

PAPER • OPEN ACCESS

## Research on green project certification in China based on LEED and GBES

To cite this article: Yang Liu *et al* 2019 *IOP Conf. Ser.: Earth Environ. Sci.* **233** 052036

View the [article online](#) for updates and enhancements.



**IOP | ebooks™**

Bringing you innovative digital publishing with leading voices to create your essential collection of books in STEM research.

Start exploring the collection - download the first chapter of every title for free.

# Research on green project certification in China based on LEED and GBES

Yang Liu<sup>1</sup>, Xianguo Wu<sup>2,\*</sup>, Jiaying Ten<sup>2</sup>, Shiqing Zou<sup>1</sup>, Jian Zhou<sup>1</sup>

<sup>1</sup>Wuhan Univ, Zhongnan Hosp of Wuhan University, Wuhan , Hubei 430071, China

<sup>2</sup>School of Civil Engineering & Mechanics, Huazhong University of Science & Technology, Wuhan Hubei 430074, China

Wuhan Hubei Wuchang District, Wuhan City, Dong Hu Road, No.169

zn002649@whu.edu.cn

**Abstract.** With the continuous development of China's economy, the energy-efficient building and green building initiative of China has increasingly become the concern of people at home and abroad, inside and outside the industry. Firstly, this paper analyses and compares the application background of two green certification systems, LEED in the United States and GBES in China. Then, we study the annual number, regional distribution, level distribution and regional distribution of professional certification personnel of GBES and LEED certification programs. The results show that the number of green certification projects in China is increasing rapidly yearly, but there are some regional differences. The overall certification level is 2 star (gold level), and there's no match for the green program for the less qualified professional. Based on the above situation, this paper puts forward corresponding development suggestions. Firstly, on the basis of policy and financial support, the comprehensive development of green certification programs will be gradually promoted from the developed regions to the developing regions and from the south to the north. Secondly, we should promote the development of two-star (gold) certification programs with moderate incremental costs and good ecological benefits. Finally, it is necessary to fully introduce and increase the number of professional certification personnel and consulting agencies of certification.

## 1. Introduction

With the decreasing labefaction of our environment, the useable fresh water is facing pollution and becoming the exhausted in the large-scale, the amount of energy consumed is increasing, and the amount of CO<sub>2</sub> emitted into the atmosphere every year is growing at a higher rate<sup>[1]</sup>. Facing the great pressure of environment, energy and resources green building has become the focus of attention of the international community. According to the research data, about 50% of the world's resources are used for buildings, and 50% of the solid waste generated is also from buildings. Buildings and construction-related energy consumption (such as cement, steel, glass and other building materials industry energy consumption) accounted for 46.7% of the world's total energy consumption. About 40% of the world's CO<sub>2</sub> emissions come from buildings<sup>[2-3]</sup>.

Making great efforts to promote green building development is one of the most effective ways to relieve the pressure of environment, resources and energy at present<sup>[4]</sup>. Since the 20th century, many countries and regions have vigorously developed green building certification system in order to promote the rapid development of green building. For example: Britain put forward



BREEAM(Building Research Establishment's Environmental Assessment Method)in 1990, LEED 1.0(The Leadership in Energy and Environmental Design Green Building Rating System)version proposed by the US in 1998, Japan put forward CASBEE(Comprehensive Assessment System for Building Environmental Efficiency ) in 2001. GREEN STAR was proposed by Australia in 2003. Altan and Nguyen<sup>[5]</sup> point out the American LEED standard is relatively perfect, and it is one of the most advanced and practical green building certification scoring systems in the world.

The existing stock of buildings in China is large, while many new building are being built. The pressure on China's development is far greater than that of developed countries in terms of environment, energy and resources. According to statistics, cement and steel are important production resources, while China consumes 40% of the world's cement and steel every year. Energy consumption in China is about 15% higher than that in developed countries. China's carbon emissions are basically synchronized with the world, while 40% of CO<sub>2</sub> emissions come from buildings<sup>[6]</sup>.

Faced with the deterioration of ecological environment and the rapid development of construction industry, in 2006, China proposed GBES(Green Building Evaluation System)which is widely applicable to all kinds of buildings based on LEED and other standards of the United States. The standard is set up to actively promote the development of green buildings in China and alleviate the deterioration of the ecological environment. It is based on the life cycle of building, through multi-level and multi-objective comprehensive evaluation of green building national standards, specifically defined the connotation of China's green building, technical specifications and evaluation standards<sup>[8]</sup>.

At present, the two most widely used green building certification systems in China are LEED and GBES. Based on the analysis of GBES and LEED certification systems, this paper analyzes the status quo of LEED and GBES certification projects, discusses the development of green certification projects and puts forward some suggestions for the development of green certification projects in order to further promote the development of green certification projects in China.

## 2. Analysis of LEED and GBES green certification system

Through the analysis of LEED and GBES certification system, it is easy to understand their evaluation content, clear the appropriate relationship between the two certification levels, and provide a theoretical basis for statistical analysis of the development status of green certification projects.

### 2.1. LEED and GBES evaluation contents

LEED includes LEED-NC (applies to new buildings), LEED-CS (applies to owners and tenants to develop together), LEED-CI(applies to interior decoration of commercial buildings), LEED-ND(applies to community development),LEED-EB(applies to existing building operation management), LEED-FOR SCHOOLS and many other sub evaluation systems. The core and most commonly used evaluation contents in LEED-NC include 6 aspects: ①sustainable site, ②utilization efficiency of water resources,③atmosphere and energy, ④materials and resources utilization,⑤ indoor environment quality,⑥design and innovation.

GBES includes two sub-evaluation systems ,one is GBES\_RB(applies to residential construction) the other one is GBES\_PB(applies to public buildings). GBES\_RB has the most extensive application, including six aspects: ①conservation and outdoor environment,②water conservation and utilization of water resources,③energy conservation and energy utilization,④material saving and utilization,⑤ indoor environment quality,⑥operations management.

GBES is mainly drawn from LEED and combined with China's national conditions. GBES is similar to LEED, for example: the evaluation contents ①—⑤ of GBES\_RB are similar to those of LEED-NC, but GBES\_RB and LEED\_NC are different in the evaluation contents ⑥. LEED-NC is design and innovation, and GBES\_RB is operation management in China. In contrast, China's GBES\_RB reflects the building life cycle assessment, covering the operation and management stage after the completion of the project.

## 2.2. Approximate relationship between LEED and GBES certification level

The common point of the two systems of LEED and GBES is to evaluate and authenticated by using the grading evaluation method. The difference between them is that LEED is a four-level certification system that is divided into certification, silver, gold and platinum, while GBES is a three-level certification system that is divided into one star, two star and three star. The analysis shows that the overall level of one-star GBES is between the LEED certification level and the silver level. The overall level of two-star GBES is similar to the LEED gold level, and the three-star GBES is similar to the platinum level.

## 3. Development status of green certification projects in China

By analyzing the annual number, regional distribution and level distribution of LEED and GBES certification projects in China, it is easy to understand the development status of green certification projects in China, and to clarify the development status of green building certification projects in China, and help to put forward corresponding development proposals<sup>[7]</sup>.

### 3.1. Current status of China's GBES certification program

GBES was officially promulgated in China in 2006, and the certification system was officially implemented in 2008. According to statistics, by the beginning of 2012, there had been 353 projects accredited by GBES. From the beginning of 2012 to the end of 2013, 660 construction projects in China were approved by GBES. Limited to statistical data, this article mainly carries on the statistical analysis to 353 authentication items before 2012.

3.1.1. Numbers of GBES certified projects per year. According to statistics<sup>[9-10]</sup>, China's green certification program began to appear in 2008, and the total number of GBES certification programs and the number of projects at the three evaluation levels all showed a rapid growth trend, as shown in figure 1.

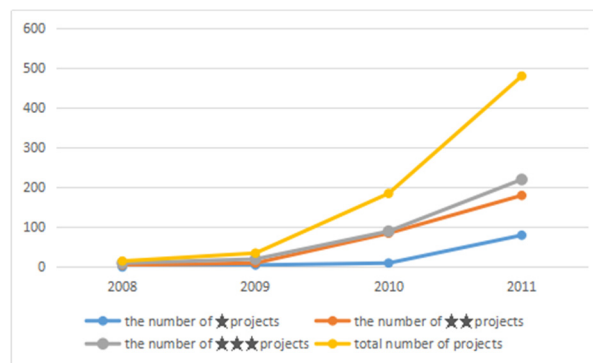


Figure 1 Numbers of GBES certified projects per year

3.1.2. Regional distribution of GBES certification project. According to statistics<sup>[9-10]</sup>, The degree of application of GBES authentication in southern China is much higher than that in the north. In developed and internationalized regions of China, more attention has been paid to the promotion of GBES certification projects. The scale of GBES certification projects is large, especially in Beijing, Tianjin, Shanghai, Guangdong, Zhejiang and Jiangsu provinces. The distribution in northern and southern parts of China is shown in figure 2 and 3.

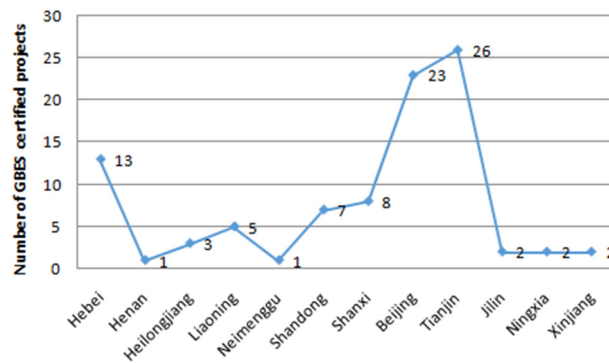


Figure2 Distribution of GBES certification projects in northern China

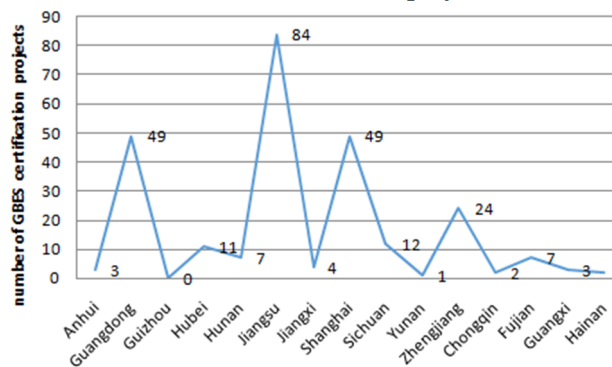


Figure 3 Distribution of GBES certification projects in southern China

3.1.3. *Level distribution of GBES certification projects.* According to statistics<sup>[9-10]</sup>, the percentage of the three evaluation levels in China's GBES certification projects is shown in Figure 4. The proportion of GBES two-star certification projects is the largest.

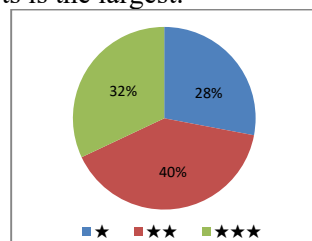


Figure4 Percentage of each level of GBES Certification Project

### 3.2. Current status of LEED certification projects in China

3.2.1. *The number of LEED certified projects per year .* Since LEED entered the Chinese market in 2005, it has developed rapidly and gained high recognition. According to the statistic data<sup>[11]</sup>, the annual trend of the number of LEED certified platinum projects, gold projects, silver projects, certified projects, unqualified projects and LEED certified projects is shown in figure 5. From 2009 to 2012, it showed a rapid growth trend.

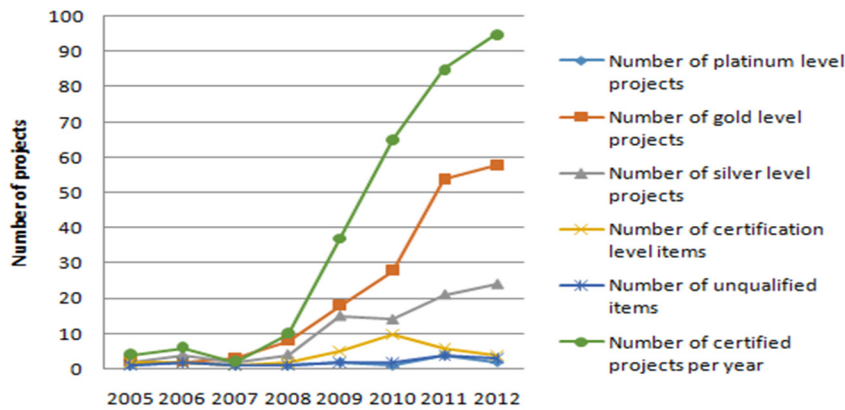


Figure5 LEED certification project and its number of projects at all levels

3.2.2. *Area distribution of LEED certification programs.* According to statistics<sup>[11]</sup>, the implementation and recognition degree of LEED certification varies greatly in different regions of China, and the application degree of LEED in southern regions is much higher than that in northern regions. The six regions of Beijing, tianjin, Shanghai, guangdong, zhejiang and jiangsu are among the top in terms of national GDP due to their advanced economy and rapid development of urban construction. They have a high degree of internationalization vision openness and high recognition of LEED. LEED certification programs have developed relatively mature in the certification market in these six regions. The specific distribution of LEED certification projects in north and south China is shown in figure 6 and 7.

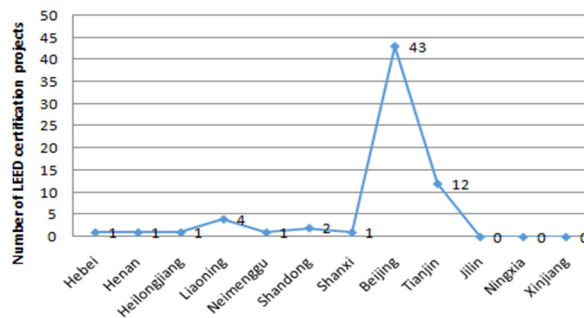


Figure6 Distribution of LEED certification projects in northern China

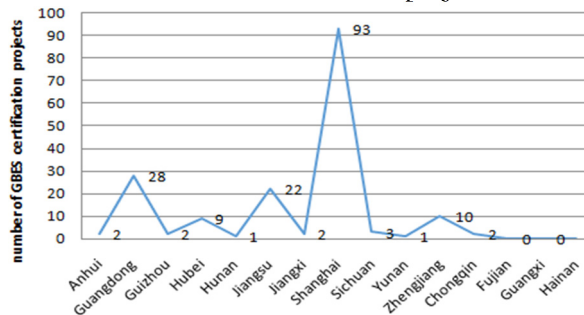


Figure7 Distribution of LEED certification projects in southern China

3.2.3. *Level distribution of LEED certification programs.* There are four levels of LEED certification in China. According to the statistics<sup>[11]</sup>, the percentages of four certification grades and unqualified items are shown in figure 8, among which gold LEED project certification is the most.

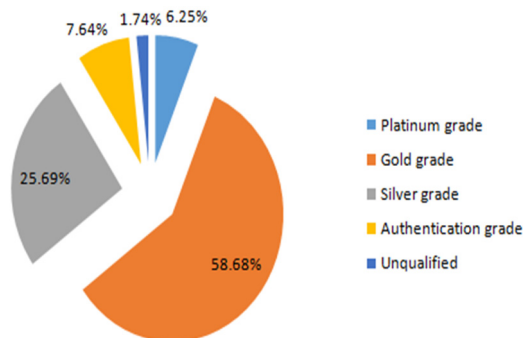


Figure8 LEED percentage of projects at all levels

3.2.4. *The area distribution of LEED professional certification personnel.* There must be professional involvement in the LEED certification of the project, and LEED AP (professional certification personnel) participation is critical to promoting the comprehensive development of the LEED certification program. According to relevant data[12], there are now 846 LEED AP in China, and the distribution of LEED AP in various regions of China is shown in figure 9.

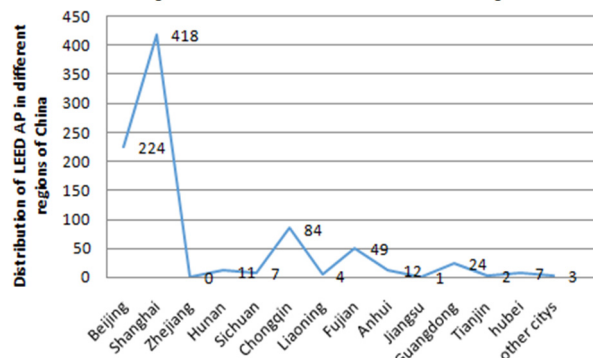


Figure9 Distribution of LEED AP in different regions of China

#### 4. Analysis and suggestions on the development of green certification projects

By analyzing the annual number of projects, regional distribution, level distribution and regional distribution of professional certification personnel of GBES and LEED certification programs in China, the aim is to clarify the development status of green certification programs in China and put forward corresponding development suggestions.

##### 4.1. Regional development status analysis and suggestions

A comprehensive analysis of the annual number and regional distribution of GBES and LEED certification projects shows that the number of green certification projects in China is increasing year by year, and the development is very rapid. And in such metropolises as Beijing, Shanghai, Tianjin, Guangdong, Zhejiang and Jiangsu, which are economically developed and highly internationalized, the development is more mature.

However, due to the level of economic development in various regions, the concept of sustainable development, the degree of internationalization, interdisciplinary research is not popular, and developers worry about the high cost of green building factors, the development of green certification projects show a certain regional differences. Green certification projects in economically developed and internationalized areas (such as Beijing and Shanghai) are far greater than those in economically developed and less internationalized areas (Guizhou and Xinjiang). The number of green certification projects in southern cities of China is far greater than that in northern cities.

Faced with the imbalance of regional development, government support should be strengthened in areas with low level of economic development and low degree of internationalization, a strong

economic subsidy mechanism should be formulated encourage developers to actively develop green certification projects and raise awareness of them.

It is highly recommended that our country should encourage the successful experience of green certification projects from economically developed areas to economically developed areas, from the south to the north, as far as possible, so that the concept of green building covers all buildings, all regions, and ultimately achieve the overall development of green certification projects.

#### *4.2. Analysis and suggestions on the development status of certification level*

Comprehensive analysis of GBES and LEED certification project level distribution status, we know that the current two-star GBES certification projects and LEED certification projects account for the largest proportion of the gold. Because LEED's gold certification project and GBES's two-star certification project have the same collation level, the overall certification level of China's green certification project is in two-star (gold).

Generally speaking, the overall certification level of green certification projects in China is more reasonable, mainly because the incremental cost of three-star and LEED certification projects is higher. The GBES certification project has lower ecological benefits of silver grade and certification level for one star and LEED certification projects. The incremental cost and ecological benefits of the two star (gold class) are moderate. Based on the unbalanced economic and social development in China, we should advocate the development of two-star certification projects, maintain and gradually promote three-star (platinum) certification projects, while reducing one-star (silver and certification) certification projects.

#### *4.3. Analysis and suggestions on the development of professional certification personnel*

By analyzing the regional distribution of professional certifiers in LEED and GBES certification projects, the contradiction between the rapid development of green certification projects and the lack of professional certifiers is obvious. GBES lacks a professional certification personnel training system, and the certification of professional personnel is just starting, so it is not yet possible to statistics about the specific regional distribution of professional certification personnel. In addition, GBES 'assessment experts and professionals still lack experience in green certification programs, and practitioners still lack knowledge and experience in technology. In view of this situation, by referring to foreign professional certification personnel training and certification examination system, China can further improve the GBES certification institutions and professional certification personnel training and assessment mechanism, to alleviate the conflict between the rapid development of green certification programs and the lack of GBES professional certification personnel.

As far as LEED is concerned, there are 846 LEED AP professionals in China. Most of them are concentrated in Shanghai and Beijing. This shows that there is a great lack of LEED AP in China.

## **5. Introduction**

Based on the analysis of GBES and LEED certification system, it is found that GBES and LEED have a certain similarity in the evaluation content. The overall level of GBES one star is between LEED certification grade and silver grade, the overall level of two-star is approximately LEED gold grade, and the overall level of three-star is approximately platinum grade.

By analyzing the annual number of projects, regional distribution, level distribution and regional distribution of professional certification personnel of LEED and GBES certification programs in China, this paper finds that the number of green certification programs in China is increasing rapidly year by year. However, due to the influence of economic development level and internationalization level, the development of green certification projects presents certain regional differences.

In view of the current status of green certification projects in China, this paper proposes the following development suggestions: Firstly, on the basis of policy and financial support, we should gradually promote the overall development of green certification projects from the developed economy to the developing regions and from the south to the north. Secondly, We should advocate

vigorously developing two-star (gold) certification projects with moderate incremental cost and good ecological benefits, gradually promoting three-star (platinum) certification projects, and reducing one-star (silver and certification) certification projects. Thirdly, the training and assessment mechanism of professional certification personnel should be improved, and the number of professional certification personnel and certification consultation institutions should be introduced and increased in China.

## References

- [1] Nguyen H T, Skitmore M, Gray M, et al. Will green building development take off? An exploratory study of barriers to green building in Vietnam[J]. *Resources Conservation & Recycling*, 2017, 127:8-20.
- [2] Zhao H X, Magoulès F. A review on the prediction of building energy consumption[J]. *Renewable & Sustainable Energy Reviews*, 2012, 16(6):3586-3592.
- [3] Chang C, Zhu N, Yang K, et al. Data and analytics for heating energy consumption of residential buildings: The case of a severe cold climate region of China[J]. *Energy & Buildings*, 2018.
- [4] Guy R, Newsham S M B J. Do LEED-certified buildings save energy Yes, but[J]. *Energy and Buildings*, 2009, 41: 897-905.
- [5] Binh K, Nguyen H A. Comparative review of five sustainable rating systems [J]. *Procedia Engineering*, 2011, 21: 376-386.
- [6] Xiaoling Zhang A P L S. Green property development practice in China:Costs and barriers [J]. *Building and Environment*, 2011, 46: 2153-2160.
- [7] Chen S, Li N, Guan J. Research on statistical methodology to investigate energy consumption in public buildings sector in China[J]. *Energy Conversion & Management*, 2008, 49(8):2152-2159.
- [8] Zhang Y, Wang J, Hu F, et al. Comparison of evaluation standards for green building in China, Britain, United States[J]. *Renewable & Sustainable Energy Reviews*, 2017, 68:262-271.
- [9] Tan Z, Liu Z, Xiao G, et al. Introduction for Singapore Green Mark Certification Standard and Green Mark Assessment Criteria[J]. *Construction Technology*, 2011.
- [10] <http://www.mohurd.gov.cn/>.
- [11] LEED Project Directory[EB/OL] <http://www.gbci.org/main-nav/building-certification/registered-project-list.aspx>.
- [12] GBCI: My Credentials[EB/OL] <https://ssl111.cyzap.net/dzapps/dbzap.bin/apps/assess/webmembers/tool>