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Sustainability "How-To Guide" Series

Green Building Rating Systems

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FOREWORD

It is no secret that a focused, well-defined sustainability strategy is beneficial to an organization's bottom line, whether it is a federal, private-sector, military or nonprofit entity. Sustainable practices are not only the right thing to do for the environment; they also benefit the communities in which they are implemented. Sustainability is the business implementation of environmental responsibility.

Sustainability is all around us. Federal, state and local governments are increasingly applying regulatory constraints on design, construction and facility operations standards. Employees expect their employers to act responsibly, and vice versa. Going green is no longer a fad or a trend, but a course of action for individuals and businesses alike – benefiting the triple bottom line of people, planet and profit.

Today's facility manager needs to be able to clearly communicate the benefits and positive economic impact of sustainability and energy-efficient practices, not only to the public, but also to the C-suite. While there is a dramatic need for each of us – and our organizations – to care for the environment, it is just as important that we convey to executives and stakeholders how these initiatives can benefit our company's financial success.

The document in your hands is the result of a partnership between the IFMA Foundation and IFMA, through its Sustainability Committee, each working to fulfill the shared goal of furthering sustainability knowledge. Conducting research like this provides both IFMA and the foundation with great insight into what each can do as an organization to assist the facility management community at large.

It is my hope that you, as a facility professional, will join us in our mission of furthering sustainable practices. This resource is a good place to start.

Tony Keane, CAE
President and CEO
International Facility Management Association

FOREWORD

IFMA Sustainability Committee (ISC)

The IFMA Sustainablitiy Committee (ISC) is charged with developing and implementing strategic and tactical sustainability initiatives. A current initiative involves working with the IFMA Foundation on the development of a series of "How-To Guides" that will help educate facility management professionals and others with similar interests in a wide variety of topics associated with sustainability and the built environment.

The general objectives of these "How-To Guides" are as follows:

1. To provide data associated with a wide range of subjects related to sustainability, energy savings and the built environment

2. To provide practical information associated with how to implement the steps being recommended

3. To present a business case and return-on-investment (ROI) analysis, wherever possible, justifying each green initiative being discussed

4. To provide information on how to sell management on the implementation of the sustainability technology under discussion

5. To provide case studies of successful examples of implementing each green initiative

6. To provide references and additional resources (e.g., Web sites, articles, glossary) where readers can go for additional information

7. To work with other associations for the purpose of sharing and promoting sustainability content

The guides are reviewed by an editorial board, an advisory board and, in most cases, by invited external reviewers. Once the guides are completed, they are distributed via the IFMA Foundation's Web site (www.ifmafoundation.org) free of charge.

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The mission of the IFMA Foundation is to promote and support scholarships, educational and research opportunities for the advancement of facility management worldwide.

Established in 1990 as a nonprofit, 501(c)(3) corporation, the IFMA Foundation is supported by the generosity of a community of individuals – IFMA members, chapters, councils, corporate sponsors and private contributors – and is proud to be an instrument of information and opportunities for the profession and its representatives.

A separate entity from IFMA, the IFMA Foundation receives no funding from annual membership dues to carry out its mission. Supported by the generosity of the FM community, the IFMA Foundation provides education, research and scholarships for the benefit of FM professionals and students. Foundation contributors share the belief that education and research improve the FM profession.

1 EXECUTIVE SUMMARY

'Expand knowledge of the built environment, in a changing world, through scholarships, education and research'

The Vision Statement of the IFMA Foundation

This sustainability "How-To Guide" will explore the topic of green building rating systems and discuss their attributes, utilization on a global basis and benefits to facility management. It will provide the readers with:

- An overall understanding of the different rating systems available
- Costs involved in each of the highlighted systems
- Insights from facility management experts about how and why a particular rating or certification was achieved for a specific building

The intent of the guide is to provide the reader with realistic data, including costs and benefits of the systems, allowing the reader to make educated sustainability decisions. Each system has its own merits and the authors have tried not to influence or direct the readers toward any particular rating system. Every organization should investigate and understand each option to determine which system best suits the specific operations, budget and desired goals. The authors also do not pass judgment on the quality of the rating systems discussed; instead, they seek to clarify and demystify the features and possible benefits of each system to allow readers to "do the right thing" – whether that is certifying a facility using a particular rating system or blending attributes from several systems into a facility-specific sustainability plan.

In addition to detailed discussion about multiple rating systems, this guide includes:

- A discussion of how green building rating systems evolved
- Results of the IFMA Green Building Rating Systems Survey, which canvassed practitioners about the use of building certification systems
- A practical step-by-step approach to create the business case for green building rating systems
- Nine case studies of buildings that have been certified under four different certification systems:
    - Two buildings certified using the Building Research Establishment Environmental Assessment Method (BREEAM)
    - Four buildings certified using the Leadership in Energy and Environmental Design (LEED) rating system
    - Two buildings certified using Green Globes
    - One building certified using Green Mark

Key findings of the IFMA Green Building Rating Systems Survey include:

- The most common reason for certification are to:
    - Demonstrate corporate responsibility to stakeholders and the public
    - Provide evidence of building efficiency
- Changes made to facilities to make them more sustainable included:
    - Lighting retrofits
    - Adoption of green cleaning processes
    - Smart irrigation
    - Purchase of more sustainable products
    - Heating, ventilating and air-conditioning upgrades
- The United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED) (or a derivative thereof) is the most commonly used rating system
- Reasons why an organization opted not to certify their building(s) include:
    - Certification is very new in some countries
    - Lack of similar facilities to score some building types against
    - Cost of certification is too high; principles and practices can be implemented without the cost of certification

It would be impossible to include all of the rating systems available within this guide. However the authors have endeavored to include as many as fit the evaluation criteria:

- Rating system with a formal certification program
- Excluded systems solely for one area of sustainability, such as just energy conserva-

tion (i.e., ENERGY STAR)

- System must not be a modified version of another major system or directly translated from another certification system
- System must not be in development or in pilot stages

Overall, the authors' findings were conclusive that the rating systems reviewed provide a practical structure to work within several detailed focus areas necessary for a green building. The results of the survey support this conclusion, as survey respondents agreed that whether or not full certification of any type was pursued, the rigor of the system criteria gave users a useful framework to structure a much needed process to achieve more efficient and sustainable facilities.

As you read this guide remember:

"The earth has enough resources to meet the needs of all people but will never have enough to serve their greed." Mahatma Gandhi

The spirit of conservation and preservation must underscore any strategy for sustainability. Rating systems are mere guidelines to assist in doing the right thing.

2 INTRODUCTION

The team of authors for this guide approached its creation as honest brokers, dedicated to providing an unbiased account of several green rating systems. It is not an endorsement, ranking or referendum of any one particular system. The guide seeks to provide clarification of the basic aspects of the systems and share case studies that demonstrate successful implementation of the systems discussed. As a reader, the guide should serve as an information source to help make sound decisions about the use of rating systems.

Many different certification systems exist. Fifteen have been identified worldwide; four of the systems are the most widely accepted and utilized. Part 3 Detailed Findings begins with a discussion of the evolution of green rating systems, followed by the results of the green rating systems survey. To complement the survey results, the author team conducted interviews, reviewed academic studies and case studies, and conducted many hours of market research to round out the information contained within this guide. Interviewees included professional engineers, consultants, facility managers and property managers, who each had their own story to tell regarding the challenges and successes of utilizing various rating systems.

A brief overview of the 15 rating systems identified is located in Part 3 Detailed Findings, including information on the criteria of each system, features and benefits of the most widely used rating systems, certification costs and additional resources needed for achieving the certification. A brief discussion of the evolution of green and sustainable rating systems is also provided.

Additionally, the guide offers tips to determine which system is right for the facility you manage or provide service to, as well as guidance to build a business case to sell the work of attaining a green rating system.

3 DETAILED FINDINGS

3.1 Evolution of Green Rating Systems

During the late 20th century, awareness of the impact of technology and the expanding human population on the earth increased. People started to expand their efforts to reduce their environmental impact and buildings started to be recognized as major contributors to the world's energy usage, landfill waste and diminishing green space.

In 1990, the Building Research Establishment, LLC (BRE) started a voluntary environmental assessment method, BRE Environmental Assessment Method (BREEAM). The purpose of the assessment method was to objectively measure the environmental performance of new and existing buildings in the United Kingdom. As the system evolved, goals were set for buildings to have a better rating. Instead of buildings simply being designed to meet code requirements, designers were striving to achieve improved building performance. The third-party assessment became a critical part of the assessment program as all buildings were held to the same standard. In the following years, BREEAM was introduced to other countries, including Canada, Hong Kong and New Zealand (BREEAM 2009).

In 1996, 14 countries (Austria, Canada, Denmark, Finland, France, Germany, Japan, Netherlands, Norway, Poland, Sweden, Switzerland, United Kingdom and United States) began the two-year developmental process known as the Green Building Challenge. The goal was to develop and test a method for measuring building performance considering environmental and energy issues. The Green Building Challenge continued its development through 2000, 2002 and 2005, and resulted in the development of the GBTool, a tool used to assist in the environmental evaluation of buildings. The Green Building Challenge is now known as the Sustainable Building Challenge and continues to stimulate debate about building environmental performance and green building design (iiSEBE 2009).

Over the years, many additional green rating systems have been created based on BREEAM, the GBTool or through research into the environmental needs of a country. Rating systems have evolved over the years based both on user feedback and the development of new technology to improve the environmental performance of buildings. Green rating systems started out as a voluntary measure of environmental performance. However, certification is now a mandate for buildings in many areas across the globe. Fifteen rating systems that offer certifications are currently available throughout the world and more are in development or pilot stages (Figure 1). Three systems are currently available for buildings outside of their home countries: BREEAM, Leadership in Energy and Environmental Design (LEED) and Green Globes.

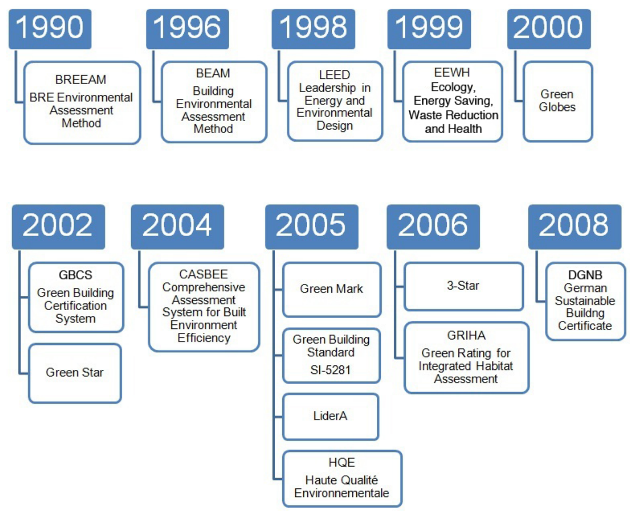

Figure 1: Rating systems timeline

3.2 Gaining an Industry Perspective on the Use of Green Rating Systems Through a Global Survey

During the initial stages of development of this guide, the authors conducted a global industry survey to gain a world view of the use of green rating systems. The survey was distributed by the International Facility Management Association (IFMA) research department. It was sent to facility managers around the world and focused on experiences with all types of green rating systems.

Responses were received from Austria, Belgium, Cayman Islands, Denmark, Germany, Hong

Kong, India, Nigeria, Portugal, Qatar, Russia, Spain, South Africa and the United States. The responses to the survey revealed insights about the motivation for using rating systems, benefits achieved from the use of green rating systems and reasons for opting out of a formalized certification process.

3.2.1 Detailed Survey Findings

Below are some of the key findings of the survey. In summary, 85 percent of survey respondents achieved energy and water savings as a result of the sustainable initiatives they implemented in their facility.

When survey respondents were asked why it was important to achieve certification for their facility, the most common responses were to demonstrate corporate social responsibility to stakeholders and the public, and to provide evidence of building efficiency. Survey respondents shared the real rewards, as a result of going through the certification process, included changes in employee awareness and education and improvements in facility operations. However, how can that be translated into a business case? Even respondents who had green elements in their building and had incorporated green practices into their operations were hesitant to certify buildings, stating that costs and lack of perceived value were major hurdles to certification.

Some of the changes survey respondents made in their facilities to make them more sustainable included:

- Lighting retrofits
- Green cleaning processes adoption
- Smart irrigation
- More sustainable products purchases
- Heating, ventilating and air-conditioning (HVAC) upgrades

Most all respondents agreed that these changes resulted in significant energy and water savings. The energy reduction percentages ranged from 3 to 40 percent, with an average of 17 percent overall savings. Reported water savings ranged from 3 to 75 percent, with an average of 18 percent.

Average Savings From Survey

Through implementing sustainable initiatives, survey respondents achieved an average of:

- **17% energy savings**
- **18% water savings**

When respondents were asked to choose from all the known green and sustainable rating systems that could be used, the United States Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED), or a derivative of this rating system, was selected most often. Reasons cited included that LEED was the most universally accepted in their geographical region, and it was better suited to their type of facility than other options they had researched.

The survey results revealed the costs to achieve certification varied greatly, from $50,000 to $300,000 (US dollars). One reason for the large cost variation is the use of in-house staff versus outsourced consultants to complete the certification process. Additionally, costs varied based on changes made to the facility to achieve the certification.

As a result, the authors discovered that LEED is definitely ahead of the pack when it comes to acceptance and recognition. However, there are many other rating systems available, as well as a contender that comes up close behind: “all but certified” (ABC). With some facility management professionals, it is about the process and not so much about the prize.

When asked in the survey why an organization opted not to certify, some of the respondents stated:

- “This is still very new in my country.”
- “There was a lack of similar facilities to score my buildings [against].”
- “Our initiatives were mainly focused on occupants work practices rather than extensive infrastructure changes.”
- “Certification costs are too high – principles and practices could be implemented without the added cost of certification.”
- “The owner saw no value in certification.”

3.3 Most Widely Used Green Rating Systems

Now that the evolution of green rating systems has been introduced, sections 3.4 through 3.7 will take an in-depth look at some of the most widely used systems: BREEAM, LEED, Green Globes and Green Star (Table 1). These systems were chosen for their popularity and their international usage. The discussion will include:

- Steps required for certification
- Scoring system
- Costs and considerations

Table 1: Most widely used green rating systems

System	Year established	Country of origination	Buildings certified	Rating schemes	Certification levels	Categories
BREEAM	1990	United Kingdom	Over 110,000	Communities Courts Education Health care Homes Industrial International Multiresidential Offices Prisons Retail Other	Pass Good Very Good Excellent Outstanding	Energy Health & well-being Land use & ecology Management Materials & water Pollution Transport Water
LEED	1998	United States	Over 7,400	Commercial interiors Core & shell Existing buildings Health care Homes Neighborhood development New construction Retail Schools	Certified Silver Gold Platinum	Awareness & education Energy & atmosphere Indoor environmental quality Innovation in design Locations & linkages Materials & resources Regional priority Sustainable sites Water efficiency
Green Globes	2000	Canada	Over 1,400	Existing buildings New construction	1 Globe 2 Globes 3 Globes 4 Globes	Effluents & other impacts Emissions Energy Indoor environment Project management Resources Site Water
Green Star	2002	Australia	Over 220	Education Health care Industrial Multiresidential Office as built Office design Office interiors Retail center	4 Star 5 Star 6 Star	Emissions Energy Indoor environmental quality Innovation Land use & ecology Management Materials Transport Water

- Composition of the rating system
- Countries where the systems are currently in use
- How the systems are perceived outside of their home country

3.4 BRE Environmental Assessment Method (BREEAM)

BREEAM includes eight main categories of environmental impacts (Table 1). The categories consider topics such as:

- Maintenance and operation policies
- Occupant control
- Carbon dioxide (CO_2) reduction
- Energy and water management
- Recycled and responsible use of materials
- Effect of the building on ecology

Credits are awarded in each of the categories. Weightings are applied to each category and then scores from each category are added together to produce an overall percentage score (Figure 2). In the United Kingdom, many new developments, schools and government buildings require a Very Good or Excellent rating. Check with www.breeam.org/page.jsp?id=43 to see which regions require a certain rating and if there are penalties for not achieving the required rating. As the regulations are for new construction schemes, and evaluations occur at several stages during the process, in the authors' opinion, it is unlikely the process will be completed without achieving the required rating.

Outside the United Kingdom, a country can develop its own adapted version or use a BREEAM International scheme to certify buildings. Two countries that have established their own versions of BREEAM are Canada and the Netherlands. When the International scheme is used, it is necessary that a BREEAM International assessor be used to assess the buildings (BREEAM assessors will be discussed below). Two geographical schemes, BREEAM Europe and BREEAM Gulf, are available for use by BREEAM International

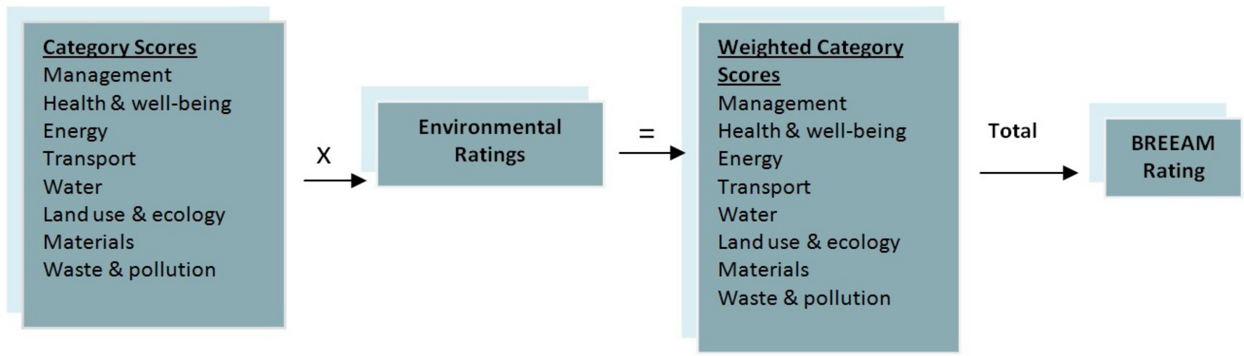

Figure 2: BREEAM rating calculation process

assessors. In situations where standards are incomplete or nonexistent, BREEAM has set certain standards that must be followed to achieve certification (BREEAM 2009).

Internationally, the BREEAM system is perceived as being flexible to local regulations but strict in areas where local regulations are not applicable. Since the BRE is one of the largest certification bodies in the world and there is a need for the assessor to be involved in all stages of the process, there can be a delay in responding to certification information requests (Julien 2009).

breeam

3.4.1 BREEAM Certification Process

The first step in attaining BREEAM certification is to have a pre-assessment of the building completed by a BREEAM pre-assessment estimator. The pre-assessment estimator will explain the BREEAM process and determine which scheme the building should be assessed under. As shown in Figure 3, BREEAM offers 12 standard rating systems; in addition, a domestic refurbishment scheme is under development. For buildings that do not fit within one of the normal assessment schemes, a custom version of the scheme, called a bespoke assessment, can be completed.

After the correct scheme has been determined, the next step of the process is to decide what the goals are for the building, including certification level, improved processes, the addition of alternative energy sources and more. The certification levels include a:

- Pass, requiring a rating of 30 percent
- Good, requiring a rating of 45 percent
- Very good, requiring a rating of 55 percent
- Excellent, requiring a rating of 70 percent
- Outstanding, requiring a rating of 85 percent

As the rating levels increase, additional requirements must be met to achieve that certification. The Outstanding level also requires that information about the building be published as a case study written by BRE (BREEAM 2009).

Figure 3: BREEAM rating system schemes

When determining which goals to achieve, it is necessary to take into account which credits must be attained, the feasibility of implementing required technologies in the building and the cost of achieving certification. In 2006, a study titled *Schools for the Future – The Cost of BREEAM Compliance in Schools* was conducted (Lockie 2006) to determine the costs for schools to achieve a specific level of certification. The study found that there was little to no extra cost to achieve a Good rating, but the cost increased exponentially for each level thereafter (Table 2).

Table 2: BREEAM school costs per rating level (Lockie 2006)

Rating	Score	Additional cost
Good	40	Little to none
Very Good	55	£19/m² $360/SF
Excellent	70+	£60/m² $1,134/SF

Note: The scores in this table are based on the 2008 version of BREEAM.

The Excellent rating generally requires the use of renewable energy, which has a higher cost per credit (Lockie 2006). A 2005 study, *Costing sustainability: How much does it cost to achieve BREEAM and EcoHomes ratings?* found a similar exponential increase in costs for the higher ratings (BRE and Sweett 2005). However, as renewable energy technologies become more common, costs are expected to decrease.

For new buildings and major renovations, once the goals and desired certification level are determined, it is necessary to contact a licensed assessor. Licensed assessors can be found by searching Green Book Live: www.greenbooklive.com/search/search.jsp?partid=10001. It is best to involve an assessor as early in the design stage as possible to ensure the maximum performance per cost. It is also important to provide the assessor with necessary information during the design stage for all new construction projects. This information will be documented in a report. A copy of the report will be forwarded to BRE for quality assurance and a design stage certification will be issued. Once construction is finished, a post-construction review will be completed and the final certification will be issued. The time period required to complete the assessment varies based on the building type and location, but will not last longer than five years.

For existing buildings, the BREEAM In-Use scheme measures the actual operation of the building. BREEAM In-Use certification can be provided by an auditor with the aid of the assessment tool.

3.5 Leadership in Energy and Environmental Design (LEED®)

The Leadership in Energy and Environmental Design (LEED) rating system was developed by the U.S. Green Building Council (USGBC). The first LEED rating system developed was for new construction. Currently, LEED has been expanded to include several additional rating systems, as shown in Figures 4 and 5.

Figure 4: LEED rating systems

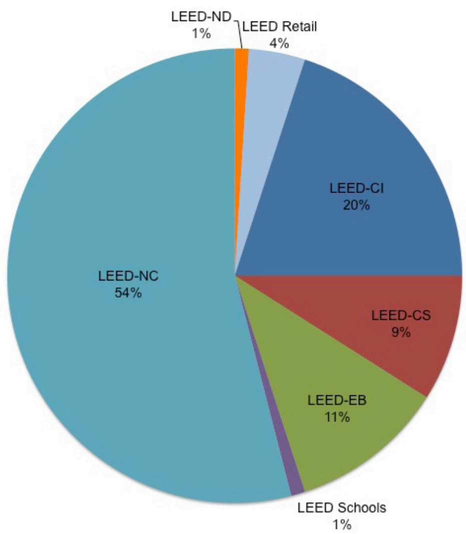

Figure 5: LEED-certified buildings as of July 2010

Most of the LEED rating systems focus on the design and construction stages of a building. LEED for Existing Buildings Operations and Maintenance (LEED-EBOM), which was referred to as LEED for Existing Buildings (LEED-EB) until 2009, is for existing buildings and for buildings that originally certified under new construction and are seeking recertification. Overall, certification processes for both new and existing buildings are nearly the same. The existing buildings certification process also requires a performance period of three months to two years where performance data, such as energy and water usage, is collected.

LEED includes nine different categories (Table 1). Category topics include (USGBC 2010):

- Effects of the building on the ecology
- Water and energy usage
- Sustainable use and transportation of materials
- Indoor air quality
- Location of the building
- Utilization of technology
- Innovation
- Regional issues

Outside of the United States, there are two options to use the LEED system. One is to adapt the LEED rating system to the local system by working with the U.S. Green Building Council. Under this option, certification would be completed by the local system. Many countries have implemented and adapted this option or are in the process of adopting LEED for their own usage, including Brazil, Canada, India and Spain. These countries have their own versions of LEED that are regulated by the Green Building Council within each country (IGBC 2008; Spain GBC 2010; Canada GBC 2010; GBCB 2008). Several other countries are also developing their own versions of LEED.

The second option for using LEED outside of the United States is to certify the international system under the US version of LEED. If this option is pursued, the building is subject to the codes and regulations of the United States and the USGBC. When this option is selected, the regional priority credits are not available. When used in the United States, the regional priority credits give greater weight to certain credits based on the region of the US the building is in. However, in other countries some of these credits may not be sustainable solutions. As all documentation for certification is submitted through the LEED online system, it is not necessary for an assessor to come to the project site (Julien 2009).

3.5.1 LEED Certification Process and Accredited Professionals

The first step in achieving LEED certification is to register the building with the Green Building Certification Institute (GBCI). Although the U.S. Green Building Council develops and manages the LEED rating systems, the GBCI is responsible for all certification applications. The GBCI administers an accreditation program for LEED Green Associates (LEED GA) and LEED Accredited Professionals (LEED AP). The LEED Green Associate designation is typically held by those with a nontechnical background, such as marketing professionals; while those earning the LEED AP generally have a more technical background and have demonstrated experience in helping guide others through the LEED process. While involving a LEED Accredited Professional in a LEED project is not mandatory, it can help streamline the certification process, provide valuable information on achieving certification and allow one credit toward certification to be achieved.

USGBC provides checklists for each rating system that cover the prerequisites and credits. The checklists can be used to identify the possibility of earning each credit as a yes, no or maybe. The prerequisites must be completed in order to submit for certification. The checklist should be used at the beginning of either the design or construction process to determine which credits are feasible for the building and what level of certification is sought. Certification levels are:

- Certified
- Silver
- Gold
- Platinum

When evaluating the credits, consider the cost of achieving each credit. Costs for LEED registration can be found at www.gbci.org.

The number of credits available and the number of credits needed for each rating level varies with each rating system.

Once a project is registered, the team will have access to the USGBC's LEED Online system.

This system provides online templates that must be completed for each prerequisite and credit, and is used to upload supporting documentation. As the project progresses, be sure to document necessary data. The LEED Online system also has credit interpretations rulings that provide technical answers to the questions officially submitted by other users. It is important to note that achieving some credits requires that the building be occupied for a certain period of time after construction. Once all of the documentation is assembled and the construction is finished, the documentation is submitted to the GBCI for review and certification. The entire LEED process typically takes anywhere from one to five years, depending on the type and requirements of the desired certification.

3.6 Green Globes®

Green Globes is offered in Canada, the United States and the United Kingdom. Green Globes has two rating systems: one for existing buildings and one for new buildings (Figure 6). The Green Globes for Continual Improvement of Existing Buildings (CIEB) in Canada is managed by the Building Owners and Managers Association of Canada (BOMA) under the title BOMA BESt. (BOMA Canada also has three other tools: Building Emergency Management, Building Intelligence and Fit-Up tools: www.greenglobes.com/default.asp.) All other Green Globes products in Canada are administered by ECD Jones Lang LaSalle. In the United States, Green Globes is managed by the Green Building Initiative (GBI). In the United Kingdom, the existing buildings version of Green Globes is called Gem UK. Slight modifications have been made to Green Globes among the three countries. While Green Globes is primarily offered in the United States, Canada and the United Kingdom, it is not restricted to those countries (GBI 2010).

Figure 6: Green Globes rating systems

GREEN BUILDING INITIATIVE™
www.thegbi.org

Green Globes includes seven categories of environmental impacts (Table 1). The categories include topics such as:

- Energy reduction
- Environmental purchasing
- Development area
- Water performance
- Low impact systems and materials
- Air emissions and occupancy comfort

The system is heavily weighted toward energy reduction and integration of energy-efficient systems. The Green Globes tool also includes a life cycle assessment, which evaluates the impact of various building materials over the lifetime of the building. As a result, different design scenarios can be compared with the life cycle of the building (Green Globes 2010).

The Green Globes certification level depends on in which country the rating system is being used. There are four or five ratings levels based on the total percentage of points. As shown in Figure 7, there are four levels of Green Globes ratings in the United States. In Canada, BOMA BESt also has four categories (Figure 8).

Figure 7: Green Globes ratings in the United States

BOMA BESt level 1	Basic practice compliance
BOMA BESt level 2	70-79%
BOMA BESt level 3	80-89%
BOMA BESt level 4	90-99%

Figure 8: BOMA BESt rating levels

3.6.1 Green Globes Certification Process

Green Globes certification starts with an online assessment tool. There are eight different times during the building life that the Green Globes tool can be used:

- Project initiation
- Site analysis
- Programming
- Concept design
- Design development
- Construction documents
- Contracting and construction
- Commissioning

Once an online account is created, it is necessary to complete a survey of approximately 150 questions. The questions range from yes or no answers to entry of energy and water bills data. The online tool allows for direct interface with other online tools, such as the Natural Resources Canada screening tool and the US Environmental Protection Agency's ENERGY STAR Portfolio Manager, which can be used for benchmarking.

After the survey is complete and the data is submitted, a report (Figure 9) is provided summarizing the certification score and suggestions for improvement. The system is composed of 1,000 points. A percentage score is provided for each of the categories as well as an overall score for the building, which dictates how many globes the building is eligible for. To receive a certification, a third-party verifier must examine the building and supporting documentation.

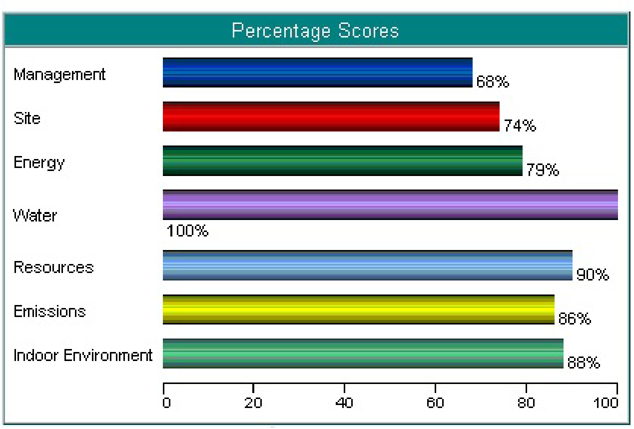

Figure 9: Excerpt from Green Globes report

Cost for access to the online tool and third-party verification can be found at www.thegbi.org/assets/pdfs/Green-Globes-Price-List-01-01-2010-Building-Certifications.pdf.

If any corrections need to be made to the supporting documentation, the verifier will make the changes with justification as to why the changes were made. In existing buildings, the verifier can be engaged as soon as the survey has been completed and any desired improvements have been made. For new construction, a verifier can be engaged once the construction documents for the Green Globes survey has been completed.

3.7 Green Star Australia

Green Star Australia is the green building rating system used in Australia, and is currently not available for use outside of Australia. The system has also been adopted as Green Star New Zealand and Green Star South Africa to fit the environmental and regulation requirements of those countries (NZGBC 2008; GBCSA 2010).

Green Star Australia has eight different environmental management categories (Table 1) (GBCA 2010). Some of the category topics include:

- Daylight and lighting
- Volatile organic compounds (VOCs)
- Energy efficiency and improvements
- Sustainable transportation
- Water efficiency
- Sustainable materials
- Building conservation
- Ozone depleting potential

The percentage of points within each category is shown in Figure 10. Once the credits are assessed, a percentage score for each category is calculated and a weighting factor using environmental factors is applied. As a result, three certification levels can be achieved:

- 4 Star, with a score of 45 to 59 signifying best practice
- 5 Star, with a score of 60 to 74 signifying Australian excellence
- 6 Star, with a score of 75 to 100 signifying world leadership

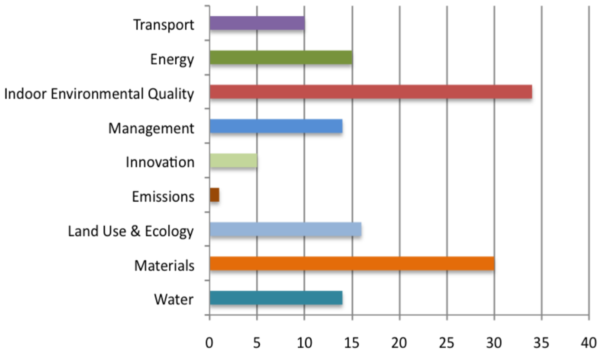

Figure 10: Green Star categories

3.7.1 Green Star Certification Process

To obtain Green Star certification in Australia, it is necessary to register the building with the Green Building Council of Australia (GBCA). The GBCA will verify the eligibility of the building and assign a case manager to support the team through the process. Once the building is registered, documentation can be prepared for submission using the online Excel-based Green Star tools. The Green Star tools are available for free to everyone, even those outside of Australia, to assist in assessing and benchmarking a facility. Credit interpretation requests and technical clarifications, including previous rulings, are available online. The current Green Star system is for new buildings or major renovations in design or construction (Figure 11). A pilot program for existing office buildings is currently in progress.

The certification process consists of two rounds of submissions. The first round of submissions requires that each credit be identified as awarded, to be confirmed or not awarded. The review of

Figure 11: Green Star rating systems

the first round submissions is completed within six weeks of the submission. Typically, after the first round, one-third of the points will be awarded, and two-thirds will have to be confirmed with more information. The credits that need to be confirmed can be resubmitted during the second round of submissions with additional supporting documentation. The second round of submissions can take up to four weeks. Once the second round review is complete, a certification decision is made. Ninety percent of certifications are granted in the second round. If the desired result is not reached at the end of the second round, the process can be completed again or an appeal can be filed.

Fees for certification can range up to $28,000 (US dollars).

3.7.2 Green Star Accredited Professionals

The GBCA administers an accreditation program to certify Green Star Accredited Professionals. Involvement of a Green Star Accredited Professional is not mandatory. However, Green Star Accredited Professionals can provide valuable guidance throughout the certification of the project.

3.8 Other Green Rating Systems

Now that the four most prominent rating systems have been described, 11 additional rating systems used around the world will be discussed in order of origination date. The authors acknowledge that there are other systems that are not mentioned that offer ways to evaluate the sustainability of buildings. However, the authors' review has found the systems not mentioned do not offer certification or that the certification systems are in testing or developmental stages. A summary of the 11 rating systems is found in section 3.8.12.

3.8.1 Building Environmental Assessment Method (BEAM)

The Building Environmental Assessment Method (BEAM) was established as a voluntary certification system by the Hong Kong Environmental Assessment Method (HK-BEAM) society in 1996. As of October 2009, 199 buildings have been certified in Hong Kong, which accounts for 37 percent of commercial space and 28 percent of residential space. Assessments are conducted by the Business Environmental Council (BEC), an independent nonprofit environmental center. Points are assigned to items within categories. Certification is based on two achievements: the percentage of points in each category and total number of points achieved in all categories (HK BEAM 2003).

3.8.2 Ecology, Energy Saving, Waste Reduction and Health (EEWH)

Ecology, Energy Saving, Waste Reduction and Health (EEWH) was established in Taiwan in 1999 by the Architecture Research Institute of the Ministry of the Interior. Certification is based on the total points accumulated in the predefined categories. Certification is mandatory for any new public building construction project funded by the government that exceeds $1.5 million (US dollars) and is voluntary for other buildings. The Ministry of the Interior regulates awards with support from the Taiwan Green Building Council. While the program is aimed at new construction, it has also been used as a guide for retrofitting government buildings and public schools (Hong 2007).

3.8.3 Green Building Certification System (GBCS)

In South Korea, the Green Building Certification System (GBCS) was established in 2002 by the Ministry of Construction and Transportation and the Ministry of Environment. The evaluation of participating buildings must be verified by at least four outside experts. Certification is based on the total number of points awarded in the predefined categories, and is awarded by a certification party designated by the government. Additionally, preliminary certifications may be earned for new construction buildings during the blueprint phase (Song 2002).

3.8.4 Comprehensive Assessment System for Built Environment Efficiency (CASBEE)

The Comprehensive Assessment System for Built Environment Efficiency (CASBEE) was developed by the Japan Sustainable Building Consortium. Buildings are assessed by trained individuals that have passed the CASBEE exam. CASBEE certification is currently being encouraged by local governments (CASBEE 2009).

CASBEE has four categories: energy efficiency, resource efficiency, local environment and indoor environment. Points are awarded in each category, then weighted and divided into two sections:

- Quality (Q), which includes:
    - Indoor environment
    - Quality of service
    - Outdoor environment on site
- Loading (L), which includes:
    - Energy
    - Resources and materials
    - Off-site environment

The built environment efficiency is then calculated by dividing Q by L, which is then used to assign a grade.

3.8.5 Green Mark

The Building and Construction Authority established the Green Mark rating system in Singapore in 2005 as an effort to raise environmental awareness during the construction process. The certification process includes a pre-assessment briefing with the assessment team and an assessment at the end of the process to review documentation and intent of certification level. Certification is awarded based on the total number of points earned in each category. Currently, there are plans to make Green Mark implementation mandatory for all new public sector buildings and those undergoing major renovations (BCA 2010).

3.8.6 Green Building Standard SI-5281

SI-5281 was created by the Standards Institution of Israel in 2005. Accreditation is awarded by an auditor who performs an assessment during two different stages. The first stage is planning, where the auditor will inspect building plans and permits. The second stage is construction, where the auditor will monitor the on-site construction for compliance with plans (Nelin 2007). Certification is awarded based on the total number of points achieved. The building must achieve minimum requirements for building certification (Ayal 2007).

3.8.7 LiderA

The LiderA system was developed by Manual Duarte Pinheiro, PhD, a professor at the Department of Civil Engineering and Architecture at the Instituto Superior Técnico in Portugal, in 2005. Voluntary trained facilitators guide the team through the process used to submit documentation to LiderA for certification. Each category has certain criteria that must be achieved. The building is graded on its improvement over a baseline determined from actual performance data. The system is currently intended for commercial and institutional buildings, and is designed to be able to evaluate the buildings throughout their entire life cycle, from construction to operation to demolition (LiderA 2010).

3.8.8 Haute Qualité Environnementale (HQE)

In France, the Haute Qualité Environnementale (HQE) Association created the HQE system, which began official certifications in 2005. CertiVéA, a certification body, certifies commercial buildings and QUALITEL, a nonprofit, certifies residential buildings. An independent auditor is required if it is the manager's first time through the process. There are two sections to the HQE system: Environmental Management System (EMS), which defines the tools that should be used throughout the project, and Environmental Building Quality (EBQ), which defines the 14 targets that the building is graded upon. At the beginning of the process for each step (design, construction, operation), the tools are defined and preliminary performance goals for the 14 areas are set. At the end of the process, a certification is issued that details the performance level achieved for each of the 14 sections (Table 3). (CertiVéA 2010; Association HQE 2006)

HQE Is the Foundation for AQUA

Alta Qualidade Ambiental (AQUA) is a rating system created in Brazil by the Vanzolini Foundation in 2008. AQUA is based upon the HQE system but is adapted to Brazil's codes and climate (Vanzolini 2010).

Table 3: HQE certification sections

Eco-Construction	Eco-Management	Comfort	Health
1. Harmonious relation between buildings and their immediate environment 2. Integrated choice of products and construction materials 3. Low site nuisance	4. Management of energy 5. Management of water 6. Management of waste caused by activities 7. Management of servicing and maintenance	8. Hygrometric comfort 9. Acoustic comfort 10. Visual comfort 11. No unpleasant smells	12. Sanitary quality of areas 13. Sanitary air quality 14. Sanitary water quality

3.8.9 3-Star

The Ministry of Construction in China established the Evaluation Standard for Green Building, commonly known as the 3-Star system, in 2006. Building evaluations cannot occur until after the building has been occupied for at least a year (Lewis 2009). The Ministry of Construction collects building consumption data, assesses energy performance based on the standard and issues 3-Star Green Building certifications. Local governments are in charge of processing 1- and 2- Star buildings (Hong 2007). Certifications are awarded when all the prerequisites have been met for each category and the total number of points earned (Lewis 2009).

3.8.10 Green Rating for Integrated Habitat Assessment (GRIHA)

The Energy and Resources Institute (TERI) India created the Green Rating for Integrated Habitat Assessment (GRIHA) in 2006 in an effort to establish a system that addressed India's concerns about resource consumption in the power and water sectors and about eroding biodiversity. The system stresses passive solar techniques for optimizing thermal comfort and to only use refrigeration-based air conditioning systems in case of extreme discomfort. The system is primarily geared toward large, new construction buildings. Certification is based on a point system and evaluation is performed by a secretariat (GRIHA 2010).

3.8.11 German Sustainable Building Certificate

The German Sustainable Building Certificate was created by the German Sustainable Building Council (DGNB) in 2008. The system is based upon the GBTool. The certification process requires the presence of a certified auditor for the entire submission process. The process includes building registration, issuance of a pre-certificate based on specifications signifying intent to earn a certain rating level, documentation of the construction process and issuance of the final certificate. Additionally, DGNB has a partner system in Austria called OGNI, formed in 2009. OGNI is a partner of DGNB and adapts the DGNB system for Austria's needs (DGNB 2010).

3.8.12 Summary of Other Rating Systems

Table 4 provides a summary of the 11 rating systems discussed in sections 3.8.1 through 3.8.11. The table allows for quick comparison between year established, country of origin, number of buildings certified under each system at the time of publication of this guide, types of rating systems (such as commercial buildings), levels of certification and categories.

Table 4: Summary of other rating systems

System	Year established	Country of origination	Buildings certified	Rating schemes	Certification levels	Categories
BEAM	1996	Hong Kong	199	Existing buildings New buildings	Bronze Silver Gold Platinum	Energy use Indoor environmental quality Material aspects Site aspects Water use
EEWH	1999	Taiwan	Over 200	New construction	Certified Bronze Silver Gold Diamond	Biodiversity Carbon dioxide emissions reduction Conservation Energy conservation Green landscaping Indoor environment Sewage & garbage treatment Site water Waste reduction Water resource
GBCS	2002	South Korea	Over 120	Hotels Multiuse Multiuse dwellings Office buildings Residential Schools Stores	Best Excellent	Energy efficiency & load on the environment Indoor environmental quality Land use & transportation Site ecology
CASBEE	2004	Japan	80	Existing building Heat island Home New construction Renovation Urban area & buildings Urban development	S (excellent) A B+ B- C (poor)	Energy efficiency Indoor environment Local environment Resource efficiency
Green Mark	2005	Singapore	300	District Existing buildings Infrastructure Landed houses Nonresidential new buildings Office interiors Residential new buildings	Certified Gold Gold plus Platinum	Energy efficiency Environmental protection Indoor environmental quality Other green features & innovation Water efficiency
SI-5281	2005	Israel	1	New construction	Green building Outstanding green building	Energy General assessment Land Water Wastewater & drainage Other environmental subjects
LiderA	2005	Portugal	9	Buildings	C level B level A level A+ level A++ level A+++ level	Efficiency Environmental comfort Environmental management & innovation Load impacts Resources consumption Site & integration Socioeconomic adaptability
HQE	2005	France	Over 340	NC lodging NF Tertiary buildings NF MI – Detached homes	Basic performance High performance Very high performance	Comfort Eco-construction Eco-management Health
3-Star	2006	China	15	Commercial Residential	1 Star 2 Star 3 Star	Energy savings Land savings & outdoor environment Material savings Indoor environmental quality Operations & management Preference items Water savings
GRIHA	2006	India	1	Education Health care Multiunit residential Office as built Office design Office interiors Retail center	1 Star 2 Stars 3 Stars 4 Stars 5 Stars	Building operation & maintenance Conservation & efficient utilization of resources Energy Health & well-being Waste management Water
DGNB	2008	Germany	78	New building - office	Bronze Silver Gold	Ecology Economy Location Processes Social-cultural & functional Techniques

3.9 Selecting a Building Rating System

As discussed within this guide, there are many green building rating systems. This can make selecting the most appropriate rating system quite challenging. To make the decision about which one to use, some basic questions to ask include:

- Why should the building be certified?
- Does the government have any requirements?
- Has the organization that owns or manages the building mandated the use of a specific rating system?
- Are there any minimum requirements that could not be met?

Answering these questions will help to narrow the choices. Ultimately, it is likely that there will be two or three choices that will require some further analysis.

A good starting point when selecting a rating system is to perform a sustainability audit. The audit should be designed to look at the current sustainable practices at the facility, which in turn will identify opportunities for improvement. The audit should include five main categories:

- Site
- Water efficiency
- Energy efficiency
- What's coming in and out of the building?
- Indoor environment

It will be necessary to look at management and operational practices in place, with an emphasis on each of the five categories. Regardless if it is completed internally or by a third party, the first step of the audit is to have the auditor interview staff or service providers who have knowledge of each category. If the certification system choices have been narrowed to one or two rating systems, the rating system checklists and/or guidelines can be used as a guide to determine interview questions.

Following the audit, a side-by-side comparison of costs, improvements needed, and major advantages and disadvantages of the rating system can be reviewed for each credit the building could earn. The key question to ask during this process is: what drives the organization to seek a green building certification? If saving money is the motivation, it will be necessary to focus on costs and projected savings. If the motivation is environmental stewardship, the focus may be more on the environmental benefit and cost may be secondary, although often not very far behind.

Once the rating system has been selected, what is next? The first step is to establish a certification goal:

- What certification level do you want to achieve?
- Is the minimum level sufficient? Or are there requirements – government or organizational – to pursue a higher level of certification?

After the goal has been established, the sustainability audit results should be used to develop a certification plan. First, look at projects and/or initiatives that may grant points or credits toward the certification. (Note: The word credits will be used for the remainder of this discussion to mean points or credits.) Determine whether or not the credits are high, medium or low feasibility. The best scenario is to choose those that not only are considered high feasibility, but also no cost or low cost. If these projects and/or initiatives are not sufficient to reach the goal, then proceed to those that are considered medium feasibility.

More often than not, those medium- to low-feasibility projects or initiatives require a lot of time and financial investment and are often classified as capital improvement projects. Rather than dismissing these items altogether, consider incorporating them into long-term planning by making capital improvement decisions that will allow operation improvement from both an efficiency and sustainability standpoint. For example, if replacing the current chiller is not economically feasible at this time, make a conscious decision to replace it at the end of its useful life with a more sustainable and efficient option. This will not only help to plan the capital budget for the future, but will also help add sustainable operating procedures to the long-term plan for a future date when recertification of the building is considered.

What's coming in and out of the building? Procurement and waste management practices help achieve goals of reuse, reduce and recycle to minimize the amount of waste placed in landfills.

To help prioritize the initiatives and finalize the certification plan, make use of the triple bottom line. For more information about the triple bottom line, see the IFMA Foundation Sustainability How-To Guide: Getting Started (Hodges 2009). This can serve as a compass when aligning project goals with the organization's mission.

Using the triple bottom line approach is a good way to graphically evaluate available options. For example, Figure 12 lists adding more windows to increase the amount of daylight brought into the building but has two negatives associated with it, one of which is a high cost. Therefore, this initiative may move to the bottom of the list, unless there is a strong internal argument to increase the amount of daylight provided to the building occupants. Performing retro-commissioning in a facility to identify energy saving measures appears to be an overall good initiative to include based on the triple bottom line analysis because it has a positive environmental impact, economic impact and social impact. Although retro-commissioning is given a positive economic impact based on a quick payback period, it can have a high up-front cost. The purpose of the triple bottom line analysis is to help prioritize initiatives and pursue those that will both meet the certification goals and align with the motivation of the organization.

After enough points to meet the goal have been identified, it is time to start implementation. The implementation stage of the certification process includes putting any necessary policies in place, performing testing, making repairs, making capital improvements and/or implementing any project that was identified during the sustainability audit necessary to achieve the goal. During implementation, it is important to keep documentation requirements in mind so that proper documentation can be submitted for achievement of the credit. This implementation stage must generally be completed by the end of construction for new buildings or prior to the beginning of a performance period

Initiative	Intent	Environmental Benefit	Economic Benefit	Social Benefit
Reflective Roof	↓ Heat Island Effect	+/-	+/-	+/-
Low H_2O Fixtures	↓ Water Use	+	+	+/-
Retro-commissioning	↓ Energy Use	+	+	+
Reduced Mercury	↓ Hazardous Waste	+	-	+/-
Lighting Retrotfit	↓ Energy Use	+	+	+/-
More Windows	↑ Daylighting	-	-	+
Education	↑ Knowledge	+	+/-	+

Figure 12: Sample triple bottom line analysis

(reporting period), which is selected by the team based on estimated date of completion and the goal date to achieve certification.

Once the implementation period is complete, the next task is to gather data and documentation. The goal is to document that the sustainability plan has met (and hopefully exceeded) the targets to achieve the certification level desired. It is important to monitor and report progress throughout the project to determine if the right information is being collected and to track the progress of the credits being pursued. If the project has gotten off track, make adjustments as necessary. This process is known as the cycle of continuous improvement (Figure 13) and is based on Deming and Shewhart's philosophy of total quality management (TQM). By using TQM through the continued monitoring and reporting phases, it will be possible to avoid any surprises at the end of the project that did not meet a credit or point requirement. Missing out on one credit or point could mean a different certification level than desired or no certification at all.

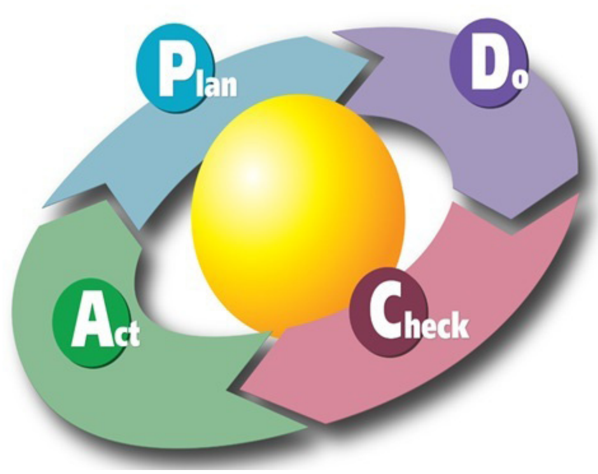

Figure 13: Cycle of continious improvement (Bulsuk 2009)

Achieving the goal will require hard work and buy-in from those involved, both at the senior level and at the building occupant level. A central team that is vested in the process and enthusiastic will help achieve success. Reporting progress to the team and major stakeholders is a way to maintain the motivation and interest of those involved as they see that their work is paying off and their money is being well invested. Holding regular meetings to determine status and identify needs will ensure that both the team and the project stay on track.

From the start, each person should be clear on their responsibilities, the requirements to achieve the credit and what documentation may be needed to substantiate compliance with the requirements. Align key team member skills with certification prerequisites and/or credits. Ideally, a sustainability champion should coordinate the entire process to make sure everyone remains on track, that all the pieces are in place, and proper documentation will be submitted to help reach the goal. The champion must be ready and willing to lead, influence and motivate the team, and be ready to assess, and at times, reassign action items to maintain momentum. To maintain momentum:

- Have regular celebration sessions to acknowledge and recognize the achievements of the team
- Share the value of certifying the building, such as marketing opportunities
- Validate sound operational procedures and demonstrate effective facility management practices

For a better chance of achieving the goal, often a desired rating, aim higher than the number of credits needed to allow for some items to "drop off." There is always the possibility that one or more credits may not be achieved. This can happen for many reasons, such as misinterpretation of the requirements, limited cooperation from occupants to achieve goals (such as commuter trip reductions) or a particularly hotter summer and/or colder winter that did not yield anticipated energy savings. Some of these things may be beyond the control of the team. Therefore, it may be necessary to be prepared to move on and have some "backup" credits (or points) in mind for consideration.

Upon achieving certification, celebrate, market the success and recognize those that helped along the way. This initial certification is only the beginning. The team will need to continue performing and monitoring past certification, especially if the goal includes continuing to improve, achieving operational excellence and recertification in the future. From an operational perspective, certification is just the first step. Truly having a sustainable building means not only certification, but transforming the way a facility is operated.

As the way a building is operated is transformed, the goal should be continued improvement, rather than stagnating. After all, operational excellence should always be a point further than where one is standing right now. Continued improvement in operations not only positions the building to achieve a better certification level, should the team choose to recertify in the future, but it will also decrease operating costs. Improvements may be measured through energy savings, water savings and decreased costs in waste hauling through recycling and waste diversion. In some cases, items that are recycled, donated or salvaged may yield a financial gain through tax breaks or payments received for the items diverted. In one case study, the money collected from recycling efforts was used to help fund the annual company picnic. Imagine the incentive that this provided to get more occupant buy-in for the recycling program if the occupants are the direct recipients of the "profits" reaped.

4 MAKING THE BUSINESS CASE

So far, this guide has described different rating systems and outlined how to determine which rating system to use. However, to pursue building certification, it can be of value to determine if certification makes good business sense. This section uses a case study of the National Education Association (NEA) to demonstrate how to make the business case for building certification and achieve a LEED-EB rating.

4.1 Steps to Making the Business Case

Building the business case can be summarized in the following steps:

- Determine the cost of certification
- Estimate potential cost savings
- Estimate the value of certification
- Determine environmental benefits
- Summarize the findings

4.1.1 Determine the Cost of Certification

Use the sustainability audit performed to determine the level of certification desired and what the total certification costs will be. The total cost can be used to determine what the budget needs to be or to perhaps decrease the certification goals to meet the budget. For example, the National Education Association (NEA) worked on their certification in a phased approach over three years, starting with a sustainability audit to determine how close they were to their goal of LEED for Existing Buildings Gold Certification and how much it would cost to achieve the goal. The estimated costs of achieving the certification are provided in Table 5.

Estimating the cost of certification for all intended projects, for all areas of certification, helps provide a clear picture of the expected cost savings.

Table 5: NEA cost estimate (US dollars) for LEED-EB Gold Certification after completion of a sustainability audit

Category	Estimated costs (US dollars)
Sustainable sites	$8,000
Water efficiency	$23,000
Energy & atmosphere	$24,000
Materials & resources	$12,000
Indoor environmental quality	$30,000
Certification fees	$12,000
Consulting costs	$64,000
Total	$173,000

NEA Project Summary

Goal:

Achieved LEED Gold under the LEED for Existing Buildings Operations & Maintenance 2008 rating system

Building Facts:

Building constructed in 1936
Major renovation in 1991

394,087 square foot (36,610 square meters) building

72,000 square foot (66,888 square meters) garage

3,500 square foot (325 square meters) data center

Hours to Complete Certification Process:

2,080 NEA team hours

500 consultant team hours

4.1.2 Estimate Potential Cost Savings

Examine the projects that should be implemented to reach the certification goal and determine what the cost savings will be as a result of implementing those projects. Within most rating systems, it is necessary to meet a minimum energy performance requirement. Additional credits are often given the better the facility performs. To increase energy efficiency, determine what projects must be implemented, and evaluate what the potential energy savings and resulting cost savings will be for each project. These tasks are part of a typical energy audit conducted by a third party. Use data in existing computerized maintenance management systems (CMMS) databases, such as maintenance plans, preventive maintenance frequencies or building operating plans, to identify potential cost savings. Some examples include discovering higher than recommended air handler outdoor air volumes in air balance or retro-commissioning reports that could result in energy savings, maintenance labor savings and reductions in equipment wear, extending the equipment life cycle.

NEA implemented the following:

- Optimized HVAC controls
- Ensured air handling units utilize economizer mode
- Eliminated use of steam humidifiers
- Rebuilt and/or replaced steam traps
- Purchased ENERGY STAR equipment
- Installed variable frequency drives on cooling tower fans
- Installed motion sensors in restrooms

Implementation results:

- Spent $16,800 (US dollars) on energy audit
- Spent $33,645 (US dollars) on energy conservation measures
- Average annual savings of $120,000 (US dollars)
- Total savings from 2007 to 2009 from energy audit recommendations of $365,000 (US dollars), using a constant, 2007 energy cost over 2008 and 2009 (US dollars)
- Carbon dioxide emissions reduction of 18 percent
- Payback of 0.7 years
- Average annual savings of 22 percent

4.1.3 Estimate the Value of Certification

This is by far the hardest step to accomplish and it may not be able to be determined quantitatively. Savings from energy and water reductions can be estimated using engineering calculations or savings estimators. Savings related to purchasing and waste diversion can also be calculated. However, how can other benefits, such as increased property value or greater longevity of tenants, be evaluated?

According to the U.S. Green Building Council's case study on the Joe Serna Jr. California EPA headquarters, which achieved LEED Platinum, the property realized a $12 million (US dollar) increase in asset value after receiving the certification. Thus, there is value to third-party recognition of sustainability efforts. However, this value is yet to be defined on a global level. Currently, the value or perceived value is highly dependent upon the organization, the type of services provided and location.

For the National Education Association example, building certification was an important part of their strategy to lead by example for their members. With the growing awareness of sustainable facility management, NEA observed the growing popularity and value of building certification as a milestone to demonstrate commitment to sustainability in their facility. As a result, the goal of NEA's sustainability facility management plan, which started with energy savings, evolved and targeted building certification as validation of their efforts.

4.1.4 Determine the Environmental Benefits

As the business case is developed, the case for environmental efforts must be included. Although not always financially beneficial, many sustainability efforts have enormous impact on the conservation of natural resources. Use the information collected through the sustainability audit to translate items, such as energy savings, water savings and others, into a direct correlation to natural resource conservation. By using various tools, such as the United States Environmental Protection Agency ENERGY STAR Portfolio Manager, it is possible to calculate what energy savings means relative to a building's carbon footprint. In NEA's case, energy savings translated to an 18 percent carbon dioxide emissions reduction. If an organization is motivated heavily by carbon footprint reduction, this is a way to enhance the case for sustainability or certification.

Portfolio Manager is an online tool that can help to determine the effect of decreased energy consumption. Portfolio Manager has features that can be used to set energy performance goals and estimate how much energy would need to be saved to meet the goals. It will also calculate the reduction in greenhouse gas emissions from the energy savings. Please refer to the IFMA Foundation's How-To Guide on ENERGY STAR Portfolio Manager for more information: www.ifmafoundation.org/programs/sustain_wp.cfm.

In the NEA example, the energy audit identified energy conservation projects, estimated the cost of each recommendation and estimated the projected energy savings from the recommendations.

4.1.5 Summarize the Findings

After completing the steps described above, a defendable case for certification or the "ABC" (all but certified) sustainability plan will be framed. The resulting business case will include the costs of the plan, the projected financial savings, the certification value and the environmental benefits. Ideally, implementing the business case will result in economic savings, even when using a third-party certification system.

In a white paper by the Leonardo Academy Inc. (Leonardo Academy 2008) it was stated that the operating costs of LEED-EB buildings are typically less than the BOMA average (BOMA 2007) and range from $4.94 to $15.59 (US dollars) per square foot (SF) of floor space ($53 to $168/m^2), with an average of $6.68/SF ($73/m^2) and a median of $6.07/SF ($65/m^2).

In the NEA example, careful planning and a practical approach to LEED certification resulted in coming out ahead (Table 6). The NEA LEED-EB certification project spent approximately $163,000 (US dollars) (estimated cost of completion was US $173,000) and saved $373,000 (US dollars), resulting in an overall savings of $210,000 (US dollars). Additionally, the implementation costs were one-time costs, while the savings will continue for years to come.

Table 6: NEA certification costs

National Education Association LEED - EB Costs Summary (US dollars)	
Total soft costs	$75,153
Total hard costs	$87,462
Total costs	$162,615
Estimated savings	$373,000
Difference	$210,385

Although tangible cost savings are the key to selling the sustainability plan, do not forget to consider the benefits such an achievement will provide the organization, such as establishing and promoting pride and confidence, as well as recognition from customers and peers. Ultimately, the choice to certify a building is up to each organization. By building a defendable business case in the beginning, and making smart, practical choices along the way, an organization can be well on its way to a successful sustainability plan.

5 CASE STUDIES

Many buildings around the world have achieved the certifications discussed within this guide. This section contains a few examples, including a(n):

- Office building that achieved an Excellence Environmental Assessment BREEAM rating
- Academic building that achieved an Excellence Environmental Assessment BREEAM rating
- Class A office tower that achieved a LEED-EB Silver certification
- Two office towers that achieved a LEED-EB Silver certification
- Class A multitenant office building with retail space that achieved a LEED-EB Gold certification
- Office relocation project that achieved a LEED-CI Gold certification
- Academic building that achieved a Green Globes rating of Two Globes
- Research and development facility that achieved a Green Globes rating of Two Globes

All of the case studies were initially printed in other formats. The content below has been reformatted and is used here by permission.

5.1 Barclays Global Headquarters, London, UK: BREEAM

The Barclays global headquarters in London, United Kingdom, received a BREEAM Excellent Environmental Assessment rating in 2002. The 1,000,000 square foot (92,900 m^2) building, has many sustainable attributes, including energy-efficiency features, utilizes daylighting and green materials, has a green roof, and recycled construction waste during construction. In 2004, the building received the National Green Champion for Environmental Best Practices award (Figure 14).

The Barclays headquarters moved its location to a BREEAM certified building to provide a better working environment for employees, to improve operational efficiency and achieve improved environmental performance. Some of the sustainable features are highlighted below.

Figure 14: Exterior of Barclays global headquarters

5.1.1 Sustainable Site Features

The most notable sustainable site feature is the reduction of environmental impacts from transportation. Specifically, the building has direct access to the underground transit system. In addition, 12 offices were consolidated into one headquarters building. This has reduced the number of deliveries per week from 115 to seven – resulting in a significant carbon dioxide emissions reduction.

5.1.2 Energy Efficiency

The building has five atria stacked vertically to maximize the use of daylight and provide a thermal buffer on the south face (Figure 15). The design target was a reduction in energy use and carbon dioxide emissions by 15 percent per square foot (160 percent per m^2) in the first full year. Additionally, the building has:

- A heat recovery system that recycles waste heat
- Lighting controls that are integrated with daylight sensors to turn off electric lighting when

there is enough daylight present
- Motion detectors that turn off lights in unused rooms

Figure 15: Atria of Barclays global headquarters

5.1.3 Water

A green roof on the top of the building helps reduce storm water runoff by capturing rainwater on the roof and releasing it slowly back into the atmosphere. The roof also encourages bio-diverse wildlife.

5.1.4 Materials

Sustainable practices were used during the construction process, and continued with furniture selection and waste management once the building was in operation. During construction:
- All timber in the building is from sustainable sources
- No tropical hardwoods were installed in the building
- Construction waste was sorted into timber, metal, packaging, concrete and hazardous materials. As a result, about 80 percent of construction waste was recycled.

To further reduce waste, furniture from the previous office spaces was reused in the new space or recycled. There is also an ongoing waste management program that requires staff to sort their own waste paper. The bank's caterers are expected to recycle at least 75 percent of plastic cups and aluminum tins.

5.2 Ellis and Kennedy Building, Manchester, UK: BREEAM

The Ellis and Kennedy building at Loreto Sixth Form College in Manchester achieved a BREEAM Excellent rating (Figure 16). The building received the majority of its funding from the Learning Skills Council (LSC). A condition of the funding was to achieve a minimum BREEAM Very Good; however, the building achieved an Excellent.

Figure 16: Exterior rendering of Ellis and Kennedy building

The Ellis and Kennedy building includes classrooms, a learning resource center, information and communication technology facilities, and a library. The building was built on a brownfield site to the south of the College estate. It is in the curtilage of a Grade II listed chapel and is bordered by a busy city arterial route.

Ellis and Kennedy Building
- **BREEAM rating: Excellent**
- **Score: 74%**
- **Size: 70,860 SF (6,583 m^2)**
- **Stage: Post-construction**
- **BREEAM version: BREEAM Schools 2006**

Features of the Ellis and Kennedy building include:
- Use of renewable and low carbon technologies, such as ground source heat pumps and photovoltaic (PV) panels
- High-efficiency chiller plant with waste heat reclamation and evacuated solar tubes
- A comfortable working environment with predominantly naturally ventilated spaces, local

controls for heating and lighting, solar control glass and high acoustic targets
- An extensive green roof with native species to reduce the ecological impact of the development
- Rainwater harvesting
- Materials with low environmental impacts

5.2.1 The BREEAM Assessment

The design achieved a high percentage in all areas of the BREEAM assessment, scoring particularly well in the management, health and well-being, water, and land use and ecology sections.

There was also a high commitment in the energy section, achieving a 22 percent reduction in carbon dioxide emissions against Building Regulations L2A 2006, with 28.6 percent of total energy use derived from sustainable technologies.

5.2.2 Green Strategy

The goal of the project was to deliver a state of the art teaching facility that would promote sustainable design to the college and its wider community. The design team and client took ownership at an early stage of the need to protect the environment and provide a sustainable building:
- Targets for reducing carbon dioxide in the building and use of renewable and low carbon technologies were set and exceeded
- Specialist ecological support was provided to reduce the ecological impact of the building, leading to the introduction of a green roof
- Materials were assessed and compared to ensure the lowest possible environmental impacts

Communication with the contractor about how to reduce impacts to the site was also important to the project because of the tight working space available and the potential effects on the existing college. Site impacts were reduced by adopting good work practices, reading and monitoring water and energy consumption, managing waste, and ensuring sustainable materials were used for all temporary work.

5.2.3 Building Services

Heating is provided by a mixture of ground source heat pumps, evacuated tube solar collectors and high-efficiency condensing boilers. Cooling is provided by ground source heat pumps and a high-efficiency evaporator chiller. Waste heat from the chiller is reclaimed to provide hot water for the building. A proportion of electrical demands are met by a 2,900 square foot (270m^2) vertical photovoltaic (PV) cell array providing about 24,300 kWh/year of electricity to the building.

All of the sustainable elements combined will reduce carbon dioxide emissions by 43.3 lb/SF/year (8.94 kg/m^2/year). The on-site renewable energy sources (173,677 kWh/year) are estimated to save 204 kWh/SF/year (18.94 kWh/m^2/year) of electricity and 1,000 kWh/SF/year (92.93 kWh/m^2/year) of natural gas. Additionally, the rainwater harvesting system is estimated to save 3,200 gallons (12,100 liters) of water per year.

> **"The key to achieving the BREEAM Excellent on this project was the commitment to sustainability by the design team at an early stage and throughout the design process. The fact that they were open to new ideas made this an interesting and successful project to work on." Sheila Mackenzie, Principal BREEAM Consultant at WYG Engineering**

5.3 Ameriprise Financial Center, Minneapolis, Minn.: LEED-EB

Ameriprise Financial Center is a 900,000 square foot (84,000 m^2), 30-story Class A office tower (Figure 17) located in the central business district of Minneapolis, Minn. Constructed in 1999, the building serves as the headquarters facility for Ameriprise Financial. To achieve LEED certification, the property management team worked in partnership with in-house staff to improve the property's environmental sustainability. The project team's initial goal was LEED-EB Certified. The project team was able to document 41 points to earn LEED-EB Silver certification. The award made Ameriprise Financial Center the first LEED-EB building in downtown Minneapolis, the fourth LEED-EB building in Minnesota and Ameriprise Financial's first LEED-EB certified building.

Ameriprise Financial Center was designed and constructed to conserve energy, water and other nonrenewable energy sources. Although many of the building's features, practices and standards already met or exceeded LEED-EB guidelines, Ameriprise Financial made additional commitments to further enhance energy reductions.

Sub-meters were installed to provide a more

Figure 17: Exterior of Ameriprise Financial Center

granular view of energy and water usage and all overhead lighting was replaced with T8 25 watt fluorescent lamps. Other investments included regular upgrades to the building automation system, the addition of variable frequency drives to domestic and heating water pumps, and expanded in-house conservation programs.

The engineering staff also adhere to a continuous commissioning program, which has been in place since the facility opened. This program helps identify supplemental operating efficiencies and has been extremely successful. Lighting schedules, HVAC start-up sequencing, chiller staging and automation controls are constantly evaluated for potential savings.

Ameriprise Financial Center

- **Awarded LEED-EB Silver certification in 2009**
- **First LEED-EB certified building in Minneapolis**
- **Single-tenant facility**
- **ENERGY STAR labeled in 2006, 2007, 2008 and 2009**

5.4 Seaport East and West, Boston, Mass.: LEED-EBOM

Constructed in 2000 and 2002, the Seaport East and West office towers consist of a 17-story tower and 16-story tower located in the historic Seaport District in South Boston (Figure 18). With a focus on increasing operating efficiency, reducing utility consumption and achieving LEED for Existing Buildings: Operations and Maintenance certification, the property manager explored all aspects of the LEED-EBOM rating system relating to the environmental impact of operations, maintenance, construction, and the health and welfare of building occupants.

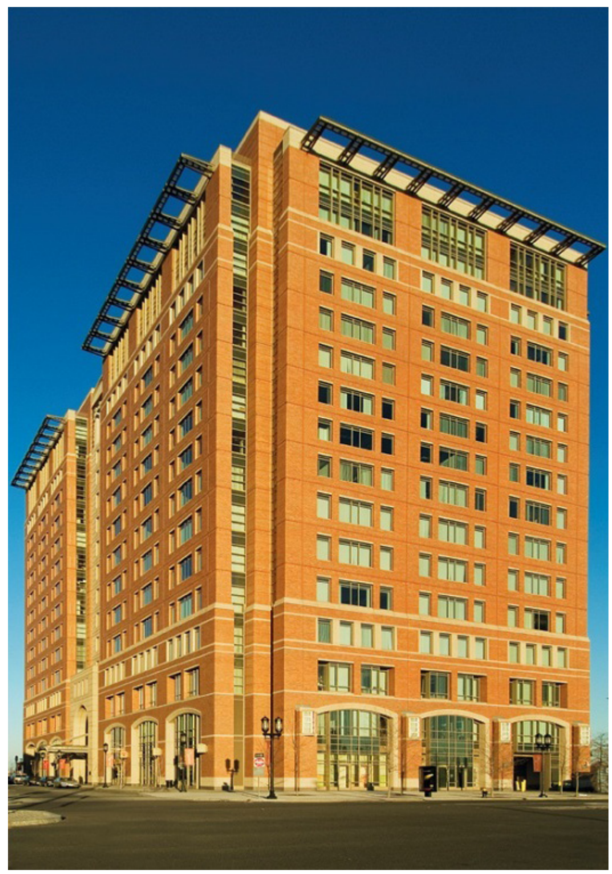

Figure 18: Exterior of Seaport East and West

To reduce base building utility consumption and lower the buildings' operating expenses, the management team implemented buildingwide energy audits. As a result, a lighting retrofit was performed in the common areas, main air handlers were rebalanced, and a package air handling unit tuneup agreement was implemented to conduct semiannual HVAC unit tuneups. To address water conservation, dual-flush handles were installed on toilets in all restrooms. The property management team also began a single stream recycling program to make it easier for tenants to participate in recycling, expanded recycling efforts to include lamps, batteries and electronics, and added a new cardboard bailer to reduce the number of dumpster pulls. To increase awareness, a presentation was made to tenants detailing the recycling program and its benefits. Green cleaning was implemented throughout the property, and a green purchasing program, which includes coreless toilet tissue, has provided costs savings.

Seaport East and West will achieve a projected $130,000 (US dollars) in annual savings with an expected payback period of approximately 2.4 years. The property's sustainability programs have saved 420,000 kilowatt hours of energy, 170 tons of carbon dioxide emissions and 1.4 million gallons (5.3 million liters) of potable water. Additionally, 277 tons (250 tonnes) of waste was diverted from landfills.

Seaport East earned the ENERGY STAR with a score of 76 and, as a result of the project team's sustainability efforts, both buildings achieved LEED Silver certification in 2009.

Seaport East and West

- **1,076,839 square feet (100,038 m^2)**
- **Achieved LEED Silver certification in 2009**
- **ENERGY STAR labeled**
- **Projected $130,000 (US dollars) in annual savings**

5.5 500 North Brand, Glendale, Calif.: LEED-EBOM

Situated in Glendale, California's central business district, 500 North Brand is a multitenant office building offering 419,760 square feet (38,996 m^2) of Class A commercial office and retail space (Figure 19). In 2009, the property manager was engaged to pursue LEED for Existing Buildings: Operations and Maintenance certification. Together, property management LEED certification and project management teams created a strategy to address high-flow water fixtures, reduce energy consumption and work with tenants to achieve a LEED-EBOM certification.

Based on the initial analysis of the building, several design elements and operational practices were modified in preparation for the LEED performance

Figure 19: Exterior of 500 North Brand

period. Initially, 500 North Brand did not meet the minimum water efficiency requirements for LEED-EBOM. A systematic analysis of occupancy, equipment and usage patterns was completed, and the majority of the restroom fixtures were replaced or retrofitted with reduced consumption flush valves and other restrictors. New submeters were also installed on the irrigation system and the electrical switchgear to quantify usage and savings opportunities. In addition, green cleaning practices were established and formalized in written policies and plans.

Changes were also made to comply with LEED-EBOM's solid waste management requirements. The real estate management team selected a new recycling vendor, expanded the materials accepted for recycling and conducted a comprehensive waste audit for the first time.

The building earned LEED-EBOM Gold certification in 2010. The property's energy performance is in the top 8 percent of all comparable buildings. Restroom fixtures upgrades will also save 2.1 million gallons (7.9 million liters) of potable water per year, achieving $7,500 (US dollars) in savings and a 59 percent reduction from 2008. A rising ENERGY STAR score, significantly reduced water consumption and improved sustainability communications to building occupants are just a few of the long-lasting impacts this project will have on the environment, the building and its occupants.

500 North Brand

- **LEED-EBOM Gold certification in 2010**
- **ENERGY STAR score of 92**
- **ENERGY STAR label in 2006, 2007, 2008 and 2009**
- **Carbon footprint 42 percent lower than comparable buildings**
- **2.1 million gallons (7.9 million liters) of water saved annually**

5.6 HOK Office Relocation, Chicago, Ill.: LEED-CI

In January 2009, HOK completed the relocation of its Chicago, Ill. office. The 27,000 gross square foot (2,510 m^2) office space was designed to reflect sustainable values and innovation from the early stages of the project (Figure 20). A LEED-CI Platinum rating was achieved with a 5.6 percent cost premium, which is not a significant cost premium.

Figure 20: HOK reception area

Careful cost models were kept throughout the project to track LEED cost premiums associated with design and construction. All levels of LEED were considered within the case study. The design and construction teams found that for this project, LEED Certified, Silver and Gold levels could be obtained with a premium only for commissioning services (typically 0.5 to 1 percent of project costs).

HOK Cost Premium

Cost: $2,600,000 (US dollars)

$96/SF ($1,033/m^2) (US dollars)

Cost Premium for LEED-CI Gold: 0.7% (commissioning)

Cost Premium for LEED-CI Platinum: 5.6%

HOK

- **Water use reduction: 34%**
- **Construction waste recycled: 95%**
- **Reduction in lighting power density: 42%**
- **ENERGY STAR rated power: 94%**
- **Green power: 100%**
- **Reused materials: 9%**
- **Renewable materials: 2%**

5.7 Walter Cronkite School of Journalism, Phoenix, Ariz.: Green Globes New Construction

The Arizona State University (ASU) Walter Cronkite School of Journalism is a 235,700 square foot (21,897 m^2) academic facility (Figure 21) located in downtown Phoenix, Ariz. The ground floor contains retail space while the upper floors house classrooms and offices. A working TV station and a daily newspaper are also located in the building. The sixth floor consists of a newsroom, production space and control rooms. The building was designed to symbolize the role of journalism in today's society. The exterior is constructed of glass and masonry. The upper multicolored metal panels are intended to signify radio spectrums. Sunscreens on the façade of the building help reduce heat loads, and a prefabricated lightweight steel structure at the top of the building was designed to allow for long structural spans and high ceilings needed in TV studios.

The school is a public building with an immense interior atrium, and its interior walls are emblazoned with the iconic words of the First Amendment. This $55 million (US dollars) building is proof that a landmark project can greatly improve and beautify a run-down city area, blend in with

Figure 21: Exterior of Walter Cronkite School of Journalism

the existing landscape and at the same time be environmentally friendly.

When the Cronkite School received independent status in 2004, plans were made to build a new campus in an industrial area of downtown Phoenix. Construction on the new facility began in early 2007 and was completed by mid-2008. The tenants moved into the state-of-the-art facility in August 2008 and officially dedicated the new building on the Cronkite School's 25-year anniversary in November 2008.

The project team chose Green Globes for New Construction to rate and certify the sustainable attributes of the building. The team chose Green Globes because it is nationally recognized and has a user-friendly approach to environmental assessment. The following subsections describe how the building achieved points in each Green Globes section. The overall official Green Globes score was 69 percent, earning a rating of two Green Globes.

5.7.1 Project Management

The Walter Cronkite School of Journalism achieved a score of 90 percent in project management. Highlights include a robust integrated design process that was used throughout the entire project, an early commitment to environmental purchasing and a thorough commissioning plan.

A team approach was used throughout the various stages of the design and construction process, as the architects, engineers, consultants, prime contractor, owner and other stakeholders worked collaboratively to ensure the environmental goals of the project were agreed upon and ultimately implemented.

5.7.2 Site

The building was awarded a score of 71 percent in the site section. The school is constructed on an existing serviced and brownfield site that was remediated as part of the project. The development density exceeds 60,000 ft^2/acre (14,000 m^2/ha) on land that is neither a wetland nor a wildlife corridor. The design accommodates the function of the building while minimizing disturbance to topography, soils and vegetation. The project incorporated a naturalized landscape using native trees, shrubs and ground cover with minimal lawn.

5.7.3 Energy

The building was awarded a score of 62 percent in the energy section. Additionally, the design energy performance is projected to be 16 percent more energy efficient than a building with similar attributes, according to the ENERGY STAR program, with an estimated annual energy use of 28,945,568 kBTU (3.0×10^{10} kJ) (122.8 kBTU/GSF/year, 1.4×10^6 kJ/m^2/year). Additionally, carbon dioxide emissions savings compared to a benchmark building are estimated to be 601,852 pounds (273,000 kilograms).

The design of the building envelope contributed significantly to the energy performance estimates. The thermal resistance of the exterior enclosure meets building energy code levels and the thermal resistance (R) of the exterior wall is 13 while the roof is 30. Window glazing, with a low U value of 0.65, and window treatments to enhance interior thermal comfort were incorporated.

Energy-efficient equipment is utilized throughout the building, including energy-efficient lighting fixtures, lighting controls, lamps and ballasts; energy-efficient HVAC equipment; high-efficiency boilers; energy-efficient hot water service systems; a building automation system; variable speed drives; and energy-efficient motors.

5.7.4 Water

The building achieved a score of 84 percent in the water section and is designed to achieve the most stringent water consumption target of less than

720 gallons/student/year (2,700 liters).

Total water consumption is metered, and sub-meters are provided for high water-usage areas. The design includes the following water-efficient equipment: water-saving devices or proximity detectors on urinals, low flush toilets (less than 1.6 gallons [6 liters] per flush), water-saving fixtures on faucets (1.1 gallons per minute [4 L/min]) and showerheads (2.3 gallons per minute [9.0 L/min]), and other water-saving appliances. A water-efficient irrigation system was used in combination with the landscaping. Plants that are able to withstand extreme local weather conditions and require minimal irrigation were selected. The irrigation system uses non-potable water, and can be supplemented with potable water as needed.

5.7.5 Indoor Environment

The building achieved a score of 78 percent in the indoor environment section. Fresh air intakes are located more than 60 feet (18 meters) from major sources of pollution. Sufficient ventilation (0.24 CFM/SF [1.2 L/s/m^2]) is provided to obtain acceptable indoor air quality, in accordance with ANSI/ASHRAE 62.1-2004: Ventilation for Acceptable Indoor Air Quality, using the indoor air quality design procedure. The mechanical systems provide effective air exchange through the use of demand control ventilation. Demand control ventilation monitors carbon dioxide levels and adjusts ventilation rates accordingly. Additionally, enclosed parking areas are mechanically ventilated. Other features of the building that have a positive impact on the indoor environment include:

- Easy access to the air-handling units (AHUs) to facilitate their maintenance
- Janitor closets and large volume copy rooms are directly exhausted outside
- Selection of low volatile organic compound (VOC) materials, including carpet adhesives, interior caulking and sealants, paint and cabinet adhesives

Acoustical comfort was emphasized and spaces within the building are zoned so as to provide optimum protection from undesirable outside noise. The sound level transmission through the building envelope is minimized, and there are acoustic controls to meet the privacy requirements, including full height acoustically insulated walls, acoustical transfer boots for air transfer and low velocity duct distribution to acoustically sensitive areas. Additionally, all aluminum frame doors have acoustical seals around them.

5.7.6 Other Sustainable Features

In addition to the sustainable features highlighted above, the Walter Cronkite School of Journalism also includes:

- High albedo roof surfaces
- Integration of daylighting
- Located near a light rail station that connects its downtown university campus to the main campus in Tempe, Ariz.
- Preferred carpooling parking
- Building materials with recycled content
- Incorporation of durability, adaptability and disassembly in materials and structural systems
- Construction waste management plan
- Building space designed for recycling and waste management
- Ozone depleting refrigerants avoided
- Storage area properly designed for hazardous chemicals
- Solar shading for occupants to control brightness

5.8 Bristol-Myers Squibb Research and Development Facility, Wallingford, Conn.: Green Globes

Global pharmaceutical company Bristol-Myers Squibb (BMS) operates a 906,452 square foot (84,209 m^2) pharmaceutical research and development facility in Wallingford, Connecticut (Figure 22). The site covers 180 acres (73 hectare) and houses a state-of-the-art research laboratory, which was built in 1986. The multiwing, five-story complex is comprised almost equally of laboratory and office space, and is staffed by approximately 1,250 employees.

In 2007, after several years of sustainability improvements, BMS chose to evaluate the structure using Green Globes for Continual Improvement of Existing Buildings (Green Globes – CIEB), achieving a Green Globes score of 63 percent, two Green Globes (Figure 23). Highlights of the results are found in the following subsections.

5.8.1 Energy and Greenhouse Gas Emissions

Energy use ranked high on the BMS list of priorities. The Wallingford facility also participates in the U.S. EPA and Department of Energy Labs

Figure 22: Exterior of Bristol-Myers Squibb research and development facility

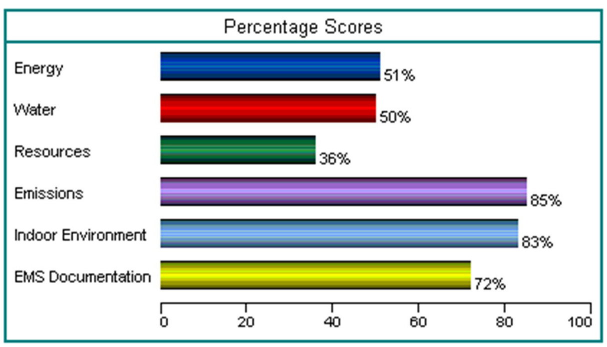

Figure 23: Percentage of points achieved by Bristol-Myers Squibb for each category

21 program for improving laboratory energy and water efficiency, encouraging the use of renewable energy sources and promoting environmental stewardship. As a result of the energy management practices implemented, the building achieved a Green Globes score of 85 percent for energy.

As with most research laboratories, the BMS building uses a significant amount of energy, including both electricity and steam. In addition to equipment and other needs, the level of indoor air quality must be extremely high, which necessitates an indoor air exchange rate of 10 or more times each hour.

Although the building does not yet meet the Labs 21 benchmark, it has a wide range of energy-efficient systems and features, including cogeneration, sensor-triggered lighting and use of sensors to control laboratory air exchange rates.

To optimize energy reliability and efficiency, BMS constructed a combined heat and power (CHP) cogeneration plant. The plant consists of a 4.8-megawatt combustion turbine that uses natural gas and a heat recovery system. According to BMS, the efficiency of the CHP system is approximately 72 percent, as compared to an estimated 32 percent efficiency for the entire US electric system. Comparing the use of electric and steam energy generated from the CHP plant to purchasing electricity from the local utility, it is estimated that greenhouse gases are reduced by about 20 percent, or roughly 6,600 tons (6,000 tonnes) per year.

To reduce the need for electric lighting, Bristol-Myers Squibb implemented a photocell lighting project in the high resolution natural ambient lit areas, which included a significant amount of common space and corridors. Self-contained ambient light sensors connected to the building automation system were installed in areas with window walls and skylights. The sensors adjust to a minimum 10-foot candle (108 lux) range. Electric lights are only commanded on if the lighting logic indicates that they are needed, as determined by the photocell and building schedule. This strategy has resulted in savings of about 80 percent.

To achieve both energy savings and reduced greenhouse gas emissions, air change rates were optimized by installing hoods with horizontal slashes, sash position sensors and infrared/ultrasonic dual technology room occupancy sensors. The control system was upgraded and optimized. Airflow is now driven by occupancy in the lab. This optimization approach provided active adjustment of hood face velocity from 100 feet per minute (FPM) (0.50 m/s) during occupied periods to 60 FPM (0.30 m/s) during daytime unoccupied mode and 40 FPM (0.20 m/s) during nighttime unoccupied mode.

In addition, an energy and greenhouse gas emissions policy was developed, and an energy audit was conducted. An energy management plan, addressing issues raised in the audit, is now in place.

5.8.2 Other Sustainable Features

Among its various sustainability achievements, the Wallingford facility has also been recognized for efforts related to water conservation, indoor air quality and minimizing the impact on wildlife habitat.

Water conservation features include low flow faucets, toilets and urinals, automatic valve controls and/or proximity detectors, and xeriscaping.

To date, the company's volunteer wildlife habitat team has developed two nature trails, installed birdhouses and monitored nesting activity, developed a butterfly garden, established a pond buffer zone and worked with local youth organizations that now use the area as an outdoor classroom.

5.9 Lasalle Investment Management, Salo Office Building in Anson Road, Singapore: Green Mark

Situated at the prominent corner of Anson Road and Gopeng Street on the southern side of the Island of Singapore, the Lasalle Investment Management Salo office building is a grade A office completed in 2009. It achieved the Singapore Green Mark Platinum Certification (Figure 24), the highest indicator of a sustainable building in Singapore. The site occupies an approximate area of 27,300 square feet (2,534 m^2) with a maximum given plot ratio of 9.24. The total gross floor area achieved is 252,100 square feet (23,418 m^2) with efficiency of 85 percent for single-tenant occupancy. The development includes a small retail space adjacent to the building's main entrance with parking for 50 cars, an open air podium roof garden that serves as an interactive space and efficiently designed air conditioned office space. Sustainable techniques have been introduced from the very outset and implemented rigorously throughout the entire design process.

Natural means of ventilation has been used to the full potential for areas such as the carpark floors, washrooms and staircases, which helps to further reduce energy consumption and operational costs over the life cycle of the building.

The generous 13.8 feet (4.2 m) floor-to-floor height with tapered ceilings at the perimeter allows daylight to enter the building, while the engineered glass facade with sensor-controlled lighting and energy-efficient mechanical and electrical systems work together to minimize operational costs, reduce energy consumption and maintain occupant comfort. External light shelves bring optimal, glare-free reflected daylight penetration deep into the floor plate, reducing the need for electrical

Figure 24: Exterior of Lasalle Investment Management

lighting and minimizing the buildup of solar gain throughout the day.

A graywater recycling and rainwater capture system have been incorporated into the building's plumbing systems to reduce potable water consumption. Additionally, efficient water fixtures have also been installed throughout the building.

Finally, the building has a centralized recyclable waste collection system at the ground level to encourage recycling where practicable.

5.10 Conclusion

As stated earlier, the purpose of this guide is to provide a comprehensive, yet concise summary of available building rating systems. The guide has been developed to serve as an easy reference and to help readers build a knowledge base about building rating systems. It was designed for those wanting background information and rating system attributes for the major systems currently used within industry and those seeking insight about how to achieve a green building certification. The case studies can be used as a resource and inspire ideas for future sustainable projects. The authors and contributors truly enjoyed creating this guide and wish you much success in future efforts focused around green rating systems.

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6.3 Appendix C: Glossary

Performance period: Continuous, unbroken time during which sustainable operations performance is being measured.

Secretariat: Officials or office entrusted with administrative duties, maintaining records and overseeing or performing secretarial duties.

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