Planning for Environmental Sustainability : Learning from LEED and the USGBC

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Recommended Citation
Chance, S. (2012) Planning for Environmental Sustainability : Learning from LEED and the USGBC , *Planning for Higher Education,* Vol. 41, No. 1, Oct-Dec, 2012. doi:10.21427/D7GS5C

Planning for Environmental Sustainability

Learning from LEED and the USGBC

by Shannon Chance

The author analyzes the relationship between the US Green Building Council and higher education by examining campus use of LEED credits over time, and also suggests that the USGBC provides a model for large-scale learning organizations.

Since its founding in 1993, the U.S. Green Building Council (USGBC) has made noteworthy strides toward its stated goal of transforming the nation's construction industry. The Washington, DC-based nonprofit organization created the LEED® Green Building Rating system to support environmentally sustainable construction. The system spurs demand for green knowledge and green technologies in an overarching effort to grow the nation's capacity to produce green buildings. In this quest, LEED also provides building owners with an incentive for participating and for providing "Leadership in Energy and Environmental Design."

A critical aspect of LEED is that it uses principles of encouragement rather than enforcement (McDonough and Braungart 2002). Participation in LEED is voluntary and carries a level of social prestige. LEED also uses an incremental approach that grows out of what we already know how to do. As innovative techniques are tested and then integrated into mainstream practice, the USGBC raises the bar by requiring new registrants to seek more rigorous standards and higher point thresholds.

The LEED system engages interested parties in providing the resources of time, money, research, and development that are necessary to foster innovation. Thus, those who elect to participate help carry the up-front cost of innovation. These investments help make new approaches viable for widespread use.

The cost of constructing to a higher standard makes good sense on college campuses, where buildings need to last 60 years or more and operating costs are notoriously high (Palmese 2009). Today the USGBC offers an ever-expanding range of programs tailored to specific user groups, including higher education. As one of LEED's largest user groups, higher education has helped the system evolve (Fedrizzi 2009). However, there is ample room to expand higher education's contribution to the green construction knowledge base. Addressing pressing social issues is a core purpose of academe, and this issue warrants increased and immediate attention (Kerr 1995; Levin 2003; Rhodes 2001).

Higher education's role in LEED has concentrated on two main areas: using LEED in the construction of campus buildings and serving as USGBC members. Members of the USGBC (2009a) represent all segments of the construction industry, and their various forms of engagement help refine the system. Changes are "consensus-based and market-driven" (USGBC 2009a, p. xi). Together, the USGBC's members define targets, goals, and agendas for the organization to meet. Members volunteer time, effort, and expertise to help establish and cultivate LEED programs. Gauging how well LEED works for members and for users of the system is critical to protecting the investments they are making.

This article investigates the popularity of the system among universities—probing strengths, weaknesses, and issues of cost—and identifies trends in universities' use of LEED. Understanding the strengths and weaknesses of the system can help LEED users and the USGBC as they refine the system and their use of it. Moreover, since the USGBC represents a successful "learning organization," it provides an effective model of planning for transformational change (Birnbaum 1988; Goleman 2009). Universities stand to benefit from using it as a precedent.

USGBC'S TRANSFORMATIVE PRACTICES

Statistical analyses indicate that universities' LEED ratings and point totals have increased over time (Chance 2010b). They also indicate that the category of "Energy and Atmosphere" has been most important in determining the ratings universities have achieved. These findings suggest that the ranking system is true to its name (by rewarding focus on "Energy and Environmental Design"), and that there is some level of organizational learning occurring.

Organizational learning of the type described by Birnbaum (1988) is further apparent in various policy and measurement changes implemented over the years by the USGBC. This suggests that the USGBC can serve as a valuable model for university administrators who seek to foster organizational learning. Scholars agree that transformational change and organizational learning are difficult for universities and other large-scale organizations to achieve. The USGBC's practices reflect recommendations made by various scholars of educational planning (Cutright 2001; Hannan and Silver 2000; Holcomb 2001; Rowley, Lujan, and Dolence 1997; Senge 1990).

University leaders, in particular, stand to learn a great deal from the success of the USGBC because models of organizational learning are few and far between (Presley and Leslie 1999; Rowley, Lujan, and Dolence 1997). Colleges and universities are notoriously slow to learn from their mistakes. They generally fail to use knowledge gained from experience to improve future actions in discernible ways. They have trouble tracking data, assessing outcomes of large-scale change initiatives, and realigning their efforts in ways that help them achieve their goals (Hannan and Silver 2000; Wilson 1997).

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Despite the odds, the USGBC has been remarkably successful in spurring market transformation. Its success results from continually gathering constituent feedback, analyzing data and generating alternatives, and revising its policies and programs. Today, the USGBC is conducting and commissioning research, organizing conferences and learning events, soliciting and responding to critique, and acting to correct the type of problems that inevitably surface in the implementation of any large-scale change program (Fullan 2001; Wilson 1997). Understanding the USGBC's basic approach and assessing the strengths and weaknesses of the system are critical to using LEED well and to improving planning and construction practice.

PARTICIPATORY, MARKET-DRIVEN APPROACH

In 1998, the members of the USGBC unveiled their first large-scale program, LEED version 1. At its most elementary level, the program was designed to promote green building practices and to recognize buildings that incorporate them. The program reflected an underlying sophistication in that it was also designed to provide markets for new products, build the capacity of the construction industry to deliver high-performing buildings, and apply the cutting-edge research being generated by universities (like Oberlin College) and architects (like William McDonough).

LEED v1 integrated the most cutting-edge research being done at the time in universities, design firms, and construction sites. It did so by including the individuals doing that work directly in the process of designing and implementing the system. The point of LEED was to grow new knowledge about environmental design and expand the nation's capacity to deliver higher-performing buildings. It provided a mechanism for integrating new techniques into practice and for doing so in economically viable ways.

The LEED system uses market forces to foster positive change, creating economically viable stimulators for change. It is based on the premise that we need to start now, using the best resources we can find, and then improve our activities quickly over time using an incremental approach that relies on constant improvement.

At a deeper level, the pilot program of LEED also introduced a new paradigm into operational practice, and, remarkably, it managed to do this on a national scale. The USGBC program uses a constructivist approach to spur change—the success of LEED depends on widespread participation as well as continual upgrade. LEED represents a shift in thinking that rewards individual contributions to a collective environmental effort (Steffen 2008). It helps facilitate wide-scale transformation by using incentives to encourage change, rather than relying on the regulations, mandates, and punishments that are typically coupled with "environmental protection" (McDonough and Braungart 2002).

Another important contribution of LEED v1 was that it introduced a new way to describe invisible environmental factors, and it did so in ways that the American public could understand and embrace (Goleman 2009). As with any new system of measurement, calibration was necessary. After two years of pilot testing, the USGBC released a more refined version (LEED v2.0) for widespread use by the public. Additional refinements were introduced in 2002 and 2005 (with the release of LEED v2.1 and v2.2). In 2009, the organization introduced a major overhaul to the system (known as both LEED v3 and LEED 2009). The USGBC held two large-scale public-input sessions in the course of developing LEED 2012, slated for release in November 2012 (Roberts 2011b).

PROS AND CONS OF THE MEASUREMENT SYSTEM

To its credit, LEED provides the public with a very easy-to-understand measure of success. The system summarizes complex relationships by using straightforward scores and rankings that facilitate rationalist comparison (Goleman 2009). However, the simple nature of LEED and its checklist format are both its strength and its weakness (Malin 2003). The system helps make invisible environmental factors visible, but some of its measures may be too simplistic to accurately predict performance (Gifford n.d.; Malin 2008; Scheuer and Keoleian 2002; Stanisstreet and Boyes 1997; Udall and Schendler 2005).

The inherent difficulty of the LEED system lies in its scorecard approach, which many applicants use in piecemeal fashion (Malin 2003). The system of awarding points in order to assign LEED Green Building Ratings leads many people to assume that environmental issues can be adequately addressed using a linear, rationalist, and well-structured approach. It is immanently clear, however, that simplistic linear approaches are inadequate to address complex, ill-structured problems (Chance 2010a).

The intent of the LEED system was not to undermine the process of complex decision making, but rather to aid designers and to nudge them in a new direction. Unfortunately, those who are new to sustainability (and/or unfamiliar with the basic process of design) often assume that the scorecard lists all the important aspects of design. They gain the false impression that design problems are clear and well structured and that adding "green gadgets" is the best (or only) way to improve the environmental performance of their buildings. This add-on, techno-centric way of thinking is not as effective in meeting environmental goals as the system's designers intended.

In response, the USGBC is likely to add a category to its system. LEED 2012 may introduce a category of "Integrated Process" to reward applicants who conduct research and analysis and use it to improve their designs.

The USGBC is working to clearly define and measure a wide range of factors—and it is expanding the range of variables through a process of research and renegotiation. Identifying and operationalizing so many different factors is a truly ambitious undertaking and one where glitches are inevitable (Goleman 2009).

Any system that attempts to *quantitatively measure* complex, interrelated, qualitative variables such as "good design" and "environmental sustainability" will inevitably meet with conflicts that require resolution.

A key component in the USGBC's success is its ability to articulate a new vision for the future and present this vision in a way that a wide range of constituents can comprehend and support. Consistent with Fullan's (2001) recommendations, the USGBC's activities reflect moral purpose, understanding of change, relationship building, coherence making, and knowledge creation and sharing. Change-related environmental activities are performed with a spirit of enthusiasm, hope, and energy. Intense commitment to the vision is evident among stakeholders inside and outside of the USGBC. As Fullan's model indicates, where these factors are in play, successful change is likely to occur.

Today, a decided shift in building practices and values is evident nationwide, and this shift is directly related to LEED. Although this shift in values has been limited by the frame of reference and metrics the USGBC has been able to develop, it is unlikely that such a swift transition could have been made without using metrics.

An upside of quantification is that standardized approaches have emerged that have been effective in fostering market capacity in many areas (e.g., green products, utilities, skills, knowledge). Moreover, the system provides a way for a wide group of people (including those who have not been trained as designers) to begin to incorporate sustainability into their work.

On the other hand, although the system was intended to foster novel new approaches, it has yet to harness its full potential to do so. While applicants have been earning Innovation credits for more than a decade, the USGBC has yet to study the results or use the resulting approaches in sustentative ways. To explain in greater detail: LEED provides points for "Innovation in Design" wherein applicants design and operationalize their own unique approaches for achieving sustainability. To earn credit, the approach must be described in such a way that others may use it in the future. As of

March 2010, the USGBC had not created a master list of innovations. This means that the organization has yet to monitor trends or assess the applicability of the full set of approaches devised by applicants.

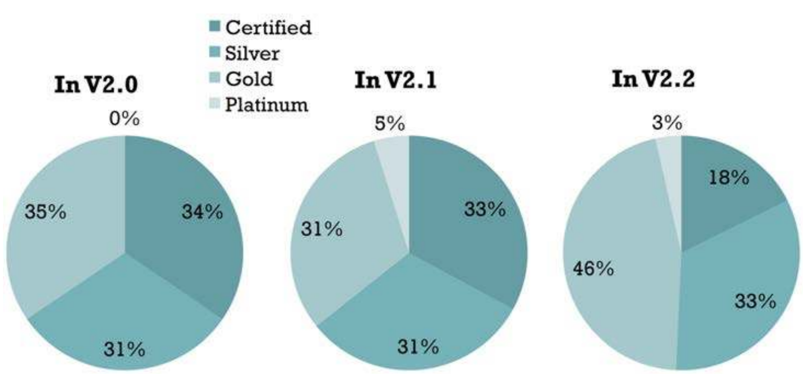
Fortunately, this lack of attention has not been true across the board. In other areas of LEED, the USGBC appears to be observing outcomes, reflecting on past experience, considering and testing new approaches, and institutionalizing effective practices (Cheatham 2009; Environmental Protection 2009; Stephens 2008; USGBC 2009c).

Despite the fact that the USGBC seems able to evaluate its performance and respond in increasingly effective ways, many LEED users have yet to develop the same acuity. They have not achieved the level of individual or organizational learning that they could have for all the effort expended.

Most LEED users do not use the process as effectively as they could to generate valuable new knowledge about environmental design, teach people through their interactions with LEED-rated buildings, or even construct comprehensively high-performing buildings. Many applicants use the LEED scorecard as a crutch for design, rather than as the simple tally sheet for assigning a level of recognition that it was meant to be. When the LEED scorecard becomes a primary driver of a building's design, applicants tend to overlook other—and often better—options. In their frenzy to achieve a specific rating, they ignore options that are not specifically operationalized in LEED's measurement system. In doing so, they overlook the learning opportunities inherent in the system and fail to achieve holistic approaches to sustainability.

Although applicants are not learning as much as they could, there is indication that some learning is happening. Statistical analyses of the 446 postsecondary buildings in the United States that used LEED-NC (LEED for New Construction and Major Renovations) v2 up through the start of 2010 revealed statistically significant increases in ratings over time, as well as significant increases in total points earned. The increase in rating is illustrated in figure 1. Individual universities report that they have become increasingly effective in using the system and can now do so without expanding their construction budgets (Chadwick 2010; President and Fellows of Harvard College 2010).

Figure 1 **Percentage of Postsecondary Buildings Earning Each Rating, Indicating Improvement Over Time Based on Version**



Yet, in most cases, universities have not developed an overarching system for making their physical facilities and the network of utilities that supports them truly sustainable (Sharp 2009). They bring some new knowledge from each new project forward, but they have yet to redesign the administrative and fiscal practices that hinder making more significant advances in the realm of environmental sustainability. So, although LEED users have shown improvement on LEED measures over time, they still tend to approach the design of LEED buildings one building at a time.

NEED FOR INCREASINGLY COMPREHENSIVE CHANGE

The overall LEED system has room for improvement and there is good reason to press ahead for more aggressive change. Woolliams (2007) explains, "LEED Platinum is not the highest level of possible achievement for a sustainable built form. It was simply the highest imaginable level of measuring sustainability at the time the rating was created" (¶ 12). If all buildings were constructed at the Platinum level today, "we would still be a long way away from sustainability" (¶ 12). Many buildings in the United States have reached beyond LEED Platinum and have done so with little to no added cost up front.

In terms defined by McDonough and Braungart (2002), today's LEED-rated buildings can be considered "less bad" than conventional construction, but still not markedly "good" for the environment. McDonough and Braungart insist that the best approach is to design buildings that nourish and regenerate the natural environment. This requires a new way of thinking about buildings and about design. It is worth noting that building owners who have a deep-seated passion for the environment often avoid LEED due to the standardized/simplistic nature of its approach as well as the administrative cost of formal review and certification (Malin 2008; Wilde 2007).

In developing the LEED system, the USGBC began shifting construction practices as well as public perceptions—but in less radical ways than recommended by McDonough and Braungart (2002). A new program, the Living Building Challenge, goes further in this realm and is attracting building owners who have a deep-seated desire to better the environment (Chadwick 2010).

The USGBC designed its system from the ground up—an approach proffered by McDonough and Braungart (2002, cover), who say we should be entirely "remaking the way we make things." Although the USGBC took this approach, it does not require building owners to be so comprehensive. Rather, the USGBC's approach has been to set goals that a wide range of applicants will be able to achieve and to periodically raise the standards as new approaches are integrated into mainstream practice. Individual LEED applicants may elect to exceed LEED standards by embracing very well-integrated, holistic strategies, but this is not yet a required component of LEED. It is, however, a ground rule of the Living Building Challenge—a program that developed as a direct outgrowth of LEED (Chadwick 2010; Woolliams 2007).

Underlying inhibitors to holistic success on college campuses have to do with categorization and compartmentalization. Many universities treat each LEED building as an isolated project, and this limits their opportunity to create significant change (Stack 2010). Institutions need to consider redesigning the way they approach construction—and particularly the way they allocate funds (Sharp 2009). Systemwide approaches are needed for spurring change, as discussed in more detail at the end of this article.

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SYSTEM OF CONTINUAL IMPROVEMENT

Nevertheless, there is a great deal of merit in the USGBC's approach. For institutions that want to foster change and promote learning, the USGBC provides an ideal precedent. The USGBC is achieving large-scale, systemwide change based on a clear and well-defined vision. The organization is a model for fostering transformation, learning from experience, harnessing emerging opportunities, and responding to areas of underperformance. Since 1998, the USGBC has continually overhauled LEED in ways that respond to public critiques and integrate new data, knowledge, and technology (Cheatham 2009; Environmental Protection 2009; Stephens 2008; USGBC 2009c).

The USGBC periodically assesses shortcomings and responds in ways that maintain enough continuity to enable LEED users to shift between systems without disruption. All variants of LEED use a common framework, point structure, and philosophy. The USGBC monitors LEED's performance—tracking results and tweaking performance—in ways recommended by planning scholars Birnbaum (1988); Cutright (2001); Holcomb (2001); Presley and Leslie (1999); Rowley, Lujan, and Dolence (1997); and Wilson (1997). The USGBC's practices reflect the use of program monitoring, the incorporation of feedback loops, and the application and synthesis of research and experience that the literature on educational planning recommends (Chance 2010a).

The USGBC works to integrate changes quickly and continually and to incorporate a variety of perspectives. As noted previously, a complete draft of LEED 2012 was circulated for public comment in the fall of 2010, and a substantially revised version was circulated in the fall of 2011 (USGBC 2011). Official public comments were gathered through online forums with each draft (Roberts 2011a).

The LEED program originally targeted achievement in six categories: Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (IEQ), and Innovation in Design (ID). In 2009, the USGBC added a category for Regional Priorities (RP). The organization is now proposing to add categories for Integrated Process (IP), Location and Transportation (LT), and Performance (PF).

Figure 2 illustrates how this has occurred in the past. It shows that the USGBC has been shifting the point values it assigns for various activities. In the current version of LEED (v3, LEED 2009), applicants are required to earn higher point totals than previously required (as per figure 3). These changes increased the incentive for applicants to earn Sustainable Sites, Water Efficiency, and Energy and Atmosphere credits.

Figure 2 **Number of Credits Available in Each LEED Category**

LEED-NC Categories	Credits in v2	Credits in v3
SS Sustainable Sites	14	26
WE Water Efficiency	5	10
EA Energy and Atmosphere	17	35
MR Materials and Resources	13	14
IEQ Indoor Environmental Quality	15	15
ID Innovation and Design Process	5	6
RP Regional Priority	n/a	4
Total Points Available	**69**	**110**

Figure 3 **Minimum Credits Required for LEED Certification at Various Levels**

LEED-NC Certification Levels	v2 (v2.0–v2.2)	v3
Certified	26	40
Silver	33	50
Gold	39	60
Platinum	52	80

Source: USGBC (2001, 2002, 2007, 2008, 2009a).

Overall, these changes reflect the USGBC's (2009c) development of a system for *transparent weighting,* defined as "the process of redistributing the available points in LEED so that a given credit's point value more accurately reflects its potential to either mitigate the negative or promote positive environmental impacts of a building" (p. 3). The organization openly acknowledged that up until 2009, it had "not used an overarching, consistent framework for allotting point values to credits" (p. 3).

In the past, weights were determined through "consensus of a large pool of talented and experienced individuals in the buildings industry" (USGBC 2009c, p. 3). This approach has been supplemented with research on emerging data. Today, "LEED 2009 goes a step further" than past programs "by weighting LEED according to a logical, transparent framework that incorporates the best available science" (p. 3).

CAMPUS CONSTRUCTION TRENDS

Improving school design is essential to raising the quality of life in the United States. The Environmental Protection Agency (2009) estimated that during 2007, roughly 84 million Americans spent their days in the 124,110 schools, colleges, and universities in our nation. In higher education, 4,635 different postsecondary institutions own and operate some 83,000 buildings (Carnegie Foundation for the Advancement of Teaching 2010; Fedrizzi 2010).

Most university buildings were constructed following the Industrial Revolution. They rely on technologies like elevators and flush toilets as well as extensive mechanical systems for heating, cooling, and ventilation. A huge number of campus buildings ignore basic design strategies that could achieve comfort without using energy derived from fossil fuels. Time-tested passive design methods—such as harnessing breezes, orienting buildings to collect heat at appropriate times, and using overhangs to block unwanted solar gain—were forgotten for many decades.

Today, almost all campuses have a large stock of buildings that disregard basic environmental principles. Campus leaders must counteract weaknesses in their existing building stocks and work to construct new buildings that perform better from the outset.

In attempting to meet this challenge, hundreds of colleges and universities across the United States have used LEED in the planning and operation of their buildings. From 2002 to 2009, postsecondary construction accounted for 15 percent of all registrations and 13 percent of all certifications granted through the four major LEED programs (Galayda and Yudelson 2010). These four programs include LEED for New Construction and Major Renovations (LEED-NC), Existing Buildings' Operations and Maintenance (LEED-EBOM), Commercial Interiors (LEED-CI), and Core and Shell construction (LEED-CS). By the start of 2010, universities had garnered 446 ratings using version 2 of LEED-NC alone (Chance 2010b). There were as many as 125 more ratings assigned when all variants of LEED and all types of higher education (e.g., military, corporate training facilities, for-profit colleges) were considered (Fedrizzi 2009).

EXPENDITURES ON CONSTRUCTION

Expenditures for education-related construction continued to rise even after the initial economic crash, according to Agron's (2009) report for *American School & University*. The report noted that construction projects underway in higher education accounted for $12.7 billion in spending in 2007 and that expenditures increased to $17.8 billion in 2008. The growth was due to the high number of projects on the drawing board before the economic crash.

The bulk of this work involved new construction. Abramson's (2011) research focuses on *completed* construction for four specific types of buildings (academic, science, library, and residence hall). Abramson, who tracks construction for the journal *College Planning & Management,* notes that on average, 71.6 percent of recent work has involved new construction. The remainder involves renovations (15.4 percent) and additions (13.0 percent).

His figures reflect a greater dip in 2008 than the figures Agron (2009) provided for campus buildings at large. Abramson (2011) calculates a total cost of $14.5 billion for projects completed in 2007, $13.3 billion for those completed in 2008, and $10.7 billion for those completed in 2009. The downward trend reversed slightly in 2010, when the total for completed construction rebounded to $11.1 billion. Campus construction has been in high gear since 2000, he says, due to increased demand for both classroom seats and residence hall beds.

Our nation has been spending a great deal of money on education-related construction. Unfortunately, Abramson (2011) says, the cost to build university facilities is on the rise. While our overall level of spending is down, the amount of space we get for those dollars is also down. New technologies for teaching and for operating and maintaining campus buildings are major contributors to the spiraling cost.

Abramson (2011) found that the median square-foot cost for academic buildings in 1997–98 was slightly over $120. By 2007, the square-foot cost exceeded $200. In 2010, three-quarters of campus buildings cost more than $258 per square foot. (This is based on his sample of 74 academic buildings constructed in 2010–11, where the median size was 76,480 square feet and the median cost was $25.2 million.) Costs continued to soar, and projections for 2011 stood at $339 per square foot.

UNDERPERFORMANCE OF EXISTING BUILDINGS

Universities were initially much slower than other sectors to adopt sustainability as a core principle (Newport 2010). Their physical facilities have suffered from their delay in acknowledging environmental degradation. Problems seemed easy to ignore; there was little pressure or visible incentive to do better.

The perception of success in higher education has tended to focus on easily measured aspects of academics, such as grades, yields, rankings, sports scores, and endowment totals (Stack 2010). Universities have used such measures to validate their successes and to gain competitive leverage in marketing.

Ignoring other signs, universities continued to operate in ways that depleted the environment and carried unnecessary environmental and financial burdens far into the future. Today the burden is tremendous. In the United States as a whole, buildings accounted for about 39 percent of all energy used in 2005; utility bills for operating those buildings totaled $365 billion (Carazo 2010).

Higher education facilities are known to consume more energy than buildings in other sectors due to the informal nature of their use (i.e., the weak sense of ownership of and/or responsibility for classroom space and the invisible connection between utility cost and use). Moreover, buildings in disrepair cost more to operate than those in good shape, and campus buildings around the nation suffer from high levels of deferred maintenance (Balderston 1995).

In the California community college system alone, 74 percent of educational facilities are at least 25 years old and 60 percent are more than 40 years old. The situation at most campuses is even more drastic, considering that a large percentage of campuses predate the community college movement. There was unusually low regard for environmental performance during the period of history when they were built. As a result, many of our existing buildings waste a great deal of energy and “are inadequate to train a workforce in new technologies,” says Palmese (2009, ¶ 5), who insists that a “massive modernization effort” is needed.

Even campuses that have a large pool of new buildings tend to operate them using outdated utility networks and steam plants. Since only a few people at each institution typically know the actual cost of providing these various utilities, a number of institutions have begun posting information about energy and water usage online in real time. They are doing this to allow stakeholders to see the results of their actions and make conscientious decisions.

EVIDENCE OF CHANGE

Environmental performance is a growing source of concern for university stakeholders. Today, students and their parents are exerting pressure on universities to change. Sustainability is also a growing factor in students' enrollment decisions (Sandeen 2009). Because LEED is now widely understood, it provides university administrators with a method for describing their institution's value to the public. The LEED rating system offers terms that an array of stakeholders can grasp, and university administrators are now using LEED data as "a primary indicator of the growth of green building on campuses" (Galayda and Yudelson 2010, p. 2).

Moreover, LEED provides the most widely recognized standard in green building today (Chadwick 2010; Galayda and Yudelson 2010). Growing recognition of the system encourages its use in higher education, and nearly 14 percent of all construction projects that have achieved LEED certification are located on college campuses (Fedrizzi 2009).

By the start of 2010, higher education had achieved a total of 571 LEED ratings (Fedrizzi 2009). A pool of 256 different universities owned the 446 buildings that used LEED-NC v2 and were on traditional, non-military, not-for-profit postsecondary campuses (Chance 2010b).

At least 79 of these institutions had earned certification for multiple buildings. Doctoral and research-intensive institutions participated in LEED at much higher rates than other types of institutions. They owned 49 percent of all LEED-NC v2 buildings, despite representing just 6.4 percent of all institutions in the United States (according to the Carnegie Foundation for the Advancement of Teaching 2010).

Although associate's colleges initially lagged behind in their use of LEED during the early years of the program, they were quickly catching up with bachelor's and master's institutions at the end of 2009.

Today, LEED is just one small facet of the green movement under way on all sorts of college campuses. Many universities have recently adopted environmental sustainability as a central, unifying force (Cortese 2005; Second Nature n.d.). Hundreds of American universities are now placing environmental issues front and center—integrating sustainability into many aspects of teaching, research, and service—and are using these issues to guide purchasing, planning, construction, operations, and maintenance decisions (Association for the Advancement of Sustainability in Higher Education 2012). If universities can harness all the many types of environmental knowledge being generated on their campuses and use it to improve their own subsequent actions, then they can help spur the type of environmental revolution that society so desperately needs (Edwards 2005).

EMPHASIS OF CONSTRUCTION

Universities that participate in the green building movement stand to benefit in many ways. Their participation pushes the movement ahead; further, it is appropriate to the overarching mission of universities as described by Kerr (1995), Levin (2003), and Rhodes (2001). Environmentally sustainable construction provides a way for campuses to control costs, protect the natural environment, promote health, and impart material and environmental values. University participation in LEED helps foster innovation, build knowledge, generate momentum, and build capacity in green construction and renewable energy. Participation influences the way structures are imagined and produced. It also positively transforms the way owners, designers, and contractors work together (Bilec and Ries 2007; Mazza 2007; USGBC 2009a).

University participation in LEED helps foster innovation, build knowledge, generate momentum, and build capacity in green construction and renewable energy.

Today, Carazo (2010) says, sustainable construction "is growing as an ever-increasing percentage of total U.S. building construction and remodeling" (¶ 3). College administrators are now acknowledging the economic, environmental, and social benefits of green buildings.

In Agron's (2009) survey, 88.3 percent of colleges and universities nationwide indicated that sustainability was an important consideration in recent choices regarding construction materials and products. They considered environmental sustainability when selecting lighting/controls (86.2 percent), HVAC (84.2 percent), building materials (79.3 percent), daylighting/windows (77.8 percent), flooring/carpeting (67 percent), washroom features (66 percent), roofing (65 percent), and furnishings (47.8 percent).

Growing enrollment has been accelerating green building trends. Consider the California community college system, which in 2005 was preparing to construct 15 million square feet of new, assignable space to accommodate anticipated growth in enrollment (Palmese 2009). A major goal of administrators was to exceed the environmental standards required of them at that time by between 10 and 15 percent. They were applying these particular benchmarks to 69 of the 86 new projects planned for construction in 2011–12.

In 2005, the state Chancellor's Office had already identified environmental performance as a central focus of its planning efforts (Palmese 2009). It visualized construction activity as a 60- to 80-year investment. This reflected a shift in thinking; it acknowledged the cost to operate, maintain, renovate, and demolish the structure in addition to the immediate up-front cost of construction. Such considerations form the basis of life-cycle cost analysis (LCA), a way of thinking about and calculating costs that can help owners make better-informed choices than with construction cost estimates alone.

In California in January 2011, a new statewide green building code known as CALGreen took effect. It is steeped in the principles of LCA. It ushered in "a new era in building construction in California" according to Palmese (2009), and now, filling "the need for more seats at higher education institutions will inevitably take a sustainable path" (¶ 14).

CALGreen is one part of a larger movement. An Energy Efficiency Partnership was also established that can help California's community colleges protect their investments (Palmese 2009). The creators of the Energy Efficiency Partnership used LEED precedents and data to create tailored approaches for California. Despite the sympathetic relationship between the State of California and LEED, not all of California's new community college buildings will be LEED rated. This has to do with the cost of compiling documentation and paying for formal review and certification of the project. Across the nation, it is common practice to construct campus buildings to LEED standards without seeking official LEED certification.

Galayda and Yudelson (2010) have noted that the overall number of higher education buildings that achieve LEED certification is considerably lower than the number registered. This means that the owners initially considered seeking certification but did not achieve that goal. This discrepancy is larger in higher education than in other sectors. It appears that even though a number of universities use LEED heavily, many are not convinced of the system's merits. A 2008 survey conducted by the National Wildlife Federation (NWF) found that only 12 percent of postsecondary institutions had campuswide standards for LEED certification. Despite this, 31 percent had campuswide standards for energy efficiency that applied to new buildings or to retrofits (Galayda and Yudelson 2010). University administrators appear to be leaving themselves room to deal with environmental issues without seeking LEED endorsement.

Higher education's reluctance to commit has not been isolated to LEED. Many university leaders have been hesitant to commit to reducing greenhouse gas emissions as well, due to a lack of hard data demonstrating true costs and financial benefits (Rowland, Sweeney, and Barnes 2010).

Moreover, in higher education, sustainability has not been viewed as "an item of tradable value or exchange" (Stack 2010, ¶ 1). Lacking measurable qualities, sustainability has typically failed to "garner the support it needed at the board of regents' level" (¶ 1). The USGBC is helping address problems of measurability by providing definitions and procedures for quantifying the intangible aspects of building design and performance. The organization seeks to provide a coherent format for measuring environmental benefits and to help its applicants gain competitive leverage.

Up through 2010, most of the LEED ratings had gone to projects that involved new construction. Although LEED has been popular for new construction, Fedrizzi (2009) insists that "the greatest opportunity is in improving the existing building stock" (¶ 3).

The idea is beginning to catch on. The NWF found that more schools were upgrading HVAC, lighting, and water systems for efficiency in 2008 than in 2001 (Galayda and Yudelson 2010).

In 2010, universities spent $1.7 billion to make repairs, according to Abramson (2011), who investigated the types of work most commonly undertaken. At that time, university renovations most often involved HVAC (44.8 percent), electrical systems (41.2 percent), plumbing (34.8 percent), lighting (33.8 percent), flooring and carpeting (31.4 percent), fire alarms (25.4 percent), compliance with the Americans with Disabilities Act (ADA) (24.0 percent), fiber optics and cable (20.3 percent), storage (17.0 percent), tile (16.9 percent), bathrooms (16.3 percent), security equipment (15.6 percent), wide area networks (WANs) (15.4 percent), local area networks (LANs) (15.2 percent), controls (14.2 percent), windows (11.6 percent), and roofing (11.5 percent).

COST OF USING LEED

Perryman (2005, ¶ 5) noted that certain LEED credits can be "realized at no additional cost due to the high level construction performance that today's contractors insist upon as standard practice." He concluded that the cost of obtaining LEED certification varied by the rating level sought, the characteristics of the specific project (including access to grants to help cover the cost of LEED reviews), the design team's level of experience with LEED, the cost estimator's level of experience, how early in the process the owner committed to seeking LEED certification, and the owner's impressions regarding the benefit and value of green design. Perryman insisted that although these variables "may seem numerous, they are quantifiable, they can be priced, and they can be managed" (¶ 8).

Udall and Schendler (2005) painted a gloomier picture. They recognized that LEED had made important contributions, but they also identified a number of ways in which they thought the system was underperforming. In 2005, their position was (1) participating in LEED added too much unnecessary cost, (2) point chasing was undermining the intent of the program, (3) energy modeling was immensely complicated, (4) the system reflected a painful level of bureaucracy, and (5) claims regarding benefits were overstated and misleading. Nevertheless, these same authors acknowledged that

> The USGBC has been enormously successful at publicizing the need for, and benefits of, greener buildings. Thanks to the USGBC and LEED, we now have momentum, media attention, broad understanding of green building, and motivated clients. Next, we need to make sure we're using the best possible tool for the job. (Udall and Schendler 2005, ¶ 61)

One specific tool that warrants attention is energy modeling software. The software being used to predict future energy performance does not always yield very accurate predictions (Turner and Frankel 2008). It is hoped that with the increase in demand for these services, the accuracy of energy modeling and simulation will improve and the cost will decrease.

New programs are being developed. Models recently developed by Wedding and Crawford-Brown (2007) use data collected by the U.S. Department of Energy, the National Renewable Energy Laboratory (NREL), the Environmental Protection Agency's (EPA's) Energy Star program, and the USGBC. These models were used in the calibration of LEED programs introduced in 2009. Additional efforts are underway to increase the accuracy of modeling and simulation programs (Poch et al. 2004).

The recent and "rapid evolution of increasingly sophisticated, accurate, and easy-to-use energy modeling software" is helping to facilitate "the investigation of many building design options, with different building system combinations and permutations," asserted Mazza (2007, p. 17). These programs can help in identifying cost-effective solutions for a given site and program. Ten years ago, Mazza emphasized, such tools did not exist.

NEED TO SUBSTANTIATE SAVINGS

There is an immediate need to validate LEED's performance and to determine if LEED-rated buildings are actually reducing expenditures and improving environmental conditions. LEED users need to know if their efforts are actually saving water and energy, reducing carbon emissions, and yielding healthier environs.

Critics have demanded proof of performance from the beginning of LEED (Gifford n.d.), and the USGBC has responded by conducting and commissioning research and by making some of this research available to the public (Scheuer and Keoleian 2002; Turner and Frankel 2008). Initial research findings underscore the need for ongoing measurement, analysis, and quality control.

In a study funded by the USGBC and the U.S. Environmental Protection Agency, Turner and Frankel (2008) obtained one complete year of energy use data from owners of 121 of the 552 buildings certified under LEED-NC v2 up through 2006.

They compared the energy performance of these buildings against three other measures: national data on energy use intensity, Energy Star criteria, and the performance predications included on the building's LEED application. They found that, on average, LEED buildings saved energy. A majority of LEED-certified buildings outperformed non-certified buildings in terms of energy usage. Unfortunately, however, 12 of the 121 buildings used far more energy than the digital simulation models had predicted. Shockingly, these 12 buildings failed to meet the minimum performance levels stipulated in the basic building codes. The 12 underperformers had obtained a full range of LEED ratings—from basic Certification all the way up to Platinum. Analyses showed that buildings with high process loads (such as laboratories) frequently underperformed.

In light of these findings, Turner and Frankel (2008) recommended calibration of energy modeling software, more stringent baseline standards, and increased verification of performance over time. The USGBC responded in many different ways. In the years since these findings were announced, the organization has continually modified its policies and procedures to improve performance in priority areas such as energy, atmosphere, and water conservation. It has done so in incremental ways that facilitate the gradual phaseout of problematic aspects of LEED. It has developed ways to change that do not adversely affect those registered under older versions of LEED. This is one reason why change happens more slowly than is really necessary, but it is also what keeps the momentum going. Now that the processes for gathering input and shifting policies have been established and tested, the rate of change may be able to accelerate quickly.

Open critique has been a critical part of improving LEED programs, and it is something that the USGBC now welcomes. Today, even LEED's most vocal critics agree that the organization has made great strides (Cheatham 2009; Environmental Protection 2009; Gifford n.d.; Stephens 2008; USGBC 2009c). The organization has created an open forum for raising questions and proposing alternatives. It has taken clear steps to identify and address underlying problems, and it has gathered input from a wide spectrum of stakeholders in a responsible and systematic way (Roberts 2010, 2011a, 2011b).

Moreover, the USGBC has been using public critique—as well as data analysis—as a means to strengthen its programs and practices. Despite all this, an ominous question still remains: Can the system evolve fast enough to overcome existing problems in the environment?

To achieve long-term environmental sustainability, leaders must get better at observing outcomes and learning from experience. The systems that drive development must become increasingly proactive. They must also be economically viable.

To achieve long-term environmental sustainability, leaders must get better at observing outcomes and learning from experience.

KNOWN SOURCES OF COST

Morris and Matthiessen (2007) determined that for many types of buildings, the average cost of green building construction is not significantly different from that of standard construction. They reported that many LEED projects cost the same as non-LEED projects, and, although construction costs have risen dramatically across non-LEED and LEED buildings alike, building owners are still able to achieve LEED certification within their budgets. Like Udall and Schendler

(2005), they agreed that the "idea that green is an added feature continues to be a problem" (Morris and Matthiessen 2007, p. 3).

Chadwick (2010) conducted a cost analysis of education-related construction. He analyzed data on cost per square foot, cost per student, and square footage per student. He found that "there is no statistically significant difference between average construction costs for LEED-seeking and non-LEED projects of similar program types" and that "most owners are able to achieve LEED certification at their desired level within available funds" (¶ 19).

As with any major change, however, an organization's first attempt at a new approach typically takes longer and costs more than the standard approach. This pattern is so common in educational planning that it carries its own name—the "implementation dip" (Fullan 2001; Holcomb 2001). Following this dip, a streamlined approach usually emerges, with cost and effort returning to normal levels or even reducing. Such has been the case at Harvard University, where LEED has become more affordable over time (Sharp 2009).

The literature indicates that achieving LEED certification within the budget allotted for typical buildings requires (1) having the owner's commitment to sustainability from the inception of the project; (2) having a team of owners, designers, and builders who are committed to sustainability and willing to work in a collaborative and integrated fashion; (3) including goals for sustainability in the written program; and (4) taking a holistic rather than add-on approach to design (Chadwick 2010; Malin 2008).

A number of studies have sought to quantify the cost of using LEED. In 2004, Steven Winter Associates, Inc., conducted a major study on behalf of the General Services Administration (GSA) of the U.S. government. More recently, BuildingGreen, Inc., (2011) collaborated with LEEDuser and a variety of experienced professionals to investigate the costs associated with LEED certification. Each of these investigations is discussed below to provide campus administrators with financial information to aid in planning.

2004 STUDY BY STEVEN WINTER ASSOCIATES, INC. In 2004, the GSA commissioned a study to appraise what it would cost to use LEED v2.1 for the construction of federally owned facilities. Steven Winter Associates, Inc., conducted analyses and identified "hard" as well as "soft" costs associated with earning LEED ratings at the levels of basic Certification, Silver, and Gold. The researchers focused on two specific building types commonly constructed by the GSA. The resulting case study included 12 GSA buildings that had earned LEED ratings and were either (1) five-story courthouses or (2) mid-rise office buildings.

Steven Winter Associates, Inc., (2004) used GSA's existing standards to make comparisons. The study identified energy modeling and commissioning of systems as the biggest added expenses for LEED projects. However, since the GSA already requires commissioning and energy modeling (like many owners of large building stocks), the cost of conducting these activities was not considered as an add-on to obtain LEED certification. In fact, the "GSA's commissioning scope is more comprehensive than the LEED requirements" (Steven Winter Associates, Inc., 2004, p. 70), and the GSA typically exceeds both the required and optional commissioning procedures of LEED when it constructs facilities.

Based on the GSA projects under analysis, energy modeling was determined to cost 15 to 30 cents per gross square foot (GSF). The cost of the essential (prerequisite) level of commissioning ranged from 60 to 80 cents per GSF. For buildings of this particular scale and complexity, earning the extra/optional commissioning credit (Credit EA-3) added about 10 to 15 cents per GSF over and above the cost of basic commissioning. (The cost to exceed the optional credits—common GSA practice—is not included in these figures; this is assumed to carry some additional cost as well.)

Steven Winter Associates, Inc., (2004) also noted that the soft costs associated with using LEED "will vary depending on the structure of the design team, the types of tasks being performed, the number of credits being pursued, and other project variables" (p. 183).

Steven Winter Associates, Inc., (2004) also broke down the cost by LEED rating. Soft costs added roughly 35 to 45 cents per GSF for buildings that achieved basic Certification, 40 to 55 cents for those that earned Silver ratings, and 55 to 80 cents for those that achieved Gold ratings. The researchers found similar patterns in the escalation of hard costs by rating, with higher ratings adding somewhat more expense.

2011 REPORT BY BUILDINGGREEN, INC. This report summarized from previous research that achieving LEED certification could add as much as 2 to 15 percent to the cost of a typical project (BuildingGreen, Inc. 2011). Projects at the high end of the range typically included additional hard costs, such as the cost of equipment necessary to generate a high level of on-site renewable energy. The report noted, however, that "if the design team is experienced and the goals aren't too aggressive, there may be no overall added cost because every cost premium has been offset with savings somewhere else" (¶ 13). A more efficient building envelope can mean that the project requires a smaller system for heating and cooling, for instance.

Moreover, the authors emphasized that many projects have achieved LEED certification despite the fact that their budgets were set before LEED became a requirement for them. Thus, it is clearly possible to acquire ratings without adding to the overall cost of a project. Sources of additional cost identified in the report are described below in ascending order. The first two categories do not amount to much of the overall cost, and they are the only two categories that are due solely to LEED. The least expensive of these categories involves fees for the official review of LEED credits. This review is conducted by the USGBC's spin-off organization, the Green Building Certification Institute (GBCI), and it adds an estimated cost of 3 to 5 cents per square foot. The next biggest expense involves the time and effort required for LEED documentation and management. This typically requires a few hundred hours of labor on a large-scale project.

The remaining categories deal with upgrading the quality of the building itself. Thus, the added expense is expected to yield a higher quality building and/or a higher quality experience for the building's users. The authors noted that any high-performance building will require extra time for research and design. As such, the next most expensive category reflects the added cost of good, careful design.

The next-to-largest category of expense involves building commissioning and energy modeling. These activities can carry a hefty price tag. BuildingGreen, Inc., (2011) indicated that the cost of commissioning can run from 50 cents to one dollar per square foot. The cost for energy modeling typically starts somewhere between $5,000 and $10,000. In the past, many small projects have bypassed energy modeling by using the easier, prescriptive route. Many universities have also done so (Chance 2010b), but LEED 2009 offers increased incentive to conduct modeling. LEED 2012 will likely offer an additional incentive for using energy models to refine a design. Up until now, many applicants have had energy modeling done after the design was complete simply to predict energy savings but not necessarily to help make better design choices (Roberts 2011a).

BuildingGreen, Inc., (2011) noted that the final and most expensive category involves the "hard cost" of construction itself. In the case of a LEED building, solar panels and wind turbines might increase the hard cost of construction. Buildings at the lower levels of rating do not typically include much on-site power generation.

EFFECT OF COST

Most universities are seeking the greatest good for their dollars. Most of them cannot afford to invest in too many unproven technologies. They do not have the resources to conduct a great deal of research and development in the course of construction. A few funding mechanisms exist to support this type of applied construction research (such as funding for the Solar Decathlon, provided through the National Renewable Energy Laboratories). However, until this type of funding increases, universities are unlikely to use many of the credit options that carry a high cost.

Many of the high-cost items mentioned above fall within the category of Energy and Atmosphere—the category that also has the highest potential for improving the environment globally. Unfortunately, this category has been one of the least used of all the LEED categories.

The 181 postsecondary buildings sampled by Chance (2010b) used the categories of Energy and Atmosphere (EA) and Materials and Resources (MR) at lower rates than the other categories (see figure 4). Stated in another way, the 181 buildings used the categories of EA and MR at lower rates than would be expected based on the proportion of points that they could possibly earn in these two categories. The high cost associated with Energy and Atmosphere credits appears to discourage their use. The energy modeling, on-site generation of power, and purchase of green energy required to earn some specific EA credits carries a high up-front cost.

The MR category is also relatively underutilized; however, this is because some of the points in Materials and Resources are only available to renovation projects—not all projects are eligible to receive them. Such is not the case for Energy and Atmosphere.

Figure 4 **Comparison of the Portion of LEED Credits Available to Totals Earned**

Categories	Credits Offered to Each Applicant	Total Credits Earned by Sample
SS Sustainable Sites	14 (20.3%)	1,348 (21.8%)
WE Water Efficiency	5 (7.3%)	522 (8.4%)
EA Energy and Atmosphere	*17 (24.6%)*	*1,111 (18.0%)*
MR Materials and Resources	*13 (18.8%)*	*968 (15.6%)*
IEQ Indoor Environmental Quality	15 (21.7%)	1,590 (25.7%)
ID Innovation and Design Process	5 (7.3%)	648 (10.5%)
Total	**69 (100%)**	**6,187 (100%)**

PATTERNS OF USE AND IMPLICATIONS FOR THE FUTURE

Understanding how postsecondary institutions have used LEED and its various categories can help educational and facilities planners. Providing information about universities' past use of LEED is the focus of this portion of the article.

The section directly below discusses findings about the way universities used LEED v2. The section after it identifies how this information can help applicants using v3. The final section on this topic summarizes changes that have been discussed for implementation in 2012.

LEED V2: TRENDS IN CREDIT EARNINGS

Of the 446 postsecondary buildings in the United States certified using LEED-NC v2 up through the start of 2010, buildings that used the most recent version (v2.2) averaged 36.76 credits. This was significantly higher than buildings that used v2.0 (average 33.59 credits) and buildings that used v2.1 (average 32.95 credits). Factors that are likely to account for the higher achievement of LEED v2.2 applicants include experience in green construction, refinement of LEED definitions, increased market capacity (i.e., market transformation), and observation of successful applicants.

In analyzing the way that buildings in the sample group (the 181 postsecondary buildings for which the USGBC provided credit data) earned their ratings, two categories stood out. Significant increases in ratings and credit totals among applicants that used the new version resulted from corresponding increases in Sustainable Sites (SS) and Indoor Environmental Quality (IEQ). Applicants averaged 8.43 credits in SS under v2.2 (significantly exceeding the 7.2 and 6.99 points they earned using v2.0 and 2.1). They also averaged 9.8 credits in IEQ (significantly above the 8.55 and 8.3 earned using prior versions).

As indicated in figure 5, the most powerful predictor of rating for the sample group was Energy and Atmosphere (EA). Using a stepwise regression procedure, Sustainable Sites (SS) added the most new information after EA. The order of predictors was Energy and Atmosphere, then Sustainable Sites, Indoor Environmental Quality, Innovative Design, Materials and Resources, and, lastly, Water Efficiency.

Figure 5 **Summary of Regression Model for LEED Rating for the Sample Group**

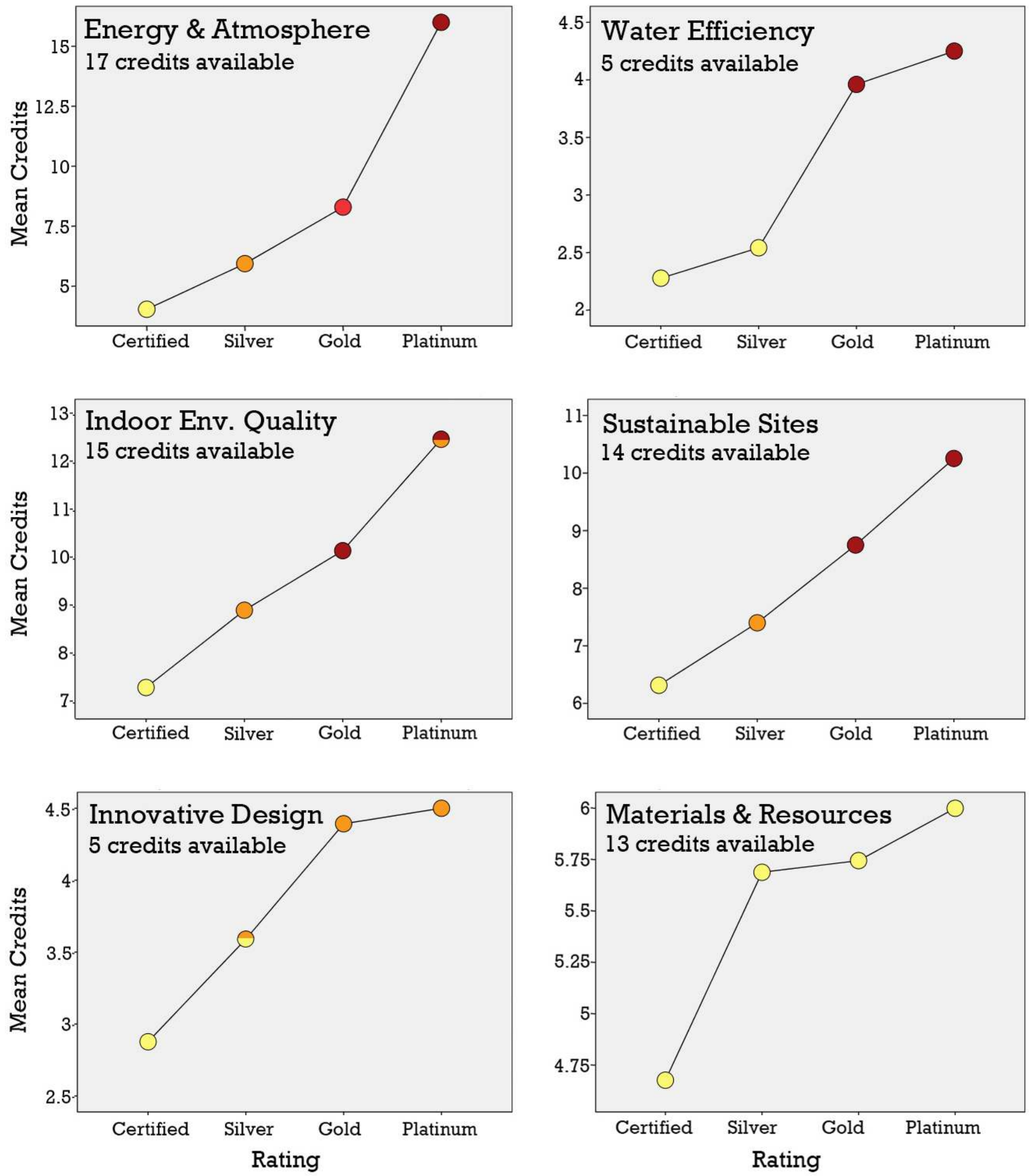
Predictors of LEED Rating, in order of influence	R	R^2
starting with EA (Energy and Atmosphere)	0.641	0.411
adding SS (Sustainable Sites)	0.776	0.602
adding IEQ (Indoor Environmental Quality)	0.854	0.728
adding ID (Innovative Design)	0.897	0.804
adding MR (Materials and Resources)	0.928	0.861
adding WE (Water Efficiency)	0.952	0.906

Notes: R indicates relationship between category and LEED rating.
R2 indicates the portion of the category's variance shared with LEED rating.

Among sampled buildings, those that made solid use of EA credits were best able to earn Gold and Platinum ratings. The importance of EA in the sample's ratings was further confirmed through multivariate analysis. The MANOVA indicated that the number-one factor propelling Platinum earners beyond Gold (and Gold beyond Sliver and Silver beyond Certified) was their score in Energy and Atmosphere.

The results of the MANOVA are illustrated in figure 6. Certified, Silver, Gold, and Platinum groups used EA in ways that differed significantly from one another; in fact, EA was the only category where each and every one of the four rating groups differed significantly. (Thus, in figure 6, each rating group has its own distinct shading in the graph for Energy and Atmosphere.) The 65 Certified buildings in the sample averaged just 4.03 credits in EA. The 61 Silver buildings earned significantly more, averaging 5.93. The 51 Gold buildings earned 8.29, another significant jump. The four Platinum buildings in the sample reflected the largest increase. They earned 94.1 percent of all Energy credits offered or an average of 16 points.

Figure 6 **Means Plots for Each Category**



Note: Similar shading indicates similar behavior.

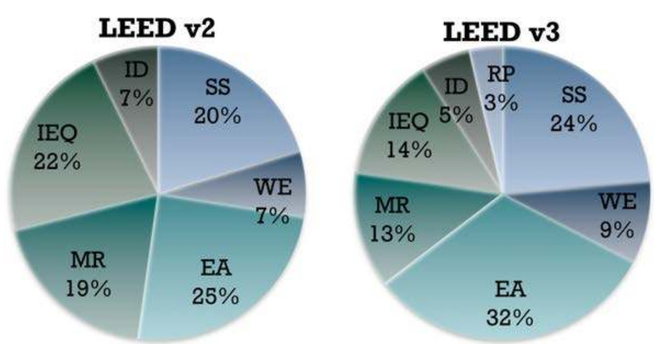
There were only four Platinum earners, so precautionary measures were adopted in the MANOVA. A Games-Howell procedure was used to account for the fact that assumptions of equal groups and equal variances were not met in the EA category. The stability of the Platinum group's average was also considered (in accruing totals of 15, 16, 16, and 17 points in EA, Platinum earners were consistent in their high use of this category). These conservative techniques helped confirm the importance of EA in achieving high ratings.

To better understand the coding system used in figure 6, it is helpful to compare the dots in EA with those in Materials and Resources (MR). Unlike EA, all rating groups earned fairly similar numbers of credits in MR. There were no significant differences in the way various rating groups behaved in the MR category. As such, all groups are shown with the same shade for MR.

Although EA was a distinguishing feature among rating groups in the sample, earning Energy credits was clearly not a focus for every applicant. Overall, the 181 buildings in this sample earned an average of just 6.14 of the 17 credits available in EA. Up until 2007, it was possible to earn a LEED rating without accruing *any* EA points beyond the mandatory prerequisites. Four members of the sample did exactly that—three of them received basic Certification and one received Silver certification despite earning zero points in EA. All told, 29 percent of the sample earned four or fewer credits in Energy and Atmosphere. To address this problem, all LEED-NC projects registered with the USGBC since June 26, 2007, have been required to earn at least two points in Energy and Atmosphere.

LEED 2009 point thresholds will also encourage achievement in EA. Figure 7 shows that EA now accounts for a much larger share of the point offerings than it did before. Moreover, the number of credits required to earn each rating is also higher under LEED v3 (as per figure 3). With clear phaseout dates set for v2 programs, it will become increasingly difficult for applicants to achieve certification without investing in Energy.

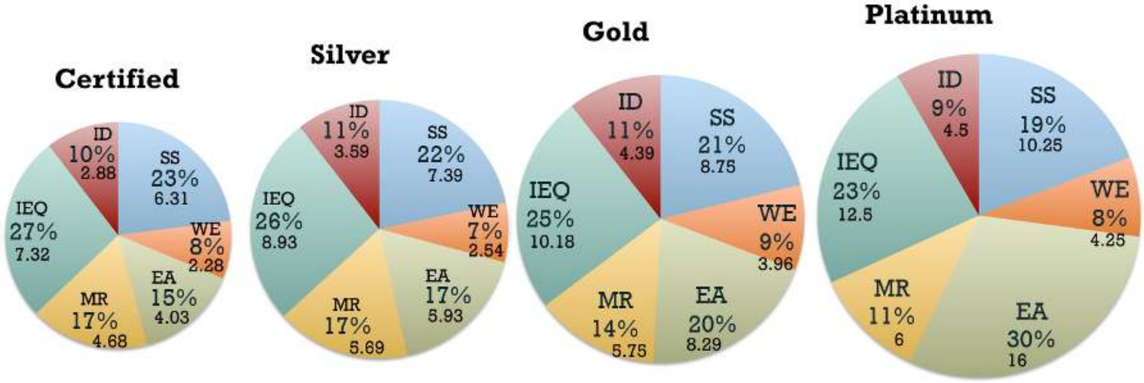
Figure 7 **Comparison of v2 and v3 Point Offerings by Category**



Note: The categories are Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (IEQ), and Innovation in Design (ID).

Figure 8 illustrates that as the rating increased within the sample, the proportion of credits earned in Energy and Atmosphere also rose dramatically. Use of EA increased from 15 percent among Certified earners to 17 percent at the Silver level, 20 percent at the Gold level, and 30 percent at the Platinum level. Notably, the four Platinum buildings averaged 16 of the 17 available points. Thus, although the sample of Platinum earners was very small, the four of them were quite consistent in their use of all categories except IEQ.

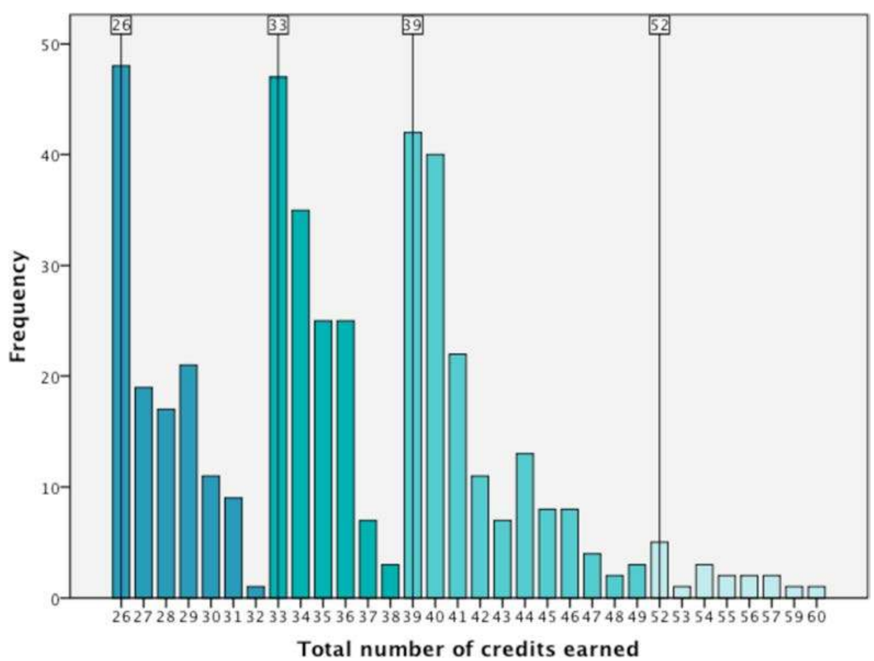
Figure 8 **Proportion and Number of Credits the Sample Earned in Each Category, by Rating**



Note: The categories are Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (IEQ), and Innovation in Design (ID).

The statistically significant rise in ratings and point totals seems to suggest that applicants are getting better at environmental design, but it could also indicate that they are getting better at chasing LEED points. The frequency with which universities achieved just the minimum threshold for their rating (see figure 9) indicates that point thresholds are a major motivating factor for LEED participants.

Figure 9 **Number of Credits Earned by All LEED-NC v2 Postsecondary Applicants Up through January 2010**



Note: Basic Certification requires a minimum of 26 points, Silver requires 33, Gold requires 39, and Platinum requires 52.

LEED V3: WHAT PRIOR USE SUGGESTS FOR USING THE CURRENT VERSION

As discussed earlier, analysis of the sample group indicated that increases in ratings resulted from significant increases in the categories of Sustainable Sites and Indoor Environmental Quality. In LEED 2009 (i.e., LEED v3), SS will continue to be an important source of credits. Points available in SS have been increased from 14 under v2 to 26 under v3. However, the USGBC is curbing applicants' reliance on IEQ under v3. Points available in IEQ remain constant at 15. However, IEQ now has a much smaller share of the overall pie (as shown in figure 7). In LEED 2009, IEQ accounts for just 14 percent of all available points, down from the 22 percent previously allotted.

Overall, LEED v3, unveiled in the fall of 2009, reflects a number of meaningful policy changes. It offers a range of programs tailored to active user groups, and it requires more investment from applicants to reach higher point totals. Using v3 will require greater commitment, and this, in turn, will require an even higher level of leadership from the people who organize and finance construction.

LEED v3 shifts its focus decisively toward Energy. Figure 7 shows the percentage of credits v2 offered in each category and compares them with v3. Point offerings have been greatly expanded in three categories: Sustainable Sites, Water Efficiency, and Energy and Atmosphere. In LEED v3, these three categories take a much bigger share of the overall pie than they did in v2. A new category, Regional Priorities (RP), accounts for three percent of the points available in LEED v3. The overall number of available credits has also risen. The remaining three categories (Materials and Resources, Indoor Environmental Quality, and Innovative Design) now have smaller proportionate shares of the pie, even though two of them have each gained a point. Due to dramatic increases in the availability of EA and SS credits under v3, use of both categories will undoubtedly grow.

As previously noted, in the analyses of the sample group, differences in Energy and Atmosphere were significant at every rating level. With 35 credits now available in EA, variability in the use of this category is very likely to be even greater under v3. This is expected to increase the category's overall predictive value.

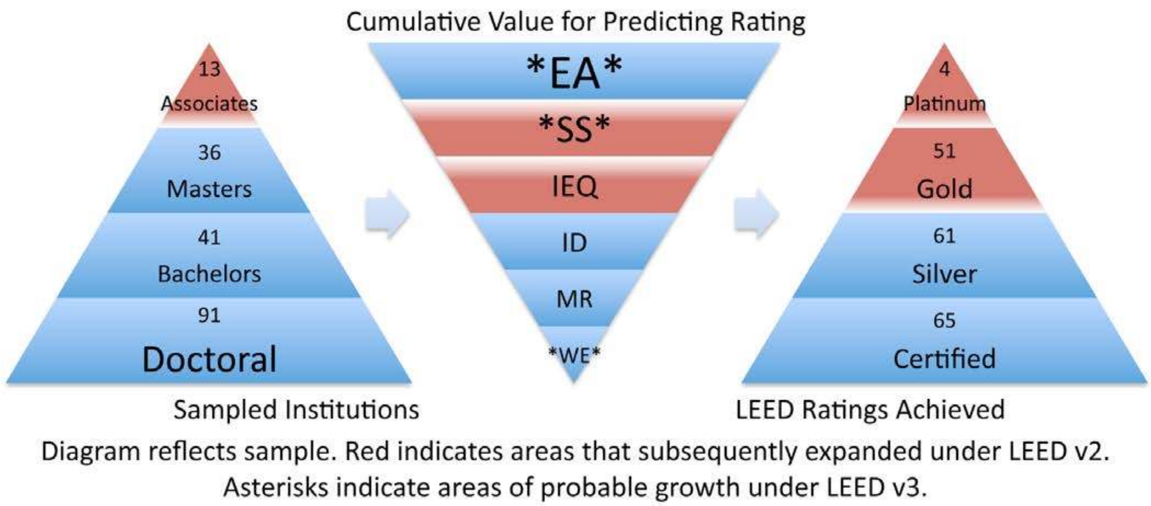
Regression analysis showed that under v2, the sample's achievements in Energy and Atmosphere have not mimicked (or "overlapped") achievements in Sustainable Sites. The two categories do not share a great deal of variance with each other. As such, focusing on both of these categories simultaneously may help institutions secure a high rating. In contrast, patterns in Water Efficiency credit earnings were quite similar to those of EA, and thus WE was not listed as a dominant predictor of rating in the v2 sample group. With point offerings in WE expanded from five to 10 under v3, however, both the variability and predictive power of this category are likely to rise.

Based on new point allotments in v3, the category of SS should continue to be a primary contender along EA with regard to predictive value. On the other hand, since applicants have little new incentive to use IEQ and ID, the predictive value of these categories is likely to fall.

Figure 10 summarizes findings about how the sampled buildings earned their LEED ratings. The first triangle represents the distribution of LEED users in the sample. The second triangle represents the findings of the step-wise prediction model, with the categories that most influenced rating shown on the top. Due to new point allocations under v3, the importance and predictive values of EA, SS, and WE (those indicated with asterisks) are likely to grow. The third triangle shows the ratings earned by the sample.

In the diagram, the color red indicates areas that have recently grown. The first triangle shows that use of LEED by associate's level colleges has been on the rise. The second triangle highlights recent gains in SS and IEQ that have helped boost ratings significantly above earlier versions. The third triangle indicates that Platinum and Gold ratings have risen over time among v2 applicants.

Figure 10 **Sampled Institutions' Predictors for LEED Rating**



Note: The categories are Sustainable Sites (SS), Water Efficiency (WE), Energy and Atmosphere (EA), Materials and Resources (MR), Indoor Environmental Quality (IEQ), and Innovation in Design (ID).

LEED 2012: CHANGES ON THE HORIZON

An analysis of the documents posted for public review suggests that LEED 2012 will include more prerequisites than earlier versions—about 19 prerequisites in all. LEED 2012 is likely to use 10 categories, rather than the seven in effect today (Roberts 2011a). New categories for Performance (PF), Integrated Process (IP), and Location and Transportation (LT) have been proposed. A brief summary of changes is provided below as a way of illustrating the USGBC's change mechanisms and new areas of focus.

The new Performance category is likely to include water metering and building-level energy metering as prerequisites. These additions will help address the need to substantiate water savings. The data collected can aid building owners in adjusting their systems to achieve higher levels of performance. The data can also help the USGBC monitor progress and develop better approaches.

The new Integrated Process category will help address the piecemeal approach discussed earlier. It is likely to reward analyses conducted to support an integrative process. To earn points in this category, the design team would have to conduct analyses in energy load reduction, water systems, and site assessment "and identify ways to reduce environmental burdens" in all three categories (Roberts 2011a, ¶ 6). Implementing strategies identified in that process can earn additional credit. Together, these credits would reward applicants who conduct analyses that inform their subsequent design decisions and who otherwise undertake holistic design using an iterative design process.

Also under Integrated Process, LEED 2012 will encourage designers to receive continuing education. To earn credit under LEED 2012, the LEED Accredited Professionals working on the project must have a higher level of expertise than before and must participate in continuing education and periodic testing (Roberts 2011b).

The new Location and Transportation category includes several aspects that used to be categories under Sustainable Sites. This category is likely to include a prerequisite for protection of sensitive land, a higher standard for enhanced site protection, new credits for location near neighborhoods, and a range of new credits related to reducing automobile dependence and pollution.

Proposed changes in the Energy and Atmosphere category would extend the length of "green power" contracts (Roberts 2010) and would require about twice the amount of on-site renewable energy production as needed to earn credits under LEED v3 (Roberts 2011a). The points available for refrigerant management are likely to decrease, which Roberts says seems to reflect improved industry standards. If his interpretation is correct, then this indicates a move by the USGBC to stop awarding credit once a new approach has become industry standard. To earn points for Optimizing Energy Performance, applicants using LEED 2012 may have to show that energy modeling was used to improve their designs. In the past, modeling was only required post-design to check for compliance (Roberts 2011a).

In the category of Water Efficiency, refinements to the sustainable wastewater management credit "appear to make this credit more achievable, while also offering a higher bar" (Roberts 2011c, ¶ 6). Changes in Indoor Environmental Quality may encourage more thorough assessment of air quality prior to occupancy and reward acoustic performance. Developing acoustic measures has been a focus of the LEED for Schools (USGBC 2009b), and, as such, this move illustrates the application of new knowledge and the institutionalization of new approaches through an ongoing process of research and testing.

The Materials and Resource category is undergoing a major overhaul to reflect the many varied attributes that materials have (Roberts 2011a). Changes will emphasize life-cycle assessment (LCA) and reward transparency by manufacturers (Roberts 2011b). Thresholds for building reuse may become easier to achieve (Roberts 2010), and reuse of abandoned, blighted, and/or historic buildings may be rewarded (Roberts 2011b).

Lastly, the USGBC may also expand Innovation by offering an additional credit (raising the total in this category from five to six). It may promote the development of new strategies by restricting four of these credits to new innovations—limiting how much credit an applicant can earn for simply exceeding existing thresholds (i.e., Exemplary Performance) to two credits (Roberts 2011a).

CONCLUSIONS AND RECOMMENDATIONS

The colleges and universities that used LEED in the past decade have helped pave the way for hosts of subsequent LEED applicants. The LEED buildings constructed on America's college campuses have helped the program reach a tipping point. Today, sustainability and LEED have become household terms, there is increased availability of sustainable products, and the public understands the value of sustainable construction. Sustainability has become a goal of building owners and academic leaders, and LEED construction is visible on campuses throughout the country and world. The closing section of this article provides an overview of recommendations for improving LEED and the way colleges and universities use it. It discusses the need to impart knowledge and values, model sustainability, act holistically, overhaul administrative procedures, learn through experience, and track performance.

IMPART KNOWLEDGE AND VALUES

Institutions that have participated in LEED enroll more than 2.2 million full-time (FTE) students each year. Although green construction is a way for campus leaders to communicate environmental values to their students, today's LEED standards do not explicitly require postsecondary buildings to teach students about the environment. Universities have yet to harness the pedagogical opportunities inherent in LEED that K–12 schools have already embraced.

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The K–12 sector has been an active part of developing and using the LEED 2009 for Schools program. This tailored program includes some requirements that are higher than those included in the standard LEED-NC program (which is geared to commercial construction and is highly favored by universities). LEED-rated facilities for higher education are rarely designed to be teaching tools in and of themselves. Few have features embedded in them that have the primary purpose of educating the buildings' users. In contrast, it is not uncommon for K–12 schools to include features explicitly designed to impart knowledge and instill certain behaviors and values in students.

Didactic features that are appropriate for use in campus buildings include (1) elements that convey knowledge (such as signage that identifies environmental issues or illustrates energy flows through the building), (2) aspects that encourage certain behaviors or elicit reflection, and/or (3) operations and maintenance activities that are visible to students and raise student awareness.

It sometimes appears that higher education is not seeking the same level of excellence in environmental design as K–12. For instance, Learning by Design is a program designed to honor innovation and excellence in the design of educational facilities. Postsecondary institutions owned just four of the 37 educational facilities honored by the program in 2010 (Chadwick 2010).

Fortunately, higher education is now getting more involved in helping to tailor programs for its own use. Some universities are involved in piloting the USGBC's new Portfolio Program and in using LEED for Neighborhood Design (LEED-ND) in campus planning. By contributing their insight, universities can help develop programs that are more useful to them.

MODEL SUSTAINABILITY

Reynolds, Brondizio, and Robinson (2010) claim that

> the American educational system has been turning out "environmental illiterates," ill-equipped to understand emerging information about the environmental, social and economic dimensions of human–environment interactions and make informed choices on the suite of issues, from lifestyle to politics, that will decide whether and how society moves towards a more sustainable economy. (p. xiv)

Environmental education is about fostering a sense of ownership and empowerment (Palmer 1998).

People need to see options for sustainability expressed repeatedly and in many different ways before they really understand and internalize the concept. It is important for educational organizations to provide a vision for achieving sustainability and to model sustainable behaviors for their students (Rowe 2004). Green schools should teach aspects of traditional disciplines in addition to teaching their students environmental stewardship and providing an identity for the community (*Building Operating Management* 2005).

In a qualitative research study, Higgs and McMillan (2006) investigated four secondary schools involved in sustainability and discovered "modeling" as a powerful common theme at these schools. The schools modeled sustainability in four main ways: (1) individuals modeled positive behaviors, (2) school facilities and their operation imparted knowledge and values, (3) school governance modeled social equity and conflict resolution and fostered ownership of issues, and (4) school culture created and reinforced values and behaviors. Some schools aim to make operations visible to students. By using all four forms of modeling, the schools Higgs and McMillan studied provided consistency in the messages they sent to students.

Effective modeling eliminates the need to "preach or proselytize" about sustainability (Higgs and McMillan 2006, p. 50). It helps students transfer abstract concepts into tangible, personal applications. Student involvement in operations "makes the waste, consumption, inequities, governance, and economics of the school more visible and tangible" (p. 45). Peer-to-peer learning among faculty, staff, and students can be highly effective in prompting change at the individual and organizational levels (Sharp 2009). Gora and Koester (2010, subhead) note that "a culture of collaboration develops out of an intense commitment to immersive learning, understanding the campus-as-a-whole system, maintaining transparency and openness, and empowering community members." Likewise, on a global scale, construction trends are transforming working patterns and roles (Carazo 2010).

ACT HOLISTICALLY

Although the USGBC's strategic and adaptive approach has been highly successful, many LEED users take a linear, rationalist approach to green design. Using the LEED system with a checklist mentality, rather than aiming to create a truly sustainable design, limits the positive effect of green construction and can add to the cost of construction. The USGBC's (2010a) proposal to add a category for Integrated Process in 2012 reflects a desire to encourage holistic, rather than add-on, approaches.

The USGBC's proposal to add a category for Integrated Process in 2012 reflects a desire to encourage holistic, rather than add-on, approaches.

One problem is that some LEED users meet their primary objective—recognition—by simply achieving certification. Without a sincere effort to properly install and commission systems, operate them effectively, track performance, and recalibrate periodically, many buildings never achieve optimal performance.

OVERHAUL ADMINISTRATIVE PROCEDURES

Comprehensive approaches to sustainable facilities that include construction, operations, and maintenance must be incorporated into the university's overall plan. LEED should be just one aspect of the institution's strategy for achieving long-term sustainability. The widespread emergence of environmental courses, research, and service activities reported by the Association for the Advancement of Sustainability in Higher Education (2012) reflects intense and sincere engagement with sustainability topics. This enthusiastic sense of exploration does not extend to construction on most campuses today, as evidenced by the lack of pedagogical features incorporated into LEED building designs.

Sharp (2009) insists that despite 15 years of effort by the campus sustainability movement, higher education still lacks widespread environmental reform. Higher education has failed to embrace simple concepts—such as the triple bottom line concept for balancing economic, social, and environmental factors—that have aided other industry sectors (Stack 2010). Universities have also neglected to overhaul poor business practices that continually limit their performance.

The "organizational structures, internal politics, responsibility distribution, and lack of sustainability infrastructure" in many institutions "make it difficult to begin the processes for obtaining [environmental] commitment, as each individual believes it is the responsibility of someone else" (Rowland, Sweeney, and Barnes 2010, ¶ 5). Nevertheless, there is growing pressure for universities to respond. Galayda and Yudelson (2010, p. 2) assert that "institutions of higher education don't want to be seen as laggards on climate change." Today, there are more than 670 signers of the American College and University Presidents' Climate Commitment.

To achieve "carbon neutrality while serving a growing population," Newport (2010, subhead) says that "higher education must embrace a profound reformation that redirects its entire business model around sustainability by building its tenets into the fabric of the academe."

Current funding mechanisms for construction on campuses inhibit taking an integrated, comprehensive approach. There is still great resistance to making the sort of large-scale infrastructure improvements that can have the biggest impact on environmental sustainability in campus operations. Confining budgets to single projects means that utilities often remain outdated, for instance. Addressing this may require overhauling the way colleges and universities build and manage their budgets, which historically separate capital from operations. Leith Sharp (2009) of Harvard University specifically states

> To increase its effectiveness, the campus sustainability movement must now turn toward organizational change management, basing its strategies on a much more sophisticated understanding about how universities (and other large organizations) actually function so we can begin to unearth the

> enormous opportunities for increased innovation and transformation, adopting a systems-thinking perspective to steer an effective course forward. (p. 3)

The new approach, Sharp says, should include rational techniques for planning and management that are supplemented by an increasingly sophisticated approach that diagnoses and reforms the nature of organizations. Sharp's comments are consistent with Chaffee's (1985) planning recommendations. Chaffee argues that planning models are most effective when they include (1) a foundation in rational analysis, (2) the flexibility and ability to respond to unforeseen changes creatively, and (3) a future-oriented strategy or metaphor to help people conceptualize various situations/solutions and construct their collective future.

Campuses and their sustainability movements continue to rely heavily on rationalist approaches, but effective planning requires a mix of linear and non-linear thinking (Chaffee 1985; Chance 2010a; Cutright 2001; Sharp 2009). Achieving sustainability will require creative thinking and a shared sense of responsibility. Accountability and decision making must be pooled among top-level administrators so that all actions take into account and involve a wide array of concerns, including finance, operations, facilities, personnel, institutional development, and public relations—in addition to learning by faculty, staff, and students within and across disciplines. The academic and administrative silos that exist on campuses hinder the possibilities for innovation and change. It is important to coordinate and distribute decision-making responsibilities among a wide array of constituents (Lauer 2006; Sharp 2009).

Achieving sustainability will require creative thinking and a shared sense of responsibility.

The learning curve in constructing sustainable schools has been steep, and achieving excellence in this realm has not come easily (Chadwick 2010). "It may be that for higher education the only way to zero carbon is to build sustainability into the fabric of the academe in ways we have not even discovered yet," posits Newport (2010, ¶ 30).

Santos (2009) has identified three primary models used in strategic management today: (1) systems alignment, (2) dashboard performance reporting, and (3) business process reengineering. To create sustainable campuses, it may prove necessary to use business process reengineering—the most radical of these three. Effective change may require a ground-up approach and a complete redesign of all processes and operating structures, Santos says. Policies and operating procedures (including those for overall management as well as daily operations) will need extensive revamping.

Sharp (2009) indicates that for higher education, the new environmentally sustainable approach must specifically address (1) structures of governance, (2) processes for decision making, (3) practices of accounting and finance, (4) compartmentalization, (5) unseen institutional drivers, (6) engagement of stakeholders, (7) capacity building, (8) systems thinking, and (9) leadership.

For many universities, outdated structures for business and accounting prevent new, more effective techniques from being implemented. This costs higher education dearly—most measurably in financial terms. Management of operating budgets is typically separate from capital budgets and rarely allows operating savings to be reinvested. Further, saving money on operations can inadvertently hurt a unit overall because its budget may be reduced in following years. These savings, Sharp says, should instead be used to fund a cycle of continual improvement, including environmental improvements and pilot-testing innovations.

As a step in this direction, Harvard University set up a program that loaned funds to various units for the purpose of implementing conservation projects (Sharp 2009). The first 200 funded projects were able to recoup costs with a payback period averaging three years. Taking steps like these could provide immense savings for Harvard and other universities. Sharp's vision includes "structurally connecting capital and operating budgets and institutionalizing life-cycle costing" (p. 5).

Newport (2010) insists that if organizations are to achieve environmental sustainability, then change must encompass five areas: leadership, methods, strategy, management, and reporting. In each of these areas, "companies must transition from tactical, ad hoc, and siloed approaches to strategic, systematic, and integrated ones" (¶ 29).

LEARN THROUGH EXPERIENCE

Overall, the USGBC has shown itself to be a model of organizational learning. Postsecondary applicants have been increasingly successful in using LEED over time. The USGBC appears to be learning from past experience and continually revising its policies in response to the increased capacity of the market and of applicants to use and understand the system. The system's users seem to be learning, too (President and Fellows of Harvard College 2010). Applicants are learning to excel with regard to priorities identified by the USGBC and to use the LEED system more effectively. Campuses can benefit from contributing to the development of new LEED programs and by supporting new programs that supplement and extend LEED.

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CONTRIBUTE TO NEW CAMPUS-FRIENDLY LEED PROGRAMS. New LEED programs have been developed with campuses in mind. LEED for Neighborhood Design (LEED-ND), which has been in operation for several years now, can help campus planners coordinate large-scale development. The USGBC also offers a range of helpful new resources, such as the *Paid-from-Savings Guide to Green Existing Buildings* that it developed in collaboration with the Energy Services Coalition to help organizations finance green construction (Fedrizzi 2010).

The USGBC has also developed a Center for Green Schools that seeks to "expedite the transformation of all campuses into sustainable places to live and learn, work and play" (Fedrizzi 2010, ¶ 8). The aim is to foster holistic, campuswide approaches to sustainability.

Because so many universities are repeat users of LEED, they may have interest in the USGBC's new Portfolio Program. The USGBC (2010b) is piloting the Portfolio Program as a way to help streamline the certification process for applicants who use LEED in high volume. The USGBC identified a number of universities as prime candidates for the Portfolio Program.

In coming years, LEED for Existing Buildings: Operations and Maintenance (LEED-EBOM) is likely to gain popularity on campuses since most established universities face deferred maintenance, limited capital funding, and limited land on which to build. Their older buildings will soon require attention (Balderston 1995; Ehrenberg 2002). Facilities planners can use LEED-EBOM to enhance environmental performance in operations and maintenance and to plan renovations.

Today, universities are more and more aware of the need to green their existing building stock. The number of campus projects registered with LEED-EBOM is steadily increasing. "This is a promising change for the better" say Galayda and Yudelson (2010) because "reducing the impacts of existing buildings is critical to meeting carbon emission reduction and green building goals" (p. 3). Nevertheless, because the EBOM certification process is quite involved, registration growth will not be "reflected in cumulative certification numbers for a few more years" (Galayda and Yudelson 2010, p. 4).

The USGBC has been working to improve and enhance its EBOM program. The language of this credit "has been modified extensively to make it align better with how buildings are actually operated, and how data is collected in those buildings" (Roberts 2011b, ¶ 14).

SUPPORT NEW PROGRAMS TO SUPPLEMENT LEED. Today, new programs are emerging to help campuses reach beyond LEED. One such program is the Sustainability Tracking, Assessment & Rating System (STARS) developed by the Association for the Advancement of Sustainability in Higher Education. The STARS program aims to deliver a framework for transformational change within higher education (Rowland, Sweeney, and Barnes 2010).

The institutions that are aggressively tackling environmental issues use a range of programs to guide their work. American University in Washington, DC, cut its carbon emissions in half in just one year. To do this, it developed a comprehensive strategic plan that uses LEED, STARS, and a calculator for inventorying carbon emissions that was developed by the organization Clean Air-Cool Planet (O'Brien 2010).

A noteworthy successor to LEED is the Living Building Challenge (Woolliams 2007). The Challenge program was created and is operated by a chapter of the USGBC alongside the Canada Green Building Council (Chadwick 2010).

Woolliams (2007) says that the Living Building Challenge is "not a rejection of LEED, far from it. We wouldn't be able to talk about living buildings if LEED hadn't introduced green buildings into the market" (¶ 17). The creators of this program do, however, seek to achieve vastly higher levels of building performance than are typically achieved through LEED.

The Living Building Challenge aims to make "every single act of design and construction" directed toward making "the world a better place" (Chadwick 2010, ¶ 7). The program encompasses seven main performance areas (site, water, energy, health, materials, equity, and beauty), and each of these areas involves several prerequisites, which it calls "imperatives" (Solomon 2010). In essence, the Challenge relies solely on prerequisites; making significant achievements in every area is mandatory (Woolliams 2007).

Wilde (2007) goes so far as to say that the buildings "being erected today are a 200-year asset, and the only way to reduce their environmental footprint is to make them replenish, rather than deplete, natural resources" (p. 50). Even net-zero is not a good-enough goal for new construction, he insists: "A broader industry goal is to create buildings that produce more energy than they consume, and consume more waste than they generate" (p. 50). The Living Building Challenge aims to achieve net-zero buildings that regenerate the environment (Chadwick 2010).

Unlike LEED, which is prescriptive, the Living Building Challenge is performance based (Solomon 2010). It seeks to inspire creativity. In this way, LEED represents a more linear/rationalist approach that is now being supplemented by the Living Building Challenge's more comprehensive/holistic approach.

Designers of the Living Building Challenge seek to define the ideal and to inspire others to reach as far as possible toward that ideal. This differs from the incremental approach that the USGBC has taken that encourages widespread transformation one step at a time.

TRACK PERFORMANCE

To enhance the benefits of planning with LEED, it is imperative to track the outcomes of the system's policies and assess how LEED buildings actually perform over time. The data that LEED applicants submit to earn certification provide an ideal way to benchmark achievement and track performance. The USGBC (2009a) is moving in this direction, and campus leaders should too. Such work is necessary to ensure return on investment and make sure all participants—and the natural environment—are receiving an appropriate range of benefits. It is essential that researchers keep tracking the way LEED is used and making this information public.

CONCLUSION

LEED has triggered change and brought attention to important environmental issues. It provides an easy way for higher education to demonstrate achievement. Postsecondary institutions have embraced LEED and have attained higher levels of success over time. Now, it is time for colleges and universities to step up their game. They should become leaders in green construction—not just followers that use a system designed, for the most part, by others. They must generate and apply new knowledge to help society achieve lasting sustainability. They must create buildings that do more to model good behavior, impart environmental values, and teach students about the environment. And, finally, they must re-design their funding mechanisms to facilitate comprehensive approaches to sustainability. They should take cues from the USGBC about how to learn from experience and integrate feedback. Perhaps one of the USGBC's greatest contributions to higher education lies in the model it provides as a large-scale learning organization. As an organization that monitors its own progress and continually revamps its systems, the USGBC has been able to achieve a visible and much-needed shift in American culture. American colleges and universities need to follow suit and become more proactive in the areas of environmental research and green construction.

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