Chapter 12

Environmental Assessment Tools: An Overview of the UK's BREEAM and the U.S.' LEED

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1. INTRODUCTION

The Building Research Establishment Environmental Assessment Method (BREEAM) is to the UK what the United States Green Building Council's Leadership in Energy and Environmental Design (LEED) is to the U.S. Design economics is intrinsically linked to the environmental aspects of buildings and often involves a complex relationship establishing a trade-off between the initial capital cost, life cycle cost and environmental cost. BREEAM and LEED provide the means to better appreciate these relationships. Case studies show that to achieve a BREEAM environmental rating of 'very good:' i.e., to reduce environmental cost or increase environmental scores, an uplift of 0.2% on capital cost is required. To achieve 'excellent' rating, 0.7% increase in capital cost is necessary. Although no such relationships have been specifically drawn between capital costs and the LEED rating, there is likely to be a close comparison in capital cost uplifts for LEED ratings of certified, silver, gold, and platinum. The initial capital cost comprises the cost of design, construction, supply and installation of building components. The life cycle costs relate to the daily, weekly and annual maintenance costs for cleaning, repair, redecoration, replacement and energy consumption. The environmental costs include the costs associated with resource utilisation and environmental pollution, extraction, manufacturing, transportation of materials, use and disposal of buildings, as well as carbon emission associated with the use of materials, ground water, indoor environmental quality and energy. Sustainable buildings can provide additional benefits for building owners and users in terms of savings relating to the use of energy and water, wastewater, health and productivity, operations and maintenance of the facilities, as well as the reduction of carbon costs associated with greenhouse gases.

This chapter focuses on the key features and operationalization of two of the most widely used assessment tools which are the UK's BREEAM and the U.S.'s LEED. Examples of other tools abound such as life cycle assessment (LCA), Green Globe, Environmentally Sustainable Design (ESD), material flow accounting (MFA), material input/output service unit (MIPS), cumulative energy requirements analysis (CERA), Building for Environmental and Economic Sustainability (BEES) and Ecohomes (now replaced by the Code for Sustainable Homes) and environmental input/output analysis (IOA), environmental risk (ERA), and check lists for eco-design. Little effort has been made before now to view these two most widely used tools side by side. It is envisaged that doing so as this current work would assist potential users in both hemispheres, and others in other countries without a similar assessment system, but desirous to assess the environmental performance of their buildings. In addition, it can facilitate interchangeable use of the tools whereby some in the U.S. may prefer and go for BREEAM assessment and certification, and those in the U.K. preferring LEED certification, can go for it. The chapter starts with a brief context, the rationale for design to reduce carbon emission, followed by an outline and a discussion of the key features of environmental assessment tools; the main structure of BREEAM and LEED tools are explained; the key assessment stages, as well as the mitigation principles, scoring and rating systems are discussed.

2. CONTEXT AND THE NEED TO DESIGN TO REDUCE CARBON EMISSION

It is increasingly recognised that good design should focus on reducing carbon emission. In response to the challenge of reducing emissions of carbon and greenhouse gases to the atmosphere, developed countries signed the Kyoto Protocol in December 1997, which proposed to reduce six greenhouse gases (UNEP, 1997; UNFCCC, 1997). The European Union member states adopted a collective target to reduce EU emissions, and each member state has a legally binding target, with the UK undertaking to reduce its emissions significantly by some 60% by 2050 (DEFRA, 2006).

Today, a significant proportion of carbon emission (almost half of the UK's carbon emissions) come from the use of buildings whether domestic or commercial buildings. The Worldwatch Institute (an independent American research organization that focuses on innovative solutions to global environmental, resource, and economic issues) estimates that buildings consume at least 40% of the energy utilized in the world each year, generate 1/3 of the CO2, and 2/5 of acid-rain-causing compounds. In the U.S., buildings annually consume more than 30% of the total energy and more than 60% of the electricity used (LEED Reference Guide, 2010). Commercial buildings accounted for more than one billion metric tons of carbon dioxide produced in 2006, and this represents an increase of over 30% over the 1990 levels (Energy Information Administration, 2006). Five billion gallons of potable water are used daily to flush toilets (LEED Reference Guide, 2010). Americans generate 1.6 million tons of household hazardous waste per year, and an average home can accumulate as much as 100 pounds of household hazardous waste, which when improperly disposed of, creates a potential risk to people and the environment (Bonneville County, Idaho, 2011). A major part of the energy used in developed countries is for the purposes of heating or cooling (DTI, 2007). In the UK both the retail and housing sectors are currently under significant pressure to reduce their energy requirements and environmental impacts. Indeed, recent building regulations in the UK stipulate that both will need to be 'zero carbon' by 2019 [DCLG, 2007]. In the last decades, the development of environmental or green (sustainable) buildings rating systems has become a significant initiative to address global warming and its associated negative environmental impact due to the carbon emission. Various environmental assessment tools have been developed with differences in their structure, technical details and evaluation methodology, but they all have common objectives of targeting the environmental aspects of design to determine a building's carbon footprint. They mitigate the effects of buildings on the environment and provide a measure indicating the extent to which environmental issues are addressed.

3. KEY FEATURES OF ENVIRONMENTAL ASSESSMENT TOOLS

Environmental assessment tools should have a number of characteristics. First, it should have a scoring system, designed to evaluate the performance of buildings, based on selected criteria reflecting environmental issues relating to the design, construction and operation of a building. The rating system should use measurable indicators to demonstrate the extent of sustainable design incorporated into the building. For example, in the BREEAM tool, buildings are evaluated with performance criteria and scoring system set by the BRE with 'credits' awarded based on the level of performance and an overall environmental performance rating which is pass, good, very good, excellent or outstanding. LEED follows the route with prerequisites and credits, and performance rating levels categorized as Certified, Silver, Gold, and Platinum. Second, there is the issue of applicability: Can the rating system be applied to all type of buildings (e.g., commercial, residential, offices, hospitals, etc.?). Third, there is the issue of availability: Is the rating system easily adaptable to other market? For instance can a UK residential house be certified by means of an American LEED rating system or vice versa? BREEAM can be used to assess buildings anywhere in the world. For

example, the new building of the European Investment Bank in Luxembourg and the Van der Kamp bakery building in Los Angeles City College, California has BREEAM ratings. Clients in India, Dubai, Qatar, Spain, and many other countries have also expressed interest in using the scheme. LEED format has been adapted in other countries such as Green Building Council Italia (GBC Italia), and Canada Green Building Council (CaGBC), and LEED certification has been used for projects in Mexico, China, India, Brazil, Arab Emirates, etc. Making LEED adaptable internationally is one of the core objectives of LEED Version 4 expected to be released in late 2013. Fourth, there is the issue of the robustness and maturity of the methodology. Is the methodology based on sound concepts, technical standards and legislation, and does it reflect changes in national and international agreements on environmental or sustainability standards? The concepts underpinning the methodology should be based on an acceptable and tested idea of how to achieve sustainability such as life-cycle thinking, John Elkington's triple bottom line (profit, people and planet), design for better environment, and cleaner technology. It could also be based on the concept of green architecture, embodied energy, embodied water, embodied carbon, or ecological design principles which provide specific ways of minimizing energy and materials use, reducing pollution, preserving habitat, and fostering community.

The fifth aspect is its usability, which is a key to success: Is it practical and easy for the user to apply and understand? Dilemmas often occur in putting any new idea into practice, so it must be simplified to increase its usability. The sixth aspect is the communicability relating to the reporting style of certification at the end of the evaluation process and its recognition and acceptance. Some tools are usually supported by technical elements, such as models, software and simulation tools to facilitate the decision process, and communication based on the implementation data. The final aspect is the cost. This criterion is very important to the user (building developer, owner, and occupant), and consists of all the costs arising during the building's certification process.

4. THE BREEAM TOOL

BREEAM is UK's leading environmental building assessment tool. It sets the standards for best practices in sustainable building design, construction and operation, and has become one of the most comprehensive and widely recognised measures of a building's environmental performance. A BREEAM assessment uses recognised measures of performance, which are set against established benchmarks, to evaluate a building's specification, design, construction and use. The measures used represent a broad range of categories and criteria from energy to ecology. They include aspects related to energy and water use, health and well-being, pollution, transport, materials, waste, ecology and management processes. BREEAM addresses wide-ranging environmental and sustainability issues and help developers, designers and building managers to demonstrate the environmental worthiness and attributes of their buildings to clients, planners, funders and other initial parties. According to BRE (Ref), BREEAM:

- uses a straightforward scoring system that is transparent, flexible, easy to understand and supported by evidence-based science and research,
- has a positive influence on the design, construction and management of buildings,
- And defines and maintains a robust technical standard with rigorous quality assurance and certification.

Just as LEED in the U.S., BREEAM is currently not mandatory in the UK. It is a voluntary commitment from clients and developers to do right by the environment. However, many local planning authorities now require a BREEAM assessment and certification.

4.1 Evolution of BREEAM

Since its creation in 1990, several versions of BREEAM have been introduced and updated regularly to align it with the UK building regulations. In August 2008, a significant review of BREEAM was carried out to cover different types of building such as retail offices, education, prisons, courts, healthcare, industrial, including the creation of the BREEAM Bespoke method and multi-residential for specialised buildings. The main differences between previous versions and BREEAM 2008 is the introduction of mandatory credits (similar to LEED's prerequisites), a new rating level of BREEAM – Outstanding, and a new two-stage assessment processes of the design stage (DS) and the post-construction stage (PCS). BREEAM 2008 was updated to BREAM 2010 with minor changes, but the 2011 version had a major adjustment particularly relating to the carbon emissions of buildings. The BREEAM 2011 New Construction (NC) scheme was updated to simplify the assessment process which is now just one scheme that covers 49 common sustainability issues across nine categories through the project's design and construction phases. BREEAM NC covers the following type of non-domestic buildings: commercial buildings (offices, industrial and retail), public buildings (education, healthcare, prisons and law courts), multi-residential accommodation buildings and others buildings (residential institutions, non-residential institutions, assembly and leisure).

4.2 Assessment Stages and Mitigation Principles of BREEAM NC

The BREEAM NC aims to mitigate the life cycle impacts of new buildings on the environment in a vigorous and cost effective manner. A certificated BREEAM assessor trained under the UKAS accredited competent person scheme is responsible to evaluate the performance of buildings against the best practice of environmental issues and to provide a strategy to achieve the assessment measures. The BREEAM assessor is generally engaged at the pre-assessment stage of the design and procurement stages in line with the clients, design team, principal contractor and other stakeholders to ensure that realistic targets are assigned and can be met without adverse effect on the design and budgets. The assessor is in charge of evaluating the information provided by the stakeholders against the BREEAM guidelines and advises if further actions should be undertaken on the environmental issues relating to the design and the award of credits. After completion of the evaluation, the assessment is forwarded to the National Scheme Operator (NSO) to provide formal verification. If the amount of credits provided is not sufficient, BREEAM assessor has to respond to the NSO enquiries within a timescale to justify the credit assessments. In some cases, credits may not be awarded if the evidence provided does not comply with the BREEAM guidelines and criteria. After the final approval from the NSO, a certified BREEAM rating; i.e., the label is issued that provides quality assurance of the building performance based on the BREEAM standard.

The engagement process for the BREEAM pre-assessment stage should not be later than stage B of the RIBA Outline Plan of Works and ideally sooner as shown in Figure 1.

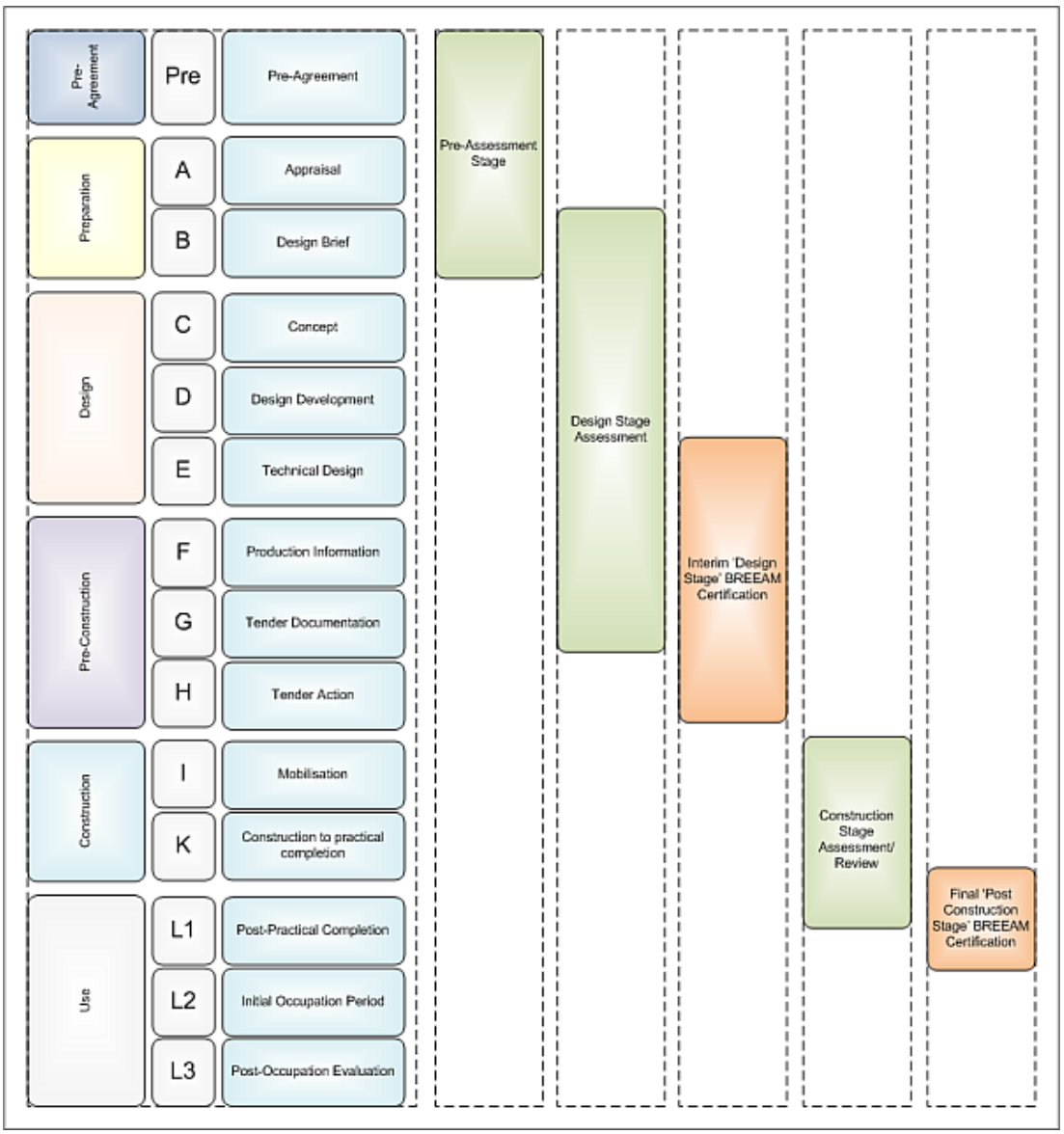

Figure 1: RIBA Outline Plan of Works vs. the BREEAM assessment stages [BRE, 2011]

As shown in Figure 1, there are 2 types of BREEAM certifications: the interim design Stage (DS) and the post-construction stage (PCS). These assessments can be done individually or together depending on the client's requirement. The post-construction stage confirms the performance of building as built and can be reviewed at the interim DS assessment. In cases where the DS assessment has not been done previously, a full construction stage assessment will be required. In both cases, the PCS will be certified. For each environment issues, there is a different assessment criterion for the DS and PCS with different range of ratings.

4.3 BREEAM Scoring and Rating Procedures

To evaluate the sustainability performance of the assessed buildings, a BREEAM benchmark rating is applied in terms of a percentage score. Figure 2 summaries the principles of the rating and scoring of BREEAM and shows the 9 environmental categories with their related 49 environmental issues that need to be addressed. The column "Credit Available" indicates the achievable maximum credit of each environmental issue. BREEAM NC guideline explains in details the requirement to achieve the credits. The "Credit Category" varies slightly according to the type of building assessed. Based

on the total credits achieved, an overall percentage rating is obtained which corresponds to a categorization that varies from 'Unclassified' to 'Outstanding' ratings. Below 30% rating, the building is considered 'Unclassified' meaning that the assessed building is not complaint with BREEAM by failing to meet minimum standards of performance set by BREEAM. In order to ensure that the scoring is consistent among categories, there is mandatory minimum standard level of 14 environmental issues and associated credits to be achieved based on the ratings targeted as shown in Figure 2. The letters "O, E, VG, G, P" indicated in the BREEAM ratings table, shows the credits to be awarded to achieve mandatory minimum standard level. For instance, if an assessed building has a target rating of "Excellent", it will be required to achieve all 14 minimum standard credits except the "construction waste management" credit. The credits with asterisk (*) indicate that these credits are essential for achieving the 'Excellent' rating. Also, there is a minimum standard credits for the "reduction of CO_2 emission" issues which is 6 credits for "Excellent" rating, and 10 credits for "Outstanding" rating. There are 10 credits for the Innovation additional category. These credits can be awarded for new technologies, designs or construction projects that meet the BREEAM eligibility criteria for Innovation credits.

Categories			Environmental Issues	Credits Available	Credits Category	Credits %	Minimum Standard Level
	Management	Man 01	Sustainable procurement	8	22	12%	1 or 2* credit(s)
		Man 02	Responsible construction practices	2			1 or 2* credit(s)
		Man 03	Construction site impacts	5			
		Man 04	Stakeholder participation	4			1 credit (Building user info)
		Man 05	Service life planning and costing	3			
	Health and wellbeing	Hea 01	Visual comfort	2	10	15%	Criterion 1 only
		Hea 02	Indoor air quality	2			
		Hea 03	Thermal comfort	2			
		Hea 04	Water quality	1			Criterion 1 only
		Hea 05	Acoustic performance	1			
		Hea 06	Safety and security	2			
	Energy	Ene 01	Reduction of CO_2 emissions	15	30	19%	10 or 6 credits
		Ene 02	Energy monitoring	1			1 credit (First sub-metering)
		Ene 03	Energy efficient external lighting	1			
		Ene 04	Low or zero carbon technologies	5			1 credit
		Ene 05	Energy efficient cold storage	2			
		Ene 06	Energy efficient transportation systems	2			
		Ene 07	Energy efficient laboratory systems	1			
		Ene 08	Energy efficient equipment (process)	2			
		Ene 09	Drying space	1			
	Transport	Tra 01	Public transport accessibility	5	9	8%	
		Tra 02	Proximity to amenities	1			
		Tra 03	Cyclist amenities	2			
		Tra 04	Maximum car parking capacity	2			
		Tra 05	Travel plan	1			
	Water	Wat 01	Water consumption	5	9	6%	1 or 2* credit(s)
		Wat 02	Water monitoring	1			Criterion 1 only
		Wat 03	Water leak detection and prevention	2			
		Wat 04	Water efficient equipment (process)	2			
	Materials	Mat 01	Life cycle impacts	5	12	13%	
		Mat 02	Hard landscaping and boundary protection	1			
		Mat 03	Responsible sourcing of materials	3			Criterion 3 only
		Mat 04	Insulation	2			
		Mat 05	Designing for robustness	1			
	Waste	Wst 01	Construction waste management	4	7	8%	1 credit
		Wst 02	Recycled aggregate	1			
		Wst 03	Operational waste	1			1 credit
		Wst 04	Drying space	1			
		Wst 05	Speculative floor and ceiling finishes	1			
	Land use and ecology	LE 01	Site selection	2	10	10%	
		LE 02	Ecological value of site/protection of ecological features	1			
		LE 03	Mitigating ecological impact	2			1 credit
		LE 04	Enhancing site ecology	3			
		LE 05	Long term impact on biodiversity	3			
	Pollution	Pol 01	Impact of refrigerants	3	13	10%	
		Pol 02	NOx emissions from heating/cooling source	3			
		Pol 03	Surface water run-off	5			
		Pol 04	Reduction of night time light pollution	1			
		Pol 05	Noise attenuation	1			
	Innovation	Inn 01	Innovation (Additional)	10	2	100%	

BREEAM Rating %		
O	OUTSTANDING	85
E	EXCELLENT	70
VG	VERY GOOD	55
G	GOOD	45
P	PASS	30
U	UNCLASSIFIED	<30

Figure 2: BREEAM rating road map

5. THE LEED TOOL

LEED is the U.S. premier environmental building assessment tool. LEED recognizes the negative impacts of buildings on the environment, and posits that responsible green building practices can eliminate or reduce these impacts through various high-performance design, construction, and operation approaches. The added benefits of green practices to all stakeholders are reduced operating costs, elevated building marketability, increased occupant productivity, and reduced potential for liability associated with sick-building syndrome and various building-related illnesses.

Based on extensive studies of existing green metrics and rating systems such as that by the American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE), LEED developed a rating system for buildings. As LEED matured, it undertook further initiatives expanding into rating systems that go beyond LEED for New Construction (Building Design + Construction) (LEED NC BD+C) to include LEED for Existing Buildings: Operations & Maintenance (LEED EB O+M), LEED for Commercial Interiors (Interior Design + Construction) (LEED CI ID+C), LEED for Core & Shell (LEED CS), LEED for Schools, LEED for Retail, LEED for Healthcare, LEED for Homes, LEED for Neighbourhood Development (LEED ND), and SITES – LEED for Landscape proposed by the American Society of Landscape Architects (ASLA).

LEED-certified buildings are designed to:

a. Lower operating costs and increase asset value
b. Reduce waste sent to landfills
c. Conserve energy and water
d. Be healthier and safer for occupants compared with non-LEED-certified counterparts
e. Reduce their harmful greenhouse gas emissions
f. Qualify for owners tax rebates and incentives, zoning allowances in some municipalities
g. Demonstrate owner's commitment to environmental stewardship and social responsibility.

LEED assesses five environmental categories and two bonus categories. The environmental categories are:

1. Sustainable sites
2. Water efficiency
3. Energy and atmosphere
4. Materials and resources
5. Indoor environmental quality.

The two bonus assessment categories are:

1. Innovation in design
2. Regional priority.

The sustainable sites category encourages and awards credits to building project stakeholders seeking LEED certification for:

a. Selecting and developing their sites wisely
b. Reducing emissions associated with transportation through their development
c. Planting sustainable landscapes
d. Protecting surrounding habitats
e. Managing storm-water runoff
f. Reducing the heat island effect

g. Eliminating light pollution.

The water efficiency category encourages and awards credits to building project stakeholders seeking LEED certification for:

a. Monitoring their water consumption performance
b. Reducing indoor potable water consumption
c. Reducing water consumption in a way that it saves energy and improves environmental well-being
d. Practicing water-efficient landscaping.

The energy and atmosphere category encourages and awards credits to building project stakeholders seeking LEED certification for:

a. Tracking building energy performance – designing, commissioning and monitoring their developments
b. Managing refrigerants used in their developments to eliminate chlorofluorocarbon (CFCs)
c. Using renewable energy.

The materials and resources category encourages and awards credits to building project stakeholders seeking LEED certification for:

a. Selecting sustainable materials
b. Practicing waste reduction
c. Reducing waste at its source
d. Reusing and recycling
e. Using local materials
f. Using rapidly renewable materials
g. Using third-party certified wood.

The indoor environmental quality category encourages and awards credits to building project stakeholders seeking LEED certification for:

a. Improving indoor ventilation
b. Managing air contaminants
c. Specifying less harmful materials
d. Allowing occupants to control desired settings
e. Providing daylight and views.

The innovation in design (exemplary performance) category encourages and awards credits to building project stakeholders seeking LEED certification for building performance that greatly exceeds what is required in an existing LEED credit(s).

The regional priority category encourages and awards credits or gives exceptions to building project stakeholders seeking LEED certification depending on a consideration of regionally important issues, such as water conservation in the arid and desert regions. The category acknowledges the importance of local conditions in determining best environmental design, construction, and operation practices. LEED is not mandatory in the U.S. However, some owners in the public and private sectors request LEED certifications of various levels for building projects financed by them.

5.1 Evolution of LEED

Created in 1993, the United States Green Building Council (USGBC) soon found the need to develop metrics to measure performance of green buildings far more extensive than what existed then. To focus squarely on attaining this objective, it came with LEED to take charge of formulating the assessments. The initial efforts led to the launching of LEED Version 1.0 in August 1998. Following various updates, revisions and errata, LEED Version 2.0 was released in March 2000. Version 2.1 followed in 2002 and Version 2.2 came in 2005. The currently used Version 3.0 was launched in April 2009. There have been successive errata and addenda, with major revisions to appear in Version 4.0 due to be released in late 2013.

The initial four levels of LEED certification were: Certified (26-32 credit points), Silver (33-38 credit points), Gold (39-51 credit points), and Platinum (52-69 credit points). However, with the revisions came increased credit points requirement, but the four levels of certification remain. Currently they are: Certified 40-49 credit points, Silver 50-59 credit points, Gold 60-79 credit points, and Platinum 80 or more credit points. Version 4.0 will introduce yet other significant changes if ballot succeeds. Certified is the lowest level of certification, while Platinum is the highest.

The reason for the updates and revisions is an acknowledgement that LEED is continually evolving, and will continue to improve. While the new version is not going for net zero, it is seeks to be "net positive" to move in the right direction in terms of entire market transformation. It opens up LEED to a wider range of buildings, including manufacturing industries, to deliver green building practices throughout building supply chain.

Anticipated changes include extension to new market sectors such as hospitality facilities like hotels, existing schools and existing retail, warehouses and distribution facilities, data centres, and LEED for mid-rise homes; increased technical rigor involving revisions to credit weights, new credit categories focusing on integrated design, life cycle analysis of materials, and an increased emphasis on measurement and performance; and streamlined services including an improved LEED user experience that makes the LEED Online platform more intuitive and introduces tools to make LEED documentation process more efficient. (USGBC 2013).

These revisions may well change before the release and adoption of this version, but here are the key notations:

The credit categories will expand from 7 to 10, and there are more prerequisites – increasing from 9 to 15. The 10 credit categories are: Integrated Process, Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Performance, Innovation, and Regional Priority. Besides the new categories, the intent is to also better align the credits among the existing categories, while borrowing existing credits for the new categories. Some of the existing credits will also be combined.

5.2 LEED Assessment

Green Building Certification Institute (GBCI) a separately incorporated entity established in 2008 to administer credentialing and certification programs related to green building practice. Assessments operate through rating systems supported by reference guides. Each rating system is organized into the five environmental categories, plus the two bonus categories previous outlined.

All prerequisites must be met before any project can seek credits. The reference guide outlines for all prerequisites and credits the intent, requirements, benefits and issues to consider, related credits, the referenced standards, implementation, timeline and team, calculations if any, the documentation guidance, examples, exemplary performance, regional variations, and resources.

For project certification, those who consider LEED right for their developments must prepare an application and register their project with GBCI online otherwise called LEED Online. A registration fee of US$450 applies for member organizations of USGBC, while US$600 has to be paid by non-members. If in doubt whether a credit can be obtained or not, they can consult Credit Interpretation Rulings (CIR) or go for Credit Interpretation Requests. Credit Interpretation Request applies if a new issue arises, while Credit Interpretation Ruling applies to previous decisions and rulings. LEED for Core & Shell requires precertification application, and all (LEED for New Construction, Core & Shell, Schools, etc.) must complete certification applications. The certification applications can be reviewed in one or two stages; namely, Design Phase Review, and Construction Phase Review. Certain features are amenable for Design Phase Review or Construction Phase Review, or both. One can seek review of its design-related prerequisites and credits before completion, and then apply for construction-related credits after the project is finished. Alternatively, one can wait until the project is complete to submit documentation for all the credits being pursued. The credits are warded after this review.

The certification fee charged is based on the project size, and the rating system under which the project will be considered for certification. The fee is paid when one submits documentation for review through LEED Online. The two tables below show the current certification review rates for all projects applying for certification after January 1, 2010. The fees apply to single-building projects only; special rates may apply to multiple-building projects, and the determination rests with GBCI who will provide a quote prior to submitting an application for certification.

Table 1: Project Certification Rates Effective from January 1, 2010

	Less than 50,000 Square Feet	**50,000- 500,000 Square Feet**	**More Than 500,000 Square Feet**	**Appeals (if applicable)**
LEED 2009; New Construction, Commercial Interiors, Schools, Core & Shell full certification	Fixed Rate	Based on Square Footage	Fixed Rate	Per credit
Design Review				
USGBC Members	$2,000	$0.04/sf	$20,000	$500
Non-Members	$2,250	$0.045/sf	$22,500	$500
Expedited Fee*	$5,000 regardless of square footage			$500
Construction Review				

USGBC Members	$500	$0.010/sf	$5,000	$500
Non-Members	$750	$0.015/sf	$7,500	$500
Expedited Fee*	$5,000 regardless of square footage			$500
Combined Design & Construction Review				
USGBC Members	$2,250	$0.045/sf	$22,500	$500
Non-Members	$2,750	$0.055/sf	$27,500	$500
Expedited Fee*	$10,000 regardless of square footage			$500

Table 2: Project Certification Rates Effective from January 1, 2010

Recertification Review**				
USGBC Members	$750	$0.015/sf	$7,500	$500
Non-Members	$1,000	$0.02/sf	$10,000	$500
Expedited Fee*	$10,000 regardless of square footage			$500
LEED for Core & Shell: Precertification	Fixed Rate			Per credit
USGBC Members	$3,250			$500
Non-Members	$4,250			$500
Expedited Fee*	$5,000			$500
CIRs (for all Rating Systems)				$220

The score for each LEED credit is estimated based on the carbon footprint for a typical LEED building. A building's carbon footprint is the total greenhouse gas emissions associated with its construction and operation, with its construction and operation (LEED Reference Guide, 2010):

- energy used by building systems;
- building-related transportation;
- embodied emissions of water (electricity used to extract, convey, treat, and deliver water);
- embodied emissions of solid waste (life-cycle emissions associated with solid waste); and
- embodied emissions of materials (emissions associated with the manufacture and transport of materials).

5.3 LEED Project Scoring and Rating Procedures

LEED project scoring and rating procedures are provided here. This LEED rating is scored on 100 points, plus 10 points of bonus for in the Innovation in Design and Regional Priority categories. The points distribute across the categories thus (see the tabulation under):

1. Sustainable Sites – 26 points
2. Water Efficiency – 10 points
3. Energy & Atmosphere – 35 points
4. Materials & Resources – 14 points
5. Indoor Environmental Quality – 15 points
6. Innovation in Design – 6 points maximum
7. Regional Priority – 4 points maximum.

LEED 2009 for New Construction and Major Renovations

Project Checklist

Project Name

Date

Sustainable Sites — Possible Points: 26

Y	?	N			
Y			Prereq 1	Construction Activity Pollution Prevention	
			Credit 1	Site Selection	1
			Credit 2	Development Density and Community Connectivity	5
			Credit 3	Brownfield Redevelopment	1
			Credit 4.1	Alternative Transportation—Public Transportation Access	6
			Credit 4.2	Alternative Transportation—Bicycle Storage and Changing Room	1
			Credit 4.3	Alternative Transportation—Low-Emitting and Fuel-Efficient Ve	3
			Credit 4.4	Alternative Transportation—Parking Capacity	2
			Credit 5.1	Site Development—Protect or Restore Habitat	1
			Credit 5.2	Site Development—Maximize Open Space	1
			Credit 6.1	Stormwater Design—Quantity Control	1
			Credit 6.2	Stormwater Design—Quality Control	1
			Credit 7.1	Heat Island Effect—Non-roof	1
			Credit 7.2	Heat Island Effect—Roof	1
			Credit 8	Light Pollution Reduction	1

Water Efficiency — Possible Points: 10

Y			Prereq 1	Water Use Reduction—20% Reduction	
			Credit 1	Water Efficient Landscaping	2 to 4
			Credit 2	Innovative Wastewater Technologies	2
			Credit 3	Water Use Reduction	2 to 4

Energy and Atmosphere — Possible Points: 35

Y			Prereq 1	Fundamental Commissioning of Building Energy Systems	
Y			Prereq 2	Minimum Energy Performance	
Y			Prereq 3	Fundamental Refrigerant Management	
			Credit 1	Optimize Energy Performance	1 to 19
			Credit 2	On-Site Renewable Energy	1 to 7
			Credit 3	Enhanced Commissioning	2
			Credit 4	Enhanced Refrigerant Management	2
			Credit 5	Measurement and Verification	3
			Credit 6	Green Power	2

Materials and Resources — Possible Points: 14

Y			Prereq 1	Storage and Collection of Recyclables	
			Credit 1.1	Building Reuse—Maintain Existing Walls, Floors, and Roof	1 to 3
			Credit 1.2	Building Reuse—Maintain 50% of Interior Non-Structural Element	1
			Credit 2	Construction Waste Management	1 to 2
			Credit 3	Materials Reuse	1 to 2

Materials and Resources, Continued

Y	?	N			
			Credit 4	Recycled Content	1 to 2
			Credit 5	Regional Materials	1 to 2
			Credit 6	Rapidly Renewable Materials	1
			Credit 7	Certified Wood	1

Indoor Environmental Quality — Possible Points: 15

Y			Prereq 1	Minimum Indoor Air Quality Performance	
Y			Prereq 2	Environmental Tobacco Smoke (ETS) Control	
			Credit 1	Outdoor Air Delivery Monitoring	1
			Credit 2	Increased Ventilation	1
			Credit 3.1	Construction IAQ Management Plan—During Construction	1
			Credit 3.2	Construction IAQ Management Plan—Before Occupancy	1
			Credit 4.1	Low-Emitting Materials—Adhesives and Sealants	1
			Credit 4.2	Low-Emitting Materials—Paints and Coatings	1
			Credit 4.3	Low-Emitting Materials—Flooring Systems	1
			Credit 4.4	Low-Emitting Materials—Composite Wood and Agrifiber Product	1
			Credit 5	Indoor Chemical and Pollutant Source Control	1
			Credit 6.1	Controllability of Systems—Lighting	1
			Credit 6.2	Controllability of Systems—Thermal Comfort	1
			Credit 7.1	Thermal Comfort—Design	1
			Credit 7.2	Thermal Comfort—Verification	1
			Credit 8.1	Daylight and Views—Daylight	1
			Credit 8.2	Daylight and Views—Views	1

Innovation and Design Process — Possible Points: 6

			Credit 1.1	Innovation in Design: Specific Title	1
			Credit 1.2	Innovation in Design: Specific Title	1
			Credit 1.3	Innovation in Design: Specific Title	1
			Credit 1.4	Innovation in Design: Specific Title	1
			Credit 1.5	Innovation in Design: Specific Title	1
			Credit 2	LEED Accredited Professional	1

Regional Priority Credits — Possible Points: 4

			Credit 1.1	Regional Priority: Specific Credit	1
			Credit 1.2	Regional Priority: Specific Credit	1
			Credit 1.3	Regional Priority: Specific Credit	1
			Credit 1.4	Regional Priority: Specific Credit	1

Total — Possible Points: 110

Certified 40 to 49 points Silver 50 to 59 points Gold 60 to 79 points Platinum 80 to 110

Figure 3: LEED New Construction and Major Renovation Scorecard (USGBC, 2013)

As indicated previously, the four certification levels are:

1. Certified --- 40-49 credit points,
2. Silver --- 50-59 credit points,
3. Gold --- 60-79 credit points, and
4. Platinum --- 80 or more credit points.

5. CONCLUDING REMARKS

Considering that LEED and BREEAM compare closely to each other as can be seen from the above, it is possible to use them interchangeably. Some in the U.S. and elsewhere complain of how onerous and costly LEED certification process is, while those in the UK criticize BREEAM for being too broad, these complainants may find use in substituting one for the other, depending on their preferences. Both are good tools, but work remains to fine-tune them to better serve people and projects, while pursuing the highest responsible environmental attainments. Perhaps, attempts may be made in the future to marry both environmental assessment systems, rather than have two closely competing system co-exist for the same customers.

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