Title:	**Sustainable Rating Systems Around the World**
Authors:	Candace Say, Architect, SmithGroup Antony Wood, Executive Director, Council on Tall Buildings and Urban Habitat
Subject:	Sustainability/Green/Energy
Keyword:	Sustainability Certification
Publication Date:	2008
Original Publication:	CTBUH Journal, 2008 Issue II
Paper Type:	1. Book chapter/Part chapter 2. **Journal paper** 3. Conference proceeding 4. Unpublished conference paper 5. Magazine article 6. Unpublished

Sustainable rating systems around the world

Candace Say

Antony Wood

Authors
Candace Say

t: 312-596-9833
e: csay@iit.edu

Candace Say is a graduate of the Illinois Institute of Technology with a Master of Architecture degree. She is currently employed in the healthcare architecture studio of SmithGroup in Chicago, Illinois and is a LEED Accredited Professional.

Antony Wood
CTBUH Executive Director

Council on Tall Buildings and Urban Habitat
Illinois Institute of Technology
3360 S. State Street
Chicago, IL 60616

t: 312-567 3307
f: 312-567 5820
e: awood@ctbuh.org

www.ctbuh.org

Antony Wood is Executive Director of the CTBUH, responsible for the day-to-day running of the Council and steering in conjunction with the Chairman and the executive committee. His field of specialism is the design, and in particular the sustainable design, of tall buildings.

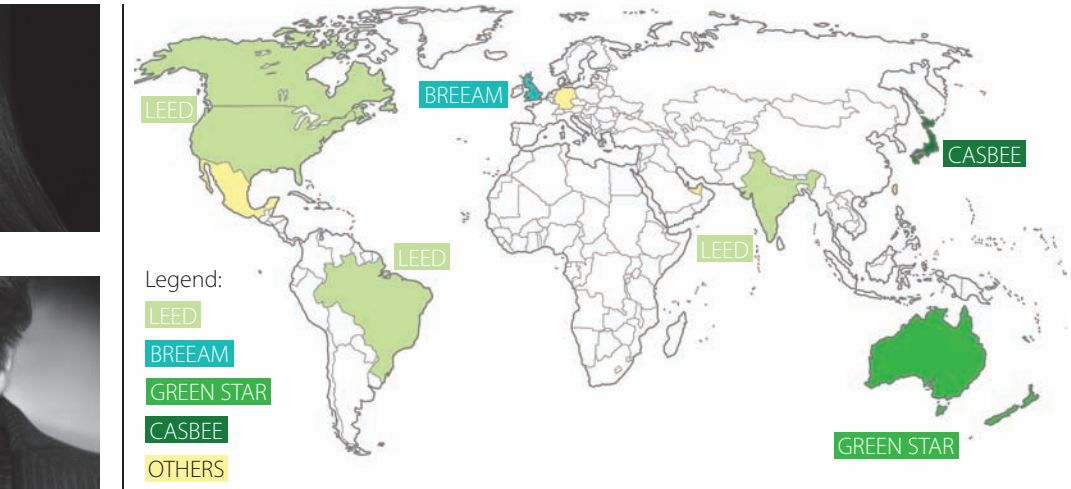

Figure 1. World map showing countries using the four predominate ranking systems.

Introduction

The World Green Building Council, founded in 1998, is comprised of national councils from twelve countries. Of these countries, there are four predominate ranking systems (see Figure 1). Australia and New Zealand follow Green Star; United Kingdom, Building Research Establishment Environmental Assessment Method (BREEAM); Japan, Comprehensive Assessment System for Building Environmental Efficiency (CASBEE); and the United States, Brazil, Canada, and India use Leadership in Energy and Environmental Design (LEED), with slight variations. Together the members of the World Green Building Council represent over 50% of global construction activity. (World Green Building Council, 2008)

This paper will focus on the similarities and differences between the four rating systems and look into the environmental and cultural factors that impact the rating system development. An additional rating system, Green Globes, which is commonly used in North America but is not affiliated with any one country, is also included. Many of the rating systems have different subsections. However, this paper will focus on new construction and major renovation for office buildings as opposed to residential, industrial and other building types.

There are many definitions on sustainability and sustainable development. This paper will use the definition from the 1987 publication of the World Commission on Environment and Development known as "Our Common Future" or the "Brundlant Report," Which describes sustainable development as that "that meets the needs of the present without compromising the ability of future generations to meet their own needs." (United Nations, 1987)

Effects of Buildings

Worldwide, buildings account for 17% of the fresh water usage, 25% of the wood harvest, 33% of the carbon dioxide emissions and 40% of material and energy use. In the United States alone, buildings are responsible for 71% of electricity consumption (including mechanical, electrical, and building systems), 30% of the waste output, 39% of carbon dioxide emissions and 12% of potable water consumption. (World Green Building Council, 2008; U.S. Department of Energy, 2008)

While green buildings usually have a higher upfront cost, they offer several benefits. The average increased cost of a green building has been estimated at an additional 2%, with an average lifecycle savings of 20% for a savings of ten times the initial investment. (Kats, 2003) In addition to lifecycle savings, building green creates other economic, environmental, health and community benefits.

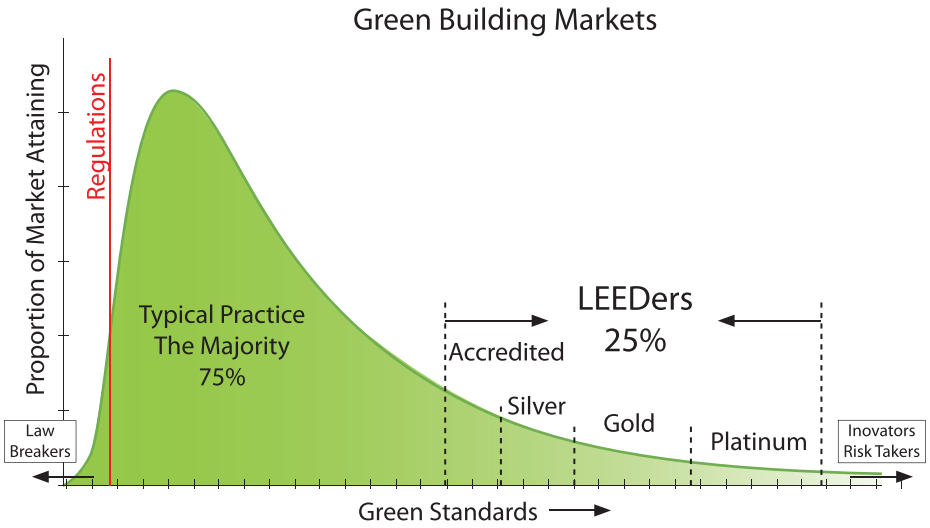

Figure 2. Green Building Markets. Source: Zenhong p15

Economic Benefits

- Reduced operating costs of 9% on average
- Improved employee productivity and satisfaction
- Increased building value by an average of 7%
- Increased rent values by a 3% average (World Green Building Council, 2008)

Environmental Benefits

- Decreased fuel use
- Decreased fresh water use
- Decreased waste output
- Decreased raw material use
- Decreased greenhouse gas emissions

Health and Community Benefits

- Improved air quality
- Improved thermal comfort
- Improved overall quality of life

The growth of green buildings in the US has been increased by city and government initiatives, residential market activity and improved quality, greater variety, and lower prices of sustainable materials.

Why use sustainability rating systems?

Current developments in sustainability rating systems have led to a number of comprehensive systems that take into account many aspects of sustainability. Older successful systems such as Energy Star, part of the United States Environmental Protection Agency and the United States Department of Energy, only took into account one category. In the context of Energy Star, for example, the one category has been energy consumption.

While current rating systems have different categories, there are underlying themes such as comprehensive approach to sustainability, Increased awareness in sustainability, set target points for building performance, and recognition when building targets of sustainability have been met.

Sustainability rating system fees

Using a rating system costs money, with the end result often only being a title or category. The overall rating system usage fee and certification is small in comparison to the consultant fees to put together the paperwork and documentation. However, depending on the tax breaks and increased speed in building permits, using the rating system may be beneficial. Some governments are beginning to mandate that government-funded buildings achieve a set threshold in a green rating system.

Current ratings systems are designed to target 25% of new building construction. Figure 2 shows the desired curve for LEED green building standards.

LEED

Leadership in Energy and Environmental Design

United States, variations for Canada and India

Background

The U.S. Green Building Council (USGBC) was established as a nonprofit organization in 1993. The council is made up of construction industry stakeholders including owners, contractors, architects, engineers, product manufacturers, and environmental groups. The U.S. Green Building Council established LEED in 1998 under a pilot version to transform the way buildings and communities are designed, built and operated. By being environmentally and socially responsible LEED enables a healthy and prosperous environment that improves quality of life.

After extensive revisions by the council, LEED New Construction and Major Renovation version 2.0 was released in 2000. Since then, development of different LEED assessment categories has occurred along with version revisions.

Assessment Categories

LEED currently has eight different assessment categories to accommodate a variety of projects including New Commercial Construction and Major Renovation Projects, Existing Building Operations and Maintenance, Commercial Interior Projects, Core and Shell Development Projects, Homes, Neighborhood Development, Schools, and Retail.

Two additional assessment categories currently under development focus on healthcare and laboratories.

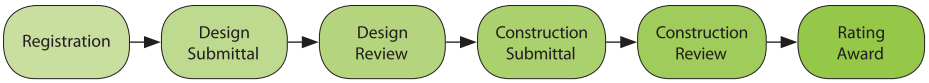

Figure 3. LEED Assessment Process

Building Statistics

Since the development of LEED New Construction and Major Renovation, there has been a growth in participation. Currently, there are over 4,200 projects registered and working to achieve certification. Over 600 projects have completed the process and achieved one of the four LEED certification levels. To promote and facilitate the LEED process, there are over 50,000 LEED Accredited Professionals.

Assessment Process

The assessment process for LEED begins with building registration by the design team. The team submits info at two stages, design submittal and construction submittal. A review by the USGBC occurs after each submittal. After the final submittal, a LEED certified designation is issued to the building (see Figure 3).

Breakdown in Categories

LEED New Construction and Major Renovation points are broken down into six categories: sustainable sites; water efficiency; energy and atmosphere; materials and resource; indoor environmental quality; and innovation. The graph below shows the breakdown of percentage of points in each category. The categories do overlap however. For example, adding a green roof to a building can earn the project points in "sustainable sites" and "energy and atmosphere."

Calculation of Scores

LEED uses a simple process for calculation of the final scores. A point is awarded if the criteria are met. There are no fractions of points awarded for partial completion. The sum of the category points produces the final number. There are no weighted factors applied at the end (see Figure 4 & 5).

Rating System for New Construction and Major Renovation Projects

In order to achieve the lowest level for LEED 2.2 New Construction, a total of 26, or 37%, of the possible points is needed. Other levels of certification are shown below. Tax breaks and incentives vary by location if a set level is achieved.

• Certified	26-32 points
• Silver	33-38 points
• Gold	39-51 points
• Platinum	52- 69 points

(U.S. Green Building Council, 2008)

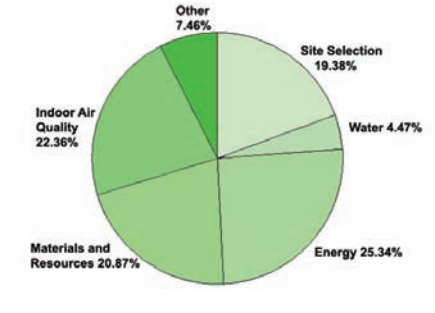

Figure 4. Breakdown in LEED 2.2 New Construction points[1]

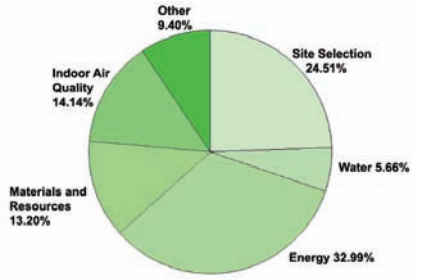

Figure 5. Breakdown in LEED 3.0 New Construction points

[1] The graphs presented correspond to the chart included in this paper. In order to compare all building ranking systems, set categories of points were created. These categories may not match the categories in each rating system, however all points were included in the comparisons.

BREEAM

Building Research Establishment Environmental Assessment Method
United Kingdom

Figure 6. BREEAM Assessment Process

Background

BREEAM was developed in the United Kingdom in 1990 by Building Research Establishment Global Ltd., a division of the larger research charity, Building Research Establishment Trust. A sustainability board meets to review and oversee all assessment material and tools. The board is comprised of stakeholders in all aspects of the construction industry.

The goals of BREEAM are to reduce environmental impact, ensure the best environmental practices in design, operation, and management, and to increase awareness of the impacts of buildings on the environment.

Assessment Categories

BREEAM contains nine variations of assessment tools to fit the building occupancy type. They include: Courts, Ecohomes, (single family residential) Industrial, Multi-Residential, Prisons, Offices, Retail, Schools, and Bespoke (which includes all buildings that fall outside the standard BREEAM categories.)

Building Statistics

For all of the BREEAM systems combined, there are over 290,000 projects registered, with over 73,000 certified. BREEAM projects are evaluated using independent licensed assessors. There are currently over 1,200 assessors. BREEAM has currently achieved a 25% market share in all new building construction in the United Kingdom.

Assessment Process

The BREEAM assessment process begins with registration and completion of the necessary documents by the design team. The project is then reviewed by a BREEAM assessor. The assessment report is filed and then reviewed by a member of the BREEAM team. Upon successful completion, certification is issued (see Figure 6).

Breakdown of Categories

Like LEED, BREEAM is broken down into categories. BREEAM does, however, include categories for the management of the facility. Other categories include health and wellbeing, energy and transport, water, materials and waste, land use and ecology, and pollution (see Figure 7).

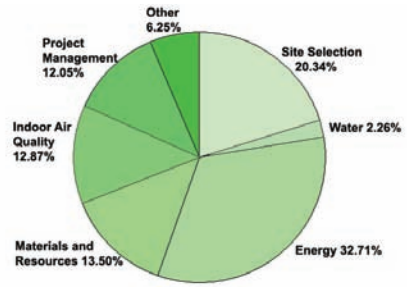

Figure 7. Breakdown in BREEAM Office 2008 points

Calculation of Scores

A BREEAM score is compiled by category. A predetermined weighting is subsequently applied to each category score. The sum of the category scores then determines the final score and the BREEAM Rating (see Figure 8).

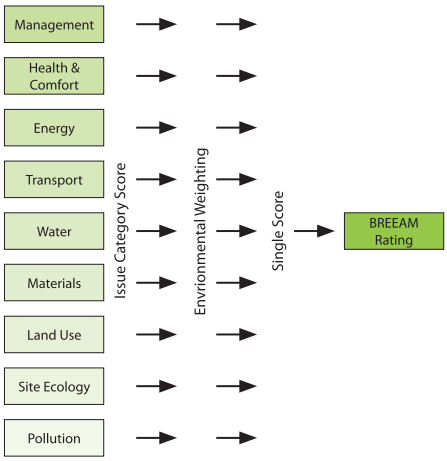

Figure 8. BREEAM Rating

BREEAM ratings are determined by achieving a set percentage of the benchmark points. Buildings must achieve at least 30% of the benchmark to qualify.

BREEAM Rating System

• Unclassified	Below 30% of Benchmark
• Pass	30%- 45% of Benchmark
• Good	45%- 55% of Benchmark
• Very Good	55%-70% of Benchmark
• Excellent	Above 70% of Benchmark
• Outstanding	Above 85% of Benchmark

(Building Research Establishment Ltd, 2008)

GREEN STAR

Australia

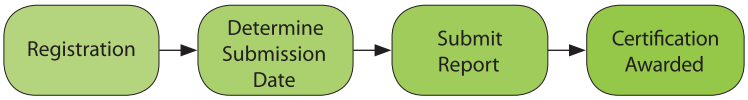

Figure 9. GREEN STAR Assessment Process

Guiding Principles

Launched in 2003 by the Green Building Council of Australia, Green Star was developed to establish a common rating tool to measure the environmental leadership and awareness in the green building design movement. Green Star, like BREEAM, is also focused on building life-cycle impacts.

Assessment Categories

Green Star currently has four assessment categories for different phases: Office Design, Office as Built, Office Existing Building, and Office Interiors. Three assessment categories are currently under pilot testing: Shopping Center, Healthcare, and Education.

Building Statistics

Green Star currently has over 100 projects registered with over 50 certified. Over 800 green building professionals have become accredited through the Green Star system.

Assessment Process

The assessment process of Green Star begins with registration by the design team and setting a date for submitting your paperwork. The report is then due by that date where it is reviewed. Upon a successful review, certification is awarded (see Figure 9).

Breakdown by Categories

Green Star is broken down into the following categories: management, indoor environmental quality, energy, transport, water, materials, land use and ecology, emissions and innovation. Like LEED and BREEAM, a large amount of points are applied to energy conservation and improved indoor air quality. Green Star also includes an innovation section like LEED, although the points do not have as great of an impact (see Figure 10).

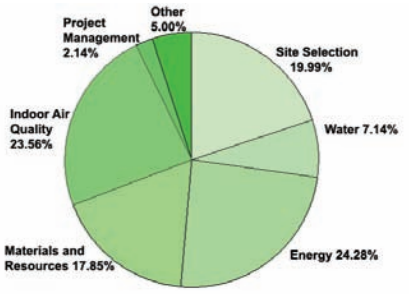

Figure 10. Breakdown in BREEAM Office 2008 points

Scoring System

Green Star projects are scored slightly different than LEED or BREEAM. The system takes into account the location of the project in certain categories which affects how much of an impact completing the category will have on the set score. This helps to take into account the different climates in Australia (see Figure 10).

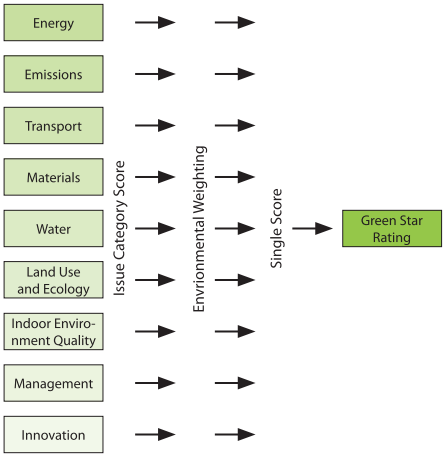

Figure 10. GREEN STAR Rating

GREEN STAR Rating System

Green Star certified ratings for each project include:

- One Star 10 - 19 pts
- Two Star 20 - 29 pts
- Three Star 30 - 44 pts
- Four Star Green Star 45 - 59 pts

Certified Ratings for "Best Practice"

- Five Star Green Star 60 - 74 pts

Certified Rating "Australian Excellence"

- Six Star Green Star 75+ pts,

Certified Rating "World Leader"

Green Star encourages all users to track their performance through various levels of stars, however buildings must achieve 31% of the possible points, or the four star level, to be considered certified. (Green Building Council of Australia, 2008)

CASBEE™ 建築物総合環境性能評価システム
Comprehensive Assessment System for Building Environmental Efficiency

CASBEE

Comprehensive Assessment System for Building Environmental Efficiency
Japan

Background

CASBEE, part of the Japan Sustainable Building Consortium, was developed out of a three phase process to take into account sustainability issues particular to Japan and Asia. The first phase aimed at improving indoor air quality for occupants with little regard to the exterior conditions or building development. Phase two grew out of concerns over air pollution in Tokyo in the 1960s which led to the establishment of exterior environmental impact assessment systems. During the second phase, buildings were viewed as having negative effects on the surroundings. The third phase began to look at the broad picture, the impact that a building has on the interior and exterior environment.

Assessment Categories

CASBEE is comprised of four assessment categories corresponding to the building's lifecycle pre-design for building planning and site selection, new construction for design specifications and anticipated performance, existing buildings to assess actual specifications and performance, and renovation to assist on improvement of specifications and performance.

CASBEE contains an assessment category for temporary construction of exhibition facilities with a lifetime of less than five years. An assessment tool for the single family home is under development.

Building Statistics

Currently there are over 20 projects registered under CASBEE and an additional 23 certified. There are over 500 accredited building professionals.

Rating System Breakdown

The scoring breakdown for CASBEE is broken down to the categories listed below. Due to the complex nature of the CASBEE system, the percentage that each category contributes to the overall score varies by project.

- Energy
- Resources and Materials
- Off-Site Environment
- Noise and Acoustics
- Thermal Comfort
- Lighting and Illumination
- Air Quality
- Flexibility and Adaptability
- Preservation and Creation of Biotope
- Townscape and Landscape

Scoring System

CASBEE, compared to LEED or BREEAM, uses a more complex scoring system. It places the categories into two groups, environmental loading (resource use and ecological impacts) and environmental quality performance (indoor environmental quality and amenities) to determine the building environmental efficiency. This efficiency is defined as the ratio of environmental quality and performance to environmental loading (see Figure 11).

$$\text{Building Environmental Efficiency (BEE)} = \frac{\text{Q (Building environmental quality and performance)}}{\text{L (Building environmental loadings)}}$$

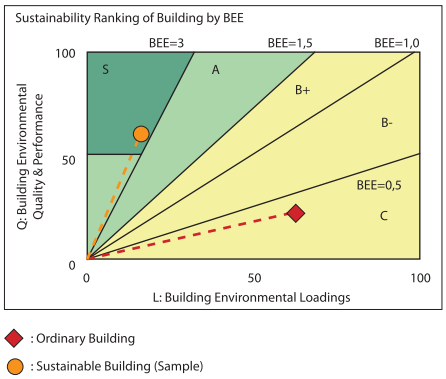

Figure 11. Sustainable Ranking of Building by BEE (Source: CASBEE website)

CASBEE Rating System

CASBEE buildings are designated with the following ratings: C, B-, B+, A, S, with C being the lowest and S the highest. Achievement of a category is determined by the building's score placement in the graph above. CASBEE website does contain an excel file that calculates out the entire scoring process, including the final score, based off of user inputs. This allows the user to estimate the achievable points through the complex system. (Japan Sustainable Building Consortium, 2007)

S	Highest Rating
A	
B+	
B-	Lowest Rating
C	

GREEN GLOBES

United States and Canada

Background

Green Globes was developed in 2000, and based off of the preexisting structure of BREEAM. The system is commonly used in the United States and Canada, although it does not have an affiliation with one country like the previously mentioned systems. It is accredited as a standards developer by the American National Standards Institute.

Assessment Categories

Green Globes is comprised of the following assessment tools: design of new buildings or significant renovation, management and operation of existing buildings, building emergency management, building Intelligence, and fit-up.

Breakdown of Categories

Seven categories are included in the Green Globes Design of New Buildings or Significant Renovation: pre-design project initiation, pre-design site analysis, design development, construction documents, contracting and construction, and commissioning. Each phase is further divided into seven areas: project management, energy, indoor environment, site, water, resources, and emissions (see Figure 12).

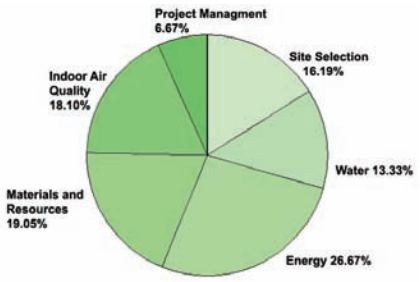

Figure 12. Breakdown in Green Globes Design of New Buildings or Significant Renovation points

Scoring System

The sum of the points from each category provides the final score for Green Globes. A third party certification is required to formally complete the process. Upon certification a final rating of the following is awarded.

GREEN GLOBES Rating System

• One	35%-54% of total points
• Two	55%-69% of total points
• Three	70%-84% of total points
• Four	85%-100% of total points

Similarities and Differences

Introduction

While there are many similarities in the different rating systems, differences are also present. Many of the similarities and differences can be attributed to cultural and climatic differences in their designated countries.

Site Selection and Development

Redevelopment of a Brownfield for the site selection earns points in LEED, Green Globes, and Green Star. Green Star also awards points for selection of sites that have already been built on. Many of the other systems simply have different requirements for obtaining points depending if the site is a Greenfield or previously been used. Selection of a site with low ecological value is required for Green Star, and earns points in LEED, Green Globes, and BREEAM. CASBEE does not award any points for land selection. While two-thirds of Japan is currently covered in forest, the land is hilly and considered to be poor for buildings. CASBEE, along with LEED and Green Star, awards points for use of native vegetation on the completed site. CASBEE, along with LEED and Green Star, awards points for use of native vegetation on the completed site.

Water

All five major rating systems award points for reduction of indoor water use. The reduction is set according to a baseline by rating system. It does not take into account the excessive water use by certain countries and regions. The United Nations indicates the average water usage for most countries in Europe is 200-300 liters per person per day. The United States average is 575 liters per person per day, and in some desert areas such as Phoenix, Arizona where green lawns are prevalent, the average is 1,000 liters a day (United Nations Development Programme p 34). BREEAM also focuses on prevention and detection of wasted potable water through leaks and human error.

LEED, Green Globes, and Green Star also award points for the use of water efficient landscaping. LEED and CASBEE also award points for innovative waste water treatments such as the use of graywater. Graywater reuse is only permitted in non-sewered areas in Australia (Center for the Study of the Built Environment). Decline in rainfall and increased population and usage rates have prompted governmental officials to revisit the issue (Australian Government). The permitted use of graywater is not defined in the United Kingdom, and therefore the practice is not used (Center for the Study of the Built Environment).

Energy Use

All systems award points for energy conservation. No system currently accounts for indirect factors such as the need to conserve energy in California during the summer months to prevent rolling blackouts. LEED-India adjusts the thresholds to achieve energy saving points to account for different cultural and energy use conditions.

Transportation

In development and selection of sustainable sites, encouraging the use of bicycle racks is a common way to earn points. To achieve points, bicycle racks and changing facilities must be included in the design and construction. No measurements of how many of the building's users ride bicycles or other infrastructure such as bicycle lanes on surroundings roads is required.

LEED, BREEAM, Green Globes, and Green Star all award points for sites near mass transit systems. CASBEE is the only major rating system that does not award points for the use of mass transit or for encouraging the use of fuel efficient cars. In Japan, mass transit is the typical form of transportation. None of the systems currently take into account to a large degree the differences in location such as urban site or rural sites.

Recyclables

CASBEE is the only system that does not award points for various aspects of recycling. Providing space for collection of building occupant recyclables is required for LEED, and points are awarded for incorporating it in Green Star, Green Globes and BREEAM. LEED, Green Globes, and Green Star also award points for recycling of construction waste as well as incorporating materials in the project that include recycled materials.

CASBEE is the only rating system that does not encourage recycling. This is a notable omission as experts predicted in 2003 that Japan's commercial landfills had sufficient capacity for only 13 years of general waste and 5 years of commercial waste disposal at current volumetric rates. Japan, however, does have a mandatory home appliance recycling law.

Tobacco Smoke

LEED is the only rating system to include the limitation of tobacco smoke. The interior of commercial buildings are required to be smoke free. In the United States, smoking bans are set on state and local levels and vary by location.

In Japan, 26.0% of the population smoked on a regular basis in 2007. A smoking ban prohibiting smoking in schools, hospitals, bars, restaurants and stores in the second largest prefecture in Japan was recently proposed in April 2008. If passed, this ban would be first of its type in Japan (Yahoo News). In Australia, and in the United Kingdom where the smoking rate were at 22% in 2006, smoking bans were enacted which prohibited smoking in restaurants in July 2007 (Department of Health, News 24).

Increased Ventilation

All rating systems include points for increased ventilation, be it natural or mechanical. The increase in ventilation required to earn points varied due to the difference in the baseline system. People in northern Europe spend an average of 90% of their time indoors, and increased ventilation helps to improve their quality of life (Brandon, 1998). Increased ventilation can be achieved through the use of open windows or increased air exchanges in the mechanical systems. The second option, however, does increase the energy consumption of the building and may hurt the building's assessment score in other categories.

Sustainable Material Selection

LEED, Green Star, Green Globes and CASBEE all promote the use of sustainable timber through various certification programs, and BREEAM similarly promotes the use of socially responsible use of all building materials. LEED is the only rating system that awards points for the use of rapidly renewable materials. A rapidly renewable material is defined by LEED as being able to renew within a time frame of ten years or less. Bamboo is currently a popular rapidly renewable material. It is typically grown in China, thereby incorporating substantial transportation costs when implemented in the United States. Green Globes encourages minimizing the use of non-renewable resources, but the definition of these terms are loose.

Controllability of Thermal and Lighting Systems

BREEAM, LEED, CASBEE, and Green Star all award points for thermal comfort levels of the individual occupants, and controllability of lighting and thermal systems. Ability to adjust these systems has been tied to greater worker productivity in office situations.

Views to Exterior

CASBEE is the only rating system that does not award points for building schemes that include views to the outdoors for a set percentage of occupants. Views to the exterior can both help and hurt in other LEED categories depending on the climate. For example, with the use of proper daylighting sensors, energy use can be lowered. However, windows can increase energy bills associated with heating and cooling.

Glare Control

LEED and Green Globes are the only rating systems that do not award points for the use of glare control on daylighting systems. With the use of computers and other visual technology, glare control is necessary. Glare control can be as simple as adding a shear shade to a window to allow natural light to filter in while keeping direct light out.

Low-Emitting Materials

All of the rating systems award credits for low amounts of volatile organic compounds (VOCs) and formaldehyde. These materials have a higher upfront cost, but can contribute to better indoor air quality. A study in 2002 determined that improvements to indoor air quality could save over $43 billion dollars to U.S. companies. At an average of 225 square feet per worker, this is a potential annual productivity gain of $0.58 per square foot on the low end to $3.19 on the high end (Kats 2003).

Noise Control

Noise pollution from surrounding offices, buildings, or the outdoors can decrease worker productivity and comfort. Noise pollution can also have effects on the outdoor ecosystem. LEED is the only rating system that does not award points for internal noise control levels. Other systems award points for using acoustical batt and other insulations to prevent noise transfer.

Criticisms

While green building rating systems have increased the public's awareness and interest in sustainability, the end result is questionable. Assessment methods offer a quantifiable view of how "green" a building may be. This provides an easy explanation that the public can grasp. However, the level of certification that the building receives does not directly or thoroughly communicate its performance within specific categories of sustainable design, nor does it correlate reliably to the overall reduction in realized environmental impact. Some categories within the rating system have a greater positive impact on the earth than others yet still receive the same level of points. Other times, "point- chasing" occurs, where the building team works to achieve the greatest number of points possible at an affordable cost rather than looking at which methods would have the greatest environmental benefit. Lingering discrepancies between the reward to the designer for a specific inclusion and its lasting impact on the surrounding environment is a fundamental flaw in all major sustainability rating systems.

Not All Credits are Equal

This fundamental flaw is further exacerbated by a variance in the level of difficulty inherent in achieving the various metrics. For example, LEED, BREEAM, Green Globes, and Green Star all provide points for encouraging the use of bicycles and mass transit. This credit is very easy to achieve in urban settings, and practically impossible to achieve in rural areas. There currently is no adjustment to the point total or thresholds for rating levels based on site specificity and corresponding ease of achieving points.

Certain credits have a higher cost of implementation. For example, equal credit is given for using a highly reflective color for the roof of a building and installing a green roof system. Moreover, some of the more environmentally positive credits do not inherently posses the potential to provide direct lifecycle payback costs to the owner, which typically serve as ingrained incentives. This often leads owners and developers to favor credits that have monetary benefits over those that posess greater positive environmental impacts.

Variations in Climate

Green Star applies an environmental factor to the project based on the location. This helps to normalize the variations of importance of achieving specified credit. For example, it is much easier to obtain points for use of onsite renewable energy in sunnier locations compared to cloudy ones. LEED is used in the United States, but also has a variation that is used in Canada and India. Despite drastic climactic differences between sites in the United States, Canada and India, there exist very few variations in LEED system credits across these regions. LEED 3.0, which will be placed into effect in 2009, maintains this omission of region-specific issues.

Rating Systems are Not Universal

While the rating systems are typically designed with one country in mind they are often applied to other areas as a means of gaining increased exposure to the worldwide building industry. However, these rating systems are not adjusted to take into account the local climate or cultural differences. Construction materials and technology, thermal comfort levels, water availability and electricity demands are all major site-specific factors that are not included.

For example, almost 7% of the points possible in LEED come from energy reduction. To determine the amount of energy reduced, a base model is built using the baseline materials, window placement, orientation, fixtures and use. A model of the building is built using the intended materials, windows, orientation and fixtures. This model does take into account the climate of the building location, but not the cultural differences. For example, India has different thermal comfort levels allowing for greater energy savings through decreased use of air conditioning.

"In America, I could never do work like I do here. We've become too backward-looking. In China, they want to make everything look new. This is their moment in time. They want to make the 21st century their century. For some reason, our society wants to make everything old. I think we somehow lost our nerve."

Steven Holl speaking to Nicolai Ouroussoff, referring to his latest project in Beijing, the 'Linked Hybrid.' From "The New, New City" by Nicolai Ouroussoff, New York Times, June 8

Conclusions

Sustainability and the thoughts and practices about it are global. The means of determining the level of environmental sustainability inherent in a given building design, however, are not. All five rating systems surveyed in this paper show variations in their point system which reflect their geographic and cultural singularity, yet there are few variations to allow for climate or cultural differences within each specific system. Green Star currently weights points differently for various climates and LEED has indicated they are planning to do so in their next revision. Yet LEED has been used around the world with very few changes to the scoring system designed to take into account climate or cultural differences.

The "one size fits all" approach to ranking buildings across the world, or even within the United States, might be a convenient way to compare sustainability, but its true sustainable impact is questionable. While the rating systems do encourage developers and design teams to think "green," they are only just beginning to tap into the changes that are needed to move towards a sustainable world.

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Appendix: Sustainable rating systems around the world

Comparison of Content Between Four Rating Systems - Original chart prepared with material gathered from each of the four assessment systems.

Strengths and weaknesses can both be seen in each rating system. In this abridged table, each system discussed is reviewed for its inclusion of several key considerations, organized thematically under the categories of Site Selection, Water, Energy, Materials and Resources, Indoor Air Quality, and Project Management. Due to the broad scope of these modern rating systems, not all considerations are shown here.

	LEED 2.2		LEED 3.0		Breeam	
Category	Criteria	Value	Criteria	Value	Criteria	Value
Site Selection						
Alternative Transportation	Promote the use of mass transit, bicycles, low emitting and fuel efficient vehicles.	4	Promote the use of mass transit, bicycles, low emitting and fuel efficient vehicles.	12	Promote the use of mass transit systems and bicycles.	0.72
Development Density	Promote the placement of structures near existing infrastructure	1	Promote the placement of structures near existing infrastructure	5	Promote the placement of structures near existing infrastructure	0.08
Site Development	Limit the use of site disturbance during construction.	1	Limit the use of site disturbance during construction.	2	Encourage building on land that has been previously developed.	0.1
Site Selection	Avoid developing on sites that have a high ecological impact	1	Avoid developing on sites that have a high ecological impact	1	Avoid developing on sites that have a high ecological impact	0.1
Water						
Efficient Landscaping	Limit the use of potable water for landscaping.	2	Limit the use of potable water for landscaping.	4		
Water Meters					Encourage the use of systems that monitor and manage water consumption	0.06
Water Use Reduction	Promote water reduction through fixture selection.	2	Promote water reduction through fixture selection.	4	Encourage reduction in potable water consumption	0.18
Energy						
Commissioning	Ensure the building mechanical system are working.	1	Ensure the building mechanical system are working.	2	Ensure the building mechanical system are working.	0.24
Measurement and Verification	Monitor building energy consumption over the life of the building.	1	Monitor building energy consumption over the life of the building.	3		
Reduced Energy Use	Reduce the energy used from fossil fuels.	10	Reduce the energy used from fossil fuels.	19	Encourage reduction in greenhouse gases.	2.85
Refrigeration	Reduce ozone depletion by eliminating the use of refrigerants.	1	Reduce ozone depletion by eliminating the use of refrigerants.	2	Encourage the use of refrigerants that do not harm to the ozone.	0.1
Materials and Resources						
Building Reuse	Encourage the use of existing building walls, floors, and roof.	3	Encourage the use of existing building walls, floors, and roof.	4	Encourage the reuse of exterior building walls and structure.	0.25
Certified Wood/ building materials	Encourage the use of wood that has been properly harvested.	1	Encourage the use of wood that has been properly harvested.	1	Encourage the use of responsibly sourced building materials.	0.5
Construction Waste	Encourage the recycling of construction waste materials.	2	Encourage the recycling of construction waste materials.	2	Encourage the recycling of construction waste materials.	0.3
Recycled Content	Encourage the use of materials containing recycled content.	2	Encourage the use of materials containing recycled content.	2	Encourage the use of materials containing recycled content.	0.075
Regional Materials	Promote the use materials with a 500 mile radius of the site.	2	Promote the use materials with a 500 mile radius of the site.	2		
Storage and Collection of Recyclables	Encourage the use of recycling by building occupants	Required	Encourage the use of recycling by building occupants	Required	Encourage the use of recycling by building occupants	0.075
Indoor Air Quality						
Controllability of Systems	Encourage the use of individual thermal comfort and lighting controls.	2	Encourage the use of individual thermal comfort and lighting controls.	2	Encourage the use of individual thermal comfort controls.	0.15
Daylight	Encourage the use of natural daylight.	1	Encourage the use of natural daylight.	1	Encourage the use of natural daylight.	0.15
Low-Emitting Materials	Encourage the use of substances that do not deplete the ozone.	4	Encourage the use of substances that do not deplete the ozone.	4	Encourage the use of materials with low Volatile Organic Compounds.	0.15
Minimum Indoor Air Performance	Ensure the use of increased ventilation.	1	Ensure the use of increased ventilation.	1		
Project Management						
Environmental Management System					Encourage environmentally friendly use of resources within the building.	0.48
Rating System Total Points		67		106		16

The relative weight of each criterion can be seen by comparing its value against the total number of points available within a given system. These point totals, which represent the summation of all available points within each system, are given in the bottom row of this table. These point totals include not only the criteria listed but those omitted in the interest of brevity. Visit www.ctbuh.org/sustainableratingchart.htm to view an expanded version of this table with full details of each rating system.

	Green Star		Green Globes	
Category	Criteria	Value	Criteria	Value
Site Selection				
Alternative Transportation	Encourage minimum parking lots, preferred parking for fuel-efficient vehicles, cyclist facilities and locations close to mass transit..	11	Encourage the use of energy-conserving forms of transpiration.	
Development Density				
Site Development	Encourage building on land that has been previously developed.	1	Limit the use of site disturbance during construction.	20
Site Selection			Select a site with low ecological value.	30
Water				
Efficient Landscaping	Limit the use of potable water for landscaping.	1	Limit the use of potable water for landscaping.	15
Water Meters	Encourage the use of systems that monitor and manage water consumption	1		
Water Use Reduction	Encourage reduction in potable water consumption	5	Encourage reduction in potable water consumption	60
Energy				
Commissioning	Ensure the building mechanical system are working.	5	Verify the buildings energy systems and water conservation and treatment systems have been installed and calibrated properly.	15
Measurement and Verification	Encourage sub-metering of energy consumption.	2		
Reduced Energy Use	Encourage reduction in greenhouse gases.	20	Reduce the fossil fuel energy demand on the building.	
Refrigeration	Encourage the use of refrigerants that do not harm to the ozone.	3	Reduce ozone depletion by eliminating the use of refrigerants.	25
Materials and Resources				
Building Reuse	Encourage the use of existing building walls, floors, and roof.	6	Encourage the use of existing building walls, floors, and roof.	20
Certified Wood/ building materials	Encourage the use of sustainable wood..	2	Encourage the use of wood that has been properly harvested.	4
Construction Waste	Encourage the recycling of construction waste materials.	2	Encourage the recycling of construction waste materials.	5
Recycled Content			Encourage the use of materials containing recycled content.	4
Regional Materials			Encourage the use of locally manufactured materials.	4
Storage and Collection of Recyclables	Encourage the use of recycling by building occupants	2	Encourages minimizing waste generated by the building occupancy through recycling and compost.	10
Indoor Air Quality				
Controllability of Systems	Encourage the use of individual thermal comfort controls.	2		
Daylight	Encourage the use of natural daylight.	3		
Low-Emitting Materials	Encourage the use of substances that do not deplete the ozone.	4		
Minimum Indoor Air Performance	Encourage increased mechanic or natural ventilation.	5	Provide healthy indoor air	40
Project Management				
Environmental Management System	Encourage the use of a formal environmental management system.	2	Encourages the project managers to use an environmental management system	10
Rating System Total Points		140		525

This is an abridged comparison between four sustainable rating systems around the world. Visit www.ctbuh.org/sustainableratingchart.htm to view an expanded version of this table with full details of each rating system.