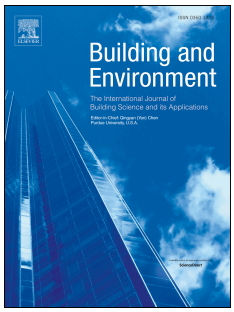
Accepted Manuscript



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PII: S0360-1323(17)30293-7

DOI: 10.1016/j.buildenv.2017.07.007

Reference: BAE 4986

To appear in: *Building and Environment*

Received Date: 13 April 2017

Revised Date: 5 July 2017

Accepted Date: 5 July 2017

Please cite this article as: Doan DT, Ghaffarianhoseini A, Naismith N, Zhang T, Ghaffarianhoseini A, Tookey J, A critical comparison of green building rating systems, *Building and Environment* (2017), doi: 10.1016/j.buildenv.2017.07.007.

A CRITICAL COMPARISON OF GREEN BUILDING RATING SYSTEMS

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Abstract
Various green rating systems are established globally to evaluate the sustainability of construction projects. Their categories and criteria have been under constant updates to follow the sustainable trend of building development. This paper aims to develop a systematic review of the development of green rating systems. The specific objectives are: 1) discover how interest and research in green rating systems have developed; 2) identify the similarity, difference, strength and weakness of green rating systems; 3) examine whether they fully assess the projects in all aspects of sustainability. *Specifically, LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Assessment Method), CASBEE (Comprehensive Assessment System for Building Environmental Efficiency) and Green Star NZ were analysed in this paper. The results indicate that BREEAM, LEED, and CASBEE have been utilized since late the 2000s while Green Star NZ is still in its earlier stages. 70% of the research papers focusing on BREEAM, LEED, CASBEE are developed geographically in the USA, Canada, the UK, China, and Australia. Although these four rating systems were initiated in different contexts with different standards, Indoor Environment Quality, Energy, and Material are core common categories for all. Environmental concerns are the main focus in New Construction manuals while Society is emphasized in Neighbourhood Development manuals. Currently, BREEAM has been the only tool which could assess all four sustainable factors. Further in-depth research is anticipated to focus more on economic and institutional factors to improve the capability of green rating systems for sustainability assessment purposes.*

Keywords: *Green Rating Systems, Sustainability, BREEAM, LEED, CASBEE, Green Star NZ*

1. INTRODUCTION

The construction industry plays an important role in satisfying the needs of society, enhancing the quality of life [1-3], and contributing to the economic growth of a country [3-6]. However, it has been heavily criticised for being a major contributor to carbon emissions, environmental degradation, and global warming [7-11] due to its utilization of a large proportion of natural resources and energy consumption [11-14]. The building sector consumes a third of global resources [15, 16], one sixth of global freshwater withdrawals [17], 25% of wood harvested [16], and 40% of all raw materials [16]. Approximately 10% of all global energy supply takes place during the manufacturing of building materials [10, 15]. Also, the building sector generates a large amount of construction and demolition waste, accounting for 40% of total solid waste in developed countries [18-20]. Moreover, the construction industry is responsible for major energy consumption, accounting for 40-50% of all energy usage and anthropogenic greenhouse gas emissions globally [21-25].

Recognizing the importance of sustainable building practices, “going green” and “environment sustainability” has been introduced for many years [10, 26]. However, construction is still a major energy consumer based on official statistics [10]. This could be due to the passive attitude of construction practitioners towards adopting sustainable solutions [7]. Facing the rising energy costs and growing environmental concerns, the demand for sustainable building facilities with minimal environmental impact has been pushed recently [27-29].

Authorities and organizations initiated the rating systems for green buildings to minimize/optimize consumption of natural resources and control pollutions. Buildings certified by those rating systems are considered as consuming less energy, providing a better living environment and contributing to the overall reputation of the property [30]. It is estimated that there are approximately 600 green rating systems globally [31]. BREEAM (Building Research Establishment Assessment Method) is known as the first rating tool to assess building performance based on certain target values for different criteria [32-34]. In addition, numerous schemes such as the United States’ LEED (Leadership in Energy and Environmental Design), Canada’s LEED Canada, France’s HQE (High Environmental Quality), Germany’s DGNB (Deutsche Gesellschaft für Nachhaltiges Bauen e.V.), Australia’s Green Star, New Zealand’s Green Star, Japan’s CASBEE (Comprehensive Assessment System for