

# 1

## Introducing Green

*The best way to predict the future is to invent it.*

—Alan Kay

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*What you'll find in this chapter is an introduction to what it means to be green or sustainable in the architectural profession and why this has become such an important topic both in the design and construction industry and global culture.*

## Sustainability

We, the authors, started our professional careers near the beginning of what Bob Berkebile, FAIA, a founding principal of BNIM Architects, refers to as one of the greatest changes in the profession of architecture in his professional lifetime. The year was 1995 and architects were starting to use terms like *green* and *environmentally friendly* to describe their projects and project approaches. Dialogue, experience, and marketplace transition have allowed the people not only in the profession of architecture but also other professions involved in the design, construction, and operation of the built environment to garner a better understanding of what *green* means. Generally speaking, however, today we think in terms of *sustainability*.

### A Brief History of Sustainable Design

The practice of sustainable thinking is in many ways ancient. If we look at the buildings from some of the North American indigenous cultures, we can see that they were highly skilled at adapting the location and materials of their structures to climate and place. For example, igloos constructed in Greenland's Thule area and by the people of Canada's Central Arctic, which were made of materials found on site, were built in a way to create thermal mass and wind resistance. Another example is the Native American teepee, built from both natural plant and animal materials found in the region. The teepee was lightweight and easy to transport for reuse and was designed utilizing natural convection flows for heating and cooling. The ancient Pueblo peoples of the southwest (who are often referred to as the Anasazi) utilized naturally formed cliffs and caves as the location for some of our first sedentary civilizations, adding structures made of earthen materials found on site (Figure 1.1). They understood the sun and natural rock formations enough to utilize passive solar techniques for cooling, heating, and lighting.



Image courtesy of Jean D. Dodd

Figure 1.1 Cliff Palace at Mesa Verde National Park

Over time as civilizations grew static, buildings took on a different significance. Civic structure and time for play and leisure developed buildings of cultural and political significance. Humankind was no longer building for survival alone. Some examples of this transitional period were the inspiring and elegant structures built by highly skilled craftsmen to last lifetimes. Buildings like St. Peter's Basilica in Vatican City, St. Basil's Cathedral in Moscow, and the Alhambra in Granada, Spain, are now centuries old and still exist today (Figure 1.2).



Image courtesy of Brad Nies

**Figure 1.2** St. Peter's Basilica, Vatican City

With the Industrial Revolution came the ability to mass-produce interchangeable building materials more quickly and inexpensively than skilled laborers of the past. The goal of the Industrial Revolution was to conserve human labor while increasing production of all things needed for human society. Herein lay the beginning of prefabrication and interchangeable parts. Natural resources, in the industrial model, were rarely valued at their true cost. Most natural resources were treated as if they were abundant, unlimited, and inexpensive.

As we turned the corner into the early twentieth century, humankind started to master premanufactured materials and components, transporting materials from around the globe. At this stage, buildings were still responding to natural light and

natural ventilation with narrow footprints and tall operable windows. However, the invention of better technologies for electric lighting, elevators, and other mechanical systems soon changed our built environment for decades to follow (Figure 1.3).



Image courtesy of Brad Nies

**Figure 1.3** The Wainwright Building, one of the world's first skyscrapers, 1891.

As technologies like heating, ventilation, and air-conditioning (HVAC) systems continued to flourish, the building industry moved away from design that was specific to climate, culture, and place and toward uniform standards for all situations. Our built environment relies on developed technology standards that for the most part have been turned into building codes and thereby linked to product warranties. Most of our heating and cooling is mechanical, most of our lighting is artificial, and we get our building materials from anywhere in the world. Starting in the middle of the twentieth century through today, humans, especially North Americans, have continued to develop buildings in each and every one of our major climate zones with no respect for local climate.

We believe the modern understanding of human impact on the natural environment started in the 1960s, with the exact event remaining unclear. The key milestones from that decade that we refer to are the 1962 release of Rachel Carson's best-selling book *Silent Spring*—a book Brad's high school chemistry professor assigned as required reading in 1987—and the passing of the Wilderness Act of 1964.

*Silent Spring* was the first open look at widespread ecological degradation from poisons, insecticides, weed killers, and other common products.

The Wilderness Act for the first time established a National Wilderness Preservation System and, according to the U.S. Department of Interior, legally protected almost 9 million acres of wilderness in the United States by designating it as preservation area.

Interest continued in the 1970s as a growing number of people realized that humans have a direct impact on the natural environment. Two creations from the 1970s that are still with us today are Earth Day and the U.S. Environmental Protection Agency (EPA).

A U.S. Senator from Wisconsin, Gaylord Nelson, called for an environmental teach-in, or Earth Day, to be held in the spring of 1970. It is estimated that on April 22, 1970, over 20 million Americans participated in demonstrations that year. Earth Day is now coordinated by the nonprofit Earth Day Network and is observed in 175 countries. Earth Day Network claims that Earth Day is now “the largest secular holiday in the world, celebrated by more than a half billion people every year.”

The EPA was also founded in 1970 by then-President Richard Nixon. According to the EPA, its mission is “to protect human health and the environment.”

Also during the 1970s a small group of design professionals and building occupants started to understand how standard design and construction practices had veered too far away from earlier reliance on natural principles. This short-lived portion of the *Green Building* movement began as a reaction to oil shortages and the political and environmental events of the time. This part of the movement was therefore focused primarily on energy conservation. However, after the oil embargo and the Arab-Israeli and Vietnam wars ended in the middle part of the 1970s, we went back to our path of ecological ignorance, staying in that pattern until the early 1990s.

The period just over a decade long where our thinking lapsed saw several major environmental events that provided plenty of reasons to create change in our human behavior. These negative events were Love Canal, the Amoco Cadiz oil spill, the Three Mile Island nuclear incident, the British/American discovery of the Antarctic ozone hole, and the Exxon Valdez oil spill. One positive event during late 1980s was the adoption of the Montreal Protocol, an international treaty designed to phase out production of substances responsible for ozone depletion.

### **Recent Trends Toward Sustainable Design**

So where did the most recent dialogue about *green* start in the realm of building design and construction? We believe it started in the early 1990s with the formation of the American Institute of Architects (AIA) Committee on the Environment (COTE) and the formation of the U.S. Green Building Council (USGBC).

During the 1970s portion of the Green Building movement, the AIA formed the Energy Committee. According to AIA historical documents, committee members created documents that helped the AIA lobby Capitol Hill and collaborated with government agencies for energy efficiency. Unfortunately, the committee's efforts lost steam as the price of energy became more affordable. Leaders from this group strived to keep energy and environmental concerns as a major design topic, and support surfaced at the 1989 AIA Convention in St. Louis, Missouri. AIA Kansas City Chapter President Kirk Gastinger, FAIA (AIA Fellow), and president-elect Bob Berkebille, FAIA, presented Critical Planet Rescue (CPR), a measure calling for the Institute to sponsor research and to develop a resource guide to help architects and their clients to act responsibly. A combination of national support for CPR and more than \$1 million of grant funding from the EPA led to the formation of AIA/COTE at the 1990 convention.

### **AIA/COTE**

AIA/COTE continues to be a large part of the continuing dialogue with industry partners, communities, not-for-profit organizations, and government agencies about sustainable design. As a result of being a part of this dialogue, there are two key things that AIA/COTE has contributed to moving us all forward. First is AIA/COTE's original top priority, which was the creation and publication of the Environmental Resource Guide (ERG) from 1992 to 1998. Second is the creation of the AIA/COTE Top Ten Green Projects program in 1997, a program that still runs today.

The ERG was funded primarily by the EPA grant and produced by the early members of AIA/COTE and a Scientific Advisory Group on the Environment (SAGE), which was comprised of nonarchitectural partners. The purpose of the ERG was to provide architects and others in the building industry a basis for comparing the environmental impact of building materials, products, and systems. This was accomplished

by a simplified method and consistent format for assessing the environmental impacts of building materials from their original extraction and manufacture to their final disposal or reuse. The ERG exemplified the following ideals that are foundational to sustainable thinking:

- The understanding that dialogue about solutions must be multidisciplinary
- The latest information even if developing should be shared for a broader perspective and understanding
- That everyone can contribute to a better understanding

The AIA/COTE's Top Ten Green Projects program (<http://www.aiaopten.org/>) was created to share built examples of successful integrated thinking so that others can learn. Both the Department of Energy (DoE) and EPA have been involved with support since the beginning of the program. Currently, the EPA Energy Star program, the DoE, and Building Green Inc. provide support for the Top Ten Green Projects awards (Figure 1.4).



Image courtesy of Richard Payne, FAIA

**Figure 1.4** University of Texas School of Nursing AIA COTE Top 10 Winner in 2006

The program is open to any project that has been designed by an architect licensed in the United States and completed by a selected date. Project teams submit projects electronically plus one printed board to be judged according to AIA/COTE's following ten "Measures of Sustainable Design and Performance Metrics":

- Design and Innovation
- Regional/Community Design
- Land Use and Site Ecology

- Bioclimatic Design
- Light and Air
- Water Cycle
- Energy Flows and Energy Future
- Materials and Construction
- Long Life, Loose Fit
- Collective Wisdom and Feedback Loops

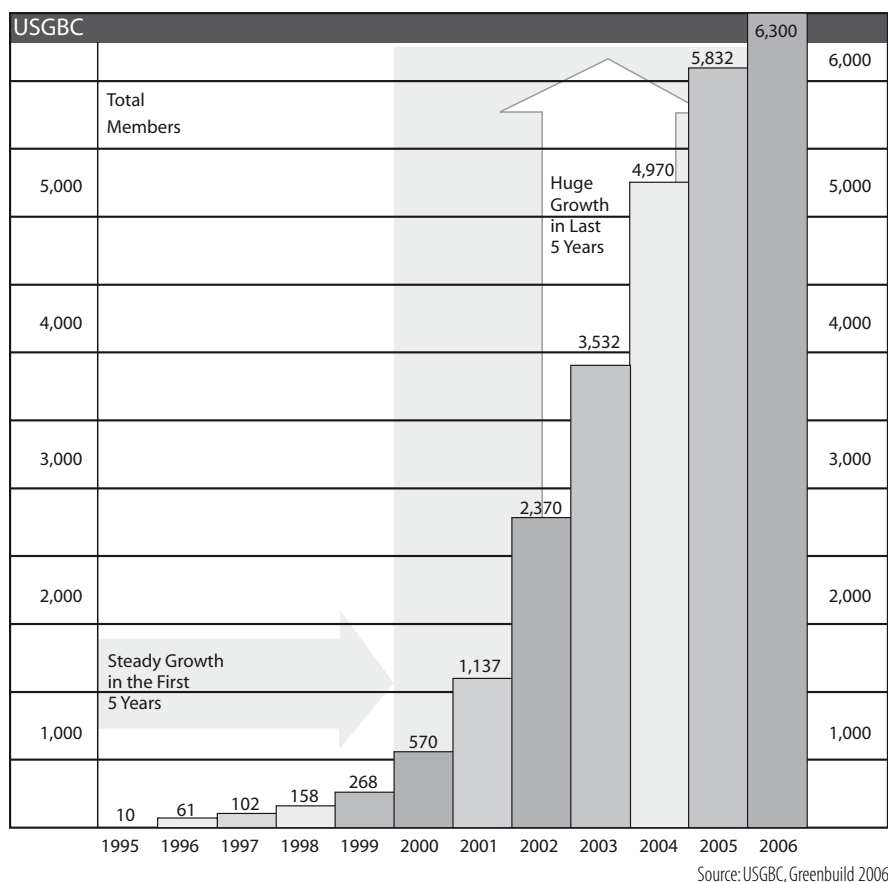
The multidiscipline invited jury reviews both the qualitative and quantitative information provided by the project team and then awards ten projects a Top Ten award, solidifying those projects as some of the greenest buildings that year. According to the AIA, the number of project submissions continues to grow each year. During the first year there were only around 15 entries. Then from 1998 to 2004 entries grew from just over 20 to around 45. From 2005 to 2006, entries hovered around 60–65, and in 2007 the number jumped to 100.

### **The USGBC**

The USGBC (<http://www.usgbc.org>), a nonprofit organization, was formed in 1993 with the intent to help define and promote sustainable building practices. Several original steering committee members from AIA/COTE participated in the early steering of the USGBC. One of the primary differences between the groups is that the USGBC is not beholden to any one profession; it includes all building industry professionals. A main staple of the USGBC is the Leadership in Energy and Environmental Design (LEED) green building rating system, which we will cover in depth later in this chapter in the section “Green Building Rating Systems.”

As a result of defining standards for measuring how green a building is, the USGBC has established itself as a recognized trade name that manufacturers, building designers, contractors, and owners use to compete for third-party recognition that what they do, offer, or produce is recognized as green. Much like the ERG, LEED has educated the building construction industry, building owners, and designers. It has also raised consumer awareness of better, greener buildings. A testament to this is the rapid growth of both the LEED program and the USGBC membership. As last reported by the USGBC in 2007, they have 12,400 member companies and organizations, quadruple the number from five years prior. Individuals from these companies participate in over 72 local chapter components, and attendance at the national conference, Greenbuild, has grown to more than 20,000 people. Through 2007, according to the USGBC, over 3 billion square feet of building space are a part of the LEED program (Figure 1.5).





**Figure 1.5** Growth of the USGBC

Groups like AIA/COTE, the USGBC, and others have defined what a *green building* is and tirelessly continue to educate the industry. Unfortunately, that definition is still widely debated even within the systems that have been created for our daily use. Is a green building sustainable? Can a building be considered green without achieving complete sustainability? As our knowledge has increased, rightly so have our questions.

### Defining Sustainable Design

Before moving forward, we should be clear about the terms *green* and *sustainable*. What does being *green* mean to you? Undoubtedly it will mean something a bit different to you than the person next to you. In fact, in only the past few years has the term become common outside of the industry. In 2005 if you told someone that you were designing a green building, you would have to follow up with an explanation about how that meant it was environmentally friendly, not the color green. In a nutshell, that is how the term was and still is widely used—a green building has less of an impact on the natural environment than the traditional buildings the industry has completed over the last three decades. Only recently have we been able to quantify this impact.

Industry language has transitioned from using the term *green* to *sustainable*. This has made the definition of sustainable design more cumbersome but is definitely a vast improvement in how we think about our buildings. A *sustainable* design is better than a *green* one because sustainability takes into account a greater array of impacts than just those that burden the natural environment.

For example, whereas green building of the early 1990s might have contained some materials with some recycled content, a building of today that is approaching sustainability will consider the whole lifecycle of the product. Designers, contractors, and owners consider raw material extraction, manufacture location and processes, durability, reuse, and ability of the material to be recycled. We will cover more examples later in this book.

So what is the best definition for sustainable design? We find the World Commission on the Environment and Development, also known as the Brundtland Commission, offered the best definition in the 1987 report to the United Nations:

*Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.*

According to the report, the commission was convened by the United Nations in 1983 to address growing concern “about the accelerating deterioration of the human environment and natural resources and the consequences of that deterioration for economic and social development.” In establishing the commission, the UN General Assembly recognized that environmental problems were global in nature and determined that it was in the common interest of all nations to establish policies for sustainable development. The 1987 report, published as “Our Common Future,” deals with sustainable development and the change of politics needed for achieving that change.

In his 1998 book, *Cannibals with Forks*, John Elkington offers a deeper look into the definition of sustainability. Elkington described a concept called *Triple Bottom Line* accounting. In this form of accounting, entities would take into account their environmental and social performance in addition to their economic performance (Figure 1.6). These three areas, which we refer to as People, Planet, and Prosperity, are commonly called the three legs of the sustainability stool. We believe that correctly balancing decisions over all three areas results in a sustainable solution.

With a broader range of thinking and understanding being developed about sustainability, the building industry is also exploring the deeper meanings. Language in the building industry still remains loose, using the terms green and sustainable interchangeably. As criteria for sustainable design principles have been explored, several leading thinkers have tested designs and written about the differences between green design and sustainable design. Two documents from the first decade in the twenty-first century address the difference.

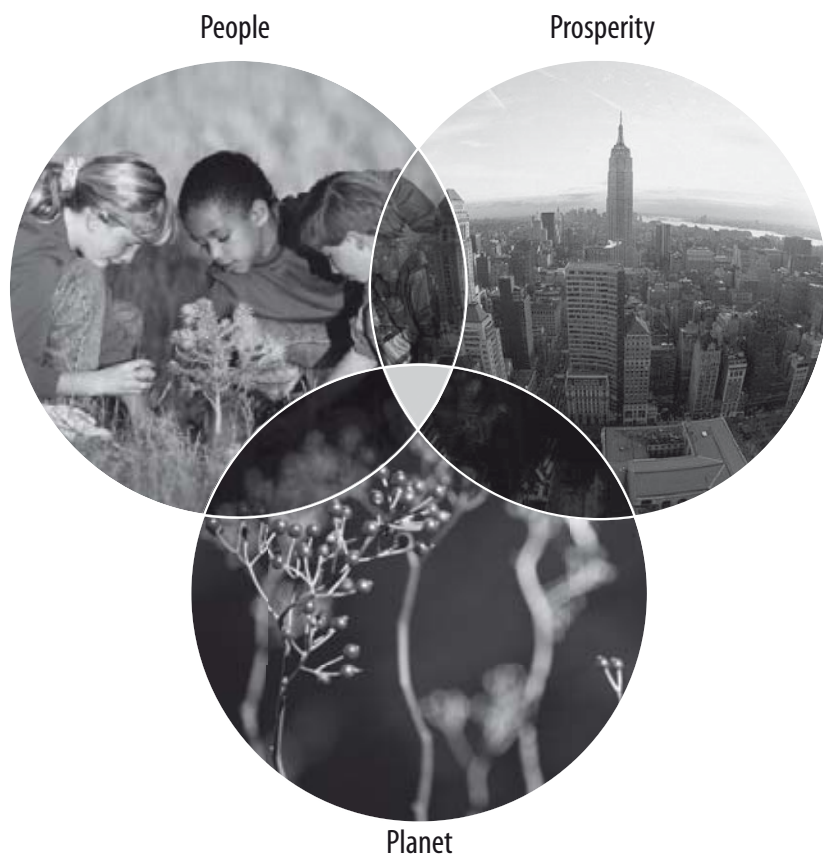


Image Courtesy of BNIM Architects

**Figure 1.6** The Triple Bottom Line

One document is “Building for Sustainability” (2002) by BNIM Architects in close collaboration with Keen Engineering, Oppenheim Lewis, Hawley Peterson & Snyder Architects, and the Facilities Steering Committee of the Packard Foundation. The document is freely available at <http://www.bnim.com/fmi/xsl/research/packard/index.xsl>. In two parts, *The Sustainability Report* and *The Sustainability Matrix*, this document describes the process and results of an exercise completed during the early design phase of the David and Lucile Packard Foundation’s Los Altos Project.

The Sustainability Report and The Sustainability Matrix were created in response to the Packard Foundation’s query about how to develop a decision-making tool to explain the impacts of different levels of green for the proposed project. Developing an answer to the question was accomplished by designing six solutions, based on the same program, same site, and meeting the required building codes, changing the

design to increase environmental performance. The solutions are organized around meeting the four different green building certification levels of the USGBC LEED Rating System (more information later in this chapter), plus one standard market design and one beyond LEED that approaches sustainability. Impacts for each of the six solutions were quantified in the categories of Building Form, Energy, Pollution, and External Cost to Society, Schedules (Design and Construction), and Short- and Long-Term Costs (Design and Construction).

The design solution that went beyond LEED was conceptualized as a *Living Building*. In “Building for Sustainability,” a Living Building is defined as having zero net annual impact on the environment from an operational standpoint. It provides its own energy and water, cleans its own wastes, and emits no pollution. The report authors also acknowledge that a truly sustainable building would mitigate impacts during design and construction.

When reviewing the report many professionals are primarily interested in the first cost premium for each solution. Compared to the market, building the green solutions of LEED Certified, Silver, Gold, and Platinum cost 1%, 13%, 15%, and 21%, respectively. The most sustainable solution, the Living Building, had an increased first cost of 29% compared to the market building, yet it was more cost effective to construct, own, and operate than the market building in less than 30 years’ time. This is where the financially conscious person’s attention should be focused—the total cost. The data showed that over a 100-year span, the Living Building wouldn’t incur the costs associated with the market building over 30 years.

Today, just five years later, the state of California has updated its building codes, and the design solutions with the two lowest levels of environmental performance from “Building for Sustainability,” the market building and the LEED Certified building, would not meet the current California Energy Code. This would change the premium between the market building and the Living Building to only 14%.

The other document addressing the difference between green and sustainable design is the *Trajectory of Environmentally Responsive Design* (2006) by Integrative Design Collaborative. The design pattern described in this document is shown in Figure 1.7 and follows the thinking described so far, but also takes it to the next level. The text refers to a truly sustainable design as neutral, or as this document attributes to Bill McDonough, a sustainable building is just “100% less bad.” To truly have an environmentally and socially responsible design solution, we must go beyond sustainable design and start thinking about how our built environment can actively restore our planet or even work as an integral part of the system helping it regenerate.

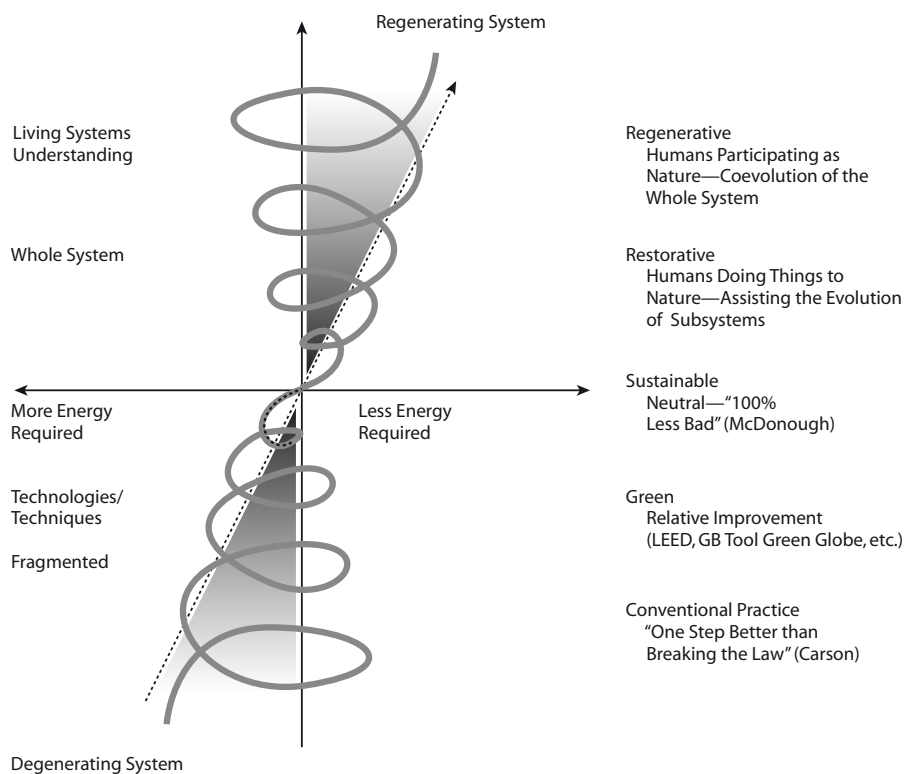


Image Courtesy of and © Integrative Design Collaborative and Regenesi 2006

**Figure 1.7** Trajectory of Environmental Responsibility

## Why Is Sustainable Design Important?

Now that we have better defined sustainability, let's talk about why it is important. As stated before, the three widely accepted legs of the sustainability stool are People, Planet, and Prosperity. Given human nature, each of us might tend to value one a little bit more than the other two, but the more that we can make the three of them balance out, the better our design solution will be.

### People

As designers, we have a code of ethics that includes our responsibility to protect life. Traditionally, this responsibility has been viewed as the lives of occupants within our buildings. In reality, the choices that we make also affect human life beyond a particular building or site. The impact of our choices ranges from those who manufactured the materials and products the building is composed of to the inhabitants in places up and downstream from the building.

There have been some commonly used materials in buildings that are suspected or known to have harmful toxins, carcinogens, endocrine disruptors, or other harmful chemicals. People can be exposed to these substances either during manufacture, an

emergency event such as a fire, or in some cases just by occupancy. Also there are naturally occurring substances in materials that off-gas and accumulate in greater quantities when enclosed within the building envelope. As the industry learned from asbestos treated materials and chromated copper arsenate (CCA)–treated wood, the temporary benefits of these materials are not worth the long-term potential to harm building users. We must eliminate the use of such materials when there is an appropriate alternative. The industry must also strive to develop alternatives when a material has become suspect.

Other factors, and of no less importance, that influence the health and well-being of building occupants include noise, temperature, humidity, access to fresh air, daylight, and views and the ability to control them. Most owners should have the well-being of their employees in mind because oftentimes the cost of employees, not to mention attracting and keeping the best ones, outweighs the first cost and operational cost of the building. Sometimes people are the company's most expensive investment.

The USGBC has compiled many of the studies that have been done on the relationship between green buildings and people. They make them all freely available on the Green Building Research page of their website, <http://www.usgbc.org>. Studies have found that green buildings have human health and productivity benefits, such as better test performance in schools, earlier discharges from hospitals, increased sales in retail environments, increased production in factories, and increased productivity in the office environment.

### **Planet**

With her book *Silent Spring*, Rachel Carson started making us aware of our impact on the planet. Since then many metrics have been developed to compare past, present, and future patterns against. The built environment has played a major part over the years.

According to the USGBC and the U.S. Census Bureau, buildings in the United States consume 30% of the world's total energy and 60% of the world's electricity annually for only 4.5% of the world's population. The energy consumption by buildings results in pollution, ozone depletion, and global warming, which in turn causes health problems for every living species. The natural resources used to make buildings are either nonrenewable, such as plastic or steel, or harvested more quickly than they can be replenished, like wood from the old-growth forests. According to the USGBC, buildings also consume 5 billion gallons of potable water per day to flush toilets, more than enough clean water wasted to provide every person in the world with clean drinking water. The USGBC LEED Reference Guide warns that the typical North American commercial construction project generates 2.5 pounds of solid waste per square foot of floor space.

In 2005, Capital E, a clean energy strategic consulting firm led by Greg Kats, studied all the buildings that had achieved LEED certification to that point. Capital E has calculated that green buildings have an average energy savings of 30%, a 35% reduction of carbon on average, a 30–50% savings in potable water use, and a 50–97% reduction in landfilled wastes.

A current metric that has garnered a lot of attention lately is carbon. The term *carbon* is actually used as a catchall for greenhouse gas emissions because it accounts for about 80% of all greenhouse gases. The built environment has many pathways for generating greenhouse gas emissions. First we think of the energy a building uses to operate. In the United States, that energy is primarily from a coal-fired power plant, one of our dirtiest sources of energy. Next are the emissions from constructing the building, which includes the harvesting, manufacturing, and transportation of the materials to the site. Finally there is the location of our building; if the building is located such that the majority of users must drive to it, we by default create an additional carbon load.

According to Architecture 2030 (<http://www.architecture2030.org>; a nonprofit, nonpartisan, and independent organization), data from the U.S. Energy Information Association (EIA; accounting for the embodied energy of materials and the operations of buildings) shows that buildings in the United States account for 48% of all greenhouse gas emissions.

## Prosperity

The continued importance for role of the prosperity leg, which has traditionally driven most corporate decisions, often surprises some of the newest triple-bottom-line thinkers. Green design as we know it today has cost benefits, and the cost benefits of a sustainable design are rapidly developing shorter return on investment times.

Of primary interest to many building owners is the first cost premium traditionally associated with green buildings. As mentioned before, the 2002 “Building for Sustainability” document showed a rising cost premium with each level of green, culminating in a 29% first cost difference between a Living Building and a Market Building. While third parties verified all of that data, the building was never built.

In 2003 Capital E looked at 33 LEED-certified buildings in California and found that the average first cost premium across all levels of LEED certification was less than 2%. Davis Langdon, an international construction cost management consulting firm, reviewed both LEED and non-LEED projects nationally and found that the level of green doesn’t necessarily determine the first cost. Davis Langdon first reported this in their 2004 report “Costing Green” and then again in “The Cost of Green Revisited (2007).”

Many of the strategies used to create healthier spaces for people have utility operational cost savings, but those savings are normally a drop in the bucket compared

to the productivity gains mentioned earlier in this section. A 1% improvement in work-force productivity likely outweighs the utility cost savings because people are the most expensive investment a company has by the time you factor in the salaries and benefits.

Whichever leg of the stool you want to most align yourself with, make sure you honor the other two for balance and the most holistic return on your effort.

## **Green Building Rating Systems**

The first building project Brad worked on was an elementary school. When the project team asked the owners if they had any environmental goals, they responded, “Yes, use 25% recycled plastic toilet partitions.” By incorporating this trendy product of the time, they felt that they were doing their part for the planet. Little did any of us know that many of our other decisions addressed issues that today are considered green-building features. During that project, the team doubled the amount of windows in each classroom compared to previous models, provided operable windows, and designed daylight clerestories with shading and glare control in public and assembly spaces. These design features have since been proven by many researchers to increase the health, productivity, and learning of school occupants by making a better environment. They also represent criteria of the model green building rating systems.

According to Fowler and Rauch’s “Sustainable Building Rating Systems Summary” in 2006, there were over 34 green building rating systems or environmental assessment tools available to the marketplace, and the number is likely to grow. In our opinion, here are the five primary developing players in green building rating systems:

- Comprehensive Assessment System for Building Environmental Efficiency (CASBEE)
- SBTool (formerly known as GBTool)
- Building Research Establishment’s Environmental Assessment Method (BREEAM)
- Green Globes U.S.
- LEED (Leadership in Energy and Environmental Design)

Each of these in some part was developed to promote environmentally responsible design, construction, and operating approaches as well as transform the built environment and marketplace as we traditionally understand it. All of them offer some form of score so that the high-performance claims of projects can be compared openly, at least within each system.

In the following sections, we provide our review of the five leading systems based on our experiences and our study of documents available at the respective organizations’ websites, rating system guides, and tools developed for using the systems. We’ve provided the website for each organization for your use.



## CASBEE

CASBEE (<http://www.ibec.or.jp/CASBEE/english/>) is the newest of the systems and was developed in 2001 for use in Japan through cooperation of academia, industry, and government under the Japan Sustainable Building Consortium (JSBC). The system has been developed for New Construction (NC), Existing Buildings (EB), Renovations (RN), Heat Islands (HI), and Urban Developments (UD). Only the 2004 NC version is available in English, but it is downloadable from the CASBEE website for free.

CASBEE distinguishes itself from the others in that it is founded on a new principal of Building Environmental Efficiency (the BEE portion) as the major indicator of overall performance. The two parts to this principal are the Building Environmental Loadings (L), which is defined as the impact of the building on the outside world beyond a hypothetical project boundary, and Building Environmental Quality and Performance (Q), which is defined as improvements for the building users within a hypothetical project boundary. Users are encouraged to think about the project boundary as the division between private and public property. It is represented by the system as the following equation:

$$\text{BEE} = \frac{\text{Building Environmental Quality and Performance (Q)}}{\text{Building Environmental Loadings (L)}}$$

Overall, 100 subitems are scored within the three major categories of Q and L. Criteria for Q are developed from Indoor Environment, Quality of Service, and Outdoor Environment on Site issues. Criteria for L are developed from Energy, Resources and Materials, and Off-Site Environment issues. Each area is scored on a scale of 1 through 5, with 3 being average and 1 being the worst. Results from comparing the quality and the load reduction are plotted on the graph, as shown in Figure 1.8, and the better buildings will graph a scenario of high quality with the least environmental load. The final score of the project is put on a graph and graded C (poor) through B–, B+, A, and S (excellent). We have been unable to find a U.S. project that has used this system.

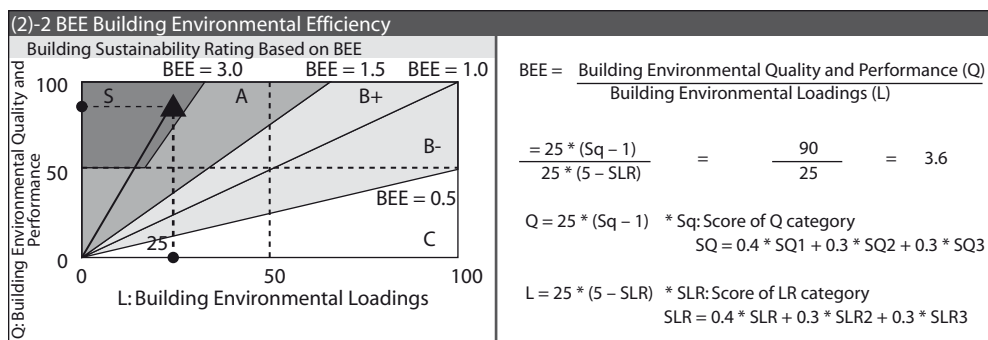


Figure 1.8 Graphic results from the CASBEE calculation tool

## SBTool

SBTool ([http://greenbuilding.ca/iisbe/sbc2k8/sbc2k8-download\\_f.htm](http://greenbuilding.ca/iisbe/sbc2k8/sbc2k8-download_f.htm)) is the current generation of GBTool, which was launched in 1998 as part of the Green Building Challenge (GBC), a program developed by Natural Resources Canada. In 2002, the International Initiative for a Sustainable Built Environment (IISBE) took over responsibility of running the GBC and has since renamed it to the Sustainable Building Challenge (SBC).

Similar to CASBEE, SBTool is a framework tool for assessing buildings based on environmental performance. The overall framework has 116 parameters spread over seven main categories. Those categories are:

- Site Selection, Project Planning, and Development
- Energy and Resource Consumption
- Environmental Loadings
- Indoor Environmental Quality
- Service Quality
- Social and Economic Aspects
- Cultural and Perceptual Aspects

One of the unique claims to this system is that it is highly adaptable to local needs and conditions. This is intentional and explains why more than 20 countries around the world are able to participate in the SBC and the development of the SBTool. As part of the adaptability, building performance is related to nationally established baselines or benchmarks. The IISBE notes that the scoring is meaningless unless the national team has established the baseline values. In other words, it only becomes a rating tool for a region if the performance baselines are agreed to. In an attempt to have further flexibility, the IISBE also touts that the SBTool can be used for projects of all sizes, commercial or residential, as well as both new construction and renovation.

The tool comes in three parts. First is the tool for noting and weighting the appropriate standards for the region the project is in. Second is a tool for the design team to describe all the project information. Last is the assessment form, which is based on information from the first two forms. At the current development stage, the IISBE recommends using the system for design assessments only.

## BREEAM

BREEAM (<http://www.breeam.org>) has been most widely used in the United Kingdom and is the oldest of the five, getting its start in 1990. According to BREEAM, versions are updated regularly in line with UK Building Regulations. BREEAM assesses the performance of buildings in the following areas:

- Management
- Health and Well-Being

- Energy
- Transport
- Water
- Material and Waste
- Land Use and Ecology
- Pollution

An officially trained assessor assesses the project to develop the overall rating for the project. A first assessment can be done at the end of the design stage, with the final assessment coming after occupancy. Becoming an assessor is open to all building professionals who are trained by the BREEAM quality assurance body called BRE.

Credits are awarded in each area according to performance and then added together through a combined weighting process. Finally, the building is rated on a scale of Pass, Good, Very Good, or Excellent, and a certificate awarded to the project. Although BREEAM was originally available in two types, one for office and one for homes, it is now available in a range of building types: offices, homes, industrial, multi-residential, prisons, retail, and schools.

Achievement of BREEAM ratings is required by several UK organizations, including English Partnerships, the Office of Government Commerce, the Department for Children Schools and Families, the Housing Corporation, and the Welsh Assembly. BREEAM has caught on in other countries, and they have developed a tool called BREEAM International to assist with this. Additionally, BREEAM has been used as the basis for other assessment tools.

### **Green Globes**

Green Globes (<http://www.greenglobes.com>) is one of the systems that grew out of BREEAM. Green Globes first appeared as an online version of BREEAM for existing buildings in Canada in 2000. In 2002 it was adapted for use in the design of new buildings, and then in 2004 it was converted to a U.S. version, which is distributed and run by the Green Building Initiative (GBI). Recently, GBI became accredited as an American National Standards Institute (ANSI) standards developer, and they are in the process of trying to establish Green Globes as an official ANSI standard.

The Green Globes tool itself is questionnaire based. To that end teams are expected to answer questionnaires and review recommendations developed from their answers at each stage of the design process. The rating system is based on the construc-

tion document questionnaire. The point system includes up to 1,000 points across the system's seven main sections:

|   |            |
|---|------------|
| Project Management—Policies and Practices     | 50 points  |
| Site  | 115 points |
| Energy  | 360 points |
| Water   | 100 points |
| Resources, Building Materials and Solid Waste | 100 points |
| Emissions and Effluents                       | 75 points  |
| Indoor Environment                            | 200 points |

The final Green Globes rating is expressed by a number of globes from one to four. The number of globes is based on the percentage of points successfully obtained:

|          |         |
|----------|---------|
| 1 Globe  | 35–54%  |
| 2 Globes | 55–69 % |
| 3 Globes | 70–84%  |
| 4 Globes | 85–100% |

A unique thing about Green Globes is the focus given to lifecycle assessment (LCA); the majority of the Resources points are LCA related. According to GBI, “LCA considers materials over the course of their entire lives and takes into account a full range of environmental impact indicators—including embodied energy, solid waste, air and water pollution, and global warming potential.” To assist project teams in developing a better understanding of these impacts, GBI commissioned the Athena Institute, one of the North American leaders in LCA, in association with the University of Minnesota and Morrison Hershfield Consulting Engineers, to develop the ATHENA EcoCalculator for Assemblies. The tool provides information on common building assemblies and has since been made available to anyone free of charge (<http://www.athenasmi.ca>).

An original goal behind the creation of the Green Globes system was to provide a simple, online, self-assessment tool. While this allows flexibility and cost savings compared to other rating systems, it can make the credibility of the assessment suspect. To that end, Green Globes has recently developed a third-party verification system. Verification is provided by a Green Globes trained licensed architect or engineer who has been approved by GBI. Precertification can be obtained after the construction document stage, with the final rating and ability to use the Green Globe certification coming after the Green Globes verifier reviews the completed project. Buildings that have been third-party verified for certification receive a plaque for display. Green Globes estimates the average total cost for all assessments to be \$4,500 to \$5,500. Currently no organizations require Green Globes ratings for their buildings.

## LEED

The USGBC introduced the LEED (<http://www.usgbc.org>) green building rating system in 1998 as LEED for New Construction (LEED-NC), making it the second oldest system of the five described here. The rating system has two key fundamental attributes.

First it was developed with an open consensus-based process, with input from a broad range of building industry professionals and other experts, including the U.S. Department of Energy. Second, and common to the other systems, using LEED is voluntary. A goal behind creating the LEED system was to establish a measurement standard for what is considered a *green* building, comparing them on an even playing field. At the time of creation, some U.S. practitioners were finding it difficult to decipher the claims of their competitors and building product manufacturers who also had started campaigns about how environmentally conscious their product or building was.

With its required third-party certification, LEED made it clear which buildings were high-performance green buildings and which ones were not. Under the LEED-NC system, buildings are judged via a 69-point credit system in five categories of environmental performance and one additional area for innovative strategies (Figure 1.9). The five major categories and credits available in each are:

- Sustainable Sites (14 points)
- Water Efficiency (5 points)
- Energy and Atmosphere (17 points)
- Materials and Resources (13 points)
- Indoor Environmental Quality (15 points)
- Innovation and Design (5 points)

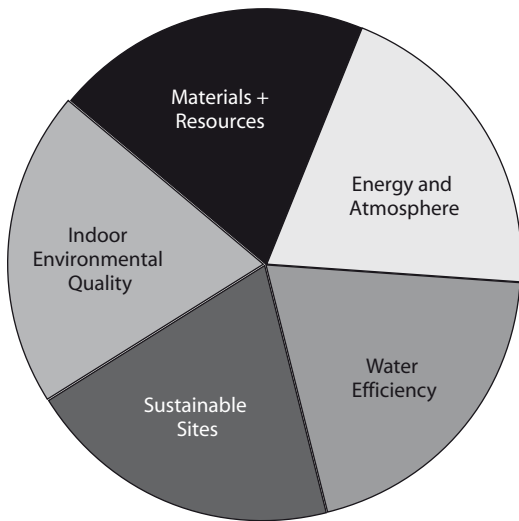


Image Courtesy of BNIM Architects

**Figure 1.9** The five sections of the USGBC LEED rating system

In addition to the points, seven prerequisites must be met to participate in the program. These are considered the basics of a green building, such as construction pollution prevention, a recycling program, no smoking, no chlorofluorocarbon (CFC) refrigerants, basic building commissioning, minimum indoor air quality performance, and a

baseline for energy performance. Up until June 26, 2007, once those seven prerequisites were met, the points attempted were left up to the team. It was at this time, in reaction to stakeholder cries for more progressive energy efficiency requirements, that the USGBC made achieving the first two Optimize Energy Performance points required as well.

To show credit achievement, the team must document in an online system per the LEED-NC Reference Guide how the project achieved each attempted credit. After the construction document phase, the team can submit design credits for a cursory review. Only after construction is complete can the team submit the project to the USGBC for certification. The total credits achieved in each category are added together for the final score to determine the level of certification awarded to the project. The four levels of certification are as follows:

|                |               |
|----------------|---------------|
| LEED Certified | 26–32 points  |
| LEED Silver    | 33–38 points) |
| LEED Gold      | 39–51 points  |
| LEED Platinum  | 52+ points    |

A plaque is provided to the building owner for display in the building upon successful certification. This clear, simple, verified system has been greeted with rapid adoption across the U.S. building design and construction industry. Originally developed for use in the United States, buildings have earned LEED in 13 other countries.

The USGBC has updated the LEED NC program three times since its inception, making the system more challenging and user friendly each time. Also, the USGBC has developed specific versions of LEED for Core and Shell Development (CS), Commercial Interiors (CI), Existing Buildings (EB), Homes (H), Schools (S), and Retail (R). As of June 2007, there are over 900 certified buildings and almost 7,000 more that are registered to seek certification.

As a result of LEED entering the marketplace, the building industry, building owners, and design practitioners have been educated and consumers made more aware. A key part of this education has been the LEED Accredited Professionals (AP) program. Individuals can show their proficiency with the LEED system and at understanding green building practices by taking the LEED accredited professionals exam. Individuals who succeed may use the designation LEED AP after their name. This is yet another level of competition among design and construction firms. One of our partners on the Building for Sustainability project, KEEN Engineering at one time had the largest amount of LEED APs. They celebrated each individual's achievement with a hockey jersey bearing the firms' KEEN Green logo. This can be a fun, inner-firm competition. We annually hold LEED Accreditation workshops open to all BNIM Architects' employees.

As a testament to how well received and beneficial the LEED program is, a number of federal government agencies, states, and local municipalities require LEED certification. The following facts were gathered from the USGBC website:

- The Department of Agriculture, Department of Agriculture-Forest Service, Department of Health and Human Services, Environmental Protection Agency, National Aeronautics and Space Administration, Smithsonian Institution, U.S. Army, U.S. Navy, and the General Services Administration all require LEED Certification, and some require achieving the Gold Level.
- More than half U.S. states have laws requiring project of specific sizes to meet LEED certification standards, six of them requiring actual certification. Ninety-two cities have adopted LEED standards of some form in ordinances, mostly for municipally owned developments.
- Washington, D.C. has provisions for requiring LEED Certification for private developments starting in 2008.
- In January 2008, the town of Greensburg, Kansas, became the first city in the United States to require LEED Platinum Certification for all city buildings.

As great as these rating systems are and have been for the industry, none of them are set up to produce or lead a team to a sustainable building—only a green one that is less bad than what we’ve seen over the past few decades.

### **Living Buildings: The Near Future of Sustainable Design**

It was only a short nine years ago when the USGBC launched LEED into the marketplace and changed the course of design for many professionals. In 2006 at Greenbuild, the USGBC national conference, the Cascadia Region Green Building Council launched the Living Building Challenge (LBC) (<http://www.cascadiagbc.org/lbc>) with remarks from Jason F. McLennan, Cascadia GBC CEO, and Bob Berkebile FAIA.

Unlike the current green building rating systems, LBC is based on what the building does, not what it is designed to do. As the name suggests, the building must achieve living status in that it has zero net annual impact on the environment from an operational and construction perspective. Buildings are judged on 16 different achievements referred to as prerequisites. Simply put, the project either complies or it doesn’t.

The 16 prerequisites are spread across six areas as follows:

- Site Design
  - Responsible Site Selection
  - Limits to Growth
  - Habitat Exchange
- Energy
  - Net Zero Energy
- Materials
  - Materials Red List
  - Construction Carbon Footprint
  - Responsible Industry

- Appropriate Materials/Service Radius
- Leadership in Construction Waste
- Water
  - Net Zero Water
  - Sustainable Water Discharge
- Indoor Environmental Quality
  - A Civilized Work Environment
  - Healthy Air/Source Control
  - Healthy Air/Ventilation
- Beauty and Inspiration
  - Beauty and Spirit
  - Inspiration and Education

In 1997 Brad worked with Bob, Jason and a highly diverse team of integrated professionals on the Montana State University Epicenter, a project which started defining the idea of a Living Building. Unfortunately, it was never built, but it did define a new benchmark to be reached. In our opinion, the Adam Joseph Lewis Center at Oberlin College, by William McDonough + Partners, currently represents the closest a completed building has come to achieving these high marks (see Figure 1.10). However, we believe in the near future there will be many actual Living Buildings as the LBC is where LEED stood only nine years ago. As the industry prevails as experienced integrated design teams, we will move on to achieve projects that are restorative and then ultimately regenerative.



Image Courtesy of David W. Orr

**Figure 1.10** Adam Joseph Lewis Center, Oberlin College