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A comprehensive analysis of the credits obtained by LEED 2009 certified green buildings

Peng Wu[a,*], Yongze Song[b], Wenchi Shou[b], Hunglin Chi[b], Heap-Yih Chong[a], Monty Sutrisna[a]

[a] Department of Construction Management, School of Built Environment, Curtin University, Australia
[b] Australasian Joint Research Centre for Building Information Modelling, Curtin University, Australia

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ABSTRACT

The concept of green building has gained rapid recognition recently. Developed by the U.S. Green Building Council, the Leadership in Energy and Environmental Design (LEED) is one of the most successful green building rating systems. Understanding the performance of LEED certified buildings on various LEED credits is therefore important for practitioners and regulatory authorities. This paper analyses the use of LEED 2009 and investigates the credit allocation pattern of 3416 LEED 2009 certified projects. The results show that compared to its previous version LEED v2.2, the point chasing problem in innovation related credits is mitigated. However, energy-related and material-related credits remain difficult for developers to obtain. LEED 2009 certified projects perform differently in water efficiency at the country level. At the state level, the projects perform differently in water efficiency, energy and atmosphere, material and resources, as well as indoor environmental quality. Varied credit achievement patterns are also identified on cross-certification and cross-sector levels. The study offers a useful guidance for practitioners to achieve relevant certification levels and for regulatory authorities to continuously improve the rating system.

1. Introduction

The concept of green building has gained rapid acknowledgement over the past few years. Due to the rising recognition of sustainable development, buildings with energy efficient designs and advanced integrated technologies to cut the energy demand and consumption are increasingly preferred when compared to conventional buildings [16]. According to the United States Green Building Council [38], there are over 74,500 commercial projects registered with the Leadership in Energy and Environmental Design (LEED), which is one of the most popular green building rating systems, in more than 155 countries and territories. LEED certified buildings are believed to have superior environmental performance, such as reduced energy consumption, carbon emissions and operating budgets, as well as less affected by economic downturn [8]. According to [27], green buildings can save up to 13.6% operating budgets. [35] also reported that a typical LEED certified building uses 32% less electricity and reduces annual average carbon emissions by 350 metric tons. Incentive schemes such as tax exemption and financing scheme are usually available for green building projects in many countries [17].

Green building rating systems are designed to assess and evaluate the life cycle performance of buildings. The ratings systems normally use the whole building as the evaluation entity. These rating systems are referred to as the whole-building rating systems, e.g. the LEED and the Green Globes. Among the whole-building rating systems, the LEED, developed by the U.S. Green Building Council, is the most commonly used whole-building rating system around the world [42]. LEED includes six main categories, all of which carry a specific amount of rating credits. For example, energy efficiency is considered as one important attribute in LEED due to the imperative need for energy savings [30]. Different certification levels, from LEED Certified, LEED Silver, LEED Gold to LEED Platinum, can be issued to the project in proportion to the amount of points that are obtained by the project [42]. According to [11,11], LEED is a globally accepted benchmark for the design, construction and operation of high-performance green buildings. Given the importance of LEED to the development and promotion of green building, many studies have been conducted on analysing LEED credits obtained by certified projects so as to refine current rating practices and guide future development. For example, [11,11] reviewed the LEED credits obtained by Canadian building projects and found that energy and atmosphere (EA) and materials and resources (MR) had the lowest credit achievement degree. [25] used a measurement called the percentage of average score (PAS) to analyse how individual credits were attained in previous LEED certified projects and found that credits like materials reuse and rapidly renewable materials were rarely achieved. [43] analysed the credit

* Corresponding author.

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allocation pattern in LEED version 2.2 (hereinafter referred to as LEED v2.2) and found that there are sector-specific considerations when developers and contractors intend to extend their previous LEED practices to other sectors. However, these studies use limited sample size and outdated LEED version. As LEED v2.2 has reached its certification sunset date, these analyses offer limited guidance at a practical level on how to prepare certification documentation and enhance the chances of being awarded with a desired rating. Therefore, this paper aims to: (1) investigate the percentage of credits obtained by LEED 2009 certified projects in each main assessment category; (2) investigate the allocation of credits in LEED 2009 over a few parameters, including project landscape, certification level, certification year and project sector; and 3) provide useful recommendations for practitioners because credits awarded in the past can offer insight into credit implementation in future projects with similar goals. The main contribution of this study is to critically analyse the USGBC databased of LEED 2009 certified projects which can help developers understand the rating systems and obtain relevant certification levels. In addition, this study also assesses the allocation of LEED 2009 credits over many parameters, such as location, certification level and certification time which can help USGBC and other regulatory authorities understand the performance of the rating system and achieve continuous improvement.

2. Overview of LEED

LEED is a voluntary consensus standard developed by the U.S. Green Building Council (USGBC) for developing sustainable buildings that have superior performance in the areas of sustainable site development, water savings, energy efficiency, materials selection and indoor air environmental quality [39]. According to [5], by the end of April of 2007, the LEED certification scheme was comprised of 7500 companies and organization members, validating its importance as the standard environmental performance measure of a building. The LEED certification scheme has become a reference system for the design, construction, and operation of green buildings beyond the U.S. [29,46]. It is proved that LEED branding has a positive effect on occupants' pro-environmental behaviour [23]. Like many other environmental rating systems, the LEED rating is based on credit allocation where credits can be allocated to six categories, including sustainable sites (SS); water efficiency (WE); energy and atmosphere (EA), material and resources (MR); indoor environmental quality (IEQ) and innovation (INNO). Through each credit, the system evaluates the performance of the candidate building and awards points if the requirements are reached in the above six categories [7].

There are two major versions of LEED, including LEED v2.2 and LEED 2009. LEED v2.2 was approved by the USGBC in 2005 and the first set of building were accredited in 2007. Since its inception, LEED v2.2 has been widely used globally and has accredited more than 5000 projects. Through the application, many problems are also identified. For example, [21] argued that there are many concerns relating to whether LEED leads to sustainable buildings as one of the major pillars in sustainability, i.e. social consideration, is missing from the current system. [3] found that almost 25% of LEED credits are allocated to site-related sustainability, which can be a limit when town-planning constraint does not allow the selection of most suitable sites for development. [42] found that, unlike other green building rating systems such as the Green Globes, LEED does not have project management process or framework that guides the green building development process. Zimmerman and Kibert [45] argued that LEED is a "one-size-fits-all" assessment tool which is used to assess every size of building from small office buildings to skyscrapers and to assess buildings located in any bioregion. One of the biggest changes from LEED v2.2 to LEED 2009 is the re-allocation of points. According to [36], the re-allocation ensures that the point allocated will reflect its potential to either mitigate the negative or promote positive environmental impacts of a building. Table 1 summarizes the re-allocation of points in main LEED credits. According to [32], the weighting system of LEED 2009 displays a significant improvement when compared to LEED v2.2, where almost each credit counted as merely 1 point and their sum made up a total of 69 points. As each credit does not contribute to decreasing environmental loads at the same level, the points allocated to credits should not be the same in the rating system. As such, LEED 2009 is believed to have a more justified evaluation approach based on stronger scientific data.

Table 1
A summary of the re-allocation of LEED points.
(Source: [43]

Assessment area	Green rating systems		Percentage change
	LEED v2.2	LEED 2009	
Sustainable sites	14 (20.3%)	26 (23.6%)	+3.3%
Water efficiency	5 (7.3%)	10 (9.1%)	+1.8%
Energy and atmosphere	17 (24.6%)	35 (31.8%)	+7.2%
Material and resources	13 (18.8%)	14 (12.7%)	−6.1%
Indoor environmental quality	15 (21.7%)	15 (13.6%)	−8.1%
Innovation	5 (7.3%)	6 (5.5%)	−1.8%
Regional priority credits	Not applicable	4 (3.7%)	+3.7%
Total points available	69 (100%)	110 (100%)	

In order to address previous critique that LEED does not consider local factors, the 2009 version also includes two innovations: alternative compliance paths (ACPs) and regional priority (RP) points. According to [37], alternative compliance paths are developed to recognize regional differences while achieving the same credit intent and requirements. For LEED 2009 Building Design + Construction, there are currently three ACPs designed for East Asia, Europe and South America respectively. LEED 2009 also introduces regional priority points to incentivize the achievement of credits that address geographically specific environmental priorities. According to [43], RP points are not new points, but instead are bonus points. LEED 2009 provides a maximum of 4 bonus RP points to reward the achievement of priority areas such as energy and water conservation [32].

Many studies have been conducted on analysing the LEED rating system and its efficacy in improving the environmental performance of buildings. Through the analyses, many issues are identified. For example, the Environmental Policy Alliance [13] found that large privately-owned buildings in Washington D.C. certified by LEED use more energy than uncertified buildings. According to the Environmental Policy Alliance [13], the energy use intensity, a unit of measurement that represents the energy consumed by a building relative to its size, of LEED certified buildings was 205, compared to 199 for non-LEED certified buildings. In addition, [40,40] found that LEED has no credits on human health factors in deciding whether a building meets its environmental and social goals. One of the major issues is that LEED has been criticized as pro forma and is more about earning points than improving the environmental performance [20]. This can lead to a game of point chasing, i.e. the tendency of applicants to chase the easiest points to obtain, which can undermine the intent of the program. As such, many studies have been conducted to investigate the credit allocation of LEED certified projects in order to continuously improve certification credits and processes. For example, through a comprehensive analysis of all LEED certified projects until 2007, Cidell [10] found that the credits gained by LEED certified buildings vary significantly from place to place, indicating that local factors are important in LEED. As such, LEED 2009 has introduced ACPs and RP points to address the issue of spatial variation. [15,15] found that there are significant clusters of projects on the lower thresholds of each level, indicating organizations seeking certification seek to minimize the effort and expense necessary to achieve the certification level they aspire to. As such, continuous improvement is required for LEED to be