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Sustainability How-to Guide Series

Green Building Rating Systems

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Foreword

Regardless of the size and scope of an organization, the shared responsibility of creating and implementing focused, well-defined sustainability strategies is the right thing to do for the environment, for the communities in which they are implemented and for the individuals who live and work there.

In recent years the focus on the triple bottom line of people, planet and profit has evolved from a fad of early adopters to the mainstream of standard business practices. Private entities are looking for competitive advantages in green markets while federal, state and local governments are increasingly applying regulatory constraints on design, construction and facility operations standards.

With this change has come renewed focus on finding people with necessary knowledge and skills. In fact, while technology continues to improve at staggering rates, it is the facility management (FM) professional who has the most critical part to play in choosing and operating that technology in the field.

Modern FM professionals around the world must be able to clearly communicate the benefits and positive economic impact of sustainability and energy-efficient practices to key stakeholders and decision makers. One way to accomplish this is to utilize rating systems, which are an optimal way to evaluate the performance of a facility. The rating systems reviewed in this document can provide a practical structure for FM professionals to achieve widespread and effective sustainability within their facilities by utilizing the system that best fits their circumstances.

This document is the result of a collaboration between the International Facility Management Association (IFMA) Environmental Stewardship and Sustainability Strategic Advisory Group and the IFMA Foundation working toward a shared goal of advancing sustainability knowledge on behalf of those responsible for its execution.

It is our hope that everyone who reads this report will join our efforts to advance sustainable practices. This resource is a good place to start. If you are interested in learning more, IFMAs fastest-growing professional credential — the Sustainability Facility Professional® (SFP®) — may be for you and your organization.

Tony Keane, CAE
President and CEO
International Facility Management Association

IFMA Environmental Stewardship and Sustainability Strategic Advisory Group

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The Environmental Stewardship and Sustainability Strategic Advisory Group (ESS SAG) serves as an advisory resource for the integration of the ESS core competency into the practice of facility management. The ESS SAG is responsible for the production of IFMA's Sustainability How-to Guide series.

II. Direction and Authority

The IFMA Board of Directors authorizes the ESS SAG, within the parameters of its role and responsibilities, to act in an advisory role to the board and the ESS community in the integration of ESS into the core competencies of the association.

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*as of June 2015

The general objectives of the How-to Guides series are:

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 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., websites, articles, glossary) where readers can go for additional information; and
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 for free online by IFMA and the IFMA Foundation.

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The IFMA Foundation originated the Sustainability How-to Guide series. The ESS SAG took over production of the guides in 2014.

Established in 1990 as a non-profit, 501(c)(3) corporation, and separate entity from IFMA (the International Facility Management Association), the IFMA Foundation works for the public good to promote priority research and educational opportunities for the advancement of facility management. The IFMA Foundation is supported by the generosity of the FM community including IFMA members, chapters, councils, corporate sponsors and private contributors who share the belief that education and research improve the FM profession. To learn more about the IFMA Foundation, visit www.ifmafoundation.org.

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1 Executive Summary

When the first sustainability How-to Guide was written, the objective was to explore the topic of green building rating systems and discuss their attributes, their utilization on a global basis and the benefits they bring to facility management. Most importantly, we wanted to provide the readers with:

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

We were very successful in that endeavor, as indicated by the fact that the original guide has been downloaded more than 500 times as of December 2014. When facility professionals are faced with the heavy decision regarding which system offers the right solution, it is important for them to have a reference guide at their fingertips.

The intent of the guide is to provide realistic data, including costs and benefits of the systems, that allows readers to make educated sustainability decisions. Each system has its own merits and the authors have tried not to influence readers or direct them 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. Rather, we 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:

- An update on how green building rating systems have evolved over the past more than 20 years
- Several case studies of buildings that have been certified under different certification systems

The most common reasons for undertaking the significant challenge of certification were to:

- Demonstrate corporate responsibility to stakeholders and the public
- Achieve cost savings in energy and water expenditures
- Provide evidence of building efficiency

Some of the modifications in processes or procedures remained the same as last reported, including:

- Lighting retrofit
- Adoption of green cleaning processes
- Smart irrigation
- Purchase of more sustainable products
- Heating, ventilating and air-conditioning (HVAC) upgrades

New additions included greater emphasis on retro-commissioning and HVAC upgrades. This change is evidence that the process of certification is expanding the possibilities for people to think about and integrate into their normal FM operations.

The top four systems — LEED, Green Globes, Green Star and BREEAM — remain the same. However, this guide gives visibility to several other very effective systems which could be considered by anyone seeking certification for their facilities.

Leadership in Energy and Environmental Design (LEED) (or a derivative thereof), is still the fastest-growing rating system within the industry. This is possible through localization within various countries and regions through the Green Building Council organizational design (e.g., the South Africa GBC, New Zealand GBC, Germany GBC, etc.). However, BREEAM still remains the leader in total buildings certified, exceeding LEED by almost 150,000 buildings (Ontario Ministry of Natural Resources 2013). Green Globes has experienced success, as well, with its unique system adopted by many satisfied customers, including the United States Department of Veterans Affairs. The Green Star rating system was developed by the Green Building Council of Australia as a national, voluntary appraisal tool that evaluates the environmental design and construction of buildings and communities. It continues to be a great contender and solution for many in the Southern Hemisphere.

To aid readers along the certification journey, this guide offers words of wisdom on how to select the right system for your organization. This includes information on utilizing the triple bottom line in your decision-making process. Last, but absolutely not least, we have highlighted successful case studies and useful information in aiding your ability to create your own business case. The case studies will educate and hopefully inspire you to reach for the ring of certification.

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

- Rating system with a formal certification program
- Excluded systems solely for one area of sustainability, such as just energy conservation (e.g., ENERGY STAR)
- The system must not be a modified version of another major system or directly translated from another certification system
- It must be a mature system and not in development or in pilot stages

Based on these criteria, our guide has added one more system during this update. Overall, the authors' findings were conclusive that the rating systems reviewed can provide a practical structure for you to achieve widespread and effective sustainability within your facilities by utilizing the system of your choice. The authors of this guide agree that the rigor of the system criteria give users a useful framework to structure a much-needed process to achieve more efficient and sustainable facilities.

Whatever system you choose, always remember that the spirit of conservation and preservation must underscore any strategy for sustainability. Rating systems are mere guidelines to assist us in simply 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 or ranking of or referendum on any particular system. This guide seeks to provide clarification of the basic aspects of the systems and share case studies that demonstrate successful implementation of the systems discussed. This guide is designed to serve as an informative source to help readers make sound decisions about the use of rating systems and what systems are available in your area, whether you are interested in pursuing building certification or merely looking for a framework for operational sustainability.

Many different certification systems exist. Fifteen have been identified worldwide based on the criteria outlined in the executive summary; four of these systems are the most widely accepted and utilized based on number of buildings certified. Part 3 – Detailed Findings begins with a discussion of the evolution of green rating systems. To complement our research, the author team conducted interviews, reviewed academic 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 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, including information on the criteria of each system, features and benefits of the most widely used rating systems, and certification costs and additional resources needed for achieving the certification, is located in the Detailed Findings section of this guide. A brief discussion of the evolution of green and sustainable rating systems is also provided.

Additionally, this guide offers tips to determine which system is right for the facility you manage or for which you provide service, 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 become 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 (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 research regarding the environmental needs of a country. Rating systems have evolved 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.

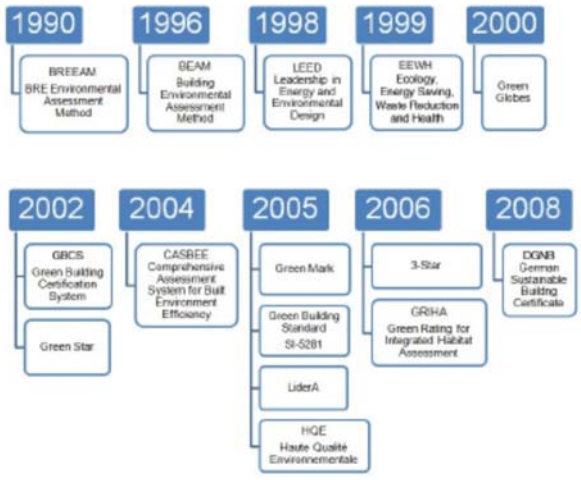


Figure 1: Rating systems timeline (source: www.irjes.com/Papers/vol3-issue5/H355364.pdf)

3.2 Most Widely Used Green Rating Systems

Now that the evolution of green rating systems has been introduced, sections 3.3 through 3.6 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 includes:

- Steps required for certification
- Scoring system
- Costs and considerations
- Composition of the rating system
- Countries where the systems are currently in use
- How the systems are perceived outside of their home country

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 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.

3.3 Building Research Establishment 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 reduction
- Energy and water management
- Recycled and responsible use of materials
- Effect of the building on ecology

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 already established their own versions of BREEAM are Spain and the Netherlands, and others are under development. 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 later in this section). Two geographical schemes, BREEAM Europe and BREEAM Gulf, are available for use by BREEAM international assessors.

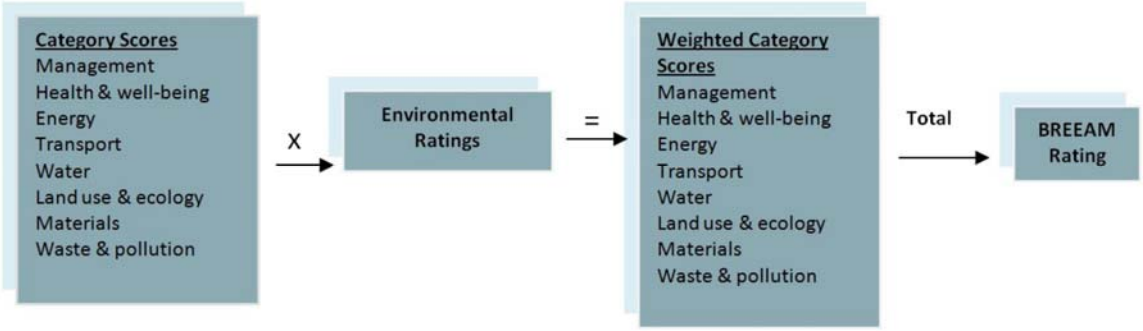


Table 1: Most widely used green rating systems

System	Year established	Country of origin	Buildings certified	Rating schemes	Certification levels	Categories
BREEAM	1990	United Kingdom	More than 250,000	▪ Communities ▪ Courts ▪ Education ▪ Health care ▪ Homes ▪ Industrial ▪ International ▪ Multi-residential ▪ Offices ▪ Prisons ▪ Retail ▪ Other	▪ Pass ▪ Good ▪ Very Good ▪ Excellent ▪ Outstanding	▪ Energy ▪ Health and well-being ▪ Land use and ecology ▪ Management ▪ Materials and water ▪ Pollution ▪ Transport ▪ Water
LEED	1998	United States	More than 103,000	▪ Building Design and Construction ▪ Interior Design and Construction ▪ Building Operations and Maintenance ▪ Neighborhood Development ▪ Homes	▪ Certified ▪ Silver ▪ Gold ▪ Platinum	▪ Awareness and education ▪ Energy and atmosphere ▪ Indoor environmental quality ▪ Innovation in design ▪ Location and linkages ▪ Materials and resources ▪ Regional priority ▪ Sustainable sites ▪ Water efficiency
Green Globes	2000	Canada	More than 3,300	▪ Existing buildings ▪ New construction	▪ 1 Globe ▪ 2 Globes ▪ 3 Globes ▪ 4 Globes	▪ Effluents and other impacts ▪ Emissions ▪ Energy ▪ Indoor environment ▪ Project management ▪ Resources ▪ Site ▪ Water
Green Star	2002	Australia	More than 800	▪ Design and as-built communities: performance, interiors ▪ Legacy rating tools: education, health care, industrial, multi-unit residential, office, office interiors, retail center and public building	▪ 4 Star ▪ 5 Star ▪ 6 Star for design and as-built communities and interiors ▪ 1-6 Star for performance	▪ Management ▪ Indoor environmental quality ▪ Energy ▪ Transport ▪ Water ▪ Materials ▪ Land use and ecology ▪ Emissions ▪ Innovation ▪ Governance ▪ Design ▪ Livability ▪ Economic prosperity ▪ Environment

For situations in which standards are incomplete or nonexistent, BREEAM has set certain standards that must be followed in order to achieve certification (BREEAM 2009). Internationally, the BREEAM system is perceived as being flexible to local regulations but strict for areas in which 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).

3.3.1 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 under which scheme the building should be assessed. 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:

- 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).

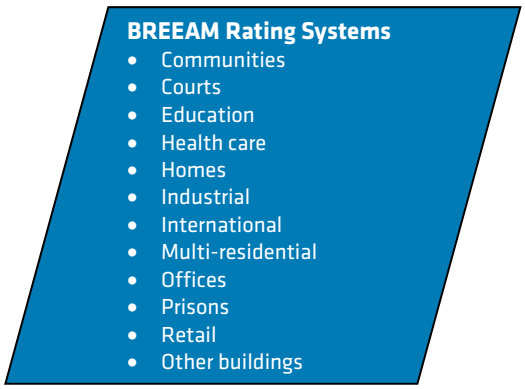


Figure 3: BREEAM rating system sectors

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 to determine the costs for schools to achieve a specific level of certification (Lockie, 2006). 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	50	£191 m^2 US$36,001 SF
Excellent	70+	£601 m^2 US$11,341 SF

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 at www.greenbooklive.com.

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 which will be forwarded to BRE for quality assurance prior to issuance of a design stage certification. 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.

3.4 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.

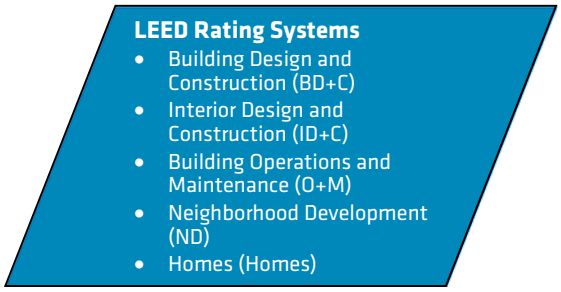


Figure 4: LEED rating systems

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 were originally certified under new construction and are seeking recertification.

Overall, certification processes for both new and existing buildings are nearly the same. The existing building certification process also requires a performance period of three months to two years during which performance data, such as energy and water usage, is collected. As of 2013, LEED launched LEED v4 which includes variations for data centers, warehouses and distribution centers, hospitality, existing schools and retail and mid-rise residential projects. LEED v4 allows the opportunity for LEED to fit the unique aspects of different projects.

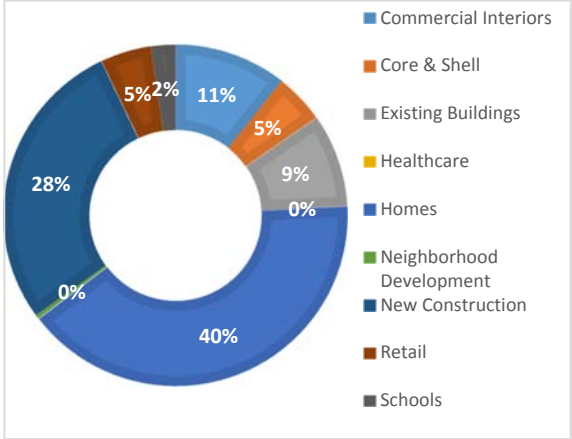


Figure 5: LEED-certified buildings as of December 2014

LEED includes nine different categories (Table 1). Category topics include (USGBC 2014):

- Effects of the building on the ecosystems
- Water and energy consumption
- Sustainable use and transportation of materials
- Indoor air and lighting quality
- Location of the building
- Utilization of technology innovation
- Regional issues and priorities
- Awareness and education
- Innovation and design

Outside of the United States, there are two options for using the LEED system. One is to adapt the LEED ratings 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 but not limited to Brazil, China, Canada, India, the Philippines 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 U.S. version of LEED. If this option is pursued, the building is subject to the codes and regulations of the United States and the USGBC, and 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 U.S. in which the building is located. 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).

3.4.1 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 and LEED Accredited Professionals (LEED AP). The LEED Green Associate designation is designed to be the first step in accreditation with GBCI and may be held by those with a nontechnical background, such as marketing professionals.

Since you are required to have worked on a LEED project prior to applying for the LEED AP, this accreditation is meant for those with a more technical background and who 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.

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

achieved in order to submit for certification. The checklist should be used at the beginning of the process to determine which credits are feasible for the building and what level of certification should be sought. Certification levels are:

- Certified (40-49 points)
- Silver (50-59 points)
- Gold (60-79 points)
- Platinum (80+ points)

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

3.5 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 (BOMA) of Canada under the title BOMA BESt. (BOMA Canada also has three other tools: Building Emergency Management, Building Intelligence and Fit-Up at www.greenglobes.com/default.asp.) All other Green Globes products in Canada are administered by ECD Jones Lang LaSalle.

Figure 6: Green Globes rating systems

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 U.K.

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 (G 81 2010). It should be noted that Green Globes was the first commercial building rating system based on an American National Standard (see www.ansi.org).

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

Figure 7: Green Globes ratings in the United States

Rating Level	Range
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

3.5.1 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 bill data. The online tool allows for direct interface with other online tools, such as the Natural Resources Canada screening tool and the U.S. 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 certification, a third-party verifier must examine the building and supporting documentation.

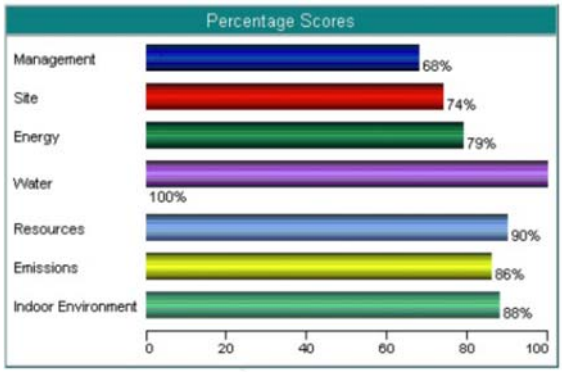


Figure 9: Excerpt from Green Globes report

Costs for access to the online tool and third-party verification can be found at: www.thegbi.org/assets/pdfs/Green-Globes-Personnel-Price-List.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 have been completed.

Green Globes also offers a Guiding Principles Compliance (GPC) Assessment Program for federal government facilities in the United States to help federal agencies and their contractors meet the guiding principles and several sustainability and energy-related executive orders. The program has been used to certify more than 250 buildings since 2012. GBI's program provides an online survey, third-party onsite assessment, compliance score and rating, detailed reports, and supplemental tools to enhance and clarify the guiding principles compliance process. More information on this can be found at www.thegbi.org/guiding-principles-compliance.

3.6 Green Star Australia

Green Star is the green building rating system used in Australia, and has been adapted and licensed to the New Zealand and South African green building councils for use in their respective markets.

Green Star ratings are available for every building type, with the exception of free-standing homes. Green Star rating tools include:

Green Star – Design and As Built, which guides the sustainable design and construction of buildings including offices, schools and university buildings, industrial facilities, public buildings, train stations, conference and retail centers, multi-unit residential dwellings and hospitals.

Green Star – Interiors, which assesses the interior fit outs of all building types.

Green Star – Communities, which addresses the sustainability of projects at the neighborhood, precinct or community scale.

Green Star – Performance, which assesses the operational efficiency of existing buildings.

Green Star assesses and rates buildings, fit outs and communities against a range of environmental impact categories. Green Star rating tools for individual building and fit out design, construction and operations assess projects against the following categories:

- Management
- Indoor environmental quality
- Energy
- Transport
- Water
- Materials
- Land use and ecology
- Emissions
- Innovation

The Green Star – Communities rating tool assesses community and precinct-level projects against six categories:

- Governance
- Design
- Livability
- Economic prosperity
- Environment
- Innovation

Once the credits are assessed, a percentage score for each category is calculated and a weighting is applied. As Green Star rewards best practice or above, three certification levels can be achieved for Design and As Built, Communities and Interiors:

- 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

Green Star – Performance encourages incremental improvement in operations, so provides ratings from 1-6 Stars. Reference Figures 10 and 11.

Figure 10: Green Star ratings

Figure 11: Green Star performance ratings

3.6.1 Green Star Certification Process

There are five general steps to achieving a Green Star rating:

1. **Registration:** Projects are registered via a simple online process at www.gbca.org.au.
2. **Documentation:** As projects are designed, built or operated, teams compile documentation to demonstrate that their building, fit out or community meets Green Star's sustainability benchmarks.
3. **Submission:** This documentation is then submitted to the GBCA for Green Star assessment.
4. **Assessment:** Green Star submissions are reviewed by an independent panel of sustainable development experts and an overall score is assigned.
5. **Certification:** A Green Star certified rating is awarded as a third-party verification of a project's sustainability.

The process varies slightly depending on the rating tool. For example, maintaining a building's Green Star – Performance rating requires greenhouse gas and potable water performance data submissions at 12- and 24-month intervals. These simple checks are submitted online and help to demonstrate that the building is operating at the level at which it was certified, and that the project is undertaking appropriate monitoring for key performance indicators and impact categories.

More information on the process and eligibility requirements for each Green Star rating can be found online at www.gbca.org.au.

Green Star rating tools are freely available for download, but official certification involves a registration fee. Credit interpretation requests and technical clarifications, including previous rulings, are also available online.

Fees for certification can range from US$5,000 to rate the operational performance of a small building to US$46,000 for a large-scale community.

Green Star Rating Tools

- Design and as built
- Communities
- Performance
- Interiors
- Legacy tools

Figure 12: Green Star rating tools

Registration of projects using legacy rating tools will be accepted until December 2015. These include education, health care, industrial, multi-unit residential, office, office interiors, retail and public building.

3.6.2 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.

3.7 Other Green Rating Systems

Now that the four most prominent rating systems have been described, we will discuss 12 additional rating systems used around the world 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 12 rating systems can be found in section 3.8.

3.7.1 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. In 2009, the Hong Kong Green Building Council (HKGBC) was established by four industry leaders: the Construction Industry Council (CIC), the Business Environment Council (BEC), the BEAM Society (BEAM) and the Professional Green Building Council (PGBC). In 2010, HKGBC took the existing rating system and launched a new assessment tool and revamped the rating system, now BEAM Plus.

As of December 2014, 586 buildings (see www.hkgbc.org.hk/eng/BEAMPlusStatistics.aspx) have been certified in Hong Kong, which was recently updated to version 1.2 (HKGBC, 2010). The BEAM Society (BSL) assigns a maximum of two BEAM assessors (BAS) to administer and review each project submission. BEAM professionals (BEAM Pro) are trained and accredited by the HKGBC in all aspects of the rating system. Their role is to help projects incorporate green building standards. The BEAM Plus certification is valid for a period of five years from the date of issuance (BEAM 2012).

3.7.2 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 predefined categories. Certification is mandatory for any new public building construction project funded by the government that exceeds US$1.5 million and for all central and local governmental buildings; it is voluntary for other buildings.

The Ministry of the Interior regulates awards with support from the Taiwan Green Building Council. By the end of 2013, a total of 4,300 buildings had been certified using the EEWH rating system. Certified buildings reported an average of 1.213 billion kilowatt hours in energy and 55.49 million tons of water savings a year (Intelligent Green Building 2013).

3.7.3 Green Building Certification System (GBCS)

In South Korea, the Green Building Certification System (GBCS) was established in 2002 by the Ministry of Land, Transport and Maritime Affairs, taking turns every two years with the Ministry of Environment to operate the jointly adopted plan (Shin 2008). It is currently known as the Korea Green Building Certification (KGBC) (ESCI, 2014). 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).

3.7.4 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 who have passed the CASBEE exam. CASBEE certification is currently being encouraged by local governments (CASBEE 2009).

CASBEE has six categories. Points are awarded in each category, then weighted and divided into two sections:

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

The built environment efficiency is then calculated by dividing Q by L, which is then used to assign a grade. As of April 2014, more than 350 buildings in Japan have been certified. Additionally, as of December 2011, 24 local governments have introduced CASBEE as the reporting system within which building owners must submit the assessment results before its construction (CASBEE 2014).

3.7.5 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, Green Mark is mandated in Singapore (BAR 2008). As of July 2014, there were more than 2,100 Green Mark building projects in Singapore (BCA, 2014).

3.7.6 Green Building Standard SI-5281

SI-5281 was created by the Standards Institution of Israel in 2005 and went through a significant upgrade in 2011 as part of a comprehensive cooperation between the Ministry of Environmental Protection, the Standards Institute of Israel, the Ministry of Interior, Ministry of Building and Housing and the Israeli Green Building Council.

It is a comprehensive green building standard in compliance with international standards but that has been adapted to the Israeli climate and construction methods (iiSBE, 2009). 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 onsite construction for compliance with plans (Nelin, 2007).

Certification is awarded based on the total number of points achieved, awarding up to five stars in eight categories. The building must achieve minimum requirements for building certification (Ayal, 2007). The current standard is currently under revision and will be under a constant biannual revision to keep it updated and current, including the addition of two new types of buildings: industrial structures and residential neighborhoods (Porter 2014).

3.7.7 LiderA

The LiderA system was developed by Manual Duarte Pinheiro, Ph.D., a professor at the

Department of Civil Engineering and Architecture at the Instituto Superior Tecnico in Portugal, in 2005. Voluntary trained facilitators guide the team through the process used to submit documentation to LiderA for certification.

The system is based on a set of principles of good sustainable performance: local integration, resources, environmental loads, environmental comfort, socioeconomic adaptability, environmental management and innovation. 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 2012).

3.7.8 Haute Qualité Environnementale (HQE)

In France, the Haute Qualité Environnementale (HQE) association created the HQE system, which began official certifications in 2005. CertiVeA, 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 upon which the building is graded. 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. In order for an operation to be certified, it must satisfy a number of fundamental prerequisites and justify performances beyond the current practice for at least seven of the 14 targets. (Table 3). (CertiveA 2012; Association HQE 2006).

Table 3: HQE targets

Eco-Construction	Eco-Management	Comfort	Health
1. Harmonious relation between buildings and their immediate environment	4. Management of energy	8. Hygrothermal comfort	12. Sanitary quality of areas
2. Integrated choice of products and construction materials	5. Management of water	9. Acoustic comfort	13. Sanitary air quality
3. Low impact worksite	6. Management of waste caused by activities	10. Visual comfort	14. Sanitary water quality
	7. Management of servicing and maintenance	11. Olfactory comfort	

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).

3.7.9 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). The 3-Star system requires every building to achieve all the control items as well as a minimum of one star in each category in order to receive certification (Connelly, 2012).

3.7.10 Green Rating for Integrated Habitat Assessment (GRIHA)

The Energy and Resources Institute (TERI) India created the Green Rating for Integrated Habitat Assessment (GR IHA) 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 rating system consists of 34 criteria within four categories. Eight of these 34 criteria are mandatory, four are partly mandatory and the rest are optional (GRIHA 2012).

3.7.11 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 and the three pillars of sustainability: environmental, economic and sociocultural aspects. The rating tool assesses the building's overall performance rather than individual measures, and life cycle assessment (LCA) and life cycle costing (LCC) are part of the assessment criteria (Dax, 2012).

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).

Indian Green Building Council
Greening India since 2001

3.7.12 Indian Green Building Council

The Indian Green Building Council (IGBC) was formed in 2001 by India's apex industry Confederation of Indian Industry (CII), a member-driven and consensus-based organization. The council involves all stakeholders of the Indian construction industry, including government, corporate, nodal agencies, architects, designers, institutions, builders and developers, product manufacturers, suppliers and facility managers.

IGBC aspires to have all of the places people live, work, study and play go green. Hence, IGBC's focus is not limited to buildings, but extends to other facets of the built environment such as homes, townships and cities. While IGBC administers the LEED rating system in India, the council offers an array of green building rating programs, certification services and training. More than 2.68 billion square feet of India's building footprint has adopted IGBC Green Building Rating Systems, which puts India among the top five countries in the world in terms of largest green building footprint. IGBC's goal is to exceed 10 billion square feet of green buildings in India by the year 2022 (when Independent India turns 75).

3.7.13 Summary of Other Rating Systems

Table 4 provides a summary of the 12 rating systems discussed in sections 3.7.1 through 3.7.12. 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 Origin	Buildings Certified	Rating Schemes	Certification Levels	Categories
BEAM Plus (formerly BEAM)	1996	Hong Kong	586	▪ Existing buildings ▪ New buildings	▪ Gold ▪ Platinum	▪ Site aspects ▪ Material aspects ▪ Energy use ▪ Water use ▪ Indoor environmental quality ▪ Innovation
EEWH	1999	Taiwan	>4,300	▪ New construction	▪ Certified ▪ Bronze ▪ Silver ▪ Gold ▪ Diamond	▪ Biodiversity ▪ Carbon dioxide emissions reduction ▪ Conservation ▪ Energy conservation ▪ Green landscaping ▪ Indoor environment ▪ Sewage and garbage treatment ▪ Site water ▪ Waste reduction ▪ Water resource
GBCS (KGBC)	2002	South Korea	1,197	▪ Hotels ▪ Multi-use ▪ Multi-use dwellings ▪ Office buildings ▪ Residential ▪ Schools ▪ Stores	▪ First Grade Green Building ▪ Certification Grade Green Building	▪ Energy efficiency and load on the environment ▪ Indoor environmental quality ▪ Land use, transportation and ecology
CASBEE	2003	Japan	>350	▪ Existing building ▪ Heat island ▪ Home ▪ New construction ▪ Renovation ▪ Urban area and buildings ▪ Urban development	▪ S (Excellent) ▪ A ▪ B+ ▪ B- ▪ C (Poor)	▪ Indoor environment ▪ Quality of service ▪ Outdoor environment on site ▪ Energy ▪ Resources and materials ▪ Off-site environment
Green Mark	2005	Singapore	>2100	▪ Residential buildings ▪ Non-residential buildings ▪ Existing buildings ▪ Office interior ▪ Landed houses ▪ New and existing parks ▪ Infrastructure ▪ District ▪ Overseas projects	▪ Certified ▪ Gold ▪ Gold Plus ▪ Platinum	▪ Energy efficiency ▪ Environmental protection ▪ Indoor environmental quality ▪ Other green features and innovation ▪ Water efficiency

System	Year Established	Country of Origin	Buildings Certified	Rating Schemes	Certification Levels	Categories
Green Building Standard (SI-5281)	2005	Israel	170	▪ Residential buildings ▪ Office buildings ▪ Educational buildings ▪ Health care buildings ▪ Retail buildings ▪ Public buildings ▪ Hospitality buildings	▪ 1 Star ▪ 2 Stars ▪ 3 Stars ▪ 4 Stars ▪ 5 Stars	▪ Site ▪ Water ▪ Materials ▪ Health and well-being ▪ Waste ▪ Transportation ▪ Construction management ▪ Innovation
India Green Building Council (IGBC)	2001	India	600	▪ Green homes ▪ New buildings rating system ▪ Green schools ▪ Green existing buildings ▪ Green factory buildings ▪ Green townships ▪ Green mass rapid transit system ▪ Green landscape ▪ Green SEZ	▪ Certified ▪ Silver ▪ Gold ▪ Platinum ▪ Super Platinum	▪ Sustainable architecture and design ▪ Site selection and planning ▪ Selection of species for landscape ▪ Transportation planning ▪ Water conservation ▪ Energy efficiency ▪ Building material and resources ▪ Indoor environment quality ▪ Health and well-being ▪ Health and hygiene ▪ Operation and maintenance ▪ Green education ▪ Innovation and development
LiderA	2005	Portugal	>1,000 (residential) >5,000 (hospitality)	▪ Buildings	▪ C Level ▪ B Level ▪ A Level ▪ A+ Level ▪ A++ Level ▪ A+++ Level	▪ Efficiency ▪ Environmental comfort ▪ Environmental management and innovation ▪ Load impacts ▪ Resources consumption ▪ Site and integration ▪ Socioeconomic adaptability
HQE	2005	France	>700	Construction: ▪ Residential ▪ Tertiary buildings ▪ Health ▪ Sports Operation and renovation: ▪ Tertiary building	▪ Good ▪ Very Good ▪ Excellent ▪ Exceptional	▪ Comfort ▪ Eco-construction ▪ Eco-management ▪ Health

System	Year Established	Country of Origin	Buildings Certified	Rating Schemes	Certification Levels	Categories
3-Star	2006	China	Approximately 200 buildings certified at the highest level	▪ Commercial ▪ Residential	▪ 1 Star ▪ 2 Stars ▪ 3 Stars	▪ Land savings ▪ Energy savings ▪ Water savings ▪ Indoor environment ▪ Operations and management ▪ Preference items
GRIHA	2006	India	203	▪ Education ▪ Health care ▪ Multi-unit residential ▪ Office as built ▪ Office design ▪ Office interiors ▪ Retail centers	▪ 1 Star ▪ 2 Stars ▪ 3 Stars ▪ 4 Stars ▪ 5 Stars	▪ Site selection and site planning ▪ Building planning and construction ▪ Building operation and maintenance ▪ Innovation
DGNB	2008	Germany	>300	▪ New buildings ▪ Existing buildings	▪ Bronze ▪ Silver ▪ Gold	▪ Environmental ▪ Economic ▪ Social-cultural and functional ▪ Technical ▪ Process ▪ Site

3.8 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?

Answering these questions will help to narrow the options to two or three choices that will require 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 help the auditors to identify opportunities for improvement. The audit should include at least the following 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 governmental or organizational requirements 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 are not only considered high-feasibility, but also no- 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 operational 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 you 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.

To help prioritize the initiatives and finalize the certification plan, make use of the triple-bottom-line approach.

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 Retrofit	↓ Energy Use	+	+	+/-
More Windows	↑ Daylighting	-	-	+
Education	↑ Knowledge	+	+/-	+

Figure 13: Sample triple-bottom-line analysis

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 13 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 for building occupants.

Performing retrocommissioning 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, economic and social impact. Although retrocommissioning 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 and capital improvements and/or implementing any project that was identified during the sustainability audit as being necessary to achieve the goal.

During implementation, it is important to keep documentation requirements in mind so that proper documentation can be submitted in order to achieve 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 (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 14) 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.

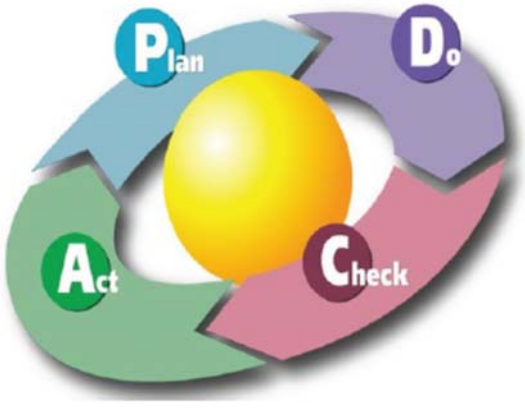


Figure 14: Cycle of continuous improvement (Bulsuk, 2009)

Achieving the goal will require hard work and buy-in from those involved, both at the senior and building occupant levels. 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 that 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 his or her 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 that 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:

- 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 who helped along the way. 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 future recertification. 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 continual improvement, rather than stagnation. After all, operational excellence should always be a point further than where one is standing right now. Continued operational improvements not only position the building to achieve a better certification level should the team choose to recertify in the future, but 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 could provide to gain more occupant buy-in 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 Austin Convention Center (ACC) to demonstrate how to make the business case for building certification. The Austin Convention Center accomplished a significant achievement in becoming the first convention center in Texas, and among only two convention centers in the country, to achieve Leadership in Energy and Environmental Design (LEED®) Gold Certification under the Existing Building rating system in November of 2011. The full case study is available for reference in section 5.2 of this guide.

Austin Convention Center Facts:

- Located in the heart of the capital of Texas
- Constructed in 1992, expanded in 2002
- Stretches over six city blocks
- Nearly 900,000 square feet
- Occupied 365 days a year
- Nearly 300,000 visitors a year
- More than 15 acres

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 the non-financial 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 the total certification costs. The total cost can be used to determine the budget or to decrease the certification goals to meet the budget. For a look at some examples of certification costs, see Table 7.

For example, ACC worked on their certification in a phased approach over four years. This was not a short or easy journey, but rather a well-planned, methodical approach to LEED certification.

The journey began in 2007 when, in addition to decreasing natural resource consumption and incorporating sustainability into its operational practices, the Austin Convention Center decided to pursue LEED certification. The ACC LEED project team believed the LEED certification would ensure maximum operational efficiency and financial savings for years to come. They started with an audit to determine how close they were to their goal of Gold Certification under the LEED for Existing Buildings rating system and how much it would cost to achieve the goal.

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

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. Energy projects often have the most immediate savings impact. Within most rating systems, it is necessary to meet a minimum energy performance requirement with additional credits often given the better the facility performs.

To increase energy efficiency, determine what projects must be implemented and evaluate the potential energy savings and resulting cost savings for each project. These tasks are part of typical energy audits which can be conducted by third parties.

Use data in existing computerized maintenance management system (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 retrocommissioning reports that could result in energy and maintenance labor savings, and reductions in equipment wear, extending the equipment life cycle and property value, or greater longevity of tenants.

Another item to consider when determining your potential savings is to look at cost avoidance. In some cases, you may not be saving money outright, but will rather be avoiding costs. For example, with ACC, utility reduction and cost avoidance were core goals for the project. ACC conducted retrofitting within the areas that needed improvement, such as the use of LED and fluorescent lighting to reduce energy consumption and mercury content where possible and to redirect exterior lighting to reduce light pollution. In addition, a comprehensive retrocommissioning project which tested all major energy consuming equipment and helped get the building back to a baseline standard, was performed.

ACC saw a 10 percent improvement in energy consumption in the first year; however further reductions were very difficult to achieve. After decreasing energy consumption in 2010, energy use started to trend upward in 2011. A few complicating factors influenced this, including weather and the fact that the majority of consumption was based on client requests (events at the center) which were more difficult to control.

However, when you dig a bit deeper in to the rise in energy consumption by performing a cooling degree days (CDD) and heating degree days (HDD) analysis, you start to see the cost avoidance results. Our analysis found that between 2010 and 2011, the number of CDD increased 24 percent, yet the total energy use of the building only increased 11 percent. When you add in utility rate increases, this results in approximately US$450,000 in cost avoidance. This number is not seen unless you look beyond cost savings to cost avoidance.

4.1.3 Determine the Non-Financial Benefits

As the business case is developed, the case for non-financial benefits, such as environmental and social, must be included. Although not always financially beneficial, many sustainability efforts have enormous impact on the conservation of natural resources.

The information collected through the sustainability audit can be used to translate items, such as energy and water savings, among 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. 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 those goals. It can 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.

There are other benefits beyond the environmental that an organization can realize through building certification. The certification process should not be seen as just a paper exercise or marking tasks off a checklist. If approached in the right manner, it requires changing the way you think about the operations of your facility. Although that may sound daunting, it is actually a good thing. The certification process will not only transform your operations, it will create conversation, engage employees and change the way you operate your facility. These benefits can be highlighted in your business case as shown with the results achieved by ACC.

Energy savings, cost savings, water savings, waste reduction and decreasing carbon footprint are the tangible metrics that are often highlighted when building the business case for sustainability (see Table 7 for examples of savings in different rating systems). However, there is an even stronger case to be made with the operational improvements that are made when taking on a challenge such as LEED certification. The LEED process gave ACC a great opportunity to fully integrate sustainability into their everyday business by setting up clear standards and requirements. It required policies and plans and forced ACC to create formal, written documents of their practices. This is an integral part of sustainable facility management that is often overlooked.

There is also an unexpected benefit of the certification process: a unified staff and an engaged population. The unique challenges the certification process brings can bond teams. Even more exciting is how that the process can change the mindset of building occupants.

Many of the changes required affect the building occupants. Seemingly harmless changes, such as changing the type of office supplies purchased, changing the plates in the cafeteria or changing the type of light bulbs in an individual's office, can illicit drastic reactions, both positive and negative. While this may not by the desired result, all of these outcomes begin a conversation about sustainability that allows the building occupants to become engaged in the process.

According to Anthony Collier, FMP, SFP, facility service coordinator at the Austin Convention Center, "The process of pursuing certification encouraged the team and building occupants to become more mindful of daily operations and how those operations impacted the environment. As a result, this promoted a conscious effort on the part of everyone in the facility to operate and use the building in a more sustainable way."

Although cumbersome at times, third-party certification can help you build a successful operations program. Achieving certification through a third party, whether LEED or another rating system, gives facility managers a tangible way to quantify sustainability success in their field. Through this infusion of sustainability into facility management, the LEED rating system gave ACC the framework to achieve operational excellence. The rigors and the timelines mandated by the certification process sets a clear path to incorporate sustainability throughout the entire organization.

Often, those who approach third-party certification in the manner that ACC did, where changing the way you operate is one of the main goals, are able to transform their operations and fully integrate sustainability.

This integration is what creates operational excellence in a facility. While it may not be the benefit first thought of, operational excellence is a benefit that should become part of the business case for sustainability.

4.1.4 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 non-financial 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 US$4.94 to US$15.59 per square foot (SF) of floor space (US$53 to US$168/m^2), with an average of US$6.68/SF (US$731/m^2 and a median of US$6.07/SF (US$651/m^2).

In the ACC example, careful planning and a practical approach to LEED certification resulted in reducing indoor water usage by 32 percent, recycling 68 percent of their waste, decreasing their carbon footprint by 93 percent, and operating at an energy efficiency level 26 percent better than their peer-comparison baseline. With an additional US$450,000 in cost avoidance associated with the energy savings.

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.

For the Austin Convention Center, building certification was an important part of their strategy to lead by example for their members. In addition to making the Austin Convention Center more competitive in the national and regional convention market, the LEED certification would ensure maximum operation efficiency and financial savings for years to come. The building blocks created by the LEED certification of the Austin Convention Center will assist ACC in meeting the goals of the Austin Climate Protection Plan and the Solid Waste Service's Zero Waste Plan. In addition, this significant achievement provides a road map for other City departments to pursue LEED for Existing Buildings certification.

Table 7: Making the business case through numbers

System	Average Energy Savings	Average Water Savings	Typical Certification Fees (USD)
LEED	40%	66.5%	$5,300 to $15,000
Green Globes	14%	25%	$3,000 to $5,000
Green Star	66%	51%	$5,000 to $42,000
Green Mark	25%	20%	$4,100 to $22,100
Green Building Standard (SI-5281)	30%	10%	N/A
GRIHA	30%		$5,840 to $5,840 plus $0.07 per square meter

Note: Savings are averages reported by IFMA's 2012 Global Survey. Green Star numbers were provided by Green Star.

5 Case Studies

The case studies on the pages that follow illustrate achievement of certification under five of the rating systems discussed within this guide:

1. Green Building Initiative Green Globes – Medtronic
2. Leadership in Energy & Environmental Design (LEED) – Austin Convention Center
3. Green Star – City of Gosnells
4. Green Mark – CleanTech One
5. HQE – Green One

CASE STUDY: Green Building Initiative Green Globes

World's largest medical technology company establishes sustainability as a cornerstone for its facilities

Project:
Medtronic World Headquarters

Location:
Minneapolis, Minnesota, USA

Floor space:
509,483 square feet

At the world's largest medical technology company, sustainability is a "big" deal. The 509,483 square foot Medtronic World Headquarters (WHQ) recently achieved Green Globes Continual Improvement of Existing Buildings (CIEB) certification by the Green Building Initiative (GBI) for achievements in sustainable operations and maintenance.

"At Medtronic we recognize the critical interdependence between human health and the environment," said Doug Fullen, Medtronic's corporate senior EHS director. "Our well-being ultimately depends on the health and resources of the planet. For this reason, we continually strive to reduce our environmental impact. Environmental stewardship is a key pillar of corporate citizenship and provides Medtronic with a competitive advantage by reducing costs and managing risks."

"It was this commitment to sustainability that caused Medtronic's Global Facilities Council to decide to take the next steps and to certify our world headquarters, in accordance with the Green Globes assessment protocol," said Sabina Ylinen, council leader.

The four-story office building, with 1,200 daily occupants, has several specialized departments including laboratory, atrium, educational center, food service and meeting spaces. Implementing and adhering to best green practices at the facility have been a priority for some time. These practices, coupled with excellent ratings in the Green Globes environmental assessment areas, resulted in an 82.4 percent rating out of 1,000 points, which helped them achieve a three Green Globes certification.

Read about Medtronic's environmental stewardship program at: http://www.medtronic.com/2010CitizenshipReport/environmental-stewardship/index.html.

Green Globes Environmental Assessment Areas

Medtronic World Headquarters environmental achievements

Using the Green Globes software tools and ratings/certification system ensures that environmental impacts are comprehensively assessed on a 1,000-point scale in multiple categories. Listed are some highlights from each of the assessment areas.

Energy. Medtronic's corporate initiatives already include the tracking and monitoring of energy usage with a portfolio-wide goal of 10 percent reduction. Energy performance was further enhanced and monitored by utilizing efficient, modern lighting, HVAC and control systems, all of which caused Medtronic's WHQ building to score high points in this category. Medtronic also minimizes their energy footprint by taking advantage of and encouraging alternative transportation. There is easy access to bus lines, plentiful bike racks, changing facilities and showers for staff. The weekly employee classified ads feature a carpool section to help cut the energy expended to get to and from work.

Water. Low-flow bathroom fixtures and automatic controls for sinks are just the beginning for water conservation at Medtronic. Recently a best-practice irrigation system was installed and has shown a marked reduction in water consumption.

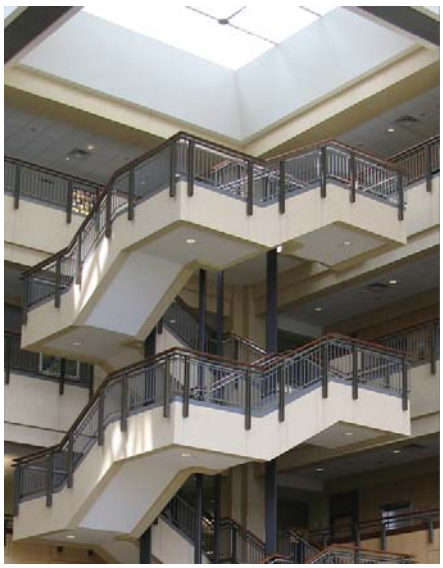
Resources. Medtronic's daily operations include maintaining many recycling stations throughout the building. Included in recyclables is a special collection for bottle caps, and polystyrene; these items are only recyclable through outside special services. Medtronic scored a perfect 110 points for resource management.

Emissions and effluents. The Medtronic WHQ scored excellent in this category thanks to careful management of emissions throughout the office, laboratory, and facilities departments.

Indoor environment. The Medtronic WHQ building scored high with 91 percent of the possible points in this category. Medtronic follows a number of indoor environmental quality best practices including active preventative/predictive maintenance of HVAC systems, management of pollutants from cooling towers, parking spaces and employee smoking areas. Additionally, the structure emphasizes natural daylight in the office spaces.

Environmental management. Members of the environmental and facilities staff started a "Conserve Team," which helped the Medtronic WHQ score a perfect 100 percent because of innovative new practices including clever irrigation management, recycling and food service, among others.

Total Score: 838.5/1000 Green Globes Points



Global Facilities Council

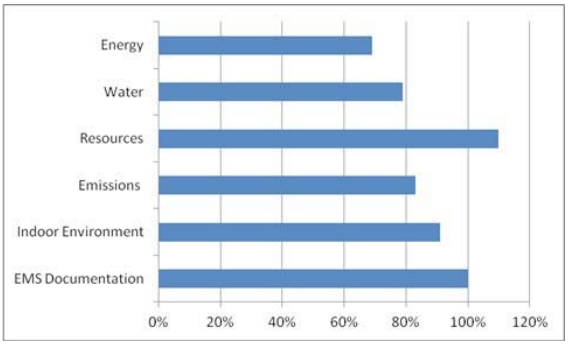
As part of its sustainability efforts Medtronic created the Global Facilities Council, which has been working to establish sustainability guidelines and standards that use life-cycle management thinking to reduce the building operating costs and environmental footprint.

They were the main driver behind the push of the WHQ toward the Green Globes assessment and certification process with the goal of lowering operating costs, continually improving Medtronic's sustainability performance and standardizing approaches which could be rolled up into best practices.

Jim Driessen, senior engineering director and the architect of the council said, "We look at 'first cost' plus 'life-cycle cost' in design, materials and systems. We may be willing to spend more upfront if there is a significant payback in reduced long-term costs. The most significant example may be energy reduction, but there can also be savings in preventive maintenance. Some materials have higher maintenance costs than others."

Green Globes allocates a percentage of points in the new construction tool for following life-cycle assessment methodologies as well as significant points in CIEB for operations and maintenance of a building.

Percentage of points achieved by Medtronic World Headquarters under the environmental assessment areas:



- Medtronic World Headquarters is a 509,483-square-foot building on four floors with 1,200 employees.
- The WHQ is operated 60 hours per week.
- The building achieved high Green Globes energy efficiency scores despite research labs and food service facilities which are notorious for their energy consumption.
- Medtronic World Headquarters achieved an official Green Globes score of 82.4 percent in the on-site certification.
- Rating: Three Green Globes

Green Globes® is North America's first Web-enabled, fully interactive green building assessment tool that allows building professionals and owners to augment their design, in the case of new construction, or incorporate sustainability operations, in the case of existing buildings, and rate the building's proposed or actual sustainability performance.

The system allows building owners and managers to have first-hand knowledge at any given time how their building is scoring. If a building achieves at least 35 percent of the total number of 1,000 points, it qualifies for certification. Upon ordering the certification, a third-party assessor appointed by the GBI begins to work with the owner and team during the assessment period which culminates in an on-site audit of the building. Green Globes rating and certification process can be completed for a fraction of the combined hard/soft costs and time associated with LEED.

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Portland, Oregon 97214 USA
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info@thegbi.org

CASE STUDY: Leadership in Energy & Environmental Design (LEED)

Bringing Home the Gold: The Austin Convention Center's pursuit of Leadership in Energy & Environmental (LEED®) Certification

Project Goals:

- Develop standard operating procedures
- Decrease carbon footprint
- Reduce utility consumption
- Give the center a marketing advantage

LEED GOLD
LEED for Existing Buildings v2.0

Sustainable Sites	10
Water Efficiency	1
Energy & Atmosphere	10
Materials & Resources	15
Indoor Environmental Quality	9
Innovation & Design	5
Total Points	50

Achievements:

68% of waste diverted

93% carbon footprint reduction

32% indoor water savings*

* estimated using the LEED water use baseline

Certification Mark is a registered trademark owned by the U.S. Green Building Council® and is used

The Austin Convention Center (ACC) accomplished a significant achievement in becoming the first convention center in Texas, and among only two convention centers in the United States, to achieve LEED Gold Certification under the Existing Building rating system in November of 2011.

This was not a short or easy journey, but rather a well-planned, methodical approach to LEED certification.

The journey began in 2007 when in addition to decreasing natural resource consumption and incorporating sustainability in to the operational practices, the Austin Convention Center decided to pursue LEED certification.

In addition to making the Austin Convention Center more competitive in the national and regional convention market, the LEED certification would ensure maximum operation efficiency and financial savings for years to come.

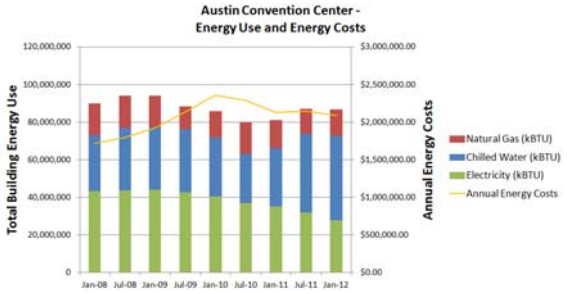
ACC pioneers the way for the rest of the city

This significant achievement provides a road map for other city departments to pursue LEED certification for their existing buildings. ACC has shown other facilities, particularly unique facilities that face greater challenges, that LEED certification is not only possible, but can vastly improve the way you operate your building.

Austin Convention Center Facts:
Located in the heart of the capital of Texas
Constructed in 1992, expanded in 2002
Stretches over six city blocks
Occupied 365 days a year
Nearly 300,000 visitors
Nearly 900,000 square feet
Over 15 acres

Energy savings

- 8 percent below initial three-year average
- 26 percent better than their peer comparison baseline
- Purchased renewable energy certificates for 100 percent of the electricity
- US$450,000 in cost avoidance



Utility reduction and cost avoidance were core goals for the project. A lighting retrofit project included the use of LED and fluorescent lighting to reduce energy consumption and mercury content where possible and to redirect exterior lighting to reduce light pollution. The schedule for the interior and the exterior lighting systems was modified to make sure that unnecessary light is turned off, and most offices and restrooms were equipped with motion detectors.

Purchasing

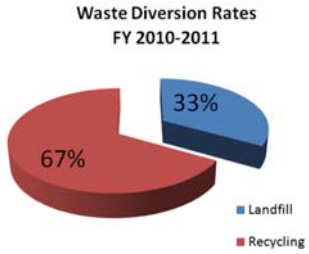
ACC created a software interface that would allow them to track sustainable purchases and achieve and surpass their goals. ACC achieved:

- 97 percent of general purchases
- 100 percent of indoor air quality-compliant products
- 100 percent of cleaning products meeting the sustainable purchasing guidelines

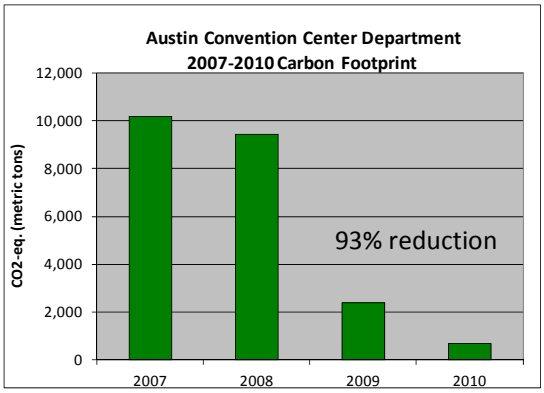
Waste management

Major efforts were made to revamp the recycling process and increase the recycling percentage. The Material Resources Waste Management Team sorts and properly disposes of all event waste. The recycling program increased through routine waste audits and policy development. A composting program was added that helped increase our recycling rate to 68 percent.

- Paper and cardboard
- Metal
- Batteries
- Plastic
- Toners
- Light bulbs and ballasts
- Glass
- Food scraps
- Disposable food
- Beverage wares



Carbon footprint



Innovation

ACC has a commitment to sustainability that spans beyond its operations and focuses on the education. ACC created a Green Exhibit Room to show sustainable initiatives at ACC, including:

- Educational programming highlighting recycling efforts, ENERGY STAR and the Green Choice Program
- Exhibition shelves with sustainable food and beverage information
- Carbon calculator kiosk that allows visitors to calculate their footprint

The team

Having a strong and committed team is crucial to the success of any energy management and sustainability program. We assembled a team of individuals from both ACC and FEA and matched their expertise with the LEED categories. This allowed us to assign credits and responsibilities to specific individuals. Over the course of the project, we held Web conference meetings with all team members to check in on credit status and to provide a resource to facilitate completion of assignments.

Achieving operational excellence

"The process of pursuing certification encouraged the team and building occupants to become more mindful of daily operations and how those operations impacted the environment. As a result, this promoted a conscious effort on the part of everyone in the facility to operate and use the building in a more sustainable way.

In addition, I would say working on and completing the project forced the team to find viable, bearable and equitable solutions to solve problems, the results of which created economic, social and environmental benefits for not only the organization but also society."

– Anthony Collier, FMP, SFP
Facility Service Coordinator
Austin Convention Center

"The LEED scorecard gave us a great opportunity to build a successful operations program. It gives facility managers a tangible way to quantify success in their field."

– David Thomas, CFM, LEED AP O+M
Facility Manager
Austin Convention Center Department

"Austin Convention Center's LEED certification demonstrates tremendous green building leadership. The work of innovative building projects such as the Austin Convention Center is a fundamental driving force in the green building movement."

– Rick Fedrizzi
President, CEO and founding chair
U.S. Green Building Council

"With the achievement of LEED Gold, ACC has not only become a leader in the industry, but also within the City of Austin. It shows that any city facility can utilize and benefit from the LEED process that provides a framework and discipline for achieving a broad array of sustainable goals. At the same time it addresses O&M issues that might otherwise continue to be undiscovered or ignored."

– Peter Davis
LEED Project Manager
City of Austin

"We are tremendously proud of this achievement. Not only is the Austin Convention Center bringing economic benefits to the city of Austin, it is also a model of sustainability that will continue to set the standard in the industry. Credit certainly goes to the convention center staff's dedication and commitment over the past four years to obtain the gold level, under the guidance of David Thomas, ACC Operations Manager, LEED-Accredited Professional and Certified Facility Manager."

– Mark Tester
Director
Austin Convention Center Department

"LEED helped us by presenting a template we could follow in order to get our building to a certain level."

– Taje Allen
Public Service Manager
Austin Convention Center Department

ACC Team Member	Category	FEA Team Member
Peter Davis	Leadership & Project Sponsor	Laurie Gilmer, PE, CFM, SFP, CxA, LEED AP O+M
David Thomas, CFM, LEED AP O+M	Project Management & Team Leadership	Maureen Roskoski , SFP, REPA, LEED AP O+M
Anthony Collier	Sustainable Sites	Wayne Malek, PE, CFM, LEED AP
Jerry Slabaugh	Water Efficiency	Maria Fara, SFP, LEED AP O+M
Curtis Jolly	Energy & Atmosphere	Conrad Kelso, PE, CEM, LEED AP O+M
Taje Allen & Ana Gomez-Sanchez	Materials & Resources	Maria Fara, SFP, LEED AP O+M
Taje Allen, David Thomas, & Curtis Jolly	Indoor Environmental Quality	Mayra Portalatin, SFP, LEED AP O+M
David Thomas & Ana Gomez-Sanchez	Innovation	Mayra Portalatin, SFP, LEED AP O+M

AUSTIN CONVENTION CENTER

www.austinconventioncenter.com

FEA FACILITY ENGINEERING ASSOCIATES

www.feapc.com

CASE STUDY: Green Star

City of Gosnells Civic Centre Redevelopment Project
Office design v2 representing Australian excellence in sustainable design

Project data

Owner: City of Gosnells

Location: 2120 Albany Highway
Gosnells, Western Australia 6110

Council size: The City of Gosnells is the fifth-largest municipality in metropolitan Perth, covering an area of 127 square kilometers with more than 105,000 residents.

Project area: 4,500 square meters of office space with a further 500 square meters of civic space including council chamber, function rooms, meeting rooms and dining area.

Project team: City of Gosnells project team

Architecture and design: Christou Design

Green Star Accredited Professional: Kellogg Brown Root

Specialist Green Star advice: AECOM

Project at a glance:

- 5 Star Green Star – Office Design v2
- Sustainability premium of just AU$750,000 (3 percent) on AU$26 million project
- Predicted payback period of five years for the Green Star investment
- Water use reduced by 35 percent compared to similar sized buildings
- Energy use reduced by more than 315,000 kilowatt hours each year, equivalent to taking 43 cars off the road

The City of Gosnells has achieved a 5 Star Green Star – Office Design v2 rating for the retrofit of its Civic Centre. In doing so the city has demonstrated its commitment to sustainability and shown that even buildings constructed during the 1970s can be given an environmental and economic overhaul.

Paul McAllister, project manager, City of Gosnells, explains: "Initially we thought the age of the building would make a sustainable retrofit unviable, however for an additional cost of 3 percent, a sustainable makeover was the only responsible option."

The council expects a five year payback period on the extra outlay of AU$750,000 demonstrating that building green is a smart financial decision. As McAllister points out: "We have a commitment to fiscal responsibility

for our rate payers. That's why we decided to build green."

The sustainable transformation means the Civic Centre is now future-proofed to withstand tighter environmental legislation, the rising cost of utilities and the introduction of a price on carbon. Its energy and water saving features will reduce bills, while the improved indoor environment quality is helping the city improve productivity as well as attract and retain staff who want to work in a healthy and sustainable workplace.

The City of Gosnells' Civic Centre demonstrates that smart, sustainable design is not the preserve of large, expensive developments. The council's 5 Star Green Star rating is positive proof that low-technology design principles and a modest budget can produce a leading-edge green building.

What the City of Gosnells achieved

Management

During the retrofit of the Civic Centre, a comprehensive building users' guide was created to help the occupants understand how to interact with the building, and to help the building managers identify and fix problems quickly. This will ensure that the City of Gosnells' building maintains the highest possible level of performance.

Energy

The council has installed a thermal energy storage tank in the building which will store cool energy in the form of ice. It is charged overnight to avoid peak energy tariffs (thereby saving the city money), with the cool energy then released during the day, reducing the city's reliance on traditional air conditioning. Overall the building is expected to reduce energy usage by 315,878 kilowatt hours each year — equivalent to taking 43 cars off the road for an entire year. The Civic Centre also uses solar energy to heat water for domestic use within the building, a measure which has reduced gas usage by 55 percent alone.

Indoor environmental quality

The OECD's Environmentally Sustainable Buildings report argues that health problems from indoor air pollution are now one of the most acute problems related to building activities. CSIRO modeling based on U.S. research into the effects of indoor environment quality on health and productivity has found that potential annual savings in Australia could be as much as AU$21 billion each year.

The City of Gosnells was determined to provide a healthier, happier and more productive working environment for employees, and that meant reducing internal noise levels and maintaining a comfortable temperature. The Civic Centre also minimizes staff exposure to volatile organic compounds (VOCs), which are linked to sick building syndrome, by specifying low-VOC paints and carpets. This will provide a healthier workplace and support the City of Gosnells' goal of becoming the local government employer of choice in Western Australia.

Water

Water-efficient fittings and fixtures, as well as a rainwater tank used to flush toilets, have been installed to reduce water use. These measures will cut the city's water use by 35 percent each year, saving 840,000 liters of water, equivalent to the water in nearly 17 average-size backyard swimming pools, from being flushed down the drain.

Emissions

Stormwater is collected and filtered on site before it enters the Canning River. This will improve the health of the river by reducing runoff contamination and will help reduce the need for extra in-ground stormwater infrastructure in the future.

CASE STUDY: Green Mark

CleanTech One

Project information

Building name: CleanTech One

Location: CleanTech One
1 Cleantech Loop
Singapore 637141

Gross area: 51,780.11 square meters

Type of building: Research/lab

Certification level: Green Mark Platinum

Year certification achieved: May 2011

Cleantech One is the first phase of JTC's latest masterplan, Cleantech Park, located near NTU which is slated to be the future center of clean technology and innovations. Passive design solutions were implemented throughout the project to allow natural ventilation and daylight to reach the livable spaces and to reduce the thermal gain, increasing thermal comfort of the building's tenants. Emphasizing on resource efficiency, all aspect of Cleantech One were designed to optimize the energy and water usage. Rainwater harvesting channeled rainwater for irrigation purposes for both the landscape and the vertical greeneries. Innovative systems such as solar air conditioning were formulated to maximize energy efficiency.

Certification costs

Overall percentage increase in construction cost due to green features: 6.2 percent (SG$6,224,448)
Assessment fee: SG$13,500

Documented savings/reductions

Energy: 55.3 percent (9,345,210 kilowatt hours per year)

Water: In Singapore, all Green Mark Platinum buildings will use the "Excellent" rating water-efficient fittings under Singapore WELS rating system

Project highlights

CleanTech One was designed as a living laboratory. The whole building leveraged an extensive array of smart sensors to monitor the environmental performance and to quickly assess and mitigate any deviations. The project was awarded with Green Mark Platinum with the following key features:

1. Low envelope thermal transfer value (ETTV) of about 32 watts per square meter with external access corridor acting as additional sun shading. (Green Mark Platinum projects require maximum ETTV value to be 40 watts per square meter.)
2. Introduction of the "wind wall" concept (designed with extensive computer simulation) resulted in improved natural ventilation to the living atrium space. This created a well-ventilated communal area.
3. The air-conditioning system was designed with an efficient chilled water system of 0.622 kilowatts per ton of refrigeration at

100 percent load. (Green Mark Platinum projects require maximum efficiency to be 0.65 kilowatts per ton of refrigeration.)

4. Rain water was collected and recycled to supply the building irrigation demand which resulted in 20 percent savings of the total building water consumption.
5. Development of data collection and analysis of building performance through integrated environmental and property asset management system (IEPAMS) in addition to common building monitoring system. With a mini weather station located at the roof and display monitor located at the living atrium, IEPAMS would be able to transform the building performance data into user-friendly display dashboard.
6. Installed 1-megawatt fuel cell plant supplying approximately 38 percent of the total building energy demand.
7. Installed 238 kilowatt-peak PV panels with a combination of BIPV and monocrystalline.
8. AHU condensation water was collected for recycling for toilet flushing which will translate to 18 percent savings of the total building potable water consumption.
9. With water-sensitive urban design strategies, a combination of dry garden and bioswales retained clean stormwater runoff.
10. Wide range of products with high recycled content and recyclability are used in the building.
11. Extensive use of LED lightings in offices as well as common areas.

Project challenges

CleanTech One is the first building in the CleanTech Eco business park. As a signature building, theCleanTech One project is set with high key performance indicators (KPIs) for consultants to achieve, especially the energy-saving KPIs (45 percent energy savings). As a Green Mark Consultant, we have implemented with the latest technologies to improve the energy savings and at the same time test new technologies in the building. We also use computer simulation tools to ensure design optimization.

CASE STUDY: HQE

Green One

Project information

Building name: Green One

Location: 22 rue Pajol
Paris, France 75018

Gross area: 5,174 square meters

Type of building: Office

Certification level: HQE® certification with the level Excellent BBC-Effinergie energy efficiency label

Year certification achieved: December 2011

Green One is a four-story office building with a garden level and a ground floor. The building structure is compact with external wall insulation and facades made of concrete resin panels. Double glazing was used except on the south side of the building where filtering glazing was chosen. There is a flat roof with a small solar photovoltaic glass roof.

Certification cost

17 328 € (HQE Construction ® + BBC Effinergie energy efficiency label)

Documented savings

- 47 percent water savings are made thanks to the hydro-thrifty system of sanitaries
- As a low-energy building (French label BBC based on 2005 Thermal Reglementation), 54 percent energy savings

Project highlights

- VRV (variable cooling volume) system for air conditioning
- District heating
- Smart grid system used with a performant BMS

6 Appendices

6.1 Appendix A: References

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6.2 Appendix B: Additional Resources

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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.