

## **A Comparative Study of Green Building Rating Systems**

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### **Abstract**

Harmful activities of the modern lifestyle to the environment have resulted into such chaos that the minimization of their negative impacts seems inevitable. Although there is no agreement on the concept of sustainable development among scientists, a variety of rating systems have been introduced to satisfy the sustainable construction criteria during recent years. There are different attitudes towards sustainable development in different countries around the globe and different approaches were adopted to reach different priorities. Also, different socio-economic, cultural, and climatic conditions of countries have caused some differences in the rating systems. However, the aim of all the rating systems is to achieve sustainable development in environmental, socio-economic, and cultural aspects. They mostly involve issues such as energy and resource efficiency, management, design, and materials. The aim of this study is to review and compare the major green building rating systems. For this purpose, the prerequisites of the rating systems, their weaknesses and strengths, scoring systems, and weightings are described and compared with one another through charts, tables, and graphs. The results of the study are expected to assist researchers in the development of a comprehensive green building code.

### **Keywords**

Green Building Rating System, Sustainable Development, Green Building Code

### **1. Introduction**

The need for more sustainable and environment-conscious construction practices has led modern societies to propose guidelines to encourage innovative measures in these areas. These guidelines, which are used to “rate” buildings, cover a set of sustainability issues which might otherwise be individually dropped or missed.

Usually, building codes are required to be met by building developers but a green building philosophy encourages designers to go beyond the conventional codes and employ their own innovations to improve a building's performance, reduce the life-cycle cost and environmental impact, and increase efficiency to meet the aforementioned needs. While these ideas have evolved from their raw and basic stages to more conventional formats, the decreased cost of implementation has resulted in the growth of such practices.

Green building rating systems provide a framework to assess the overall design in terms of sustainable requirements. There are a lot of such rating systems around the world. In this study, two major green building rating systems, namely Building Research Establishment Environmental Assessment Method (BREEAM) and Leadership in Energy and Environmental Design (LEED), along with the current system in Malaysia, dubbed the Green Building Index, will be reviewed and compared.

## 2. BREEAM 2008

In 1990 one of the first environmental performance building assessment systems was developed by the British Research Establishment. Since then, BREEAM (Building Research Establishment Environmental Assessment Method) has evolved from a design checklist to a comprehensive assessment tool to be used in various stages of a building's life cycle. This rating system is recognized by the U.K. building industry as the benchmark for assessing environmental performance.

Variations of BREEAM were developed by Canada, Australia and several European countries by adjusting the criteria based on the local environmental requirements. BEPAC (Building Environmental Performance Assessment Criteria), BREEAM Canada and BREEAM Green Leaf are examples of such efforts.

### 2.1.Overview

Since 1 August 2008, BREEAM 2008 has replaced BREEAM 2006 for building assessment. In the new version, a new rating was added for scores over 85% of "Outstanding". In order to get rated, not only does the building need to gain 85% of the score, but there are minimum requirements in several individual criteria and the information on the building has to be published as a case study.

**Table 1: BREEAM Rating System Scoring**

<b>BREEAM Rating</b>	<b>% Score</b>
Unclassified	< 30
Pass	≥ 30
Good	≥ 45
Very Good	≥ 55
Excellent	≥ 70
Outstanding	≥ 85

The other major change was the introduction of "Innovation" credits. These credits enable the rating system to evaluate the innovative design ideas which were not taken into consideration in the criteria. For each innovation in which accreditation is sought and approved, 1% is added to the overall score.

## **2.2.Mandatory credits**

Minimum levels have been set at all ratings for some criteria, the onus of which increases as the rating rises. The minimum percent for each rating band is still required to be met.

To gain a Pass (30%), three compulsory criteria should be taken into consideration, including Commissioning (Man 1), High Frequency Lighting (Hea 1) and Microbial Contamination Control (Hea 12). These are the basic criteria that should be met before getting into the rating process in BREEAM 2008.

In addition to the aforementioned criteria, Water Consumption Control and Water Meter Installation are the points needed to get a Good (45%) credit. These two criteria are under the subcategories of Wat 1 and Wat 2 respectively.

Two other criteria, namely Sub-metering of Substantial Energy Uses (Ene 2) and Mitigating Ecological Impact (LE 4), should be added to the previous points to qualify the project for a Very Good (55%) rank.

In order to earn an Excellent (70%) rank, a minimum of 6 points from the following categories must be obtained: Considerate Constructors (Man 2), Building User Guide (Man 4), Low or Zero Carbon Technologies (Ene 5), Storage of Recyclable Waste and Reduction of CO<sub>2</sub> emissions (in Ene 1 i.e. an EPC of 40 or less for a new built office).

To get the new rating of Outstanding, a score of 85% must be earned in addition to meeting the above criteria and earning at least 10 points among a host of new criteria. This new set of criteria includes: Commissioning (Man 1), Considerate Constructors (Man 2), Water Consumption (Wat 1), and Reduction of CO<sub>2</sub> Emissions (ie. an EPC of 25 or less for a newly built office).

In addition, the building now has to have a Post Construction Review (before these were not mandatory unless the client required them). A BREEAM assessment made at stage D is now known as a DS (design stage) assessment and is an interim stage towards final certification. It will not be possible to value engineer out the BREEAM features between design and completion without getting penalized.

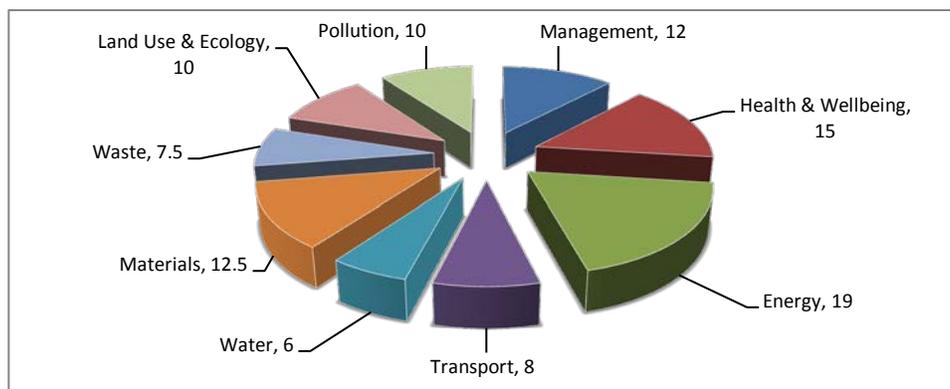
## **2.3.Weightings**

The baseline BREEAM scheme used for comparison is Offices. There are slight differences between schemes. Now, energy accounts for 19% of the total (an increase) and water accounts for a slightly larger slice of the pie.

Waste is a new section, meaning when added to Materials, there is a much greater focus on embodied energy, with Management, Land Use and Ecology and Pollution now accounting for a relatively smaller percentage of the overall score.

**Table 2: BREEAM Rating System Weighting**

BREEAM 2008	Weighting	Credits
Management	12	10
Health & Wellbeing	15	13
Energy	19	24
Transport	8	10
Water	6	6
Materials	12.5	13
Waste	7.5	7
Land Use & Ecology	10	10
Pollution	10	12
	100	105



**Figure 1: BREEAM Rating System Weighting**

Reusing or recycling façade and structure elements reduces the embodied energy of the building but at the same time impoverishes them in terms of quality and performance. On the other hand, for obvious reasons, new buildings cannot receive these credits. Therefore, it is almost impossible to gain 100% in BREEAM.

A 1% innovation credit number makes sense when you look at what credits are now worth. The spread between points has been narrowed. The mean percentage value of one credit is 0.95%, top value is 1.20% and bottom 0.79%. This is more evenly distributed than BREEAM 2006 (1.08%, 1.5% and 0.81%).

### **3. Leadership in Energy and Environmental Design (LEED 2009)**

LEED rating system was developed by the U.S. Green Building Council (USGBC) in North America in order to expedite the adoption of green building practices. The LEED rating system has gained a lot of momentum since Version 2.0 was released in March 2000. Since August 2004, about 1,450 projects have been registered for LEED certification.

LEED was originally developed as a rating system for new commercial buildings but has become a model for other building sectors and regulatory programs. LEED rating systems for existing buildings, commercial and non-residential buildings were subsequently developed based on the new requirements. LEED is also being adapted by federal agencies, states and local jurisdictions in the U.S. and Canada for the implementation of green building programs. An estimated \$15 billion worth of green buildings are in design or under construction in the U.S., representing 12% to 15% of total public construction and 2% of private construction.

### 3.1.Overview

LEED 2009 replaced LEED 2.0 on 27 April 2009. All discussion which follows refers to LEED-NC (new construction). There are small differences for the other schemes. Unlike BREEAM, LEED is a points rather than percentage system. There are 100 base points, 6 possible Innovation in Design and 4 Regional Priority points.

**Table 3: LEED Rating System Scoring**

LEED Rating	Points
Certified	40 - 49
Silver	50 – 59
Gold	60 – 79
Platinum	80 and above

### 3.2.Prerequisites

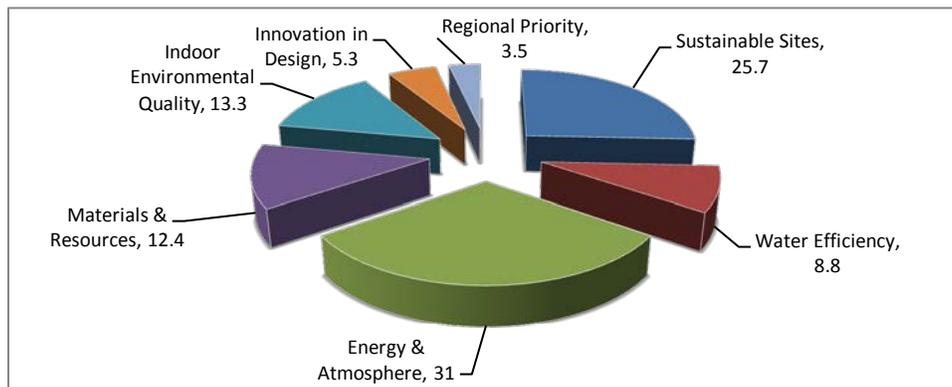
LEED introduced prerequisites before BREEAM’s mandatory credits. Prerequisites to qualify the project for being rated by LEED include SSP1 – Construction Activity Pollution Prevention in the area of Sustainable Sites, WE1 – Water Use Reduction in the area of Water Efficiency, EAP1 – Fundamental Commissioning of Building Energy Systems, EAP2 – Minimum Energy Performance and EAP3 – Fundamental Refrigerant Management in the category of Energy and Atmosphere, MRP1 – Storage and Collection of Recyclables from the category of Materials and Resources and EQP1 – Minimum Indoor Air Quality Performance and EQP2 – Environmental Tobacco Smoke (ETS) Control from the category of Indoor Environmental Quality.

### 3.3.Weightings

Whilst LEED does not convert points into a percentage in the same way that BREEAM does, there was a considerable change in allocation of points per credit between LEED 2.0 and LEED 2009 which means there is now an implicit weighting. The table below shows the points and weighting for LEED 2009.

**Table 4: LEED Rating System Weighting**

<b>LEED 2009</b>	<b>Weighting</b>	<b>Points</b>
<b>Sustainable Sites</b>	25.7	29
<b>Water Efficiency</b>	8.8	10
<b>Energy &amp; Atmosphere</b>	31	35
<b>Materials &amp; Resources</b>	12.4	14
<b>Indoor Environmental Quality</b>	13.3	15
<b>Innovation in Design</b>	5.3	6
<b>Regional Priority</b>	3.5	4
	100	113



**Figure 2: LEED Rating System Weighting**

#### **4. Green Building Index**

The Green Building Index (GBI) is Malaysia's industry recognized green rating tools for buildings to promote sustainability in the built environment and raise awareness among developers, architects, engineers, planners, designers, contractors and the public about environmental issues and our responsibility to the future generations.

The GBI rating tool provides an opportunity for developers and building owners to design and construct green, sustainable buildings that can provide energy savings, water savings, a healthier indoor environment, better connectivity to public transport and the adoption of recycling and greenery for their projects that reduce our impact on the environment.

##### **4.1.Overview**

The Green Building Index is Malaysia's first comprehensive rating system for evaluating the environmental design and performance of Malaysian buildings based on the six (6) main criteria of

Energy Efficiency, Indoor Environment Quality, Sustainable Site Planning & Management, Materials & Resources, Water Efficiency, and Innovation.

The Green Building Index was developed specifically for Malaysian tropical weather, environmental and developmental context, and cultural and social needs. The maximum number of points that can be earned is 100. The classification of the projects is similar to LEED rating system and based on the following table.

**Table 5: GBI Rating System Scoring**

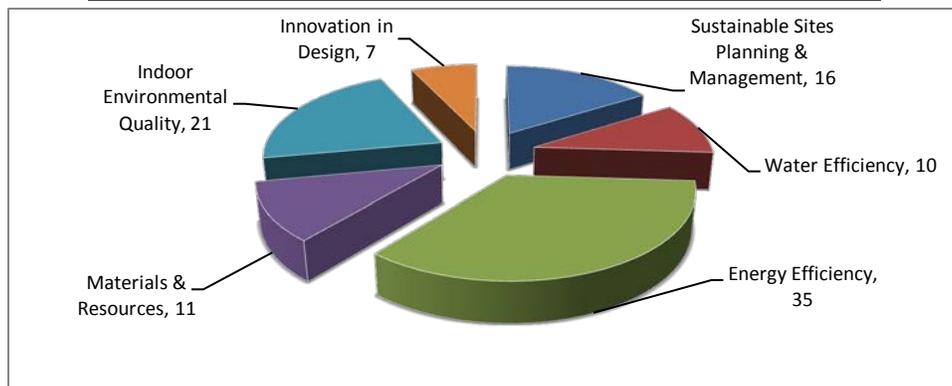
<b>GBI Rating</b>	<b>Points</b>
Certified	50 – 65
Silver	66 – 75
Gold	76 – 85
Platinum	86 and above

#### 4.2. Weightings

The distribution of points in the GBI system for non-residential new constructions can be seen in the following table. As the total point is 100, this system can be regarded as a percentage system too.

**Table 6: GBI Rating System Weighting**

<b>GBI NRNC</b>	<b>Points / Weighting</b>
<b>Sustainable Sites Planning &amp; Management</b>	16
<b>Water Efficiency</b>	10
<b>Energy Efficiency</b>	35
<b>Materials &amp; Resources</b>	11
<b>Indoor Environmental Quality</b>	21
<b>Innovation in Design</b>	7
	100



**Figure 3: GBI Rating System Weighting**

## 5. Conclusion: Comparison of the Rating Systems

The three rating systems criteria and their respective percentages are compared in Table 7. Although the terminologies and the arrangement of the items are different in these three rating systems, the overall comparison of the systems can be summarized accordingly. The BREEAM rating system is more detailed while the two other rating systems include some of BREEAM's main items under other titles. For example "Transport" is a part of the "Sustainable Sites" category in LEED and the "Sustainable Site Planning and Management" category in GBI NRNC. Hence, these items are merged together in the two systems and the total score is written. On the other hand, there are some categories in LEED and GBI which are not present in BREEAM. Altogether, all the studied rating systems show similarities in allocation of points and the differences are mostly due to different weather conditions, and geographical and environmental issues.

**Table 7: Comparison of Three Conventional Rating Systems**

Criteria	BREEAM 2008	LEED 2009	GBI NRNC
Management	12%		
Transport	8%	25.7%	16%
Land Use and Ecology	10%		
Water	6%	8.8%	10%
Pollution	10%	31%	35%
Energy	19%		
Materials	12.5%	12.4%	11%
Waste	7.5%		
Health and Wellbeing	15%	13.3%	21%
Innovation in Design		5.3%	7%
Regional Priority		3.5%	
<b>Total</b>	<b>100.00%</b>	<b>100.00%</b>	<b>100.00%</b>

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