15] demonstrates that the U-value of the external window, wall, and roof, including the window-to-wall ratio, have a positive correlation with BEP during winter, while the external wall and roof solar absorptance have a negative correlation with BEP. It was further concluded that the proposed solutions with a high potential to decrease the energy consumption have a low U-value, a large amount of solar absorptance material, and a small WWR [15].

5.3. Impact of Roof

The building roof is considered to be one of the most essential structural components of the building in a hot environment and it is estimated to bring about 19% of energy savings when properly insulated [75]. Various studies have investigated the impact of the roof on BEP and proposed effective solutions to reduce energy consumption in buildings [17,88,94]. A cool roof is proposed and substantiated as an effective solution for decreasing the heating load of the building during the winter season [17]. Some other solutions such as a green roof is professed to enhance the thermal performance and decrease the cooling energy demand in buildings [94] Nonetheless, [137] investigated further by conducting a numerical comparative analysis of all aforementioned types of roofs, namely, the cool roof, green roof, and standard roof. It was deduced that the cool and green roof provide a greater energy savings potential, as well as environmental benefits than exceeded those of the insulated standard roof.

There are various innovative roof technologies such as the cool roof, green roof, and phase change material that have been proposed as effective solutions in relation to energy efficiency. Effective designs of the standard or traditional roof have become a prerequisite to restrict the utilization of technically convoluted and expensive technologies [123]. The materials expended in the construction of roofs have many diverse thermal properties depending on the composition. Hence, it is up to the architect or building designer to select the configuration suitable for the building envelope of each building, as an insulator also has a substantial impact on heat transfer [53]. For this perspective, the design of thermally efficient building roofs can be considered a fundamental element to offer substantial energy savings and environmental benefits in buildings.

5.4. Impact of Wall

In contrast to roofs, the effect of the external walls' solar absorptivity has not received as much attention in research [138], considering the relatively high number of studies on the importance external walls for the building envelope and its significant contribution to building energy consumption [44,52,88,95]. This is anticipated because walls have a low exposure to the sky, However, the results from the research shows that solar absorptivity can constitute a substantial influence on the total energy consumption in buildings [17].

In cold climate regions, the application of an appropriate quantity of wall thickness or insulation is considered an effective approach for a reduction in energy consumed in buildings [24]. For example, [24] showed that the intensification of insulation thickness has a substantial effect on the heating energy consumption of the residential building, though it shows a comparatively minor effect on the cooling energy consumption of the building. In the study by [44], the increase in wall thickness to 250 mm from 50 mm influenced the reduction in the heating energy load. Although the proper insulation of walls often elicits energy savings, it tends to be costly. Despite this increase in insulation cost, the energy savings influence of wall insulation and thickness has become eminent in certain regions such as Greece [14]. However, studies like [23], focusing on office buildings, stipulates that the thickness in walls does not necessarily always guarantee energy savings.

There is a significant correlation between the wall and location weather, as the increase in wall thickness in cold cites often have a significant effect on the energy consumption of the building [13,24]. The research on the evaluation of the significance of the wall in relation to energy savings indicates that energy savings in buildings defer in different climatic zones [24]. For example, in the case of two cities (Harbin and Guangzhou), Harbin is situated in a relatively extreme cold region, where the heating energy use accounts for a sizeable fraction of total energy use, while Guangzhou is located in the hot summer and warm winter zone, where the heating energy use is very minor, and the annual energy use primarily comprises cooling energy use. In Harbin, an increase in wall insulation thickness elicited a significant increase in energy savings in the building, while, in Guangzhou, an increase in wall insulation thickness exhibited an insignificant deviation in the energy savings of the building [24]. Furthermore, more often than not, the configuration of the wall of a building is frequently decided by aesthetic and structural deliberations at the design phase, hence the increase in the probability of a high energy demand if the U-value is not sufficiently taken into consideration [23].

5.5. Impact of Weather

Weather data are considered one of the major factors for accurately predicting the energy consumption in buildings and the evaluation of an indoor environment [17,19]. It is noted that building energy performance is predicated on several fundamental factors that define its energy use, especially outdoor temperature, which has been established as a fundamental factor that influences energy performance in both residential and commercial buildings [18]. Various other environmental factors are closely connected to energy use in buildings such as radiation, and building envelope composition, among others. However, temperature is considered one of the most impactful factors of air conditioning energy load in buildings [57]. High temperatures in hot climates bring about human discomfort, leading to a higher consumption of air conditioning, hence resulting in a rise in building energy motivated, by the upsurge in air conditioning systems operation [42].

The research by [55] established that, among other weather features such as humidity, and precipitation, among others, outdoor temperature has the greatest effect on both the heating and cool energy load, and solar radiation did not directly influence the energy demand in residential buildings. Moreover, it is noted that, excluding relative humidity, the weather features were more significant for heating in winter than for cooling in summer [55]. Reference [29] investigated the impact of weather factors on the heating energy consumption of educational and healthcare buildings. It was found that educational buildings appeared more susceptible to weather factors than healthcare buildings.

Although weather factors are considered very essential factors that strongly affect the energy performance of both residential and commercial buildings [19,23], it is concluded that, even though different buildings of the study were situated in the same location and same climate, they would demonstrate a significantly distinctive energy performance, which dictates that factors other than weather are driving the difference in energy performance [43].

5.6. Impact of Building Orientation

Not many studies consider the building orientation. [44] argues that the building orientation is one of the most influential factors; changing the orientation would have more impact on building performance than increasing or decreasing concrete wall thickness. The selection of the architectural features, form, and orientation of a building are important decisions made at the design stage of development and can significantly reduce or increase BEP. Thus, it remains paramount to avail designers with frameworks to support decision-making for the curation of energy-efficient designs [44]. For example, a veranda with its orientation positioned northwest and northeast use a larger heating energy load than one facing north owing to the solar radiation penetration, which penetrates the north side of the veranda [44].

The ratio of building heat loss and gain is closely connected with the exposure of the surface area of a building [75]. Hence, the building orientation is considered an imperative factor to be taken into consideration during the design stage of buildings and retrofitting projects of a building [13,124]. Reference [75] stipulated that the most suitable point of a symmetrical house is directed at four cardinal points, and, for a stretched house, it is recommended that we position the long side facing south. Reference [139] also stated that the correlation between the shape factor and BEP of residential buildings is often ambiguous due to the thermal action of solar radiation.

5.7. Impact of Occupancy

The attention paid to occupant behavior originated in 1978 in a study by [140], which examined the impact of residents' behavior on the space heating energy load. In the last decade, the attention to human behavior has grown in a striking way. Specifically, 2019 was the year with more publications in this area in the academic literature [6]. Reference [40] concludes that the effects of occupant behavior on BEP cannot be ignored, as "buildings do not consume energy, but humans do". It is stated that, to understand how energy is consumed in building, knowledge of human activity and space occupancy is a prerequisite [45].

There is the concept where, if occupants utilize air conditioning systems uneconomically during the summer, there is a high probability they will do the same during winter. Likewise, occupants that are used to often opening windows during the summer are inclined to uphold the same pattern in winter [45]. Reference [40] investigated the effect of occupant behavior on energy use in office buildings and it was concluded that a convoluted relationship lies between occupant behaviors, buildings, climate conditions, and equipment. Moreover, the occupancy in residential buildings is an essential feature as there is a direct link between the energy use of a building and the occupancy patterns [55].

Furthermore, another layer of complexity to the analysis of building energy performance is the examination of the building's ability to meet the energy demand during grid outages. Grid outages can occur due to various reasons such as natural disasters, equipment failures, or high demand periods, and they can have significant impacts on buildings and their occupants.

One approach to addressing this issue is integrating renewable energy sources like solar PV with energy storage systems, which can enhance the resilience of buildings by providing a reliable source of power even during grid outages [11]. During normal grid operation, excess energy generated by the renewable sources can be stored in batteries or other storage mediums for use during outages, reducing the reliance on fossil fuels and minimizing disruptions to building operations, there ensuring occupant satisfaction.

6. Theoretical and Practical Implications

The study provides a comprehensive theoretical framework for understanding the various factors influencing building energy performance (BEP). By systematically reviewing the existing literature, the research identifies critical factors such as building envelope features, outdoor climatic conditions, and material properties that significantly affect energy consumption in buildings. The study enhances the theoretical knowledge base by highlighting the importance of accurately modelling these factors in energy prediction models, thereby addressing the gaps in current research methodologies. Additionally, it proposes a more holistic approach to evaluating BEP, which can serve as a foundation for future theoretical advancements in the field of building energy efficiency and sustainability.

Practically, the study offers valuable insights for architects, engineers, and energy managers aiming to improve building energy performance. By identifying the most relevant factors affecting BEP and demonstrating effective energy-efficient strategies, such as the use of green roofs and photovoltaic windows, the research provides actionable recommendations for designing and retrofitting buildings to optimize energy use. Furthermore, the integration of renewable energy sources and energy storage systems is emphasized, offering practical solutions for enhancing energy resilience and sustainability. The findings can inform building codes, standards, and best practices, ultimately contributing to the development of more energy-efficient and sustainable buildings.

7. Conclusions

The achievement of effective outcomes from the several methods being employed to improve building energy efficiency requires an understanding of the factors influencing energy consumed in buildings. Numerous BEPMs have been developed for improving building energy efficiency; however, the majority have been developed using factors solely based on their popularity without a proper understanding of their effect and impact on BEP. Unfortunately, these have engendered unstable models as they omit some essential BEP factors or add irrelevant factors.

The study implemented a systematic literature review research method to highlight the most pertinent factors influencing BEP. The results showed that three factors, namely, the weather, wall, and windows, are the most important factors. Though not popularly researched in the reviewed articles, the roof and building orientation are also very essential factors affecting energy use in buildings and they should be adequately considered in the development of an efficient BEPM. Based on the review studies, the window and weather factors remain the most essential or relevant factors that significantly affect and influence the energy performance of both residential and commercial buildings. The roof and wall are also very essential for residential buildings, and the building floor area and occupancy are very essential for commercial buildings. This relevant factor deduced as very essential for the different types of building are seemingly logical; for example., the occupancy is significantly more essential in commercial building due to the disparity in the number of humans that occupy the building and inconsistencies that surround occupancy. This study evidently shows that the identified factors cut across the different types of buildings and climatic conditions around the world, which makes them more relevant to potentially developing a holistic or generalisable BEPM. Additionally, this review also engendered several recommendations of energy-efficient strategies for building designers such as the utilization of a green roof, and a photovoltaic (PV) window, among others, which have been considered to have a significant effect on BEP.

Future research should explore the identification of more factors as this will benefit researchers who are required to have a group of variables to examine statistically rather than accept the recognized best variables. Future research can further investigate the other subfeature of weather factors (i.e., humidity, wind speed, precipitation, and solar radiation, among others), as they could have the individual relevance level for developing an optimal BEPM. Considering the study by [29] that found that educational buildings appeared more susceptible to weather factors than healthcare buildings, leading to an increase in energy consumption, future studies should explore the variation in the influential factors between different types of commercial buildings. Furthermore, for validation purposes, future research should attempt the development of their BEPM using the identified factors.

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