

**THE SATISFACTION MODEL FOR GREEN
HOME OWNER-OCCUPIERS IN CHINA**

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**THE SATISFACTION MODEL FOR GREEN
HOME OWNER-OCCUPIERS IN CHINA**

by

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LIST OF ABBREVIATIONS

AVE	Average Variance Extracted
BREEAM	Building Research Establishment Environmental Assessment Method
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
LEED	Leadership in Energy and Environmental Design
HTMT	Heterotrait-Monotrait Ratio
IEA	International Energy Agency
IPMA	Importance-Performance Map Analysis
NFI	Normed Fit Index
PLS-SEM	Partial Least Squares – Structural Equation Modelling
SRMR	Standardized Root Mean Square Residual
UNEP	United Nations Environment Programme
USM	Universiti Sains Malaysia
VIF	Variance Inflation Factor

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MODEL KEPUASAN PEMILIK-PENGHUNI RUMAH HIJAU DI CHINA

ABSTRAK

Peningkatan kesedaran tentang perubahan iklim global dan perlindungan alam sekitar menjadikan bangunan hijau secara beransur-ansur sebagai hala tuju penting untuk pembangunan industri pembinaan. Kepuasan terhadap perumahan hijau merupakan petunjuk penting untuk mengukur kejayaan pasaran perumahan hijau. Walau bagaimanapun, kajian semasa jarang mengkaji kepuasan pelanggan yang terlibat dalam pembeli rumah hijau di China secara komprehensif dan sistematik. Objektif utama kajian ini adalah untuk mengenal pasti faktor utama yang memberi kesan ketara kepada kualiti yang dirasakan, mengkaji kesan jangkaan pelanggan dalam mempengaruhi kepuasan pelanggan, dan meneroka peranan kualiti yang dirasakan dan nilai yang dirasakan sebagai pengantara antara jangkaan pelanggan dan kepuasan pelanggan. Memandangkan kajian ini memfokuskan kepada pemilik-penduduk kediaman hijau Shanghai, kaedah kuantitatif telah digunakan untuk menjalankan penyelidikan dengan 702 responden. Persepsi kualiti pelanggan terhadap rumah hijau boleh dicerminkan terutamanya daripada enam aspek: kualiti bangunan, persekitaran dalaman, penjimatan sumber, persekitaran komuniti, persekitaran lokasi dan perkhidmatan hartanah. Kepuasan pelanggan dikaitkan secara signifikan secara positif dengan jangkaan pelanggan, persepsi kualiti dan nilai yang dirasakan. Kualiti yang dirasakan dan nilai yang dirasakan adalah pengantara, menjelaskan hubungan yang rumit antara jangkaan pelanggan dan kepuasan pelanggan. Implikasi praktikal masa hadapan telah disediakan yang memberi penerangan tentang pembangunan rumah hijau untuk pihak berkepentingan dalam industri pembinaan China.

THE SATISFACTION MODEL FOR GREEN HOME OWNER- OCCUPIERS IN CHINA

ABSTRACT

With the increasing awareness of global climate change and environmental protection, green buildings have gradually become an important direction for the development of the construction industry. The satisfaction of green home is an important indicator to measure the success of the green home market. However, currently there are rare researches that study on the customer satisfaction involved in the green-home buyers in China comprehensively and systematically. The primary objectives of this study are to identify the key factors that significantly impact perceived quality, examine the effect of customer expectation in affecting customer satisfaction, and explore the role of perceived quality and perceived value as the mediators between customer expectation and customer satisfaction. Since this study was focusing on owner-occupiers of Shanghai's green residences, a quantitative method was employed to carry out the research with 702 respondents. Customer's quality perception of green homes can mainly be reflected from six aspects: building quality, indoor environment, resources saving, community environment, location environment and property service. Customer satisfaction was significantly positively associated with customer expectation, perceived quality and perceived value. Perceived quality and perceived value are mediators, shedding light on the intricate relationships between customer expectation and customer satisfaction. Future practical implications were provided which shed light on green homes development for stakeholders in China construction industry.

CHAPTER 1

INTRODUCTION

1.1 Introduction

This research focuses on the measurement of customer satisfaction for green home owner-occupiers in China. The following sub-chapters will delve deeper into the conceptual idea of this research thesis: research background, problem statement, research questions, research aim and objectives, research scope, research significance, research method and thesis outline.

1.2 Research Background

With the rapid development of the global economy and the acceleration of urbanization, building energy consumption has become an important part of total energy consumption. According to statistics from the International Energy Agency (IEA), energy consumption in buildings accounts for nearly 40% of global energy consumption, of which residential buildings account for nearly 60% (IEA, 2022). In China, energy consumption in buildings has also shown an upward trend, accounting for more than 30% of the country's total energy consumption in recent years (Y. Guo, 2022). Buildings are not only large energy consumers, but also an important source of carbon dioxide emissions. According to a report by the United Nations Environment Programme (UNEP), carbon dioxide emissions from the building sector account for nearly 39% of the global total, of which about 28% come from the operation stage of buildings (UNEP, 2020). In China, with the increase in per capita housing area and the improvement of living standards,

carbon emissions from residential buildings are also increasing, now accounting for more than 20% of the country's total carbon emissions (Y. Yu et al., 2024). Therefore, how to use natural resources reasonably and efficiently, while reducing environmental pollution and protecting the ecological environment, has become a key issue for exploring the future development of the construction industry.

With the global emphasize on environmental protection and energy conservation, in the 1970s, low-energy buildings appeared for the first time in some Western countries, and then Canada, the United Kingdom, and the United States successively introduced green building standards and the concept of sustainable development (Goubran, Walker, Cucuzzella, & Schwartz, 2023). As a result, the construction of green buildings has gradually developed in the construction industry (T. Liu et al., 2022a). Since China officially promulgated the Green Building Evaluation Standards in 2006, a series of policies have been issued one after another regarding to the green building or also known as the green construction activities (J. Wu & Ying, 2024). The results are shown in Table 1.1 below.

Table 1.1 Concise List of Important Policies of Green Building in China

Year and Month	Policies Name	Description
2006.6	Green Building Evaluation Standard	To sort out the content of the evaluation standard of green building: land saving and outdoor environment, energy saving and energy utilization, water saving and water utilization, material saving and material resource utilization, indoor environment and also operation management.

Year and Month	Policies Name	Description
2007.8	Green Building Evaluation Label Management Method	To stipulate China's green building in term of ranking which from the lowest to highest rank: One star, Two star, and Three Star. The approved project issued by the Ministry of Construction and along with the certificates and logo.
2011.8	Comprehensive work plan for energy conservation and emission reduction during the Twelfth Five-Year Plan	Until 2015, the northern part of China, the heating area, the eat metering and energy-saving renovation of existing residential buildings have more than 400 million m ² . In areas with hot summers and cold winters, 50 million m ² of existing residential buildings will be renovated for energy efficiency, and 60 million square m ² of public buildings have been renovated for energy saving.
2012.4	Implementation on Accelerating the Development of Green Buildings	Until 2015, the newly developed green building contains the area of 1 billion m ² and as of 2020, in the newly built building, there are 30% of it is the green building. For the ranking more than 2-star will give the reward in which for the 2-star green building will reward 45RMB per m ² , while for 3-star green building will reward 80RMB per m ² .
2012.8	Energy Conservation and Emission Reduction in Twelfth Five-Year Plan	The projects that contain high energy consumption will receive the Three-Punishment which is the punishment in stopping the delivery of goods, stopping water and stopping the electricity.
2013.1	Green Building Action Plan	Within the period of Twelve-Five, the completed newly green buildings are around 1 billion m ² ; and until 2015, 20% of the cities newly build building have reach the green building requirements. As of 2020, basically complete the energy-saving renovation task of residential buildings in cities and towns that have the renovation value in the northern heating area.

Year and Month	Policies Name	Description
2013.6	Twelve-Five Green Building and Green Ecological City Development Plan	Since 2014, Government-invested buildings, affordable housing for provincial capital cities, and public buildings with a single area of more than 20,000 square meters will be the first to implement green building standards
2014.3	National New Urbanization Plan (2014-2020)	By 2020, 50% of new buildings will meet green building standards
2014.5	2014-2015 Action Plan for Energy Conservation, Emission Reduction and Low Carbon Development	By 2015, the implementation rate of green building standards for urban new buildings will reach 20%, and 300 million square meters of new green buildings has been added
2014.5	Green building materials evaluation label management method	The green building materials evaluation can be divided into three grades: one-star, two-star and three-star from low to high.
2015.1	Green Building Evaluation Standard	On the basis of the original standard, construction management has been added.
2016.12	Assessment standard for green museum and exhibition building	National standards applicable to the evaluation of green museum and exhibition building projects.
2018.5	Standard for green performance calculation of civil buildings	Unite the civil green building performance calculation rules and standardize the green performance calculation process.
2019.3	Assessment standard for green building	Green building evaluation should combine the characteristics of the climate, environment, resources, economy and culture of the area where the building is located, and comprehensively evaluate the safety, durability, health and comfort, convenience of life, resource conservation, and liveability of the building throughout its life cycle.

Year and Month	Policies Name	Description
2021.9	General Specification for Building Energy Conservation and Renewable Energy Utilization	Stipulate the design, construction, acceptance and operation management of building energy-saving and renewable energy building application systems for newly built, expanded and rebuilt buildings and existing building, energy-saving renovation projects must implement this code.

Source: Official website of the Ministry of Housing and Urban-Rural Development of China (2021)

Dr. Qiu Baoxing, former vice minister of the Ministry of Housing and Urban-Rural Development of China and chairman of the Urban Science Research Association, at the main forum of the 11th International Conference on Green Buildings and Building Energy Conservation also pointed out: The 13th Five-Year Plan is a critical period for the comprehensive promotion of green buildings in China. All buildings that have passed financial subsidies at all levels must meet the national two-star green building standards (Qiu, 2015).

Under the active promotion of the China government, China's green buildings have shown a strong growth trend (Ren & Kim, 2023). Starting from China's first green building project evaluation in 2008, by the end of September 2021, the official website of China Green Building Evaluation Label shows that the number of green buildings in the country that have obtained green label certification has reached 4068 items. Among them, if sorted out them by building type, there are 1938 green residential buildings, 2095 green public buildings, and 38 green industrial buildings; if sorted out by the type of marks, 3856 items of design marks and 212 items of operation marks are obtained. If sorted out according to the evaluation stars, there are a total of 1655 one-star projects, a total of 1660 two-star projects, and a total of 753 three-star projects (China, 2024).

1.3 Problem Statement

The relationship between humans and the environment is crucial, with green architecture focused on peaceful coexistence between the two (Opoku, 2019). Given their significance in eco-friendly construction, green homes deserve increased focus. However, in terms of current developments, most of the green residential projects that have been awarded the Green Building Assessment Mark are design marks, while only a handful of green residential projects have been awarded the Operational Mark (J. Wu & Ying, 2024). For example, the Fanghe Garden project in Guangzhou, the Longyue Eco-City project in Chongqing, the Poly Zhongbin Garden project in Shaoguan, the Huangsha South Metro Station project in Guangzhou, and the Dongxin Expressway affordable housing project in Guangzhou are all green projects with design marks (Song, 2018). At the same time, the current emphasis on design rather than operation, quantity rather than quality in the green building industry has been highlighted, and is not in line with China's proposed development plan for building energy efficiency and green building (He, Liu, Kvan, & Yan, 2019). The focus of green homes has also long been not only on the quality of the building and resource conservation of green buildings, but also on the livability and health and comfort of the building (Teng, Mu, Wang, Xu, & Liu, 2019). The level of occupant satisfaction most accurately mirrors the eco-friendliness and quality of green homes, making it crucial to incorporate this satisfaction into the evaluation process to assess the general quality of green homes.

As one of the main components of green buildings, green home bares closely related to the daily life and rest of the people. To ensure the growth of the economic in China without affecting or to mitigate the impacts brought by active development, the green

homes should be built in the construction industry (W. Wang, Tian, Xi, Tan, & Deng, 2021). There are many researches in other fields have been done and the results show owner-occupier satisfaction improve practitioners' overall performance (Cui, Zhang, Guo, Hu, & Meng, 2019), especially in those mega projects. However, currently there are rare researches that study on the comprehensive and systematic that including the owner-occupier satisfaction involved in the green-home buyers in China (Sharpe, 2019).

Research on owner-occupier satisfaction of green homes is still in its infancy (Bowen, 2020b). Xianglin Li, Feng, Liu, and Yang (2023) analysed the main green building evaluation systems at home and abroad in terms of evaluation indicators, index synthesis and evaluation results, analyzed that China's green building evaluation system has shortcomings such as strong subjectivity and emphasis on design rather than operation. Y. Chen, Ren, Xu, Wang, and Xu (2023) analyzed China's green building evaluation system comprehensively from the perspective of overall characteristics, and took the green building evaluation system of Hangzhou as an example to propose improvement measures, suggesting that emphasis should be placed on the actual operation effect of green buildings and strengthening the later property management. Yurong Zhang, Wang, Hu, and Wang (2017) compared China's existing green building evaluation system with those of major Western countries in terms of evaluation content, objects, mechanisms, processes and methods, and argues that the promotion of green building concepts in China should be strengthened and relevant industry associations should be established to lead and popularise them. Other researchers analysed the green building evaluation system from the perspective of the whole life cycle of the project (Jamaludin & Li, 2023). It is worth mentioning that Tran, Tran, Pham, and Nguyen (2023) used the life-cycle approach to

measure the six categories involved in each phase of residential buildings and analysed the results to establish a model for a low-carbon building evaluation system. Hui (2017) used the Delphi method to identify vulnerability factors from the perspective of risk evaluation, and then constructed a green building vulnerability evaluation index system from three dimensions: exposure, sensitivity and adaptation. In the existing literature, most scholars only evaluate the owner-occupier satisfaction of green homes from the perspective of indoor environmental quality, and the evaluation system and evaluation dimensions are too single. In contrast, research on owner-occupier satisfaction in general homes has been more mature, and the main influencing factors are building quality, indoor environment, district environment, location environment, property management and value for money (Caiyan, 2016).

Customer satisfaction, a key indicator of product and service quality (Bhowmick & Seetharaman, 2023), is central to evaluating green homes. The establishment of a model for the evaluation of green home owner-occupier satisfaction and the practice of green home owner-occupier satisfaction is of great importance to urban development, developer investment and owner-occupiers. Presently, no studies have been conducted on the model of green home owner-occupier satisfaction, focusing instead on identifying the perception of green home owner-occupiers, the various elements influencing their satisfaction, and the interplay among expectation, perception, and owner-occupier satisfaction. For clearer comprehension, Table 1.2 highlights multiple challenges that must be addressed prior to enhancing and effectively executing the assessment of green home owner-occupier satisfaction in the construction sector. What is the owner-occupier's quality perception of green homes? How does owner-occupier's expectation affect satisfaction on green homes?

What kind of causal relationships exist between owner-occupier's perceived quality, perceived value, expectation and satisfaction on green homes.

Table 1.2 Current Issues in Green Homes

Current issues	Sources
Owner-occupier's quality perception of green homes	(Bowen, 2020b)
Owner-occupier's expectation affects satisfaction on green homes	(Ashfaq, Yun, Waheed, Khan, & Farrukh, 2019a)
Causal relationships exist between owner-occupier's perceived quality, perceived value, expectation and satisfaction on green homes	(Ashfaq, Yun, Waheed, Khan, & Farrukh, 2019b; Mbango, 2019)

Numerous research voids, such as evidence gap, methodological gap, and population gap, have been identified in various studies and scholarly articles for additional investigation.

The researcher identified a gap in prior research concerning customers' perceived quality of green homes. Previous research has addressed several aspects of general home perceived quality: building quality, indoor environment, district environment, location environment and property management (Kurdi, Alshurideh, & Alnaser, 2020). J. Yang and Zhang (2020) selected green residential buyers in Beijing as the research subjects, and conducted quantitative analysis on the survey data using SPSS and AMOS analysis software, and found that residential products, community environment, corporate image and perceived value all have an important impact on consumer satisfaction. Their research lacks the measurement of customer expectations for owner-occupier satisfaction. The researcher has pinpointed a lack of evidence in earlier research.

The researcher identified a methodological gap in the prior research. There is a lack of large-scale systematic stratified sampling research designs in green home customer

satisfaction. Tianyi (2018a) selected three representative green communities in Changsha City, Hunan Province, and used a simple random sampling method to distribute a total of 300 questionnaires to the three communities. Finally, 232 questionnaires were collected. Based on the research design that this study attempts to implement, it is found that previous studies on green housing owner satisfaction lack a large-scale, systematic, stratified sampling research design. This study will construct a new study to explore a large-scale, systematic, stratified sampling research design for green housing owner owners. This study aims to expand research by addressing the gap in research methods with large-scale, systematic, stratified sampling.

A population gap has been identified, as indicated by an analysis of previous studies. A number of these specific subgroups remain underexplored and inadequately studied. Buyers and residents of green homes seem significant and merit exploration, especially in relation to customer satisfaction. An investigation of this group is important because occupants are more knowledgeable about the green homes they live in. Furthermore, previous research has focused primarily on this population of buyers or tenant (Tianyi, 2018a). No research has been done on the owner-occupiers of green homes. For example, the population researched by Caiyan (2016) is users of green homes, which means both buyers and tenants.

To conclude, the above part highlights the critical gap between owner-occupier expectations and satisfaction in the context of green homes. This gap suggests that although green homes offer numerous environmental and economic advantages, owner-occupier satisfaction may not fully align with these benefits due to varying perceptions of quality and service. Therefore, the research question emerges: How do perceived quality

and value influence owner-occupier satisfaction in green homes? This study aims to investigate this relationship, bridging the gap identified in the problem statement and contributing to a deeper understanding of owner-occupier satisfaction drivers in green homes. More specifically, the following research questions need to be addressed to achieve the research objectives.

1.4 Research Questions

- i. What is owner-occupiers' quality perception of green homes in China?
- ii. How the owner-occupier's expectation impact satisfaction on green homes in China?
- iii. What are the relationships that exist between owner-occupier's expectation, perceived quality, perceived value and satisfaction of green homes in China?

1.5 Research Aim & Objectives

The aim of this research is to draft a new model describing the green-home owner-occupiers' satisfaction for stakeholders of green construction industry.

- i. To identify the owner-occupiers' quality perception of green-home in China.
- ii. To examine the impact of expectation towards owner-occupier satisfaction of green-home owner-occupiers in China.
- iii. To determine perceived quality and perceived value as the mediator variables between expectation and owner-occupier satisfaction of green home owner-occupiers in China.

1.6 Research Hypothesis

Total nine hypothesis guide this study propose the following:

H1: Green-home customer expectation has a positive effect on customer satisfaction. (CE → CS)

H2: Green-home customer expectation has a positive effect on perceived quality. (CE → PQ)

H3: Green-home customer's perceived quality has a positive effect on customer satisfaction. (PQ → CS)

H4: Green-home customer expectation has a positive effect on perceived value. (CE → PV)

H5: Green-home customer's perceived value has a positive effect on customer satisfaction. (PV → CS)

H6: Green-home customer's perceived quality has a positive effect on perceived value. (PQ → PV)

H7: Green-home customer's perceived quality has a mediating effect between customer expectation and customer satisfaction. (CE → PQ → CS)

H8: Green-home customer's perceived value has a mediating effect between customer expectation and customer satisfaction. (CE → PV → CS)

H9: Green-home customer's perceived quality and perceived value have sequential mediating effects between customer expectation and customer satisfaction. (CE → PQ → PV → CS)

1.7 Methodology

This study will employ a range of research techniques on diverse objectives and data types gathered, aiming to select the most suitable method for achieving precise outcomes that reflect the satisfaction levels of customers with China's green homes. Prior to starting the survey, we will gather secondary data from a literature review to establish an initial and fundamental understanding aimed at confirming the precision of the gathered data sets. The accuracy of the outcomes will bolster the trust in disseminating these findings globally.

Firstly, this study will employ a methodical review of literature, utilizing summaries from scholarly articles to pinpoint indicators of green home and the satisfaction levels of green home customers. Okoli and Schabram (2010) highlighted the necessity for the literature review to rely on highly credible sources to guarantee result precision. Consequently, the review of literature will primarily concentrate on highly credible sources, including journal articles from SCOPUS and Web of Science databases. Every pertinent article will undergo reading and filtration to extract the most precise and pertinent secondary information from these sources (M. M. Kelly, Martin-Peters, & Farber, 2024).

Next, quantitative research approach will be employed, involving the development of a structured questionnaire derived from an earlier systematic literature review, to verify the dependability of data gathered from journal articles sourced from these references (Mandasini, 2022). The questionnaire aims to gather information regarding the customer satisfaction of green homes in China. Data gathered will undergo analysis through IBM SPSS Statistics 27 and the SmartPLS 4 software. The background of the respondents will

be examined through descriptive analysis to gain insight into the specifics of the green home customers in China.

For the assurance that this study's findings are dependable and quantifiable for future reference, the Partial Least Squares – Structural Equation Modelling (PLS-SEM) analysis technique will be utilized to investigate the interconnections between independent and dependent constructs (J. Hair, Hult, Ringle, & Sarstedt, 2022). A variety of evaluations assessing data dependability, including Internal Consistency (Outer Loadings of the Reflective Indicator), Composite Reliability, Convergent Validity (Extracted Average Variance), and Discriminate Validity, will be conducted and documented. Following the completion of the tests, SmartPLS 4 will compute the t-test and p-value for the independent and dependent constructs to determine their respective negative and positive impacts on customer satisfaction in green homes. Subsequently, the structural model's predictive significance will be examined through the application of R^2 and f^2 values.

Lastly, a new comprehensive model will be presented, derived from the survey outcomes computed by the software, to aid practitioners in comprehensively grasping customer satisfaction with green homes. Utilizing PLS-SEM software, SmartPLS 4 aims to enhance the visual representation of an all-encompassing system of satisfaction among green home owner-occupiers, steering the growth trajectory of China's green homes.

1.8 Thesis Outline

The dissertation is divided into six sections, each of which is summarized below.

Chapter One: This chapter introduces research background, problem statement, research questions, research objectives, research scope, significance of study and research methodology.

Chapter Two: Firstly, this section delves into the interconnected ideas and traits of green homes and their impact on customer satisfaction, alongside the principles of sustainable development and the human settlement environment, thereby establishing the definition of customer satisfaction in green homes. Next, it examines pertinent papers related to both local and international green home assessment systems and models for evaluating customer satisfaction. As a third step, an examination is conducted on the literature concerning the satisfaction of customers with green buildings. Ultimately, this section undertakes an initial investigation into the determinants of customer satisfaction in green homes.

Chapter Three: This chapter delves into the design of the research, the approach to gathering data, the participants involved, the initial study, the dependability and accuracy of the data, and the analytical technique known as the PLS-SEM analysis method.

Chapter Four: This chapter delves into the analysis of data gathered from distributed questionnaires, employing quantitative research techniques for diverse analyses, including descriptive and PLS-SEM methods.

Chapter Five: This chapter delves into the results of a study examining how customer satisfaction influences the evolution of green homes in China.

Chapter Six: The conclusion of this thesis is presented in this chapter, outlining its conclusions and limitations. Guidance for upcoming research paths is also offered. This research's impact on academia and the industrial sector is examined.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter explores the factors that affecting customer perception and expectation of green home in China. Moreover, the impacts of customer's expectation and perception on customer satisfaction of green home owner-occupiers in China are also discussed in this chapter. This chapter proposes conceptual model to explain the relationships between customer's expectation, perception and satisfaction of green home owner-occupiers in China.

2.2 Operational Definitions

Green building is often defined as an energy-saving building, ecological building or sustainable building (Yas & Jaafer, 2020). The green building is more related to optimizing designs by adopting renewable energies, passive building design technologies, as well as scientific and systematic waste management techniques to minimize waste diversion to landfills (T. Liu et al., 2022b).

Green home is a concept whereby a home is created to use less energy, water and natural resources, to provide good air quality and comfort, to generate less waste, and can be considered as a sustainable development that improve the homeowners' lifestyle (Alias, Sin, & Aziz, 2012).

Customer expectation defined as “pretrial beliefs about the product or service” (Ashfaq et al., 2019a).

Perceived quality means customer perception on the quality of a product (Stylidis, Wickman, & Söderberg, 2020); represents customers' overall judgment on the superiority of a product (Solin & Curry, 2022).

Building quality refers to the degree to which a building meets a series of technical standards and performance requirements during its design, construction and use to ensure its safety, durability, comfort and functionality (Raouf & Al-Ghamdi, 2023).

Indoor environment refers to the physical, chemical and biological characteristics inside a building that affect the health, comfort and overall quality of life of the occupants. It includes many aspects such as temperature, humidity, air quality, noise level, lighting and ventilation (Mewomo, Toyin, Iyiola, & Aluko, 2023).

Resources saving refers to the process and practice of optimizing the use of natural resources and energy to reduce consumption and waste during design, construction and operation (C. Li et al., 2023). This type of conservation usually includes reducing the use of resources such as water, electricity, and materials, improving resource utilization efficiency, and promoting the use of renewable resources to minimize negative impacts on the environment (Ramírez-Márquez, Posadas-Paredes, Raya-Tapia, & Ponce-Ortega, 2024).

Community environment refers to the overall condition of the external space and social environment surrounding a residence or building. It covers both physical and social elements, including green space, public facilities, community safety, neighborhood relations, social support networks, etc. (K. Wang & Ke, 2024).

Location environment refers to the geographical location of a building or residence and the overall condition of its surroundings (Brownie, Yan, Broman, Comer, & Blanchard). It includes multiple factors, such as transportation convenience, accessibility of public service facilities (such as schools, hospitals, shopping malls, etc.), surrounding natural landscape, socio-economic environment, noise pollution level, and relative position to other communities (Locke, 2023).

Property service refers to the professional services provided by property management companies for the maintenance and management of buildings and their ancillary facilities. These services usually include security management, cleaning and maintenance, equipment maintenance, landscaping management, parking lot management, and various convenient services for residents (C. Reboso & D. Castaño, 2021).

Perceived value is the customer's overall assessment of the utility of a product based on perceptions of what is received and what is given (Matsuoka, 2022).

Customer satisfaction is a person's feeling of pleasure or disappointed resulting from comparing a product's perceived performance (or outcome) in relation to his or her expectations (Almsalam, 2014).

2.3 Green Building Evaluation Research

This section reviews the relevant foreign country green building development, China green building development and green building evaluation system in previous research.

2.3.1 Evolution of the Green Building Concept Worldwide

In the early of 1960s, an American biologist known as Rachel described a terrible

scene of ecological pollution in the book "Silent Spring" published in 1962, which triggered extensive discussions about nature and itself, and the concept of sustainable development was gradually born (Caiyan, 2016). Since then, this brand-new concept has gradually taken root in the hearts of the people, and the concept of green building is the embodiment of the concept of sustainable development of mankind. American architect Paul Solerui combined ecology and architecture to put forward a new concept of ecological architecture in 1969 (J. Wu & Ying, 2024). At the same year, American architect Ian McHague wrote the book "Design Integrates Nature" which is a new way to explore ecological and energy-saving buildings was launched in this article, marking the official birth of arcology (Tianyi, 2018b).

After the oil crisis in the 1970s, industrialized countries began to pay attention to research on building energy conservation, and developed new technologies such as solar energy, geothermal, wind energy, and energy-saving enclosure structures (C. Z. Li et al., 2022).

In the 1980s, in the developed countries, they started to use technology to improve and complete the green buildings. However, the emergence of sick building syndrome makes human physical health a hot spot in the research of the built environment (Niza, de Souza, da Luz, & Broday, 2023). In the 1980s, the Environmental Resources and Development Commission was established in the United Nations in 1984 to propose sustainable development initiatives to countries around the world, and pointed out in reports that the earth's resources cannot meet people's unrestricted development needs and must change the current development model for the present and future generations (Hajian & Jangchi Kashani, 2021).

After the 1990s, green building theory research has become formal. The UK released

BREEAM-the world's first green evaluation system (Awadh, 2017). In 1996, the US Green Building Council Energy and Environmental Design Leader LEED announced the implementation of the green evaluation system. In the course of more than 50 years of development, green building technology has made great breakthroughs (Menna et al., 2022). This development has evolved from a solitary structure to multiple buildings, broadening its scope from architectural planning to environmental evaluation, regional development, and various other areas, culminating in its all-encompassing, interdisciplinary nature (D. M. Martínez, Ebenhack, & Wagner, 2019). As sustainable development gains traction globally, the concept of green building has increasingly garnered the focus and proactive backing of industry experts. The "Beijing Charter," promulgated in 1999 by the International Association of Architects during the 20th World Conference of Architects, explicitly mandates sustainable development for architects and engineers in the upcoming century (Tianyi, 2018b).

2.3.2 China Green Building Development

Since the reform and open to the world, China has entered a period of rapid economic development, while stable and rapid urbanization is also proceeding. The green buildings developed in this context are completely different from those in European and American countries. Green buildings in European and American countries have developed in the stages of suburban urbanization and counter-urbanization after the completion of urbanization (Tianyi, 2018b).

In the 1980s, when China reform and opening up to the world, and the economy began to develop, there was a construction boom all over the country, and various places began to study ways to transform the performance of buildings, such as the earth architecture in the northern area of China (Tianyi, 2018b).

While in the 1990s, a large number of foreign green building theories poured in, setting off an upsurge in green building research, and thus, sustainable development became the focus of people's attention. The introduction of foreign green building research results and materials has then become a solid foundation for China's green building basic research (Cao, Xu, Kamaruzzaman, & Aziz, 2022).

At the beginning of the 21st century, China carried out practice on the basis of research on green buildings, such as the ultra-low energy consumption laboratory building of Tsinghua University, the ecological office building of the Shanghai Institute of Building Research, the Tiger Apartment of Shenzhen China Merchants Real Estate, and the Ministry of Science and Technology which was put into use in 2005 (Y. Lin, Zhong, Yang, Hao, & Li, 2020). The office building of the Ministry of Science and Technology Agenda 21 Research Center, as a landmark achievement of domestic green buildings, represents the prosperous development of green building technology in China (Q. Wang, Gao, Su, & Cheng, 2024). Among them, the office building of the Ministry of Science and Technology Agenda 21 Research Center is the first green building in China to receive LEED Gold Certification (Tianyi, 2018b).

After 2010, green buildings have developed from buildings to urban areas. The eco-city requires more than 80% of green buildings in new buildings and more than 50% of existing buildings (Caiyan, 2016). Its distribution also has a certain law, that is, economically more developed areas are more willing to try green building projects (Tanqiu, 2020).

2.3.3 Green Building Evaluation System

Countries all over the world have issued a relevant green building evaluation standard with their own characteristics. Among them, the most influential ones are BREEAM in

the United Kingdom, LEED in the United States, CASBEE in Japan, LNB in Germany, NABERS in Australia, and Eco Profile in Norway, ESCALE in France, and etc. (Yurong Zhang, Wang, & Hu, 2016). Among them, the earliest green evaluation system in the era was the Building Research Center Environmental Assessment Method (BREEAM), which was issued in 1990 by the British Building Research Center (Ding et al., 2018). The relatively mature systems include the BREAM system in the UK and the LEED system in the United States (Awadh, 2017).

The main advantage of the British BREAM system is the assessment of the full life cycle of the building (Doan et al., 2017). The terms and model are simple and clear, with flexibility in operation, and the introduction of software that affects the building environment. However, the system is designed for the United Kingdom and the process is too cumbersome to apply to other regions. The American LEED system is currently a universal green building evaluation system that is widely used in the world (Awadh, 2017). It is certified by a third party, has a complete system and simple operation. The core is to achieve a win-win situation by coordinating the interests of multiple parties. However, the evaluation of the whole life cycle is not considered, and the environmental performance score is not set to a negative value (Caiyan, 2016). Table 2.1 shows the green building evaluation systems in different countries.

Table 2.1 Green Building Evaluation System

No.	Name of the Evaluation System	Country	Time
1.	Building Research Establishment Environment Assessment Method (BREEAM)	England	1990
2.	Building Environment Performance Assessment Criteria (BEPAC)	Canada	1993
3.	Building Environmental Assessment Method	Hong Kong	1996
4.	Sustainable Building Tool (SBTool)	Canada etc.	1996
5.	Leadership in Energy and Environment Design	United	1998

No.	Name of the Evaluation System	Country	Time
	(LEED)	States	
6.	Ecological Community Evaluation System (EEWH)	Taiwan	1999
7.	EcoEffect	Sweden	2000
8.	Comprehensive Environmental Performance Assessment Scheme	Hong Kong	2001
9.	Comprehensive Project Evaluation (CPA)	England	2001
10.	National Australian Built Environment Rating System (NABERS)	Australia	2001
11.	High Environment Quality (HQE)	French	2002
12.	Comprehensive Assessment System for Building Environment Efficiency (CASBEE)	Japan	2004
13.	Design Quality Indicator (DQI)	England	2004
14.	Sustainable Project Appraisal Routine (SPAR)	England	2004
15.	Australian Building Greenhouse Rating (ABGR)	Australia	2005
16.	Sustainable Building Assessment Tool (SBAT)	South Africa	2005
17.	Eco-Quantum	Netherland	2006
18.	Green Star	Australia	2006
19.	Deutsche Guetesiegel Nachhaltiges Bauen (DGNB)	Germany	2008
20.	Building Environmental Assessment Method Plus	Hong Kong	2010
21.	WELL Building Standard	United States	2014
22.	BREEAM 2018 New Construction	England	2018
23.	Leadership in Energy and Environmental Design Version 4.1 (LEED v4.1)	United States	2019
24.	Green Star - Design & As Built v1.3	Australia	2020
25.	German Sustainable Building Council (DGNB 2020)	German	2020
26.	CASBEE for Cities (Updated Version)	Japan	2021

Sources: Research of China's Green Building Evaluation System Based on Performance

After the domestic basic research on green buildings has deepened, China has successively introduced green building evaluation systems suited to national conditions. In 2001, the China Ecological Housing Technology Evaluation Manual was released, which referred to the evaluation method of Japan, established various green building indicators, and evaluated it in five stages of construction (Bowen, 2020a). Before the release of the green building evaluation standards, the residential performance evaluation

technical standards released in 2005 were the highest green building evaluation system in China. The Green Building Evaluation Standards jointly issued by the Ministry of Construction and the State Administration of Supervision, Inspection and Quarantine in 2006 represented a new stage in the development of green buildings in China. After China's first green building evaluation standard was promulgated, various provinces have successively begun to develop green housing evaluation systems in their respective provinces and regions. On June 19 2014, the China Engineering Construction Standardization Association issued an announcement that the Green Housing Standards compiled by the Human Settlements Committee of the China Real Estate Research Association was formally approved for release, and officially implemented on 1st of October at the same year (Tanqiu, 2020).

2.4 Green Buildings and Green Homes

The concept of green building has attracted the attention of domestic and foreign scholars since it was put forward. Scholars have their own opinions on the concept of "green" in green building from different perspectives. Kats, Collaborative, Force, and E (2003) believes that compared with traditional buildings, the "greenness" of green buildings is reflected in their more effective use of key resources, such as energy, water, materials, and land resources, as well as better lighting effects and air quality. Burnett (2007) described the characteristics of an ideal green building from the perspective of urban architecture in which the main features are: integration with the local ecosystem; closed-loop material system; maximum use of passive design and renewable energy; optimization of building hydrological cycle; full implementation Indoor environmental quality control measures, etc. The American Society for Testing and Materials (ASTM),