Looking up to the top of the 80'x22' biowall at Drexel University's Papadakis Integrated Sciences Building. Image courtesy of Drexel University, Philadelphia, Pa.

A STUDY OF COMPARATIVE SUSTAINABILITY CERTIFICATION COSTS

Green Rating System Cost Comparison Study: LEED and GREEN GLOBES

As Adopted for Sustainability Assessments of the Papadakis Integrated Sciences Building
Drexel University, Philadelphia, Pa.

FINAL REPORT

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EXECUTIVE SUMMARY

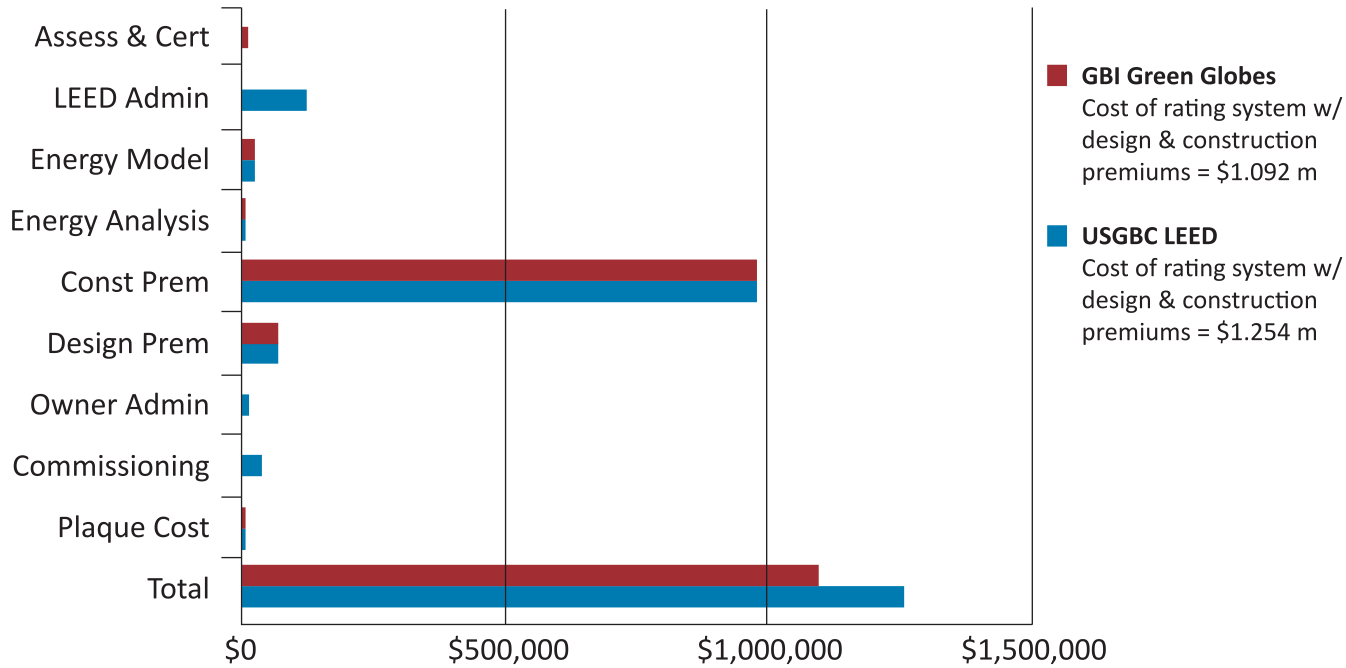
Sustainability rating systems promote improved energy and environmental performance for facilities design, construction and operations. The two leading sustainable building rating systems in terms of actual number of field applications are USGBC's LEED and the Green Building Initiative's Green Globes, yet there has been little comparative research regarding the relative costs of implementing the two systems. This targeted study examined 1) intrinsic hard costs -- allocable on a line-by-line basis -- for each of the rating systems; 2) soft costs, whether accounted for as part of the indirect project costs or secondary soft costs that arose as a result of the project, but were otherwise allocated or absorbed; and 3) optional costs arising from implementation of the rating systems.

The research was confined to facilities at the Drexel University campus, located in West Philadelphia, Pa., with specific attention to the Papadakis Integrated Sciences Building, a five story, 130,000-square-foot laboratory and classroom building that opened in September, 2011. In addition to the verifiable data, analysis and findings on the comparative costs of the two leading building rating systems that are being employed for sustainability assessments at buildings throughout the United States, some anecdotal information and evidence of the relative utility of the two systems was also uncovered, and these non-verified observations are summarized in the body of the report and may stimulate questions for future studies.

A key variance revealed by the study was the cost of engaging the rating system organizations for the Papadakis building. The breakdown summarized in the Owner's records indicates internal costs of over $125,000 for USGBC LEED versus $9,000 for GBI Green Globes. Total costs for the two systems are shown on the supporting table at the conclusion of the report, and the summation shows aggregate USGBC LEED costs (i.e., hard costs, soft costs and optional costs for sustainability rating) nearly 15 percent higher than GBI Green Globes. Perhaps a more important observation from an Owner's point-of-view would be the time required to administer an energy and environmental rating system process for a new facility. In this instance, the Owner's internal costs for administering USGBC's LEED were nearly 500 percent higher than GBI's Green Globes.

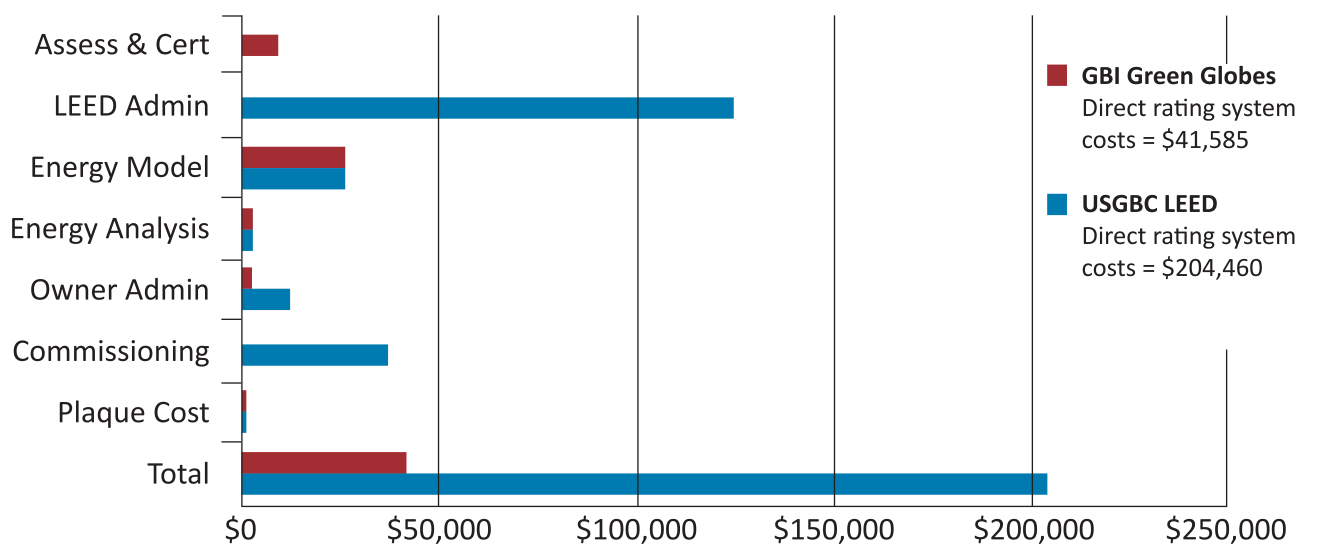
Project rating system cost comparison

Inclusive of estimated design and construction cost premiums for Drexel's Papadakis building



Direct cost comparison of LEED and Green Globes rating systems

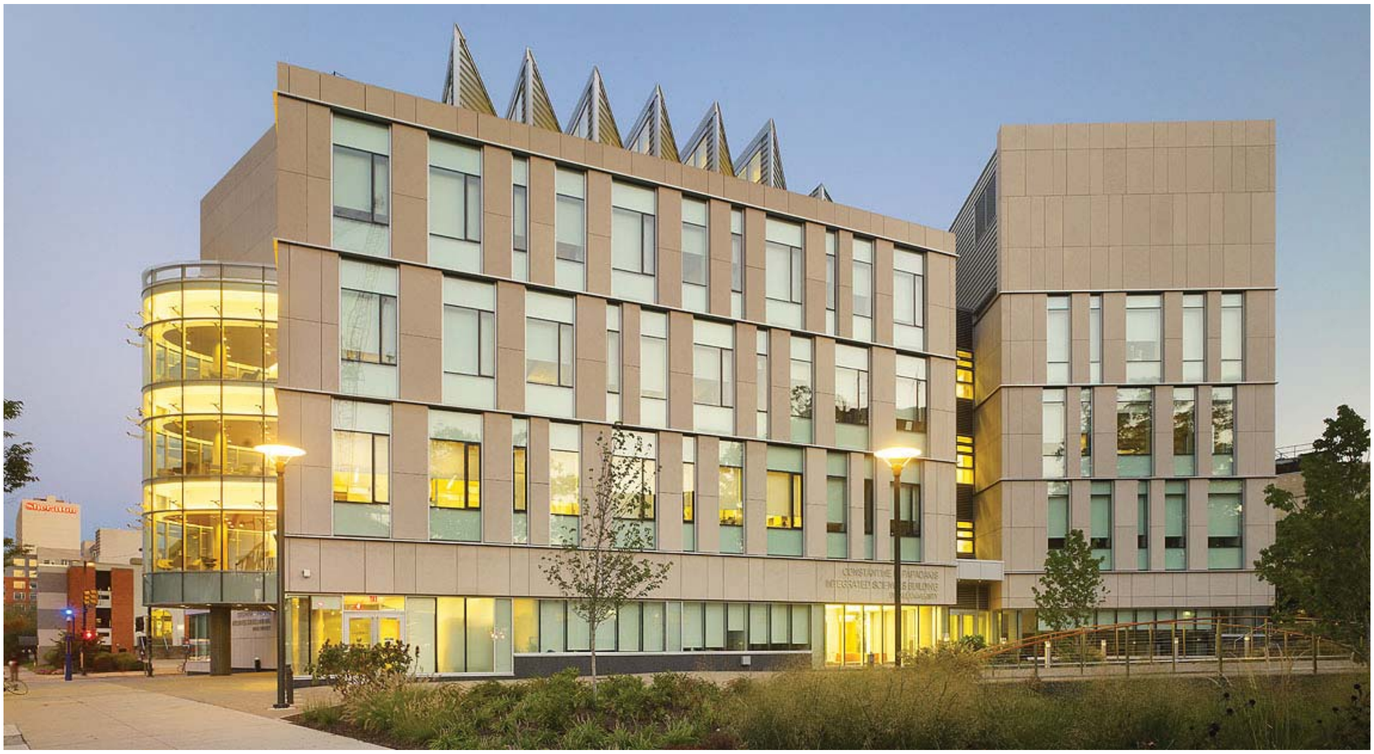
Does not include design and construction cost premiums for Drexel's Papadakis building



The study found slight variance in professional consulting costs between the two rating systems (i.e., professional consultant costs of working with Green Globes may be somewhat lower than LEED – as dependent upon choices of mandatory and optional inputs -- as explained in the body of this report), and little variance in construction costs between the two rating systems. However, there was significant variance in the number of hours devoted to the project by the Owner's facilities personnel, depending upon the rating system. Cost records indicate that the Owner posted 16 personnel-days (128 hours) of direct personnel time to the USGBC LEED rating support and administration; whereas the GBI Green Globes rating and support consumed just 3.5 personnel-days (28 hours). A distinction in the type of facility owner (large institutional owner with large facilities and building projects staff versus public or private owners with little or no in-house facilities or building project administration staff) must be acknowledged. Although not introduced as a variable in this study, it is postulated that facility owners that do not have significant in-house capital project staffs would necessarily want to use independent A/E consultants to a greater degree for both basic design services, and for specialty services required for managing and executing the building assessment program. Due to overhead, mark-ups and other factors contributing to labor burden and firm multiplier by the provider of specialty professional services, this would likely result in a greater cost differential for the owner of the rated facility.

Both rating systems were deemed valuable and helpful in leading the Owner, professional consultants and constructors toward an award-winning outcome. A number of those interviewed mentioned the prestige of earning a LEED Gold Rating, and acknowledged the market leadership of USGBC for buildings in the US. Two interviewees mentioned the changes in codes that can be partially credited to the marketplace influence of LEED. Other interviewees cited the flexibility of Green Globes, where projects are not held accountable for strategies that do not apply, and for its efficient use of Owner's time through an interactive online format that provides timely feedback and useful assessments of systems and materials.

Recommendations from this research study include improving future data samples, increasing the reliability of the analysis, and providing tendencies for improved decision-making related to sustainable facilities rating systems. The recent US General Services Administration's decision to acknowledge the acceptance of both rating systems (memo of the GSA Administrator Tangherli to DOE Secretary Moniz dated Oct 25, 2013) is tacit approval of the two leading sustainable building assessments. The Department of Defense issued a similar decision in November 2013. The quality of future studies depends upon having good data – such as this discrete study, which applies comparative rating techniques and processes to the same structures – through head-to-head comparisons. If more Owners would avail themselves of this methodology, facilities professionals would gain improved sustainability decision support tools.



East side of Drexel's Papadakis Integrated Sciences Building. Image courtesy of Drexel University, Philadelphia, Pa.

0.0 INTRODUCTION

0.1 Topic area

Concern for energy and environmental performance of buildings (which are among the largest consumers of energy from non-renewable resources) has stimulated the creation and use of sustainability rating systems for new commercial and institutional facilities throughout the United States. Rating systems are employed in facilities planning, design, construction, commissioning and operation to benchmark environmental performance of a building against a set of consensus standards.

The two leading sustainable building rating systems in terms of actual number of field applications are USGBC's LEED and the Green Building Initiative's Green Globes, yet there has been little comparative research regarding the relative costs of implementing the two systems. Until this study, reliable data comparing the application of more than one rating system on discrete building examples has not been available. However, at least one such building is now operating on the Drexel University's University City campus in Philadelphia, Pa. Therefore, this study offered a singular opportunity to compare sustainability rating systems with the highest market penetration on a head-to-head basis, without having to build a large data set of dissimilar structures in an attempt to limit the effects of multiple variables or to dampen the influence of gross outliers.

0.2 Overall research question

Building owners employ sustainability rating systems to influence financial, design and construction choices in order to achieve improved environmental and energy outcomes for their facilities. What is the actual cost to implement these systems, since there are intrinsic hard costs, soft costs and optional costs that need to be identified and analyzed? How do the respective systems achieve the rigor, accuracy and cost effectiveness sought by environmentally-conscious owners?

0.3 Significance

There is ongoing demand from government agencies and private industry for real-world data on the hard and soft costs associated with the primary green building rating and certification programs. Prior to this study, there have been a number of anecdotal enquiries into comparative costs and performance of various sustainability rating systems; however, none of these studies focused on side-by-side ratings put into place for the same facility. This research provided for such a direct comparison, without having to explain away differences in building case examples and dissimilarities in participating principals, whether from the owners', designers' or constructors' perspectives.

Specifically, this study represents the first independent analytical examination of the comparative costs associated with a new construction project undergoing dual LEED and Green Globes certification in the United States.

0.4 Overview of the Papadakis Integrated Sciences Building project

The subject facility is a five-story, 130,000-square-foot laboratory and classroom building that opened to faculty and students in September, 2011. The exterior of the $65 million building is covered with limestone and fronted by a four-story glass cylinder that serves to define the main entrance (Saffron 2011). Designed by Diamond & Schmitt Architects of Toronto, the building is composed of 44 research and teaching laboratories for the disciplines of biology, organic chemistry and biomedical engineering. A key feature of the sustainable design of the building is its 80-foot by 22-foot bio wall, consisting of 1500 ficus, arbicola, philodendron and other chlorophyllic plants in a multi-story vertical garden receiving direct sunlight through an insulating glass-fenestrated south-facing atrium. Unhealthy particles from the building interior – including but not limited to formaldehyde and ethyl benzene – are consumed by a process called phytoremediation, as developed by Canadian biologist Alan Darlington. The inventor has developed more than 150 biowalls worldwide; and Drexel's version is the largest in the United States.

1.0 LITERATURE REVIEW

1.1 State of knowledge about the topic

Since the development of basic rating systems in the 1990s, a number of organizations and individuals have created rating systems for buildings, civil infrastructure, facilities, housing and other types of projects and geographical areas. Many of these rating tools are predicated on simple value judgment, while other are based on extensive observation and scientific criteria. The Canadian-based International Institute for Sustainable Development lists 895 sustainability rating initiatives in its CSIN Compendium, and the list is only a representative sampling of world-wide efforts by government, nonprofits and private sector organizations to develop rating indicators and/or methodologies [IISD.org].

In the United States, two building sustainability rating programs with greater market penetration than others in this segment are the US Green Building Council's LEED system, first introduced in 1998, and the Green Building Initiative's Green Globes, first released in 2006 (adapted from the Building Research Establishment's BREEAM approach, which was initially published in1990). Approximately 13,500 buildings have been certified by the US Green Building Council in the past 12 years (Frank 2012). The Green Building Initiative's Green Globes has been used to rate more than 600 buildings over the past six years, as can be verified from lists available from the Green Building Initiative (thegbi.org). These two rating systems for habitable structures accounted for more than

Atrium of the Papadakis Integrated Sciences Building with freestanding spiral stairway and biowall. Images courtesy of Drexel University, Philadelphia, Pa.

90 percent of total formal ratings for new buildings in North America during 2012 (International Living Future Institute 2013).

There have been a number of studies during the past decade that have attempted to evaluate environmentally "green" and sustainable rating systems. Among those were comparative studies looking at similarities and differences in structure, criteria and documentation requirements (Gowri 2004). In 2006, the General Services Administration sponsored a research project to "collect, narrow and filter building rating system information" in order to meet GSA objectives, which centered on dependability and communicability of various approaches (Fowler and Rauch 2006). The GSA study did not analyze comparable rating systems with regard to measured performance, sustainable impact or implementation costs, but contained substantial estimated cost information about the hard and soft costs of LEED ratings for buildings owned or administered by GSA (Winter Associates 2006).

An economic study of the costs of LEED was undertaken by the Leonardo Academy in 2008 to ascertain total certification cost per square foot by level of certification (Certified, Silver, Gold and Platinum) for existing buildings. Soft costs included internal labor and outside consulting costs, plus USGBC application and registration fees. Hard costs included building improvement costs plus equipment costs. Based on the soft costs reported via a Johnson Controls-sponsored survey of 23 building owners/managers, the data indicated a mean certification cost per square foot of $1.58 with a composite of all LEED rating levels taken into consideration (Arney 2008). However, detailed data and analyses used for this study are not readily available, and with some costs that may have been inadvertently excluded in the data pool, the findings may be less reliable than what is required by independent third-party ratings professionals.

A 2009 Carnegie-Mellon study suggested that building design would benefit from a flexible rating framework for sustainable architecture, rather than reliance on prescribed means-and-methods (Biswas, Wang, Krishnamurti 2009). An international comparison of sustainable rating tools undertaken by researchers in Australia and Germany lamented the lack of transparency and compatibility among systems, and recommended harmonization among benchmark parameters to feed into a system that considered all buildings, not just "high-profile trophy buildings" (Reed et al 2009). Another study presented at the European Real Estate Conference in Stockholm decried the lack of market evidence showing evidence of improved commercial feasibility of sustainable buildings, but noted that JonesLangLaSalle was beginning to create a financial pro forma to allow tracking – through a database – of certified buildings, at least in Australia (Warren, Bienert and Warren-Myers 2009).

A study of the use of building appraisal techniques to identify premiums for sustainable facilities and discounts for "brown" buildings was published in the Journal of Sustainable Real Estate in 2010, setting forth a basic methodology to begin incorporating additional factors into comparables, as well as selection of capitalization and yield rates (Runde and Thoyre 2010). The paper also mentions the availability of third-party market surveys on "sustainability uptake" or adoption, from sources such as Cushman and Wakefield's Green Opportunity Index (Runde and Thoyre 2010).

Two Canadian researchers posited a "cohesive and logical framework" for classifying sustainability assessment tools, according to their generic, strategic and integrated attributes and argued in favor of their so-called WA-PA-SU system for industrial projects such as heavy oil extraction (Poveda and Lipsett 2011). A more practical analysis published in Construction Management and Economics provides a method for linking complex interdependencies among rating criteria by showing cause criteria that will generate improvements in dependent criteria through a decision-support tool (Hiete, Kuhlen and Schultman 2011). In his recent paper, Berardi acknowledges the diffusion of multi-criteria rating systems, discusses the limits of the systems and maintains that the dynamism of cities prevents a static approach to sustainability, thereby suggesting broader criteria and more complex calibration models (Berardi 2011).

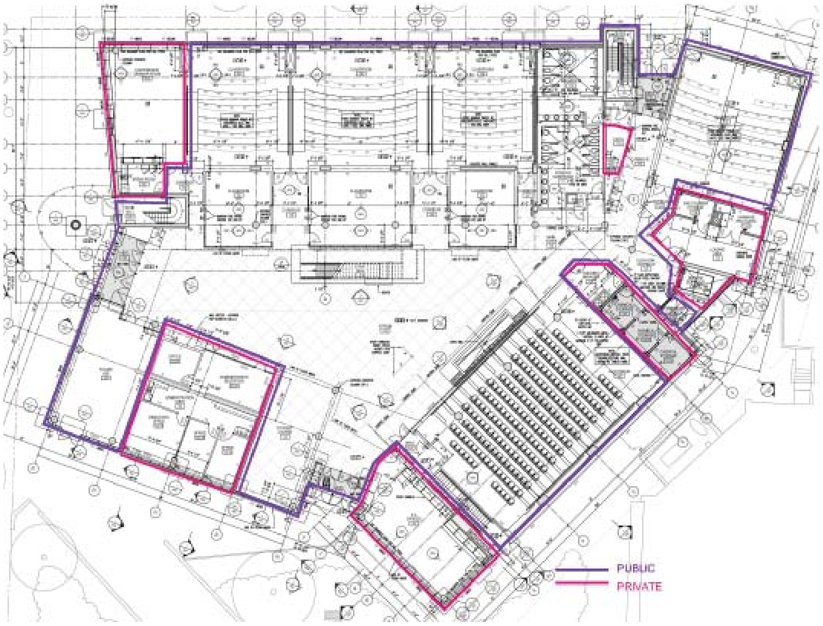
As a component of the development of the new Institute for Sustainable Infrastructure, a brief comparative study of rating systems was undertaken by ACEC staff to ascertain relative features of 20 leading rating tools, according to (among other attributes) prescriptive or performance rating criteria, triple bottom line categorizations and explicit life-cycle incorporation (Beard 2011).

The General Services Administration and the Department of Energy sponsored a 2012 report entitled "The Green Building Certification System Review" that investigated three building rating systems meeting stringent federal criteria. For new construction projects, the report concluded that the Green Globes rating system aligned with 25 of 27 Federal requirements, LEED with 20 of 27 Federal requirements and Living Building Challenge with 14 of 27 federal requirements (Wang, Fowler and Sullivan 2012).

Another recent study by Columbia University's Earth Institute reviews the Star (Sustainability Tools for Assessing and Rating) Communities approach for going beyond projects to local community assessments to determine progress toward environmental, economic and societal goals (Tjossem, Ahn et al 2012).

1.2 Need for better data and decision-support information

The Carnegie Mellon study (see previous section) maintains that rating systems must be tested and validated through case studies of real buildings – especially where the same building has been certified by multiple rating systems – to properly analyze these sustainability assessment mechanisms (Biswas et al 2009). Similarly, the Melbourne- Regensburg study recommends further research of the most used rating systems for buildings from an objective perspective due to lack of transparency and standardization (Reed et al 2009). Beltran suggests that some owners are reluctant to evaluate and publish their building's rating system experience because of fears of negative publicity or perceived higher costs as a result of incorporating specific rating assessments into their building processes (Beltran 2012). Additional research, such as the study summarized in this proposal, may begin to provide initial findings that contribute to the more universal adoption of sustainability rating systems for new and existing facilities.



Floorplan showing mix of public and private spaces in sustainably-designed Papadakis Integrated Sciences Building. Image courtesy of Drexel University, Philadelphia, Pa.

2.0 SPECIFIC RESEARCH QUESTIONS

What are the intrinsic hard costs -- allocable on a line-by-line basis -- for each of the rating systems? What are the soft costs, whether accounted for as part of the direct project costs or as a cost that arose as a direct result of the project, but was otherwise allocated or absorbed? What are the optional costs arising from implementation of the rating systems that need to be identified and analyzed? What are the cumulative costs of each rating system on a comparative basis? How do the respective systems achieve both the accuracy and cost effectiveness sought by environmentally-conscious owners? What recommendations can emanate from the research study to improve future data samples, increase the reliability of the analysis, and provide tendencies for improved decision-making related to sustainable facilities rating systems?

3.0 METHODOLOGY

3.1 Overview of the approach

A common method of capturing data related to organizational behavior is through field research questionnaires (Stone 1978). Investigative research is often accomplished by taking a simplified view of the problem, using data directly obtained from reliable sources, and focusing on a particular point-of-view to analyze the problem. Achieving perfect reliability and validity in measurement is unlikely, but those goals are held up as ideals in any quantitative research project. To improve reliability, one must clearly conceptualize the comparative constructs and eliminate ambiguous or distracting information. One can also use a pre-test, pilot study or repeat measures that have been used in previous research to achieve dependable measures (one aspect of reliability).

3.2 Data collection

The form of data collection for this research was accomplished through a directly-administered questionnaire using case study interview techniques. First, survey questions were drafted and pre-tested by knowledgeable experts. Next, interviewers (Principal Investigator and one student) were trained in conducting unbiased surveys by careful articulation of questions and in the recording of answers. Procedures for use of the survey with key interview targets and ordering of the questions were devised ahead of time, to give consistency to the process. Given the potential obscurity of some of the data, follow-up interviews (either in person, by telephone or via electronic communication) may have been necessary, and the same steps toward questionnaire clarity and unbiased survey procedures were repeated. The follow-up process improved the accuracy and confidence of the respondents in their answers, leading to more reliable data.

3.3 Data analysis and interpretation

By studying the data collected in this research, the objective of the project is to describe and explain the presence of any patterns that emerge, including a comparison of costs associated with the two rating systems, as well as qualitative variability among the respondents opinions related to the rigor, accuracy and cost effectiveness of the systems. While the former quantitative comparison lends itself to only a simple univariate analysis; the latter may allow some cross-tabulation, with further analytic discussion based on inferences in drawn from qualitative survey responses.

One could argue that the sample size is too circumscribed to derive useful measures; however, researchers have found that a sound reason for disproportionate sampling is that the main objective is direct comparison of two variables. The cross-tabulation of the answers about the two rating systems is descriptive, and coverage of the target population was evenly applied. Validity of the study depends upon uniformity of response elicitation and accuracy of field recording of responses. The patterns observed did not come about by chance, but reflected real features observed by reliable sources and then collected, categorized and analyzed by the researchers. An important aspect of the analysis was the compilation of thorough explanations of all line items placed in the tables, so as to block the introduction of bias and to prevent any part of the data from having too much impact on the final results. Fortunately, the limitation of the sample size augurs against having random error from unstructured populations.

4.0 EXPECTED RESULTS

The purpose of the research was to compare direct and indirect costs of implementing sustainable rating systems for commercial or institutional buildings. Popular assumptions and some published information from the rating systems suggested that the range of advertised hard costs were roughly equal for LEED and Green Globes, however the study was intended to verify and affirm/refute this assumption. It was further expected that there would be a significant difference in soft costs between the two ratings systems, based on the differing requirements of each system and opinions expressed in previous articles.

Another potential benefit of the study was to delineate a methodology that can be used for comparing rating systems used on subject commercial and institutional buildings, as enlightened owners employ more than one rating system on their new or existing building. Creating a replicable research methodology is as important as the research findings, because – in this case -- the sample frame is confined to one or two buildings with a single owner at the same geographical location. When the sample frame grows to multiple buildings through studies, the validity of the results will be better understood and placed into a broader context.

5.0 OVERVIEW OF FINDINGS

5.1 General observations

Rating a "green" building informs owners, practitioners, tenants and the public about the environmental benefits of a property, and the process can disclose the additional innovation and effort invested by a building owner to achieve a facility with more sustainable features and long-term performance (Lazzaro 2007). A rating system helps objectify building attributes, systems, materials and equipment as related to resource and energy efficiency, and serves as a predictor of actual operating performance. Broadly-accepted rating systems – such as USGBC's LEED and GBI's Green Globes – have provided consensus-based benchmarks for green design that have given the green building movement credibility (Quirk 2012). At the same time, critics are questioning the costs and inflexibilities of some rating systems as barriers to broader adoption (Bryan 2012).

This study is predicated on a direct comparison of LEED and Green Globes as applied to a large-scale institutional project. Generally, projects scored according to LEED receive a percentage of applicable points from a universal list applied to all projects of a similar type. Alternatively, projects rated under Green Globes are not held accountable for scores within sub-categories that are inapplicable to the specific project. A second distinction for Green Globes is the ability to compare building design approaches through inputs into an interactive online software system, allowing owners and designers to adjust and weight various systems and materials investments intended for their facility. USGBC's LEED maintains the rigor of a total point-based system that rewards end-result achievement; however, it is dependent on information input by outside consultants that some have questioned as being cumbersome and more expensive (Adams 2012).

The hard costs of rating systems are based on published price schedules that are set periodically by the respective non-profit sponsoring organization. These costs are normally transparent, predictable and non-negotiable. Hard costs can be divided into programmatic costs and formal assessment and certification costs. Programmatic costs may include subscription fees, application fees, registration fees and costs for Reference Guides. Formal assessment and certification costs include direct charges for design and construction review and for rating system assessment fees.

Soft costs generated through a rating system process are tied to project-related goals and decisions – including some mandatory items – that arise out of building features and design approaches and may also be directly linked to national or local codes, policies and laws/regulations. A first major category under soft costs includes funds needed to accomplish the entire assessment process. Individual costs may be composed of communications; professional consultation; and documentation gathering, assembly and transmittance. Billable hours may be driven by the Owner's requirements and by the rating system utilized on the project. Among the chargeable sub-categories are specialty professional consulting services, rating system administrative costs and filing services. A second soft cost category is linked to the actual design and construction premium associated with building features that are chosen (or are mandatory) for the specific project based on level of design, performance levels and best practices. These costs are manifested by billable design and construction management hours, and may include energy modeling and analysis, commissioning, design cost premiums and construction cost premiums associated with the respective rating system schemes.

Rating system programs may also have optional costs tied to the process of conducting the rating system, such as seeking redress of perceived unfair rating outcomes, costs for systems performance review during the transition from construction to owner operation, and prices of signage that acknowledge the rating level attained. Specifically, optional costs may include fees for expediting of an application or assessment, enhanced commissioning costs, appeals of lower-than-expected ratings, and plaque ordering and installation costs.

5.2 Specific findings and analysis

The summary table shows the rating systems comparisons on a line-by-line basis. Due to a discrepancy in the way the rating entities were compensated, a head-to-head comparison of hard costs for LEED versus Green Globes is not possible. However, one can infer that of the $125,000 paid by the Owner for the LEED consultant's fee, approximately one-third (or about $40,000) may have been the hard-cost portion of the contract designated for US Green Building Council program and assessment fees, based upon USGBC's published fee schedule. Hard costs for GBI Green Globes were paid directly and consisted of $9,000 for formal assessment, certification, and for site verification (total Green Globes hard costs = $9,000).

There was specific acknowledgment on the part of the Drexel University facilities staff that "ancillary costs for LEED are more expensive because of required documentation." However, this required documentation was not broken out in the financial information made available for this investigation. Anecdotal evidence did point to high prerequisite costs mandated by the LEED process. "The Owner's team did a lot of legwork toward a single point," said one of the project's design professionals. For example, "Drexel created drawings and studied development density SSc2 [and then abandoned] the work when advised that it would not bear fruit. Under GBI Green Globes, the Owner is not desperately seeking components that add up to points due to flexibility and greater variation in the points spread."

Most public and private owner entities are keenly interested in energy savings and environmental sustainability for a number of reasons cited earlier in this study and in the reference material cited in this report. Cost and user-friendliness are two of the variables driving choice of selected facility rating system. On those two factors, Drexel buildings' team had further comments: "For LEED, the Owner's staff created documents showing locations of everything from recycling containers to NO SMOKING signs. Under Green Globes, the on-site reviewer was shown the containers and the signs, and no documentation was required. Extra documentation and staff time was simply done to satisfy LEED policies." Differences between the two rating systems were also observed by the Drexel facilities operations staff. One senior maintenance engineer noted that additional monitoring and metering equipment for measurement and verification of EAc5 were purchased in pursuit of LEED Gold, but admitted that most of the additional meters will not be observed on a regular basis, since the house staff simply don't have enough capacity or hours to take advantage of the additional information.

During follow-up questioning of Drexel Facilities personnel, the Principal Investigator of the study asked whether Green Globes received any benefit from work done on behalf of USGBC rating, because the findings of the study would necessarily be skewed if "free rider" work, information and costs were accomplished under one rating system and applied at no cost to a second rating system. The Owner affirmed that no free rider costs were acknowledged or recognized by the project team, or listed in the project cost records, and that effort and costs for each rating system were fairly segregated.

6.0 SUMMARY AND CONCLUSION

The study findings detected signs of a small variance in professional consulting costs (respondents indicated design costs for projects utilizing Green Globes were slightly lower than projects using LEED) and little variance in construction costs between the two subject rating systems. However, there was significant variance in the number of hours devoted to the project by the Owner's facilities personnel depending upon the rating system utilized. Audited cost records show that the Owner posted 128 hours of direct personnel time for USGBC LEED rating support and administration; as contrasted with 28 hours of GBI Green Globes rating support and administration. A second key variance shown on the rating systems cost comparison table is the cost for engaging rating entities for the Papadakis building. A breakdown in the Owner's cost records indicates costs of over $125,000 (an estimate of approximately $40,000 of this total was directly paid to USGBC) for the USGBC LEED rating process as accomplished through an independent consultant rather than directly with USGBC versus $9,000 for GBI Green Globes. Total costs for the two systems are shown on the summary costs table at the conclusion of this report, which tabulates overall USGBC LEED costs as 14.92 percent higher than the costs of implementing GBI Green Globes.

Perhaps a more important observation from an Owner's point-of-view would be in-house personnel hours required to administer an energy and environmental rating system process for a new facility. In this instance (Papadakis building on Drexel University's Philadelphia campus), the Owner's internal costs for administering USGBC's LEED were nearly 492 percent higher than GBI's Green Globes. This institutional Owner relied on its own specialists to handle the rating system process, and this may be typical for institutional owners with larger facilities departments. Smaller facilities owners (including smaller institutional owners, commercial building owners and other private owners) may need the expertise of third-party professionals, who would likely have a multiplier of 2.4 to 3.2 over direct hourly costs, exacerbating the costs of sustainability rating systems that necessitate such third-party assistance.

Both rating systems were deemed valuable and helpful in leading the Owner, professional consultants and constructors toward a highly positive sustainability rating outcome. A number of those interviewed mentioned the prestige of earning the equivalent of a LEED Gold Rating, and acknowledged the market leadership of USGBC for buildings in the United States. Two interviewees mentioned the changes in building codes that can be partially credited to the marketplace influence of LEED, Green Globes and other sustainability rating systems actively used the marketplace. Although not quantified in this study, two interviewees cited the flexibility of Green Globes, where projects are not held accountable for strategies that do not apply, and for its efficient use of Owner's time through an interactive online format that provides timely feedback and useful assessments of systems and materials. These interviewees (members of the Drexel University Facilities Staff) were of the opinion that Green Globes was the more cost effective rating tool among the handful that had been formally considered and employed at its University City campus. The findings of this study appear to support those suppositions.

The costs and relative utility of the rating programs according to design professionals and constructors were difficult to ascertain. Spokespersons for the A/E of Record insisted that all of their projects of this general type had sustainable features built in because of the firm's practice culture. None of the persons interviewed at the Toronto-based architectural firm would respond to a direct question about the difference in design cost premium between a traditional base building and a building designed for LEED Gold or Three Green Globes. Others interviewed for this study, including Drexel facilities personnel and the independent cost estimator for the Papadakis building, suggested that there is a rule-of-thumb for percentages of incremental design cost premiums paid according to level of rating sought. More than seven years ago, energy design consultant Morrison Hershfield published a table showing "actual cost premiums" based on LEED silver [0.8 percent], gold [3.5 percent] and platinum [11.5 percent] (Lazzaro 2007). Currently, professional cost estimators for the subject building use somewhat lower design cost premiums in their estimates, with a scale ranging from 0.5 percent (silver), 2.0 percent (gold) and 5 percent (platinum), according to sources at ICI (Funk 2013). These premiums, according to those interviewed, may be applied to both design and construction costs. Despite the marketplace perception and reality of first cost premiums for rated facilities, preliminary studies showing lower life-cycle costs for sustainable buildings are beginning to appear in journal literature (Sparkling 2012, Highton 2012).

Follow-up questions to individuals who had previously answered the study questionnaire attempted to ferret out the cost premiums for design and construction at the Papadakis Integrated Sciences Building. Drexel facilities staff generally agreed with the ICI estimates for LEED provided in the above paragraph, and commented that the design and construction premium for Green Globes was likely to be some "fraction" of the LEED premium. When pressed, one interviewee said that the Green Globes effort (that is, design cost premium) could be 30 percent to 40 percent less cost than for the LEED rating process, primarily due to less stringent documentation requirements. If this is a reasonably accurate assumption, the design cost premium for Green Globes would be approximately $45,000, versus $70,000 for LEED, about one-third less. However, there is no verifiable data or official record to fully support this estimate.

Another issue related to costs is the potential for "free riding" by one rating system benefiting from work task efforts previously undertaken on behalf of the other system. Although not part of the initial Questionnaire, a follow on question was posed to multiple Drexel University employees concerning the potential for free-riding (unfair financial advantage by one system over another when more than one rating system is employed on a project), and this question was met with a unanimous "no" by all interviewees. Unless a researcher is permitted contemporaneous access to the project and key persons associated with the sustainability assessment, there is no way to independently verify this outcome; but there is also little reason to worry about the objectivity of the professionals involved due to their public licensure and codes of ethics in vocations that prize unbiased opinions and technical judgments based on protecting the public from hazards in the built environment.

Developers of sustainability rating systems are faced with creating and implementing tools that have sufficient rigor to meet the criticisms of skeptics, including from those who demand more scientific proof of their effectiveness; while at the same time providing accessible, transparent and affordable systems that appeal to facilities owners and designers. LEED and Green Globes take different paths to achieve a rough balance between these competing goals. In the near term, Drexel University seems to leaning toward the more flexible and cost-effective approach.

7.0 SUGGESTIONS FOR FURTHER RESEARCH

As a Carnegie-Mellon study pointed out in 2009, more research about rating systems applied to "real buildings" is needed to properly analyze the costs and effectiveness of environmental and energy assessment tools (Biswas 2009). This study makes a small step toward answering that concern, but it fails to draw from a sufficient pool of projects that would be necessary to derive more useful measures. Both academia and industry would benefit from a central database of rated projects. The project database should not be limited to a single rating system, but inclusive of all legitimate systems that have achieved sufficient recognition and market penetration.

Some pioneering work has been done on Sustainable Return on Investment (SROI) models for green buildings (Ellison 2010). Additional study – perhaps using some of the methodology outlined in this report – could provide costs-to-benefits comparisons for applying and conducting sustainable rating processes as a companion sub-set study to an overall facility SROI. Further research on the user-friendliness of rating systems, and usefulness and accuracy of rating metrics in each of the systems as linked directly to predicted life cycle costs, would be beneficial to facility owners, and such efforts may stimulate fruitful university – industry collaboration toward more sustainable structures.

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TABLE FOR RATING SYSTEMS COMPARISON

Note: Costs obtained from direct and third-party sources and are "best estimates" from those interviewed.

Line Item	Description of Cost Area and Sub-Areas	Green Globes $$	LEED $$	
	"HARD" COSTS			
	Green Building Program		See Admin	
1	Subscription Fee		below	
2	Application Fee			
3	Registration Fee			
4	Reference Guide			
	Formal Assessment and Certification	$9,000		Variance
5	Design and Construction Review			
6	Assessment Fee			
7	Site Verification			
	Subtotal of Hard Costs	*$9,000*	*Incl. below*	
	"SOFT" COSTS			
	Related to Managing Assessment Process			
8	Consulting Services			
9	LEED Administration		$125,000	Variance
10	Filing Services			
	Related to Sustainability Features			
11	Prerequisite Costs			
12	Business Requirements			
13	Energy Modeling	$26,000	$26,000	
14	Custom Energy Analysis	$3000	$3,000	
15	Commissioning	See below	See below	
16	Design Cost Premium	$70,000 est.	$70,000 est.	
17	Construction Cost Premium	$980,000	$980,000	
18	Owner Time for Rating Process	$2,800	$12,800	Variance
	Subtotal of Soft Costs	*$1,078,800*	*$1,216,800*	
	OPTIONAL COSTS			
	Additional Costs Associated with Rating Program			
19	Appeals			
20	Expediting Fee			
21	Enhanced Commissioning		$37,000	Variance
22	Plaque Cost	$785	$660	Variance
	Subtotal of Optional Costs	*$785*	*$37,660*	
	TOTAL COSTS	$1,091,595	$1,254,460	14.92%

Supplementary Comparison	**Green Globes**	**LEED**	
Project sustainability assessment costs NOT INCLUDING design or construction premiums	$41,585	$204,460	491.7%

QUESTIONNAIRE

A STUDY OF COMPARATIVE COSTS OF APPLYING SUSTAINABILITY RATING SYSTEMS TO NEW BUILDING PROJECTS

General Questions (to establish line items showing similarities and differences):

1. What were the hard cost items for each of the rating systems employed on the project?
2. What were the soft cost items for each of the rating systems employed on the project?
3. What were the optional costs for each of the rating systems employed on the project?
4. What were the subtotal costs by category and overall costs for each of the rating systems on the subject project?
5. In what ways do the costs of each of the sustainability certification schemes tie to return on investment (ROI) for the building project?

Specific Questions (to further refine the base line items identified through General Questions):

1. What were the direct costs related to the rating system process (separate the costs of each discrete rating system used) that were incurred and paid for by the facility owner?
2. What were the direct costs or cost increment (as a percentage of overall construction costs) of the facility over and above what would have been incurred if the facility was not designed and constructed for sustainability rating?
3. What were the indirect costs or cost increment (as a percentage of overall construction costs) of the facility over and above what would have been incurred if the facility was not designed and constructed for sustainability rating?
4. What was the rationale behind each of the various costs (such as application or registration fees imposed through a schedule published by the rating organization; or consulting or administrative services necessary to satisfy local codes, ordinances or corporate policies)?

Follow-On Questions (after the answers to General and Specific Questions had been compiled):

A. Given the hours incurred by the Owner or its consultants as necessary to handle the rating process, is it possible that the initial rating system employed generates most of the costs and the other rating systems then enjoy a “free ride”?

B. While design costs may be similar when using rigorous rating systems, is it possible that the construction costs for a specific rating system may be lower because the subject rating system does not mandate specific products, materials, equipment or systems?

C. What types of Owner effort (work hours incurred by the Owner) caused the Owner to incur more costs under a specific rating system?

D. Was the design cost premium higher for LEED or for Green Globes? What about the construction cost premium?

E. What optional costs of each rating system were incurred on the project? Which of the optional costs are appropriate or necessary for institutional Owners?