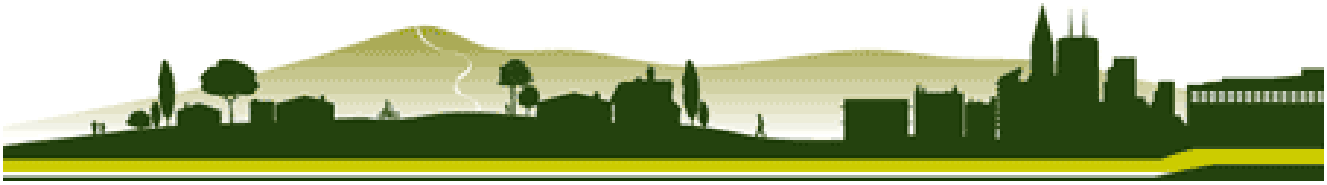

A DISCUSSION DOCUMENT COMPARING INTERNATIONAL ENVIRONMENTAL ASSESSMENT METHODS FOR BUILDINGS.

THOMAS SAUNDERS

breeam

FOREWORD

Long before Sir Nicholas Stern described Climate Change as the greatest market failure that the World has ever known, the great economist John Kenneth Galbraith warned against conventional wisdom and the "tendency to associate truth with convenience, with what most closely accords with self-interest and personal well-being or promises best to avoid awkward effort". Few now doubt that Climate Change is the greatest threat that we have ever faced and that we must use every "weapon in our armoury" in order to defeat it.

In the UK, buildings account for some 50% of energy demand and some 40% of raw materials used. By 2016 the proportion of developed land is expected to rise from 10% to 12% which is higher than most other countries in the World. In this context sustainability of the built environment is critical to the nation and much can and should be done to encourage higher environmental standards. Since its introduction in 1990 BREEAM has sought to do just that through:

- using a scientific evidence base in setting tough environmental standards for both new and existing buildings;
- raising these BREEAM standards as fast as the UK market will bear; and
- learning from technologies, regulations, problems and other standards worldwide and incorporate lessons within BREEAM.

As a voluntary standard BREEAM has long been able to help, recognise, reward and learn from those who innovate and are prepared to go beyond the baseline of sustainability regulations. In this way BREEAM has played a part in creating a climate where regulators can, with relative political safety, introduce, higher standards (as evidenced by the introduction into regulations of the requirements for domestic smoke detectors, higher levels of building insulation and increased fuel efficiency of boilers).

Recently a number of environmental standards for buildings have been introduced around the World including CASBEE from Japan, LEED from the US and Green Star from Australia. As we want BREEAM to continue to play a leading role in protecting the planet and its people, we must learn from and work with the purveyors of these standards to ensure BREEAM delivers the most "sustainable bang from every buck spent".

In the spirit of co-operation, learning and integrity we have attempted to compare and contrast these standards with BREEAM. As the first principle of science is that you must not fool yourself and as Galbraith has indicated it is easier to fool yourself than someone else, we have published this report

as a draft for peer review and consultation and would welcome feedback from other scientists and those engaged in the development of standards for environmental assessment of buildings.

The closing date for preliminary feedback is Monday 12th May 2008.

Carol Atkinson
Chief Executive BRE Global
March 2008

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SUMMARY

Introduction

Globalisation and the rise of the trans-national businesses have combined with an increased awareness of the environment. This has generated demand for ‘international’ systems of measuring the environmental performance of materials, buildings and the wider built environment.

Boards of Directors of trans-nationals are increasingly keen to demonstrate their commitment to building in a more environmentally friendly way, through more tangible means such as benchmarking using consistent, transparent and independently verified systems of measurement.

A number of major multinationals have already signed up to using either BREEAM or LEED across their international portfolio. This commitment, often, but not always, reflects the location of their corporate headquarters. However, these systems were never designed to be used across multiple countries and often have features with a significant ‘local’ flavour.

This report looks at the most commonly used schemes and how they compare to the local UK benchmark, BREEAM. Such comparisons are not straightforward, whilst Green Star is a close relative of BREEAM and LEED is also a more distant relation, CASBEE has completely independent origins and a strong focus on issues, such as earthquake resistance, which are of particular importance in Japan, its country of origin.

The results demonstrate much higher levels of variation between systems for the same “grade”, for example between BREEAM ‘Excellent’, LEED ‘Platinum’ and Green Star ‘Six Stars‘ than might have been expected. These latter two systems score buildings in the UK more kindly than the UK BREEAM. Thus buildings designed to achieve high LEED and Green Star scores in the UK will generally not score as well against BREEAM. Looked at the other way around, buildings which score modestly against BREEAM, in the UK, are likely to achieve higher scores against LEED and Green Star. We can conclude that none of these systems, including BREEAM, travel well.

It is suggested that the high level of difference exposed by the comparative approach described here arises, at least in part, from each system relying on local regulatory minima to achieve certain aspects of performance. These aspects are therefore omitted from the grading as they are taken as a 'given'. These differences are profoundly unhelpful to those businesses who wish to set 'global' standards because choosing any one national standard could lead to an inconsistency in the environmental performance of buildings assessed to the same standard. Buildings might also be awarded much higher ratings than they deserve when compared to other buildings that merely follow local regulations, guidelines and standard practice.

There may always be differences between the relative standards set between each system, even if there is a move towards more transparency and comparability. However, making it easier to compare each of the schemes may encourage competition between scheme operators. This competitive market in standards is positive in that it creates an environment where standards will tend to improve and converge as clients vie to demonstrate their commitment to ever higher levels of performance. Indeed this is the underlying dynamic of voluntary environmental certification.

Standards markets will work more efficiently if common metrics are agreed for key issues. More transparency will allow better comparison of the relative merits of each system which will help to promote the sharing of best practice. Facilitating this should therefore be a key future role for an independent body such as the World Green Building Council working closely with all scheme operators. Comparison with other standards markets, such as the LPCB and VdS standards relating to the approval of sprinkler systems and smoke detectors, suggests that once there is transparency the market will mature to allow 'licensing', 'cross certification' and 'multiple labelling'. This would allow clients to purchase several brands, say a locally recognised or government supported brand, combined with an internationally recognised brand, through a single audit.

In addition to technical standards this report compares and contrasts the various business models employed by scheme operators. The approaches are shown to fall into two main categories, 'in house assessment' where the vendor attempts to generate income through a monopoly of supply and the 'licensed assessor' route which provides for market based competition in delivery.

This study is just the starting point and aims to provoke discussion between the large and increasing number of scheme operators developing and running environmental assessment methods for buildings, building products, organisations and developments. This report makes recommendations to emerging GBC's as to the strengths and weaknesses of each approach.

The recommended next steps are therefore:

- More transparency
- Development of a set of underpinning set of standards which exclude as much 'home territory regulatory effects' as possible to facilitate comparison
- Conversations between the various scheme operators need to begin, possibly facilitated by an independent international body in order to work towards:
    - sharing best practice
    - setting key common minimum standards
    - dual or multi certification to allow multinational companies to demonstrate the environmental performance of their buildings in the countries in which they are based and compare more easily with the buildings they occupy overseas.

THE COMPARISON

Overview

Since 2000 the number of environmental assessment methodologies around the world has been increasing rapidly. BREEAM (BRE Environmental Assessment Method) was the first system (launched in 1990) to offer an environmental label for buildings. There are now a number of different schemes around the world, most of which have been based on or inspired by BREEAM, but each has been adapted to suit the region in which they are to be used. BREEAM is aimed at developers, builders, designers and owner-occupiers, environmental labels and allow users to differentiate their buildings from those of their competitors.

Adaptations have been made for a variety of reasons, but predominantly to reflect differences in standard practice or cultures around the world, and also to reflect the different environmental issues that affect those regions.

The environmental assessment methodologies covered in this report include BREEAM, CASBEE (Comprehensive Assessment System for Building Environmental Efficiency), Green Star and LEED (Leadership in Energy and Environment Design (launched in 1998). This report summarises the approach used by each of these methods and includes a quick comparison of the environmental standards demanded to meet each rating.

A common theme of each assessment method is the reliance on existing building regulations and other third party standards. As any environmental assessment methodology needs to cover such a wide range of issues there is no other way that a system could remain up to date without significant initial investment and continual extensive maintenance. Also, reliance on existing third-party standards or regulations lends credibility to the system, especially among sceptics.

As well as comparing the scores and rating levels in each of the schemes, the major differences in the processes have been investigated. The major differences between the schemes have been highlighted in table 1 and are discussed in more detail in the report.

Comparison Summary

Table 1 Process Comparison – Summary table

	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
Assessment	Trained assessors	USGBC	Accredited Professional	Design / management team
Third Party Validation	BRE	N/A	GBCA (Green Building Council of Australia) nominated assessors	Third Party Agencies eg JSBC (Japan Sustainable Building Consortium)
Certification labelling	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
Compound Annual Growth Rate	93% (1998 – 2007)	86% (2002 - 2007	Not available	Not available

	BREEAM	LEED	Green Star	CASBEE
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

Amounts shown in this table and in Charts 2 and 3 are in £sterling and (US$) using the following exchange rates: £0.50360 = US$1, £0.40311 = AUS$1, US$0.80045 = AUS$1

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

****As of February 2008**

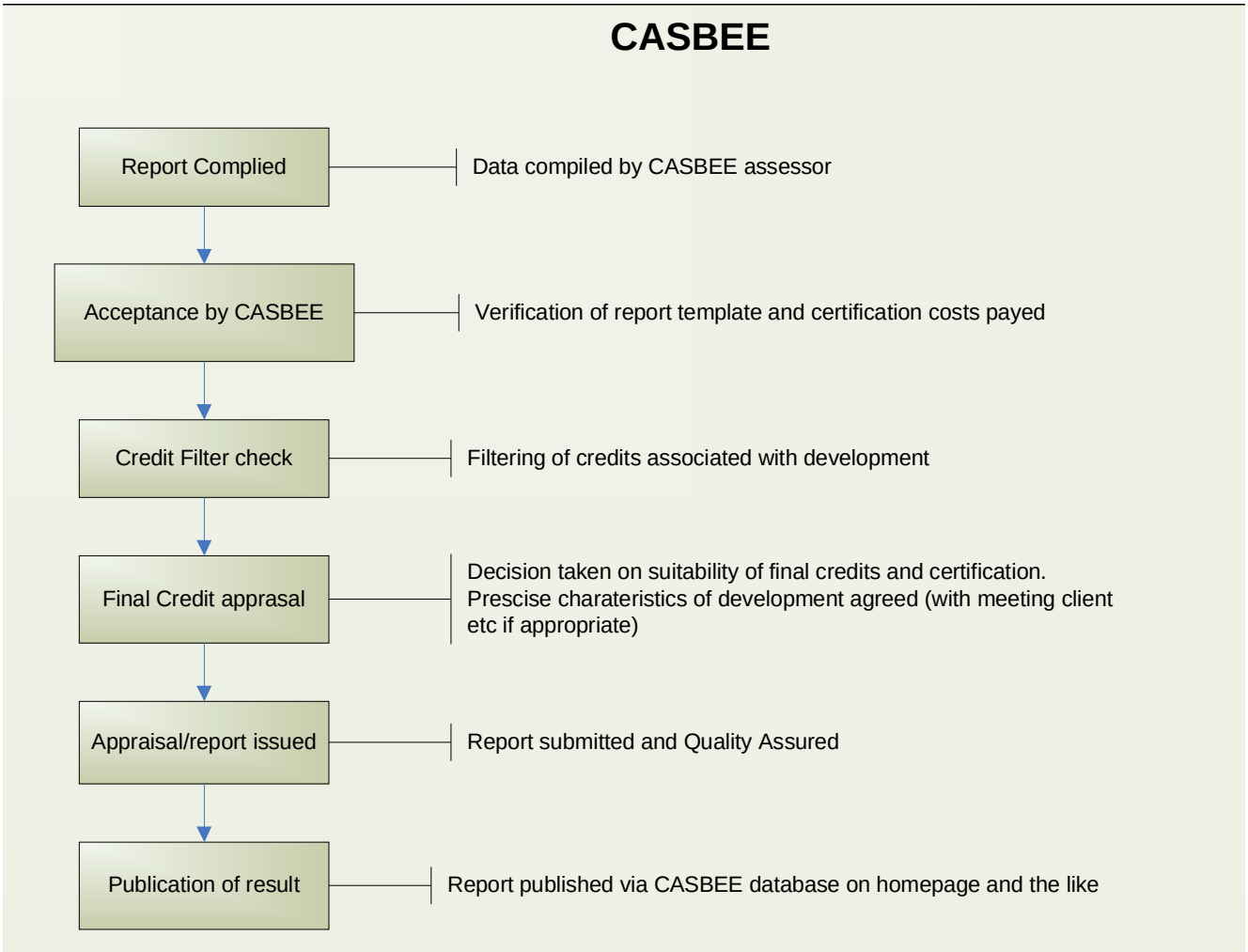
In order to calculate a single score from the diverse range of environmental issues that each of the methodologies covers, each system attributes a different weighting to the issues covered. The way that different systems set these weightings differs. In some the cases these are built into the value of each criterion, in the others these are built into the value of the environmental issue category. The weightings used are summarised in table 2. For the purposes of the comparison the weightings have all been compared to the BREEAM environmental issue categories, which are explained in more detail in the BREEAM section of this report.

<table>
<tr><th></th><th>BREEAM</th><th>LEED</th><th>Green Star</th><th>CASBEE</th></tr>
<tr><td>Management</td><td>15</td><td>8</td><td>10</td><td rowspan="9">It is not possible to calculate the value of each issue category, for CASBEE, as the value is dependant on the final score</td></tr>
<tr><td>Energy</td><td rowspan="2">25</td><td rowspan="2">25</td><td>20</td></tr>
<tr><td>Transport</td><td>10</td></tr>
<tr><td>Health and Wellbeing</td><td>15</td><td>13</td><td>10</td></tr>
<tr><td>Water</td><td>5</td><td>5</td><td>12</td></tr>
<tr><td>Materials</td><td>10</td><td>19</td><td>10</td></tr>
<tr><td>Landuse and Ecology</td><td>15</td><td>5</td><td>8</td></tr>
<tr><td>Pollution</td><td>15</td><td>11</td><td>5</td></tr>
<tr><td>Sustainable Sites</td><td>-</td><td>16</td><td>-</td></tr>
</table>

Table 2 Issue Value / Weighting Comparison – Summary Table

The following charts outline the basic processes employed by each of the schemes. They indicate each of the steps and where available indicate the approximate costs and timeframes involved. More detailed information can be found in the discussion of each method.

Chart 1 CASBEE third party verification process



NB Chart 1 is an interpretation of a literal translation of a table taken directly from the Japanese portion of the JSBC website. There is very little information available on the certification process in English.

Chart 2 Green Star third party verification process

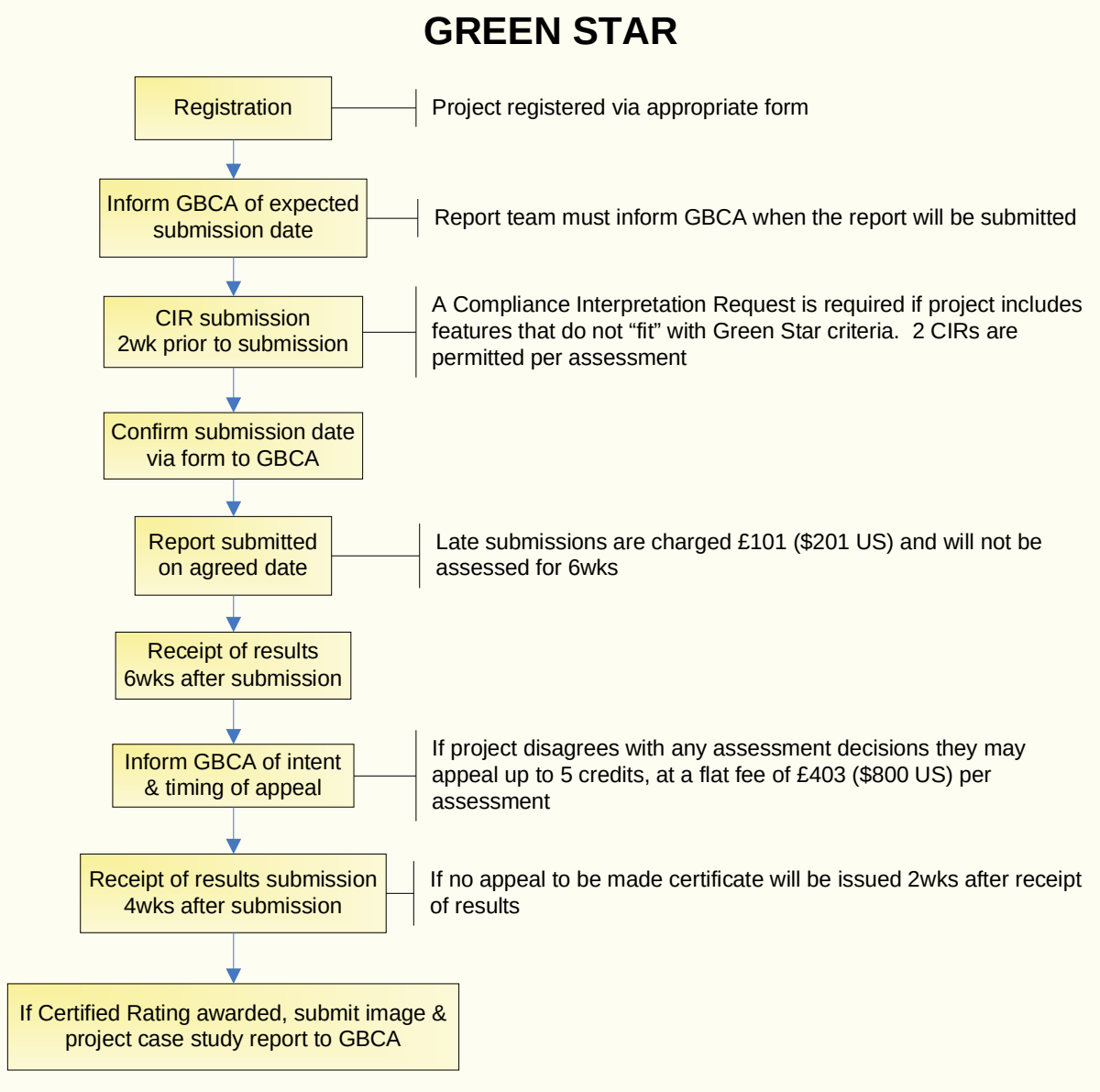


Chart 3 LEED third party verification process

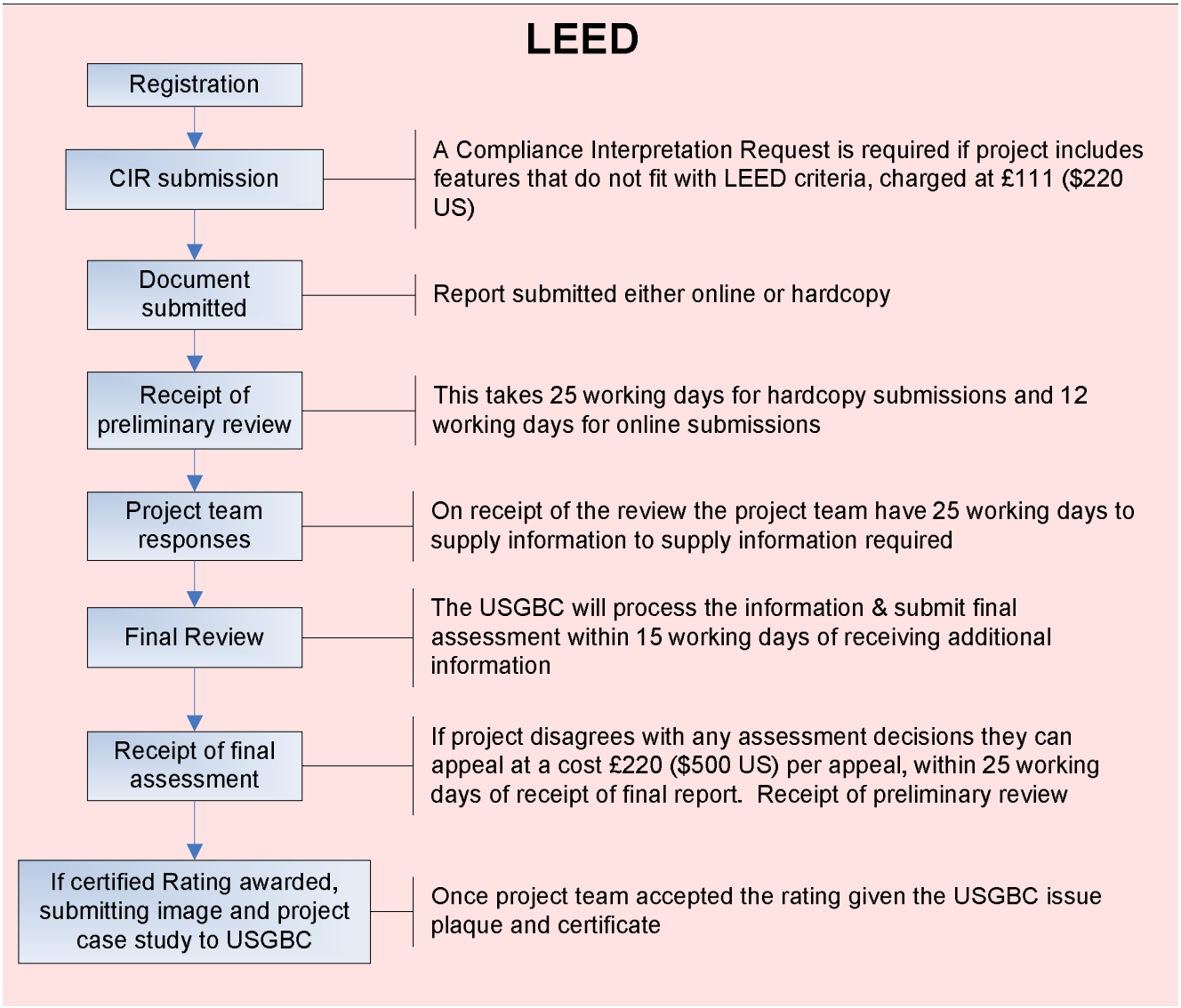
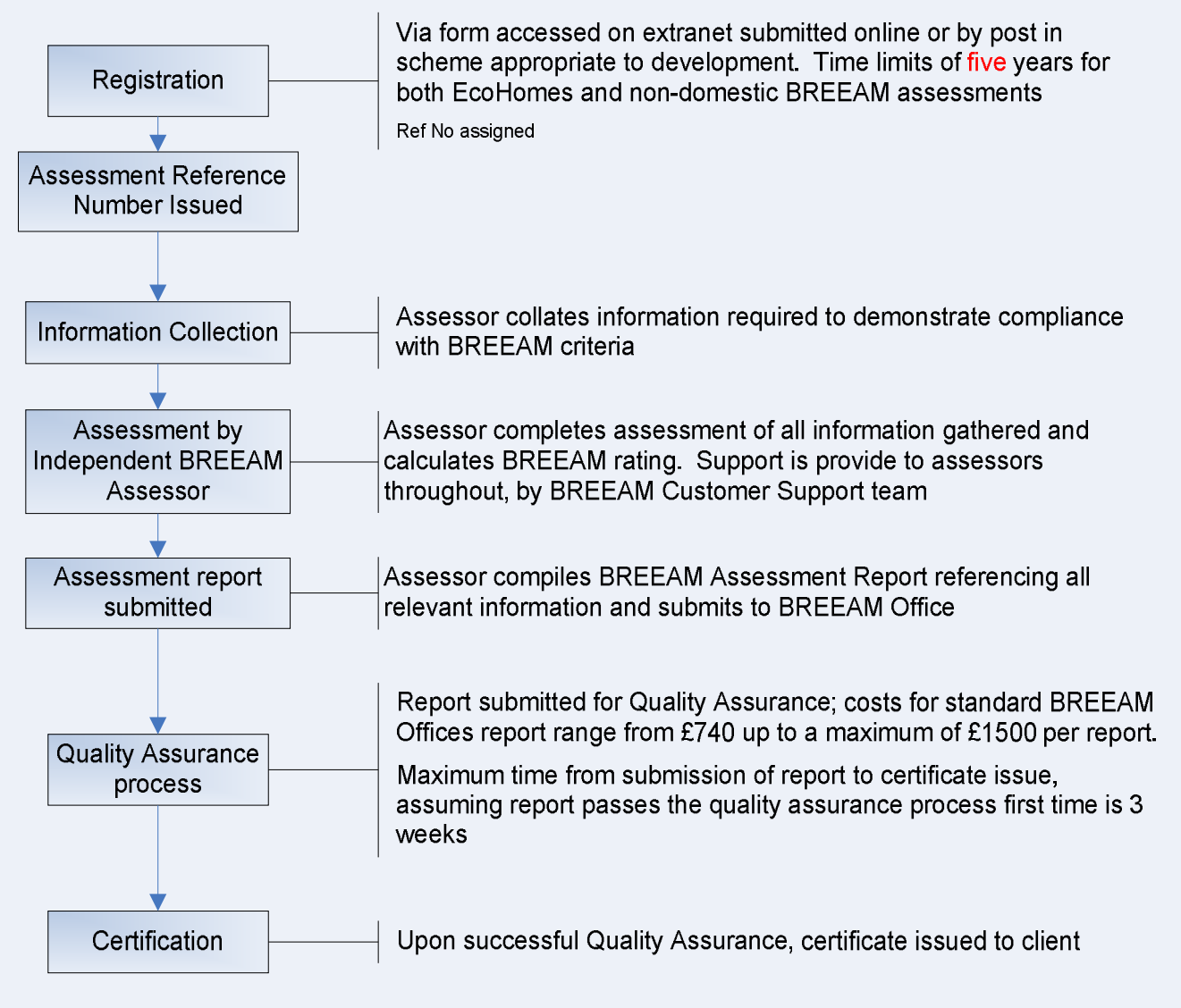


Chart 4 BREEAM third party verification process



CASBEE

CASBEE was first launched in 2004 by the Japan Sustainable Building Consortium. The methodology used to calculate the score is called BEE (Building Environmental Efficiency) that distinguishes between environmental load reduction and building quality performance. This approach was first developed by IISBE (International Initiative for a Sustainable Built Environment) in the form of GBTool. This means that, of the three methods included in this comparison, it differs the most from BREEAM.

There are 4 different versions of CASBEE:

- CASBEE for Pre-Design, for projects at a very early stage to help with planning and site selection.
- CASBEE for New Construction to assess buildings during design and construction stages.
- CASBEE for Existing Buildings for buildings that have been occupied for at least one year.
- CASBEE for Renovation to help generate proposals for building upgrades and to assess improvements.

This study focuses on CASBEE for New Construction.

The Japanese have a tradition of close relations between government and industry. The JapanSBC was organized to lead a cooperative academic, industrial and government effort to create a nationally authorized green building rating system. The result is called the “Comprehensive Assessment System for Building Environmental Efficiency”, better known as CASBEE, and it can be used to evaluate impacts throughout the life of a project. According to Professor Shuzo Murakami, Chair of JapanSBC, “CASBEE creates incentives for building owners, designers and users to develop high-quality sustainable buildings. The system meets both the political requirements and market needs for achieving a sustainable society.”

Under CASBEE, all building permit applicants must submit the required data, part of which is displayed on a public website. Through the end of 2005, several major local governments including Nagoya, Osaka and Yokohama have introduced CASBEE to their own local

regulatory directives, and there are more than 80 CASBEE projects in Nagoya alone.

Assessment Process

CASBEE is sold primarily as a “self assessment check system” to permit users to raise the environmental performance of buildings under consideration. It can also be used as labelling system, if the assessment is verified by a third party.

No change has been made to the methodology to make it applicable to the US or to the UK but the guidance has been translated into English. This makes CASBEE much more accessible internationally; it is therefore much more likely to be studied so that its applicability can be assessed.

There is no information available, in English, on how to train up to be an assessor or regarding the process for third party verification. Although there does appear to be much more information on the Japanese pages.

Scoring and Weightings

CASBEE New Construction (NC) is a complex calculation methodology. Like BREEAM, CASBEE uses weightings to balance the value addressing issues with the number of measures available (the more measures available to improve environmental performance the more credits can be developed but this does not necessarily reflect the environmental impact of addressing the issues). However, the weightings applied to CASBEE are much more complex than BREEAM, LEED or Green Star.

Weightings are applied to each category; categories include “indoor environment”, “outdoor environment onsite”, “Energy” and “Resources & Materials”. In each category there are headline issues such as “Service Ability”, “lighting and illumination” and “building thermal load” to which another layer of weightings are applied. Under these headline issues there are individual issues including “noise”, “ventilation” and “use of recycled materials” to which another layer of weightings applies. A final layer of weightings is applied to the sub-issues grouped under each of the individual issues. The sub issues include “ventilation rate”, “CO_2 monitoring”, “Adaptability of Floor Plate”, etc.

All the issues are split into two basic types – Quality measures Q and Load Reduction measures LR. Once the assessment is complete the score is calculated. For most of these sub-issues it is possible to score between 1 and 5 points, zero is not available although in a small number of cases a credit can be removed from the assessment. This prevents a negative score for Q or LR.

Once the assessment has been carried out the final score, presented as the BEE (Building Environmental Efficiency), is calculated using the following equation:

$$BEE = \frac{Building Environmental Quality \& Performance(Q)}{Building Environmental Loadings(L)} = \frac{25 \times (S_Q - 1)}{25 \times (5 - S_{LR})}$$

Where

$Q = 25 * (S_Q - 1)$

*S_Q: Score of Q category

$S_Q = 0.4 * S_{Q1} + 0.3 * S_{Q2} + 0.3 * S_{Q3}$

$L = 25 * (5 - S_{LR})$

*S_{LR}: Score of LR category

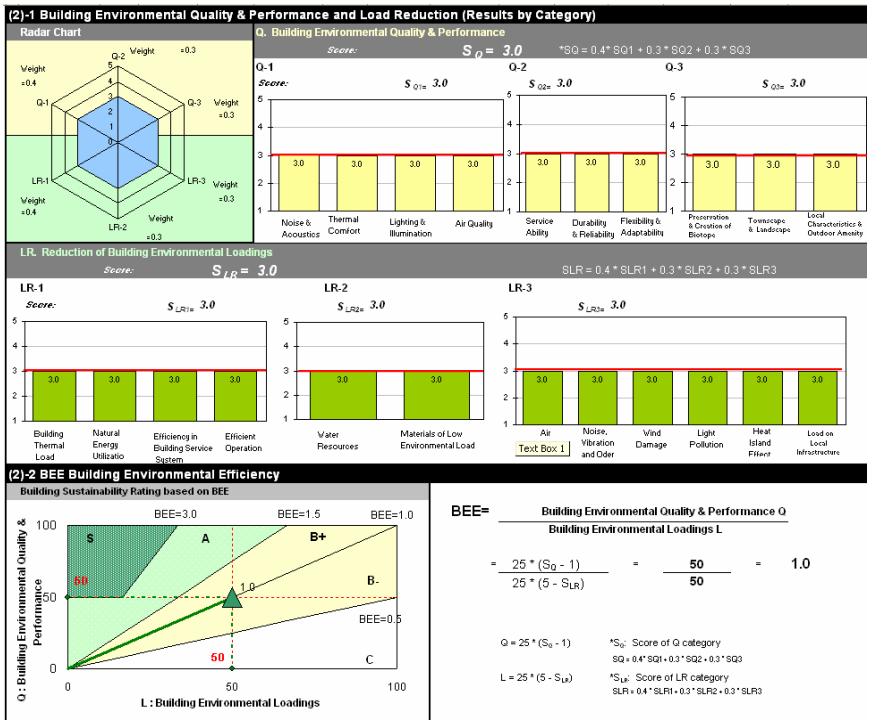
$S_{LR} = 0.4 * S_{LR1} + 0.3 * S_{LR2} + 0.3 * S_{LR3}$

Because the “Quality” credits (Q) are divided by the “Load Reduction” credits (LR), it is impossible to work out the value of each credit until a final score has been calculated. This would make it impossible to work out the on-cost of achieving the various rating levels until the assessment of a specific design is completed.

There are five different ratings available:

C:	BEE of 0 – 0.49
B-:	BEE of 0.5 – 0.99
B+:	BEE of 1 – 1.49
A:	BEE of 1.5 – 2.99
S:	BEE of 3.0 –

The score and rating is displayed in different ways in the spreadsheet that gives more flexibility in how that information can be used. However, it also leads to a greater potential for confusion and a lack of clarity. The following screen shot shows the score summary page from CASBEE.



Technical Comparison Summary

In the manual, downloaded from the CASBEE website, there is very little information on how the credits are actually assessed, other than the performance levels required. For example, in the first credit 1.1.1 Background Noise the levels are given as dB(A) but the testing methodology is not provided. This is likely to lead to some inconsistencies, unless there is a standard that must be used throughout Japan, but this is not referenced in the manual. It is worth noting that there may be additional guidance for assessors that is not freely available. Details of training courses can be seen on the Japanese section of the website but without a full translation of the text the detail of what the training entails, or even how long the training course are, is not available to non-Japanese speakers.

There are a number of credits that appear to be awarded for compliance with Japanese Building Law including:

- Q1.4.2.1 Ventilation Rate – 3 out of 5 points where the fresh air rate is “the minimum to satisfy the Building Standards Law.

- Q2.1.1.3 Barrier free planting – 3 of 5 points awarded where the design satisfies the minimum level required under Barrier-free Building Law

- Q2 2.1.1 Earthquake resistance – 3 out of 5 for compliance with building law

- LR2 1.2.1 3 out of 5 points where there are “No systems for using rainwater”

In some cases points are awarded even if the building includes no relevant system or feature including the following:

- Q1 4.2.2 Natural Ventilation Performance – Points can still be awarded where there are no effective openings for natural ventilation in rooms where windows cannot be opened.

- Q2 3.3.6 Provision of backup Space – 3 of 5 credits are awarded where there is no planned space for backup equipment.

- Q2 2.1.2 Seismic Isolation & Vibration Damping systems are used – 3 of 5 points awarded where no such system is specified.

There are a number of credits that would only be of use in extreme cases, such as the “ease of renewal credits” and the “reliability credits”. These are relevant to Japan as it is in an earthquake and typhoon zone but would not be relevant to other climatic zones. If the building is not in an earthquake zone these credits would only be applicable in high security applications such as data centres, or for essential services such as hospitals.

There are many credits that cover issues that are not included within BREEAM Offices at present. The more relevant to the UK context are:

- Q1 2.2 Humidity Control - max credits available where the humidity levels can be maintained at 50% throughout the year.

- Q2 3.1.1 Flexibility and Adaptability allowance for storey height - max credits for 3.9m storey height.

- Q2 3.1.2 Flexibility and Adaptability of floor layout - max points where the wall length ratio is less than 0.1. Wall length ratio = (Length of perimeter walls (m) + length of load bearing walls (m)) / Exclusive area (m^2).

- Q2 3.2 Flexibility and Adaptability floor load margin - max points awarded where the allowable floor loading is equal to 4500N/m^2 or more.

Overall there are 44 credits in CASBEE that do not have an equivalent credit in BREEAM. As there are only 37 credits that do have an equivalent credit, the comparison of the CASBEE ratings to BREEAM ratings is more difficult to draw conclusions from than the comparison of LEED or Green Star ratings to BREEAM.

LEED

LEED was first launched in 1998. The current version, LEED NC (New Commercial Construction and Major Renovation) projects version 2.2, was launched in 2005. It was set up by the USGBC (US Green Building Council) to improve the way that the construction industry addresses sustainability by providing a simple easy to use label. It focuses on “market transformation”.

There are 8 versions of LEED and 2 further versions under development:

- New Commercial Construction and Major Renovation projects
- Existing Building Operations and Maintenance
- Commercial Interiors projects
- Core and Shell Development projects
- Homes
- Neighbourhood Development
- LEED for Schools
- LEED for Retail
- LEED for Healthcare (under development),
- LEED for Labs (under development)

The version discussed here can be used to assess commercial, institutional and high rise residential buildings. Since the initial launch LEED has been used to certify 1823 buildings in the US. There are 4 different ratings available – Certified, Silver, Gold and Platinum.

The NC (new construction) version is used throughout the design and construction phase, but the actual label (certificate) is only available once the construction is completed.

Assessment process

The project team compile the documentation required for the assessment. A trained assessor is therefore not required, although there is a credit available for appointing a LEED AP (LEED Accredited Professional) as part of the design team.

Once all the documentation has been compiled by the project team it is submitted to the USGBC who review the evidence and calculate the score. Assessments are completed either by using an online application procedure LEED Online, or as hard copy. The USGBC allow 25 working days to review LEED submissions although project teams can pay an additional $10,000 to receive an expedited review which would take 12 working days. LEED Online submissions take the USGBC 12 working days to assess. The total time between initial submission to the USGBC and issue of the certificate can vary from 27 working days to as many as 65 working days.

If the design team feel that the USGBC has made an unfair assessment the project team are given 25 working days to appeal. A charge of $500 is made for each credit assessment appealed against. Once the final score has been accepted by the project team the USGBC issue a certificate and a plaque with the rating on it. It is worth noting that they fully rebate certification fees for any project awarded LEED platinum certification.

LEED Accredited Professionals are not required to be licensed so far There are 45,162 LEED Accredited Professionals To become a LEED Accredited Professional an exam is taken, at a cost of $350 (for non USGBC members). It is likely that delegates will attend a LEED workshop at a cost of $495 (for non USGBC member) before taking the exam. In contrast the money that people charge for putting the paperwork together for a LEED assessment can be as much as $75,000 (1).

Scoring and Weightings

There are no weightings included in LEED, instead credits are worth one point and where there are multiple performance levels each level is worth one point. As there are no weightings the value of each issue is purely dependant on the number of points available.

The lack of issue category weightings combined with the checklist approach that LEED uses to evaluate the impact of the materials mostly increases the weighting of the materials section in LEED compared to the other methods in this study. In LEED the section is worth nearly 1/5th of the final score whereas in both BREEAM and Green Star the materials section is worth just 1/10th of the final score which more closely reflects the relationship between the embodied and operational energy of a building.

There are four different LEED ratings available

Certified:	26 – 32 points
Silver:	33 – 38 points
Gold:	39 – 51 points
Platinum	52 – 69 points

Due to the simplicity of the scoring system it is easy to calculate the value of addressing each issue.

Technical Comparison Summary

One of the key aims of both LEED, and all other schemes for that matter, is to recognise and encourage developers that go beyond standard environmental practice. It is therefore important to know what the baseline in each country is as the standards in the environmental label are likely to differ by the same proportion.

The assumption is that standard practice in most areas of sustainability in America is at a lower level than in the UK. This is highlighted by a number of LEED credits including:

- EA Credit 3 Enhanced Commissioning – The compliance requirements for this credit could be achieved by complying with UK building regulations.

- EQ Credit 2 Increased ventilation – The levels required to achieve this credit in LEED would not meet UK building regulations minimum levels. (LEED Credit – 6 litres/person/sec, UK building regulations – 8 litres/person/sec.

- SS Credit 4.3 and SS Credit 4.4 provide parking for low emission vehicles for 3% or 5% respectively. In America a Honda Civic 1.8 and a Toyota Yaris are considered to be low emission (see top ten tested on http://www.greenercars.com/12green.html). In the UK these cars represent typical practice and as such fall into road tax band D where A is best and F is worst practice.

A quick comparison of ASHRAE 90.1 and UK Building Regulations suggest that some targets for energy efficiency are lower in the US than in the UK. This makes it more difficult to compare the two standards in environmental terms. Both methods are trying to encourage the mass market to improve by setting achievable standards that go beyond the legal minimum. Therefore, although a LEED Platinum building might only achieve a BREEAM rating of GOOD, the relative difficulty in achieving those ratings may be very similar.

There are many credits that cover issues that are not included within BREEAM Offices at present. The more relevant to the UK context are:

- EQ Credit 3.2 Construction IAQ Management Plan before occupancy
    - o flush out - provide 14,000 cubic feet of air per square foot of floor area.

    OR
    - o provide 3,500 cubic feet of air per square foot of floor area and then a min of 0.3 cfm/sqft or that required under EQ prerequisite 1 (whichever is the greater)

    OR
    - o Conduct testing and confirm that the levels are no higher than stated in the manual."

- EQ Credit 4 Low-emitting materials
    - o Adhesives and Sealants
    - o Paints and Coatings
    - o Carpet systems
    - o Composite Wood and Agrifiber Products"

One of the key differences between LEED and BREEAM is the use of life cycle analysis. Currently LEED uses a checklist approach to assess the embodied impact of the materials. This is an over simplification which leads to potential inaccuracies. The USGBC are currently developing an approach which will bring the assessment of materials more into line with the Ecopoints / Green Guide method, developed by BRE.

Current Development Activities

Despite the major improvements promised there is no information available on the USGBC website as to the current development activities. Jerry Yudelson[10] expects that the next version of LEED will be released in 2008 and may include the following changes:

- Ability to “customize” LEED from a ‘bookshelf of credits’ for particular geographic and climatic locations and to meet particular project needs.
- Increased minimum standards and improved method of measuring energy efficiency, which will focus on reducing carbon dioxide emissions from buildings, moving away from a “one-size-fits-all” system toward one that is more appropriate to bioregional issues
- Commissioning, ventilation and indoor air quality are all likely to be increased in importance
- Certain prerequisites will be dropped that represent standard practices
- More recognition of competing standards
- There will be more of a focus on LCA of materials used in buildings
- There may be a move to allow certification by professional auditors and by local government agencies, rather than having only a few national certification review teams.

GREEN STAR

The first version of Green Star was developed in 2003 in a partnership between Sinclair Knight Merz and BRE. As BREEAM was used as the basis of the Green Star methodology the two methods are very similar. However, adaptations have been made in order to reflect the various differences between Australia and the UK, such as the climate, local environment and the construction industry standard practice.

Since the initial launch of Green Star the GBCA (Green Building Council Australia) have also adapted the assessment methodology to make the delivery mechanism more akin to the LEED approach. There are currently 5 different versions of the methodology to assess offices at different stages from design, to post construction, to fit out. The following versions of the tool are available to download:

- Green Star - Office Design v3
- Green Star - Office As Built v3
- Green Star - Office Design v2
- Green Star - Office As Built v2
- Green Star - Office Interiors v1.1

Green Star - Office Design v3 was published in February, so this comparison has been based on Office Design v2. The main changes to the third version of Green Star have been outlined in below in ‘Current Development Activities’

Assessment Process

Unlike a BREEAM assessment, which must be carried out by a licensed assessor, Green Star can now be used by any member of a design team or wider project team. To facilitate this, the assessor’s manual is available to purchase for $555. As with LEED, 2 points are awarded where a member of the design team has received Green Star training and has achieved Accredited Professional status.

Although an assessment can be carried out by any member of a project team no score can be publicised unless the Green Star assessment is certified. In order to certify an assessment the GBCA commission a third party assessment panel to validate the self assessment rating

and recommend, or oppose, a Green Star certified rating. Certification will only be awarded if a project achieves a score of at least 45 (Four Stars).

In order to become an approved assessor an individual must first qualify as an Accredited Professional. The organisation the individual is a member of must be a member of the GBCA, and they must have been part of the Green Star technical working group of which there are 50 members.

The GBCA encourage users of the scheme to give feedback. Specific forms are made available to encourage feedback and ensure that it is in an appropriate format. GBCA will respond to these comments, officially, once every year, and produce a formal document setting out each comment received, and the formal response and action.

Scoring And Weightings

The mechanisms used to calculate a whole building rating are identical to those employed by BREEAM in the UK. Figure 1, below, is a screen shot from the actual assessment tool and it summarises the credit-based approach employed.

Figure 1 Green Star Scoring and Weighting

Criteria are developed that, if complied with, will reduce a building's impact on the environment. Credits are therefore awarded for complying with the requirements of each of

the criteria. These criteria are grouped into issue categories such as energy, water, indoor environmental quality, and it is to these categories that the weightings are applied.

Once all claimed credits in each category are assessed, a percentage score is calculated and Green Star environmental weighting factors are then applied. Green Star environmental weighting factors vary across states and territories to reflect the variety of environmental issues in each area.

The following Green Star certified ratings are available:

- 4 Star Green Star Certified Rating (score 45-59) signifies 'Best Practice'
- 5 Star Green Star Certified Rating (score 60-74) signifies 'Australian Excellence'
- 6 Star Green Star Certified Rating (score 75-100) signifies 'World Leadership'

One of the main differences to the UK version of BREEAM is in the addition of a section for Innovation credits. There are a maximum of 5 points available for the innovation credits and the total innovation points achieved are added to the weighted score calculated as set out below. This means that it is technically possible to score more than 100% although in reality it is virtually impossible.

Technical Comparison Summary

Green Star applies to a very large area and spans different climatic zones. This makes the task of setting criteria that are applicable to all climates more challenging than for BREEAM in the UK. Because of this some credits within Green Star are not always applicable or are more likely to be awarded by default. For example, a credit is awarded where no cooling towers are specified. This would be more easily achieved in cooler regions in the south of Australia which does not require air conditioning.

There are several credits that have not yet been adapted from the original draft list of credits developed in 2003. The Commissioning Clauses credit has been removed from BREEAM because it has been integrated into Building Regulations. The Electrical Sub-metering credit has been expanded to cover all energy use. Neither of these improvements have been picked up in the Green Star credits. The most controversial credit that has not been updated is the

Sustainable Timber credit. BREEAM was heavily criticised for singling out timber and so has developed a credit that considers the sourcing of all materials - Responsible Sourcing.

There are many credits that cover issues that are not included within BREEAM Offices at present. The more relevant to the UK context are:

- IEQ-13 Volatile Organic Compounds - Up to three points are awarded where it is demonstrated that various finishes meet the benchmarks for low Volatile Organic Compound (VOC) content.
- IEQ-14 Formaldehyde Minimisation - One point is awarded where it is demonstrated that:
    - All composite wood product is low emission formaldehyde;
      OR
    - No composite wood product used

- IEQ-15 Mould Prevention - One point is awarded where it is demonstrated that:
    - The mechanical ventilation system is designed to actively control humidity to be no more than 60% relative humidity in the space and no more than 80% relative humidity in the supply ductwork;
      OR
    - The building is fully naturally ventilated

Current Development Activities

GBCA published a newer version of the office tools (version 3) in February. The tools and guidance are now available from the GBCA website.

The following is a list of the key changes:

- Reduced cost for submission of assessments
- Development of an alternative method for calculating the energy performance
- Updated state weightings
- Increase in the performance required to comply with some of the criteria for example the energy and water targets have been toughened

The GBCA are also developing assessment methods that can be used to assess other building types. The following is a list of the new versions under development:

- Green Star - Office Existing Building EXTENDED PILOT
- Green Star - Education PILOT
- Green Star - Healthcare PILOT
- Green Star - Shopping Centre Design PILOT

BREEAM

BREEAM was first launched in 1990 and is currently updated annually to keep ahead of UK Building Regulations and to stay in line with current best practice. The first version of BREEAM was developed to assess the environmental performance of offices. Since then schemes have been developed to cover the following types of buildings

- Retail
- Industrial
- Schools
- Housing
- Courts
- Prisons
- Hospitals (NEAT (a self assessment method developed for the UK's Department of Health) is soon to be replaced with BREEAM Healthcare)
- Ecohomes (which has been adapted for England in partnership with the Department for Communities and Local Government for use in England as The Code for Sustainable Homes)
- Bespoke (tailored to any building not covered by a standard scheme)
- International (this version is based on any of the existing schemes which are adapted to assess any type of building and any region in the world).

Each of the assessment tools can be used at different stages of the building's life. Table 3 indicates which version can be used at which stage. BREEAM Design and Procurement (D&P) can be used during the design stage of a refurbishment project or for a new build or extension project. The Post Construction Review (PCR) is carried out once the construction is complete to verify the D&P assessment. The Fit Out assessment is carried out during major refits of existing buildings and a Management and Operation (M&O) assessment is carried out to assess the performance of a building during its operation.

There have been more than 100,000 buildings certified by BREEAM of which 1358 are non domestic buildings. There are currently more than 500,000 buildings registered of which 3177 are non domestic buildings. There are a total of 1473 registered assessors operating within 820 licensed assessor organisations.

	D&P	PCR	Fit Out	M&O
Offices	X	X	X	X
Schools	X	X		
Retail	X	X	X	X
Industrial	X	X		
Prisons	X	X		
Bespoke	X	X	X	X
NEAT	X	X		X
Courts	X	X		
Housing	X	X		X

Table 3 – Which version at which stage

Assessment Process

BREEAM assessments are carried out by licensed assessors. BRE trains, examines and licenses organisations and individuals to help design teams (or facilities management companies) gather the appropriate data and to carry out the assessments.

The cost of becoming a BREEAM assessor is £950 ($1886) to complete the training, plus approximately £2500 ($4964) for a BREEAM offices licence. The maximum recommended cost of £10,000, for a very large project to be BREEAM assessed, makes it difficult to justify unless an individual has already got some clients requiring a BREEAM assessment.

For each assessment, the assessor produces a report outlining the development's performance against each of the criteria, its overall score and the BREEAM rating achieved. This report is sent to BRE who review the report using a strictly defined quality assurance process. Once a report has successfully passed the Quality assurance process, BRE issues the client with a certificate that confirms the development's BREEAM rating.

All aspects of the BRE's operation of BREEAM are accredited under ISO9001. Assessors qualified to deliver the BREEAM assessments are also covered under a UKAS accredited

competent persons scheme. In addition, the operations relating to the certification of the BREEAM buildings versions are also covered under UKAS accredited product certification schemes.

The time an assessment takes to complete varies according to the agreement between client and assessor, and the fee can vary between £2,000 and £10,000 ($3971-$19857). There is also a QA / certification fee which is paid, through the assessor, to BRE. This fee varies, between £740 and £1500 ($1469-$2979), according to the size of the building being assessed.

Once the assessment report is submitted to BRE for quality assurance and certification it will take 15 working days for the quality assurance checks to be carried out. If the report is complete and the assessment correct a BREEAM certificate is sent directly to the client. If revisions are required a feedback form is provided to the assessor stating the changes required. Once resubmitted to BRE the report will then be reviewed within 5 working days.

During the assessment process BRE provide support to the assessors. Providing help in interpreting the criteria and setting precedents, where necessary. A dedicated email address and phone line ensures that assessors receive a response within 48 hours of submitting a query. An extranet provides additional guidance for assessors on frequently asked questions, process updates, and precedents that have been set that have a bearing on subsequent assessments.

In order to become a BREEAM assessor an individual must complete the training at a cost of £950 ($1886). Once the exam and test assessment have been successfully completed the BREEAM assessor must pay a further £2500 ($4964) for a BREEAM offices licence.

Scoring and Weightings

The BREEAM methodology calculates an environmental rating by awarding points, or credits, for meeting the requirements of series of criteria that, if complied with, would result in a reduction of the building's negative environmental impact and an increase in its environmental benefits. Each of the criteria is usually worth a single credit except where there is a large variation in the performance of buildings which meet the requirements of the criteria. For example Reduction in CO_2 Emissions is assigned 15 credits awarded on a scale which runs

from one credit for a building just above the minimum level required to meet UK Building Regulations, up 15 credits for a building which has net carbon emissions of zero. The criteria are grouped into issue categories (Energy, Water, Materials, etc (see figure 2).

Each of these environmental issue categories is weighted according to the perceived importance of the environmental issues that the section aims to address. The weightings are applied to the percentage score for each issue category. Once added together this gives the environmental score. The BREEAM rating is then awarded based on the score achieved. There is some slight variation between the rating bands for each version but the majority of ratings are awarded on the following scale:

Pass – 25%
Good – 40%
Very Good – 55%
Excellent – 70%

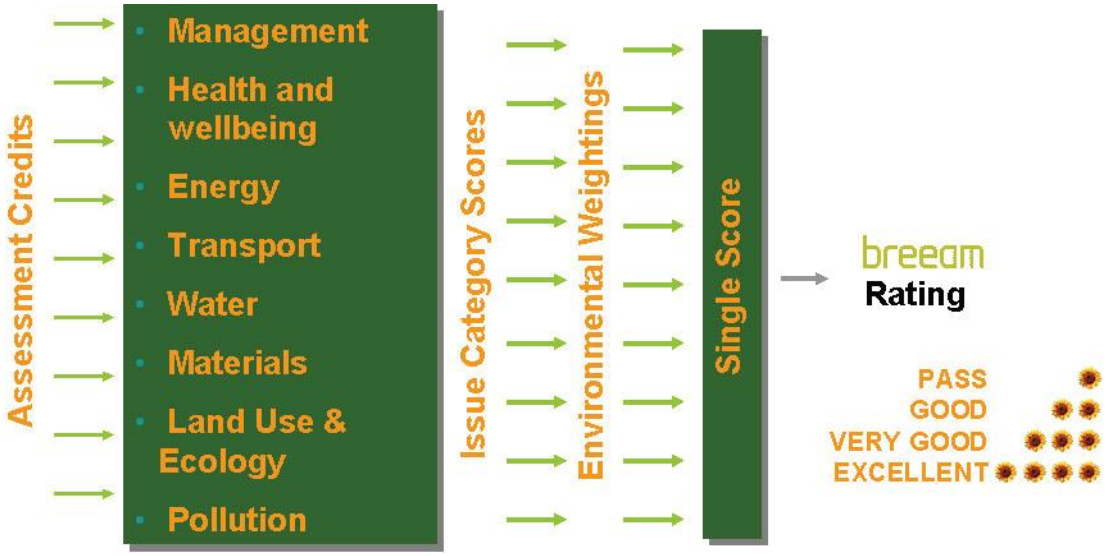


Figure 2 – BREEAM scoring and weighting for non domestic versions of BREEAM

The issue category weightings were set following a consultation with a variety of construction industry stakeholders including academics, construction industry professionals, lobbyists and scientists.

Current development activities

There are many changes expected for the next version of BREEAM – BREEAM 2008. The following changes will affect the current schemes:

- The environmental weightings have been revised to reflect the change in importance of the environmental issue categories since the last weightings exercise.
- Minimum standards are to be introduced through the introduction of mandatory BREEAM credits.
- A new BREEAM Rating of 'Outstanding' is under development to recognise the very best buildings.
- An innovation section is being introduced which will allow bonus credits for meeting an exemplary level requirement for a particular BREEAM issue or for the specification of new technologies/process not currently recognised/rewarded in the method
- A two stage certification process is being introduced an interim certificate will still be available at the design stage but a final certificate will not be awarded until post construction stage.

There will be a change of approach for assessing shell only developments in retail, offices, bespoke and industrial versions. Instead of removing credits that can not be assessed at this stage a series of default values / assumptions will be developed.

The following new schemes are currently under development:

BREEAM Education

BREEAM Education merges the BREEAM Schools methodology and the new Further Education version in to one assessment scheme. The differing assessment requirements for each building type are maintained within this single version.

BREEAM Healthcare

This assessment scheme has been developed to replace NEAT which was originally commissioned by the Department of Health as a self assessment scheme. It will be operated as an independent third party certification scheme

BREEAM In Use

This assessment scheme will be designed to assess any existing building. It will:

- Allow a quick assessment of existing buildings
- Allow more detailed building information to be added over time
- Separate the asset rating from the operation rating
- Allow assessment of portfolios and/or individual buildings
- Supports existing CSR and 14001 data and reporting

BREEAM Developments

BREEAM Developments will be a certified sustainability assessment methodology for the planning system. It will be based on the existing Regional Sustainability Checklist and will bridge the gap between the planning and building permit stages. It's focus will be on Multi-Residential & Mixed-Use Developments.

Rating Comparison

The most challenging aspect of this study was to develop a methodology that could be used to compare the relative environmental performance required to meet each of the ratings in each scheme. This is because the criteria in each one has been designed to recognise and encourage buildings which go further than would usually be achieved by designing or operating a building in line with local regulation and/or standard practice.

It was therefore decided that this study would focus on trying to work out how well a UK building might score against BREEAM, if it was designed to meet the requirements of the alternative schemes covered.

Methodology

1) The specific versions of the assessment schemes used to do this comparison were:
   a) BREEAM Offices 2006 (Design and Procurement)
   b) CASBEE for New Construction Tool 1 2004 Edition
   c) LEED NC version 2.2
   d) Green Star Office Design v2
2) Each of the schemes was investigated to identify criteria covering similar issues to those covered by BREEAM. Each of the criteria in the alternative schemes was then sorted according to the BREEAM criteria that each was equivalent to(see table of criteria in the appendix A).
3) Where equivalent criteria were identified in the other schemes the compliance requirements were compared with the requirements of BREEAM in order to see which scheme has the most stretching/stringent requirements.
4) Credits were then ‘awarded’ in the scheme which had the lowest performance requirements, and ‘withheld’ where one or more of the compliance requirements were not covered by the requirements of the other schemes.
5) The relative ‘value’ or contribution to the final score was included in this table so that the total score could be calculated once each credit had been assessed in this way.

The next step was to compare how each of the ratings in the alternative assessment methods would compare with the equivalent ratings in BREEAM, if used to assess a building in the UK.

1) Credits were awarded, in the alternative scheme, in order of easiest / cheapest first (from a UK perspective). Any credits in the alternative scheme, that would be achieved by meeting the UK regulatory minimum or standard practice was awarded first.
2) Once a credit in the alternative scheme had been awarded the compliance requirements of the equivalent BREEAM credit were reviewed and compared to the compliance requirements of the credit in the alternative scheme.
3) If the requirements of the criteria in the alternative scheme where more stringent than the equivalent criteria in BREEAM, the equivalent BREEAM credit was awarded as a building designed to meet the criteria in the alternative scheme would meet the requirements of the BREEAM credit by default.
4) As each rating level in the alternative scheme was reached, the corresponding BREEAM rating could then be calculated by adding up the value of each BREEAM credit awarded.

Normalisation Process

In order to smooth out the differences due to the local issues and standard practices, a normalisation factor was calculated.

1) Credits where identified in the alternative schemes which are not covered by BREEAM and those that are in BREEAM, but not covered by the alternative schemes. The list of credits that this relates to is set out in Appendix B.
2) Once the list of credits had been identified the total value of these credits was calculated in order that a normalisation factor could be calculated.
3) The normalisation factor was applied to the score that could be achieved. This therefore gives a fairer comparison and better indicates the maximum score that is likely to be achieved by designing a building to meet the requirements of a one assessment method when compared to another.

Rating Comparison Results

The first step in this rating comparison was simply to see how well a UK building designed to meet the compliance requirements of an alternative scheme would fare against BREEAM. In this ‘assessment’ a higher end score indicates that a greater number of the issues covered by the alternative scheme have less stringent requirements than the equivalent criteria in

BREEAM. Therefore a building designed to meet the requirements of a scheme with a higher end score is likely to perform less well when assessed against BREEAM.

This comparison was also done the other way round to see how a building designed to meet the requirements of BREEAM would fare against the alternative scheme in the country for which the alternative scheme had been designed. The closer each alternative scheme, gets to a maximum BREEAM rating therefore indicates how well a building designed to meet BREEAM in a different country might be expected to fare against the scheme designed for that location.

The first step of this comparison attempts to predict the maximum score that a building designed to meet the requirements of an alternative scheme might perform in an assessment against BREEAM, and Vice Versa. The following scores are not normalised

LEED

If designed to comply with LEED criteria, the maximum rating a UK building is likely to achieve a BREEAM rating of Good.

If designed to comply with BREEAM criteria a UK building is likely to achieve a LEED rating of Gold

Green Star

If designed to comply with Green Star criteria a UK building is likely to achieve a BREEAM rating of Pass

If designed to comply with BREEAM criteria, a UK building, is likely to achieve a Green Star rating of 5 Stars

CASBEE

If designing to comply with CASBEE criteria, a UK building is likely to achieve a BREEAM rating of Pass

If designing to comply with BREEAM criteria a UK building is likely to achieve a CASBEE rating of B-

One conclusion that can be drawn from these results is that the criteria in BREEAM tend to be more tightly defined than the equivalent criteria in the other schemes. By defining the

compliance requirements so tightly BREEAM helps to ensure that the assessments are carried out in a consistent manner.

The results of the second step of the rating comparison, summarised in Table 3, show how each rating level in the alternative schemes compares to the BREEAM rating scale. This is approximate and a much more detailed comparison is required before any accurate conclusions can be drawn. The maximum ratings achieved by designing a building to meet the requirements of the alternative schemes where normalised using the factors in Appendix B.

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

Notes

1) The CASBEE system includes many credits that are not relevant to the UK and others that do not have an equivalent credit assessed under BREEAM. Therefore if a building achieves more CASBEE credits it would not result in more BREEAM credits.
2) This table can only be used as a rough guide to the equivalence of the ratings in each of the alternative schemes to the ratings in BREEAM.

Table 3 Approximate rating comparisons of LEED, BREEAM, Green Star and CASBEE ratings for a building constructed in the UK

The comparison shows that it is tougher to meet the highest rating in BREEAM than it is to meet the requirements of the alternative schemes when building in the UK. If a building is designed to meet the highest LEED or Green Star rating it is only likely to achieve a BREEAM rating of Very Good or Good which are the second and third highest ratings respectively. The results for CASBEE are difficult to compare as more than 50% of the criteria CASBEE includes are not relevant to a country that doesn't have a major risk of severe earthquakes or Typhoons.

Rating Comparison Conclusions

This comparison focuses on the application of the assessment schemes to assess the environmental performance of buildings in the UK. However, it is reasonable to assume from these results that none of the schemes travel well if used in countries other than those which the system was initially designed to work in. It therefore suggests that, where used outside the native country, any of the systems should be tailored to take account of the local context.

It should be made clear that this rating comparison is approximate as the credits which are easy, free or cheap depends on a number of factors such as location and design, and whether the building is a refurbishment or a new build. It must also be made clear that this comparison is based on the UK market so many of the credits in the alternative schemes are now mandatory. The use of ozone depleting substances as refrigerants is banned in most countries, but it is still permitted in the US therefore quite rightly a criterion covering this issue must be included in LEED but it would be a 'free' credit for anyone using LEED in the UK.

CONCLUSIONS

The effect of BREEAM being used across the board in the UK for nearly 20 years alongside other drivers including regulation is that the UK property industry is much further ahead in greening itself (i.e. buildings, manufactured items, design teams) than other countries. What is more difficult to work out is the relative difficulty for the UK construction industry to meet the BREEAM criteria, compared to the difficulty for the construction industries in the US, Japan and Australia to meet LEED, CASBEE or Green Star criteria.

The summary tables show that BREEAM ratings are generally higher in terms of environmental performance than the equivalent ratings of the alternative schemes. However, it is difficult to say how much of this is down to the differences in standard practice.

Although LEED and Green Star have been very heavily based on BREEAM, they have since been adapted and changed. Because of these changes there are features and solutions from each that could be employed by BREEAM.

The number of people that have attained LEED Accredited Professional status far exceeds the number trained to do BREEAM assessments. There is currently no equivalent qualification for accrediting professionals in their knowledge of BREEAM. Setting up an equivalent qualification could dramatically increase market penetration which for BREEAM Offices is around 25%.

Green Star v2 is almost identical to BREEAM 2002 as that is the version that it was based on. At the time of development there were credits that could not be applied to Australia, such as change in ecological value and proximity to public transport as these issues reflect regional norms. The compliance requirements and benchmarks of these credits were therefore changed significantly. Since that initial work the main change has been in the process, which is now more akin to LEED.

CASBEE is a very different approach. Weightings are applied at the individual credit level. This addresses the problem that occurs when credits are deemed to be irrelevant to a specific project. However, because the Quality score is divided by the Load Reduction score it is

impossible to work out the value of addressing individual issues and this reduces CASBEE's value as a design tool.

More than half the credits in CASBEE do not have a BREEAM equivalent. It is therefore much more difficult to compare the rating bands of the two systems.

The Future

There is an enormous and growing appetite for rating methodologies that can be used to demonstrate the environmental performance of our activities. From personal carbon foot-printing methodologies to sustainability assessments of entire cities and standards, there is a drive to develop more and more rating methods.

The increased thirst for third party certification schemes is leading to a more and more competitive market for scheme operators as more companies see the benefits in running their own schemes. This is very positive as it will lead to an increase in the transparency as individual scheme managers rush to provide data to demonstrate the benefits of using their scheme over others. However, it would be much more positive if it was to lead to collaboration between scheme managers who could then focus their efforts and avoid duplication of research.

Recommendations

What is needed is a standard which excludes as much of the effect of 'home territory regulatory effects' as possible, for example the newly developed 'BREEAM International' from which all regional derivatives, starting with BREEAM Emirates, will be generated and independently calibrated.

By adopting this approach, when BREEAM is adopted as an international standard a BREEAM 'Excellent' rating will be equivalent wherever it is awarded across the world. To promote comparable inter-country ratings BREEAM International will be offered as 'Open Source' to Green Building Councils (GBCs) and emerging GBCs worldwide. GBCs will be able to tailor BREEAM to local conditions and then BREEAM International will calibrate the results and make recommendations to ensure broadly similar standards from locale to locale.

It is BRE's hope that all scheme operators will begin to collaborate to work towards the development of common minimum standards. Setting common minimum standards and

common indicators for all schemes would ensure consistency; it could also help the move towards dual certification. Dual or multi certification would allow multinational companies to

demonstrate and compare the environmental performance of their buildings in the countries in which they are based with the buildings they occupy overseas.

The development of 'multiple labelling' will require a great deal of work but it can be broken up into manageable steps. The essential prerequisite is that all the scheme operators work together. The first step, which is perhaps the easiest, but arguably has a greatest potential environmental benefit, is to share best practice from one country to another and also from one scheme to another. The second step would be to develop a set of key common metrics for the most important / global issues. For example by agreeing how to measure the impact of the building on fossil fuel depletion and/or climate change it will be easier to compare the different standards. The next step would be to develop a set of common minimum standards. It is these standards that could then form the basis of a dual or multiple labelling scheme.

BRE is already working alongside other the other scheme operators and major construction industry stakeholders such as government organisations, architects and engineers on the Sustainable Buildings and Construction Initiative. This global initiative, coordinated by UNEP is aiming to provide a common platform for all buildings and construction stakeholders for addressing sustainability issues of global significance, especially climate change.

In conclusion if the construction industry is to develop and improve the built environment using more and more sustainable solutions, the various scheme operators need to collaborate with the shared goal of encouraging more and more stretching targets. They also need to work together to improve transparency, so that best practice can be shared more easily. It is important that best practice is promoted not only in the operation of the various labelling schemes but also to promote the sharing of best practice in the design, construction and operation of the built environment.

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