International Comparison of Sustainable Rating Tools

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Abstract This paper undertakes an international comparison of global sustainability tools and examines their characteristics and differences. Most importantly, it focuses on which tools from different countries can be directly compared with each other (i.e., is a five-star building with one rating system directly comparable with a four-star rating of another rating system?). The results are designed to provide some clarification of the assessment tools for sustainable buildings, which in turn will assist investors, developers, tenants, and government bodies in making informed decisions about green buildings. In addition, it is envisaged that removing some of the uncertainty associated with sustainable buildings will increase transparency for stakeholders and facilitate their acceptance.

There is little dispute now that buildings are substantial CO_2 emitters and contribute substantially to climate change (Reed and Wilkinson, 2008; Wilkinson, Reed, and Cadman, 2008). This argument is based on the large environmental footprint of buildings, especially when considering the high reliance on resources due to an increased reliance on air conditioning and heating. At the same time it has been demonstrated that the value of a building can be linked to the building's perceived level of sustainability (Myers, Reed, and Robinson, 2008), where the stakeholders include building owners, tenants, and property appraisers or valuers. The problem therefore lies with how to distinguish the level of sustainability in a building, which will facilitate a direct comparison between each building. This is where sustainability rating tools can potentially play a major role.

Many countries have introduced new rating tools over the past few years in order to improve the knowledge about the level of sustainability in each country's building stock. On one hand, it can be argued that the individual characteristics of each country, such as the climate and type of building stock, necessitate an individual sustainability rating tool for that country. The downside is that to varying degrees the rating tools for different countries are constructed on different parameters. This in turn has created complications for stakeholders, including property investors, who purchase buildings in different countries; an understanding of the many differences between each market has been increasingly harder to understand (Dixon et al., 2008). This paper investigates the evolution of global building rating tools, with a concentration on office buildings. Consideration is given to the different rating tools for sustainable buildings in each country. Furthermore, it examines how rating tools have evolved over time and which

countries and their respective rating tools have contributed to their global uptake. This paper analyses the development of rating tools over time and seeks to provide insight into their positive and negative attributes.

International Rating Tools

While it is accepted that there are no identical parcels of land in the world (Australian Property Institute, 2007), in a similar manner every country is also unique. However, there are common approaches to appraising or valuing land/buildings and analyzing property values in each country, although it appears that rating tools have not followed this trend (Exhibit 1). On appearance, they are relatively complex.

While it is possible to directly compare the value of an office building in New York City, Berlin, London or Melbourne using a ten-year discounted cashflow approach (after allowing for exchange rate variations), making a similar direct comparison of the sustainable features and rating of the same building is quite complex. In the past it appears there has been an unwillingness to compromise or admit a particular rating system may not be the possible best tool, which in turn has been a barrier to developing a global rating system (Exhibit 2). The unwillingness to compromise or admit that a rating system may be deficient in certain areas may be due to a lack of knowledge and understanding on the part of those valuing or marketing buildings. A starting point is to reflect on the current development status of rating tools internationally (Exhibit 3). It can be noted that most countries with existing or emerging rating tools have developed economies

Exhibit 1 | Complex System of International Rating Tools

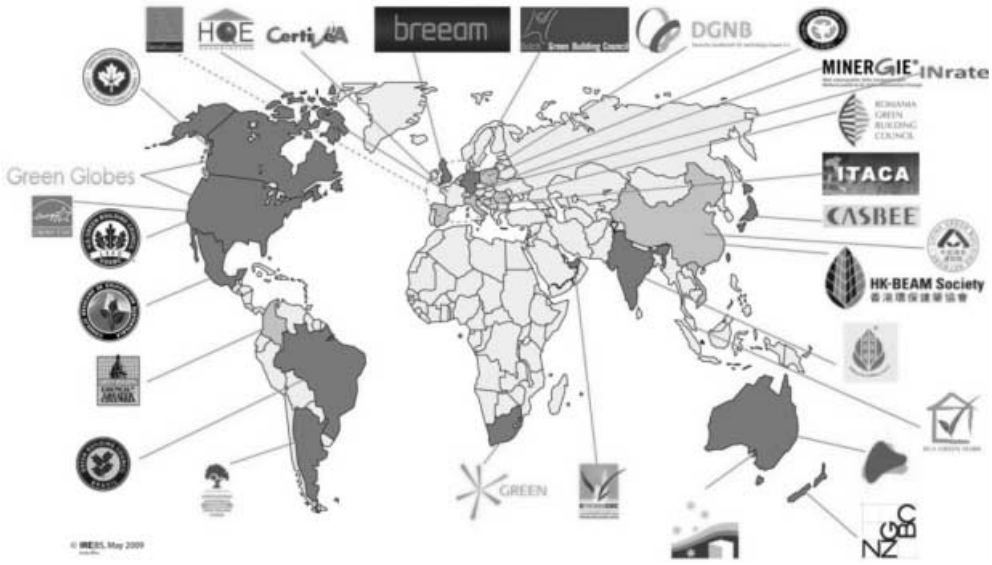


Exhibit 2 | Main Rating Tools

U.K. and Europe	Americas	Rest of the World
BREEAM (inc Eco-homes)	LEED (U.S. & Canada)	Green Star (Australia)
The Green Guide to Specification	U.S. DOE (U.S. Department of Energy) Design Guide (U.S.)	BEAM (Hong Kong)
Office Scorer	WBDG (Whole Building Design Guide) (U.S.)	LEED (China and India)
ENVEST	HOK Sustainable Design Guide (U.S.)	Greenmark (Singapore)
Sustainability Checklists (e.g. SEEDA; BRE)	BREEAM Canada (Canada)	GBTool (South Africa)
Environmental Impact Assessment (EIA)	Green Globes (U.S. & Canada)	
Strategic Environmental Assessment (SEA)		

Note: The sources are RICS (2007) and Green Globes (2009).

Exhibit 3 | Countries with Established or Emerging Rating Tools

and most often there is also a property market where information is readily available. The diverse range of countries and associated climates can be clearly observed.

The next step is to also identify countries that have expressed interest according to the World Green Building Council (WGBC) data (Exhibit 4). In this diagram, it can be observed that these countries predominantly include the Middle East, Africa, and Asia, which are located relatively close to the equator.

Often a rating tool can be linked back to common aspects with other systems, depending largely on the particular influences on each property market. Many rating tools have been modified and adopted from earlier models that were originally developed in other countries. For example, it is possible to trace many systems back to the Leadership in Energy and Environmental Design (LEED) and BRE Environmental Assessment Method (BREEAM) building rating systems (Exhibit 5). The benefits of having a common foundation with LEED and BREEAM may assist with moving towards an internationally-accepted rating tool, especially when there are recent signs of change and compromise. For example, it is reported that three of the most common rating tools, namely BREEAM, LEED, and Green Star, are seeking to develop common metrics that will help international stakeholders compare buildings in different cities using an 'international language' (Kennett, 2009).

While there has been fragmentation of rating systems as shown in Exhibit 1, it can be argued that the World Green Building Council has the largest global

Exhibit 4 | Countries with Various Rating Tool Development Levels

Exhibit 5 | LEED and BREEAM-based Rating Tools

coverage (Exhibit 6). There are common links in the United States and Canada, some parts of Europe, Japan, Australia, and South Africa.

The Need for Global Rating Tools

The importance of sustainable development has been mooted for many years since the Bruntland Report (Bruntland, 1987) and has gathered momentum, partly as a result of major economic reports to governments in developed countries, such as the Stern Report to the government in the United Kingdom (Stern, 2005) and the Garnaut Report to the Australian Federal Government (Garnaut, 2007). Both reports, written by leading economists, concluded that a 'business as usual' approach with respect of greenhouse gas emissions would lead to global economic and environmental catastrophe in the long term. With Stern and Garnaut accepting the IPCC predictions on climate change, the impetus to the adoption of sustainability within the built environment gathered pace. It is now the case that a majority of professionals and scientists accept that action is needed to mitigate climate change through the reduction of greenhouse gas emissions in particular and the adoption of sustainability practices generally (Reed and Wilkinson, 2008).

The importance of sustainable development for the built environment professions is a point that has been targeted in prominent task forces internationally (DETR, 1999a; Egan, 2004; and Dixon et al., 2008). In addition, the U.K. Government's Sustainable Development Educational Panel set a target of achieving the inclusion of sustainable development criteria within all course accreditation requirements for the professions and industry lead bodies by 2010 (DETR, 1999b). In response, the major professional body representing land, construction, and property globally,

Exhibit 6 | Countries with Rating Tools only Accepted by WGBC

the Royal Institution of Chartered Surveyors (RICS), adopted sustainability policy principles with the ''intention to place sustainability at the heart of all its activities,'' (RICS, 2007). Not only do built environment professionals need to learn the rationale for sustainable development and to appreciate the key issues, they need to learn how and when to apply the many environmental assessment tools.

Earlier studies (Upstream, 2003; Pett et al., 2004; and Sayce, Ellison, and Smith, 2004) suggested that there is an increasing focus on providing a 'business case' for sustainable development as a result of the emergence of planning policies and EU directives [e.g., the Energy Performance of Buildings Directive (IPF, 2007)]. This is linked with internal corporate drivers, such as the demand for improved risk management and better governance structures to deal with environmental risk in the real estate sector (Ellison and Sayce, 2007). But what assessment tools are at hand for built environment professionals to use to support advice to clients? In addition, what areas do the tools cover and omit? EPSRC (BRE, 2004) found approximately 600 tools that measured or evaluated the social, environmental, and economic dimensions of sustainability. In professional practice, many of these tools can be used with regards to the use and management of rural and natural resources, as well as across the whole lifecycle of buildings from inception and design, construction, and development through to the operation phase and post occupancy-monitoring. As an example, one commonly-used tool in Australia is Green Star, which is equivalent to the LEED and BREEAM rating systems. All of these tools provide a broad ranging assessment of the environmental impact of a building. Each features a suite of tools developed for different land uses such

as commercial, industrial, retail, and educational and health buildings. The issues covered include those relating to the global, local, and internal environments, focusing on design stage assessments (i.e., new build and refurbishment) and also to the ongoing operation and management of the building. Each tool leads to a rating of the building, which is used to market the building. Green Star adopts a star rating from 1 to 6; LEED uses a scale of platinum, gold, silver, and bronze to indicate a higher or lower rating; whereas BREEAM adopts a scale from pass to excellent. The questions therefore include: Are the tools equal or are the standards embraced by one tool markedly different to those adopted by others? Is a 6-Star Green Star rating equal to a Platinum LEED or an Excellent BREEAM score? Furthermore, with increasingly global financial and property markets, do the tools need to be benchmarked in a clear and transparent way? Clearly, some regional variation is appropriate; for example, the ongoing Australian drought implies that water economy measures are of high importance locally, whereas in the northern region of the U.K. where higher rainfall is a result of climate change to-date and water economy is not such an important environmental measure in contrast to arid countries.

Many of these tools measure sustainability of the built environment and have been developed to determine if any capacity exists for further development, or whether a development is sustainable, or whether progress is being made towards sustainable development. 'Indicators' are also an important part of the range of the tools available and relate mainly to parameters that can be measured to show trends or sudden changes in a particular condition. It is important to distinguish between those tools used for measurement (identifying variables measuring sustainable development and collecting relevant data), and those used for assessment (evaluating performance against criteria), as well as those tools that can be used to effect a move towards sustainable development by changing practice and procedures (BRE, 2004; Therivel, 2004). In general, the tools are attempting to: achieve continuous improvement to optimize building performance and minimize environmental impact; provide a measure of a building's effect on the environment; and set credible standards' by which buildings can be judged objectively.

There are numerous benefits of using assessment tools and also variations between ease of use. For example, the 'Green Globes' assessment tool used in Canada and the U.S. is an on-line assessment tool actively promoted as using a 'streamlined on-line approach' using an on-line questionnaire that generates a report (Green Globes, 2009). The overall goal is to have a common set of criteria and targets, and these are typically embodied in design guides, which help professionals to design, construct, and manage property in a more sustainable way. One benefit is raising awareness of environmental issues and standards is that the assessment tools recognize and encourage best practice and stimulate the market for sustainable construction and property. This is apparent in the marketing and rental levels achieved by sustainable buildings (PCA, 2008). A further benefit of the tools is that they provide a verifiable method and framework for professionals to use. In many cases, the tools set criteria and standards that go beyond the building codes and regulations in the countries in which they are used. However, it is also

possible to link the tools to government policies and regulations, such as certification and labels and incentive initiatives. The EU Energy Performance Directive is a good example of this in practice. Finally, on an individual building level, the adoption of assessment tools improves property management and prioritization of maintenance and operational needs to enhance sustainability.

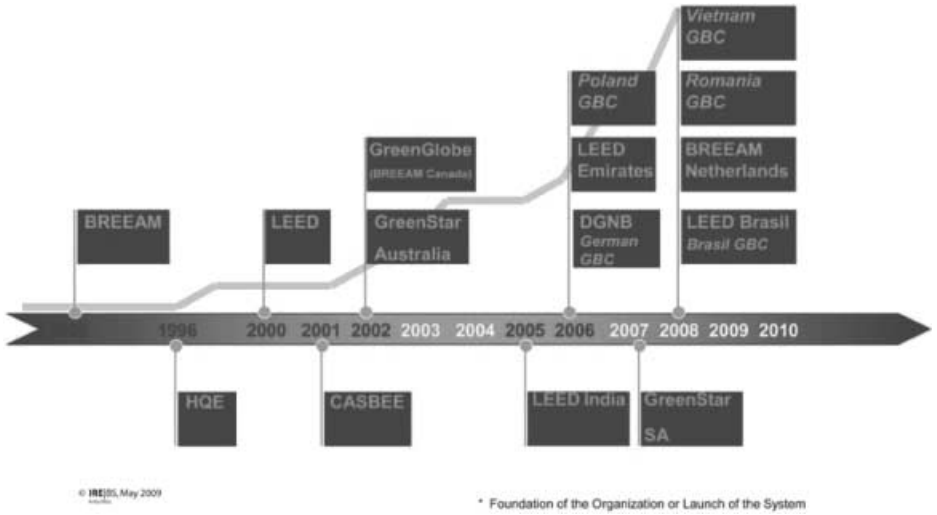
Despite the many positive aspects, arguably there are perceived shortcomings with different tools. One of the developers of the LEED tool (Schendler and Udall, 2005) stated that LEED was 'broken' and needed to be fixed. The authors argued that there was a disconnect between the concept of LEED and the reality of the tool in use. Firstly, the assessment was prohibitively expensive as designers and owners were increasingly driven by scoring points and not designing sustainable buildings for a particular site and use; a phenomenon term 'LEED brain.' The energy modeling adopted by the tool was 'fiendishly complicated' and the assessment process crippled by bureaucracy. However, of more concern was Schendler's observation relating to the ''overblown claims for green buildings.'' Thus, was it possible that buildings having high LEED ratings were not actually that sustainable? Furthermore, BRE claimed for many years that BREEAM accounted for 40% of all new buildings. When one realizes that only 1%–2% of new stock is added to the total stock each year, it will be many decades before the entire stock is 'sustainable.' To-date, the overall building assessment tools, such as BREEAM, LEED, and Green Star, have been voluntary and not mandatory schemes. While the 2003 EU Energy Performance Directive is compulsory, it requires disclosure of energy performance rather than attainment of stringent performance targets. The intention with these tools is to benchmark some key sustainability standards and then over time to increase the standards, so while some are weak in certain areas, changes will occur in future. In summary, evidence suggests that built environment professionals have embraced the SD agenda across many developed countries and are looking to the increased use of assessment tools. As yet, however, we know relatively little about the equivalence of the tools used internationally.

The Development of Rating Tools from an International Perspective

It is generally accepted the current era of rating tools commenced in 1990 with the introduction of the BREEAM rating tool (Exhibit 7). This was followed by the French system HQE and then by the U.S. LEED in 2000. Further analysis of this diagram confirms that the evolution of rating systems into different countries is largely based on the initial rating systems [e.g., BREEAM (Netherlands), LEED (Emirates), and Green Star (South Africa)]. Many of these tools and their relevant websites are listed in Appendix A.

Listed in Exhibit 2 is a summary of rating tools based on a global report of sustainability titled ''A Greener Profession'' (RICS, 2007) and Green Globes (2009). This has three broad groups: U.K. and Europe, Americas, and Rest of the World. There have also been attempts to classify rating tools on the triple bottom

Exhibit 7 | Timeline of the Development of Rating Tools in Different Countries



line criteria—economic, environmental, and social criteria—as per the U.K./ Europe Example in Appendix B. Exhibit 8 follows on from the initial concept in Exhibit 2 and therefore groups the existing 38 rating tools based on five distinct geographical regions.

An International Comparison of BREEAM, LEED, Green Star, and CASBEE

BRE undertook a comparison of the four key environmental assessment tools in 2008 and Exhibit 9 illustrates the key comparisons made. The assessment criteria were: launch date, rating scales, information gathering, assessment, third-party validation, certification and labeling, update process, governance, required qualification of assessors, assessor AP CPD requirements, compound annual growth rate, assessment fee, certification fee, cost of appeals, credit interpretation request costs, number of units certified, number of domestic and non-domestic building already certified, and availability of assessment information. Exhibit 8 highlights the considerable variation across the four tools. When the process of certification was evaluated, differences existed. For example, CASBEE has a six-stage process from start to finish, whereas Green Star has nine steps to certification, LEED has eight, and BREEAM has six (BRE, 2008).

Exhibit 10 shows that when BREEAM, LEED, Green Star, and CASBEE are compared across a number of sustainability issues, there is variation in the standards of each scheme. For example, BREEAM sets higher standards for building management compared to LEED and Green Star. LEED and BREEAM score equivalent scores for energy and transport while Green Star falls behind. In terms of health and well-being issues, BREEAM again exceeds the other schemes.

Exhibit 8 | Existing Rating Tools

World Green Building Council			*http://www.worldgbc.org/*	
continent	**labeling**	**country**	**web page**	
America	LEED*	USA	http://www.usgbc.org/	1
	Green Globes*	USA	http://www.greenglobes.com/	2
	LEED Canada*	Canada	http://www.cagbc.org/	3
	Green Globes*	Canada	http://www.greenglobes.com/	4
	LEED Mexiko/ SICES	Mexiko	http://www.mexicogbc.org/	5
	LEED Brasil*	Brazil	http://www.gbcbrasil.org.br/pt/	6
	AQUA	Brazil	http://www.vanzolini.org.br/	7
	-	Colombia		8
	-	Argentina	http://www.argentinagbc.org.ar/	9
Europe	Green Building	Europe	http://www.eu-greenbuilding.org/	10
	DGNB*	Germany	http://www.dgnb.de/	11
	BREEAM*	UK	http://www.breeam.org/	12
	HQE*	France	http://www.assohqe.org/	13
	CertiveA	France	http://www.certivea.fr/	14
	PromisE	Finland	http://www.vtt.fi/	15
	Lider A	Portugal		16
	BREEAM Netherlands	Netherlands	http://www.dgbc.nl/	17
	Protocollo Itaca	Italy	http://www.itaca.org/	18
	-	Italy	http://www.gbcitalia.org	19
	SPIN	Swiss	http://www.inrate.ch/index.php?id=49	20
	Minenergie*	Swiss	http://www.minergie.ch/	21
	-	Poland	http://www.plgbc.org/	22
	-	Romania	http://www.rogbc.org/romania-green-building-council/	23
	VERDE	Spain		24
Asia	LEED Emirates*	VAE	http://www.esoul.gohsphere.com/default.aspx	25
	LEED India*	India	http://www.cagbc.org/	26
	TGBRS India	India	http://www.teriin.org/	27
	Green Mark	Singapur	http://www.bca.gov.sg/GreenMark/green_mark_buildings.	28
	SGP 2012	Singapur	http://www.mewr.gov.sg/sgp2012/	29
	ABRI	Taiwan	http://www.abri.gov.tw/utcPageBox/ENGMAIN.aspx?ddsP	30
	GBAS	China		31
	-	Vietnam	http://vsccan.org/vgbc/green-building-tools/	32
	HK-BEAM*	Hong Kong	http://www.hk-beam.org.hk/general/home.php	33
	CASBEE*	Japan	http://www.ibec.or.jp/CASBEE/	34
Africa	Green Star SA*	Southafrica	http://www.gbcsa.org.za/	35
Australia	Green Star*	Australia	http://www.gbca.org.au/	36
	Nabers*	Australia	http://www.nabers.com.au	37
	Green Star NZ*	New Zealand	http://www.nzgbc.org.nz/main/	38
30.05.2009	not verified			
	* Certification Systems / Rating Tool			

Exhibit 9 | Comparison of BREEAM, LEED, Green Star, and CASBEE

	BREEAM	LEED	Green Star	CASBEE
Launch Date	1990	1998	2003	2004
Ratings	PASS / GOOD / VERY GOOD / EXCELLENT / OUTSTANDING	Certified / Silver / Gold / Platinum	One Star / Two Star / Three Star / Four Star / Five Star / Six Star	C / B− / B+ / A / S
Weightings	Applied to each issue category (consensus based on scientific / open consultation)	All credits equally weighted, although the number of credits related to each issue is a de facto weighting	Applied to each issue category (industry survey based)	Highly complex weighting system applied at every level
Information Gathering	Design / management team or assessor	Design / management team or Accredited Professional	Design team	Design / management team
Third-Party Valuation	BRE	N / A	GBCA (Green Building Council of Australia) nominated assessors	Third-party agencies e.g., JSBC (Japan Sustainable Building Consortium)
Certification labeling	BRE	USGBC (United States Green Buildings Council)	GBCA	JSBC
Update Process	Annual	As required	Annual	As required
Governance	UK Accreditation Service (UKAS)	USGBC	GBCA	JSBC
Required qualification	Competent persons scheme	Passed exam	Training scheme and exam	N / A
Assessor / AP CPD requirements	Carry out at least one assessment per year	No CPD requirements	Status renewed every three years	N / A

Exhibit 9 | (continued)

Comparison of BREEAM, LEED, Green Star, and CASBEE

	BREEAM	LEED	Green Star	CASBEE
Compound Annual Growth Rate	93% (1998–2007)	86% (2002–2007)	Not available	Not available
Assessment Collation Fee*	£2000-£10000 ($3971–19857)	Up to £37,770 ($75000)	£2015–4030 ($4002–8004)	Unknown
Certification fee	£740–£1500 ($1469–2979)	£1133–£11331 ($2250–22500)	£2550–£7185 ($5063–14268)	Unknown
Cost of credit appeals	Free	£252 ($500)	£403 ($800)	Unknown
Credit interpretation requests cost/allowance	Free/unlimited number	£111 ($220) unlimited number	Free/Maximum of two	Unknown
Number of units certified**	110808	1823	50	23
Domestic	109450	540	N/A	N/A
Non-Domestic	1358	1283	50	23
Availability of assessment information	Estimator tools are available free of charge. Guidance is currently only available to people who attend the training courses	The tools are available free of charge and technical guidance is available for £100 ($200)	The tools are available free of charge and the technical manual is available for £224 ($444)	The assessment tool and guidance is available free of charge in Japanese and English.

Notes: The source is (BRE, 2008). Amounts are in £ and U.S.$ using these exchange rates: £0.50360 = US$1; £0.40311=AUS$1; US$0.80445=AUS$1.

*Assessment costs for different schemes may include varying tasks. This makes a direct comparison difficult.

**As of February 2008.

Exhibit 10 | Issue Weightings Comparison Table

	BREEAM	LEED	Green Star	CASBEE[a]
Management	15	8	10	
Energy	25	25	20	
Transport				
Health	15		10	
Well-being		13		
Water	5	5	12	
Materials	10	19	10	
Landuse	15		8	
Ecology		5		
Pollution	15	11	8	
Sustainable Sites		16		

Note: The source is BRE (2008).
[a]It is not possible to calculate the value of each category as the value is dependent on the final score.

Not surprisingly, when considering the record-breaking drought conditions in Australia, the water conservation standards in Green Star are the highest compared to the other schemes. BREEAM in the U.K. has the highest standards with respect to land use and ecology where the density of the population is highest. Overall, the schemes promote standards reflecting local sustainability issues and environmental conditions.

When BRE assessed each of the schemes under a normalized set of conditions across all the rating criteria, the following results were found, as shown in Exhibit 11 (BRE, 2008). From the outset it is clear that LEED, Green Star, and CASBEE assessments are not equivalent to BREEAM. In a hypothetical scenario, a six-star Green Star building (the highest Green Star rating possible) is less sustainable than a platinum LEED building (the highest LEED rating possible) and approximately equal to a 'very good' BREEAM-rated building.

Lack of Consistency in Baseline Assumptions

Building code or building regulation standards vary from country to country and one of the assumptions in comparisons has been that all countries are starting from the same baseline standard. This is not always the case however; for example, building code standards in the U.S. are lower than those found in the U.K. Building Regulations (BRE, 2008). The reliance on local building standards as a

Exhibit 11 | A Broad Comparison of Four Rating Tools

EXCELLENT			
VERY GOOD	PLATINUM	SIX STARS	
GOOD	GOLD	FIVE STARS FOUR STARS	S A
PASS	SILVER	THREE STARS	B+
	CERTIFIED	TWO STARS ONE STAR	B- C
BREEAM	LEED	Green Star	CASBEE

Note: The source is BRE (2008).

minimum starting point for the systems means that the ratings they subsequently award are affected. Therefore, the LEED system sets lower standards than the U.K. BREEAM system. The Australian Green Star system also has lower standards than the U.K. BREEAM system. This is an issue for businesses wishing to set global standards across their property portfolios, because choosing any one standard may lead to lower rating for their properties in some countries than if they followed the local system.

The Difficulties with Comparing Rating Tools

So far this analysis has focused on the different countries and their respective rating tools, as well as the characteristics of each tool. The next step is to consider a direct comparison of the eleven rating tools based on fifteen different assessment criteria, as shown in Exhibit 12. A notable observation from this matrix confirms that every assessment criteria is considered by at least one rating tool, although importantly no single rating tool addresses all fifteen criteria. It can be argued that this is due to the differences between climate zones as previously noted, although the lack of flexibility here can also be argued.

Exhibit 12 | A Broad Comparison of Rating Tools

	U.K.	U.K.	U.K. / EU	U.K. / EU	Hong Kong	Japan	Germany	Australia	France	Canada / U.S.	U.S.	Italy
Assessment Criteria	BREEAM	CFSH[a]	EPCs	DECs	BEAM	CASBEE	DGNB-Seal	Green Star	HQE	Green Globes	LEED	Protocol ITACA
Energy	X	X	X	X	X	X	X	X	X	X	X	X
CO_2	X	X	X	X			X		X	X		X
Ecology	X	X			X	X	X	X	X	X	X	X
Economy							X		?	X		?
Health and Wellbeing	X	X			X	X	X	X	X	X		?
Indoor Environmental Quality	X	X			X	X	X	X	X	X	X	?
Innovation	X				X		?	X	?		X	?
Land Use	X	X			X		?	X	X	X	X	?
Management	X	X		X	X	X	?	X	?			?
Materials	X	X			X	X	X	X	?	X		X
Pollution	X	X			X	X	X	X	X	X	X	?
Renewable Technologies	X	X	X				?	X	?	X	X	X
Transport	X	X			X		X	X	?	X	X	?
Waste	X	X			X		?		X	X		X
Water	X	X			X	X	X	X	X	X	X	X

Notes: The source is King Sturge (2009).
? Data for DGNB-Seal, HQE, and Protocol ITACA is not exhaustive and additional criteria may be included in the assessment.
[a]Code for sustainable homes.

Conclusion

A study by BRE (2008) concluded that there are high levels of variation between the systems for the same 'grade' or 'rating' than might be expected. For example, BREEAM Excellent, LEED Platinum, and a 6-Star Green Star office building are not equivalent in terms of sustainability features or environmental impact (BRE, 2008). Both Green Star and LEED, when applied to U.K. buildings, rated those buildings higher than the U.K. BREEAM assessment method. Overall, BRE stated that none of the systems they examined (BREEAM, CASBEE, LEED, and Green Star) traveled well in terms of comparison.

For the market of international assessment to mature, additional transparency is required between the various assessment methods. While some tools are promoted as complex and are relatively expensive, others are wholly on-line and cost substantially less; such differences between rating tools increases the level of confusion with users who are not 100% familiar with or perhaps new to global rating tools. Transparency should lead to increased competition among the rating tools, and produce an environment that tends towards improvement of standards as owners compete to demonstrate their commitment to the environment and the highest possible standards of performance. Standards markets work more effectively if common metrics are agreed upon for key issues, such as greenhouse gas emissions for example. Common standards are a pre-requisite for the next stage of development. Eventually a market may emerge where licensing, cross certification, and multiple labeling occurs. Such a system would allow owners to buy into local market standards, as well as regional and international standards (BRE, 2008).

This paper has conducted an investigation into the international evolution of sustainable rating tools for buildings, predominantly office buildings. While it has now been widely acknowledged that buildings are a major contributor to CO_2 emissions, the focus is on how to use rating tools from a global perspective. In an era of international property investment where it is possible to directly compare values of individual buildings in different countries with a view to potential acquisition, unfortunately rating tools do not exhibit the same level of comparability due to their unique characteristics and focus. This in turn may hinder the take-up rate of sustainable rating tools and also be a barrier to increasing the knowledge about sustainability and buildings.

There are some key recommendations for this discussion as follows:

A global set of 'benchmark' parameters should be established for building rating tools in order to reduce the barriers between international markets and associated confusion. It is suggested a starting point is zero net emissions, which would allow buildings to be compared within each country and also between each country.

The individual characteristics of each country must not be overlooked when seeking to standardize rating tools. For example, water is a climate change issue in the U.K. (due to too much water hence flooding) and also in Australia (but due

to lack of water or drought). Accordingly, it is not possible to use the same rating tool in each country.

Consideration should be given to all buildings, not just new high-profile trophy buildings. The largest offenders to sustainability are older buildings (Reed and Wilkinson, 2006).

Further research should be conducted into global rating tools from an objective perspective for the betterment of international stakeholders. While there are positive and negative characteristics associated with each rating tool, it is important to continue to monitor their success with regards to their take-up rate and implementation. After considering all of the efforts to increase sustainability in the built environment, it is critical that the goal of more sustainable buildings is not hindered by the absence of a truly international rating system.

Appendix A

Websites of Relevant Sustainability Tools

Rating Tool	Website	Comments
Argentina Green Building Council	www.argentinagbc.com.ar	
BREEAM (Building Research Establishment Assessment Method)	www.breem.org	Created in the UK in 1990.
Canada Green Building Council	www.cagbc.org	
CASBEE	www.ibec.or.jp / casbee / english	Program of the Japan Sustainable Building Consortium in 2002.
Colombia Green Building Council	www.cccs.org.co	
DGNB (Germany)	www.dgnb.de	Commenced in 2008.
Emirates Green Building Council	www.emiratesgbc.org	
Germany Green Building Council	www.gesbc.org	
Green Building Council of Brazil	www.gbcbrazil.org.br	
Green Building Council of South Africa	www.gbcsa.org.za	
Green Globes Canada	www.greenglobes.com	On-line assessment tool since 2000 operated by BOMA Canada.
Green Globes USA	www.greenglobes.com	On-line assessment tool since 2000 operated by Green Building Initiative.
Green Star	www.gbc.aus.org.au / greenstar /	Created by the Green Building Council in Australia in 2003.
India Green Building Council	www.igbc.in	
Japan Sustainable Building Consortium	www.jgbc.com	

Appendix A (continued)
Websites of Relevant Sustainability Tools

Rating Tool	Website	Comments
LEED (Leadership in Energy and Environmental Design)	www.usgbc.org/leed	Developed by the Green Building Council in 1998.
Mexico Green Building Council	www.mexicogbc.org	
New Zealand Green Building Council	www.nzgbc.org.nz	
Province of Ontario	www.gov.on.ca	
Taiwan Green Building Council	www.taiwangbc.org.tw/	
Toronto and Regional Conservation Authority	www.trca.ca	
UK Green Building Council	www.ukgbc.org	
U.S. Green Building Council	www.usgbc.org	
Vietnam Green Building Council	www.vsccan.org	
World Green Building Council	www.worldgbc.org	Composed of national Green Building Councils.

Appendix B

Main Tools Used in the U.K. and Europe: 'Mind the Gap'?

Tool / Technique	Checklist, Toolkit / Other	Property	Environmental	Social	Economic	Description
BRE Sustainability Checklist for Developments	Checklist / toolkit	Commercial and residential	Present	Present	Present	This Checklist provides practical tools and indicators to measure the sustainability of developments (both buildings and infrastructure) at site or estate level.
BRE Green Guide to Specification	Specification Guide	Commercial, residential, and public	Present	Absent	Absent	The Green Guide to Specification is an easy-to-use publication, providing guidance for specifiers, designers and their clients on the relative environmental impacts of over 250 elemental specifications including roofs, walls, and floors.
BRE Office Scorer	Rating system	Commercial	Present	Absent	Present	The tool compares major or complete refurbishment with complete redevelopment, and redevelopment within an existing facade.
BREEAM	Rating system	Commercial and public	Present	Absent	Absent	BREEAM stands for the Building Research Establishment Environmental Assessment Method. BREEAM is a method for assessing the environmental quality of buildings. It considers design issues that affect the global environment, local environment and the health and well being of building occupants.

Appendix B (continued)

Main Tools Used in the U.K. and Europe: 'Mind the Gap'?

Tool / Technique	Checklist, Toolkit / Other	Property	Environmental	Social	Economic	Description
EcoHomes	Rating system	Residential and public	Present	Absent	Absent	EcoHomes is the homes version of BREEAM. It provides a comprehensive rating for new, converted or renovated homes, and covers both houses and apartments.
Envest 2	Software tool / toolkit	All	Present	Absent	Absent	Envest 2 is a software tool that simplifies the otherwise very complex process of designing buildings with low environmental impact and whole life costs.
Environmental Impact Assessment (IAIA)	Set of techniques	All	Present	Present	Present	International Association for Impact Assessment is a forum for advancing innovation, development and communication of best practice in impact assessment.
SEEDA Sustainability Checklist	Checklist / Toolkit	All	Present	Present	Present	This Checklist is designed to be used by those involved in planning or building sizeable developments from estates to urban villages and regeneration projects.
Strategic Environmental Assessment	Set of techniques	All	Present	Present	Present	A website with a variety of tools and useful links for SEA.

Note: The source is RICS (2007).

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