GREEN BUILDING RATING SYSTEMS

A COMPARISON OF THE LEED AND GREEN GLOBES SYSTEMS IN THE US

Prepared For:

The Western Council of Industrial Workers

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September 2006

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TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 2

2. INTRODUCTION 6

3. REVIEW OF RELEVANT LITERATURE 7

4. DISCUSSION OF SYSTEMS AND COMPARATIVE MATRICES 10

5. INCORPORATION OF LIFE-CYCLE ASSESSMENT 16

6. GSA CASE STUDY AND COMPARISON TO GREEN GLOBES 19

7. REFERENCES 25

APPENDIX A: Process comparison of Green Globes v.0 and LEED 2.2 28

APPENDIX B: Harmonized comparison of Green Globes and LEED 29

APPENDIX C: Harmonized point comparison of Green Globes v.0 and LEED 2.2 46

APPENDIX D: Comparison of Green Globes versus Green Globes v.0 Design v.1 - Post Construction Assessment 47

APPENDIX E: GSA courthouse case study - LEED 2.1 rating and corresponding Green Globes v.0 rating 48

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1. EXECUTIVE SUMMARY

Worldwide, a variety of assessment programs have been developed around environmental and energy impacts of buildings. The first environmental certification system was created in 1990 in the UK, The Building Research Environmental Assessment Method (BREEAM). In 1998 the Leadership in Energy and Environmental Design (LEED®) Green Building Rating System was introduced based quite substantially on the BREEAM system. In turn, in 2005, the Green Building Initiative (GBI) launched Green Globes by adapting the Canadian version of BREEAM and distributing it in the U.S. market.

The focal comparison of this report centers on LEED® and Green Globes™. Given their common roots and similar goals – paraphrased as providing a guiding principle and assessment system for more sustainably designed buildings – more similarities than differences exist. That said, noteworthy differences in process and content still remain and will serve as the motivation behind this analysis. The central question guiding the report remains in how far pretence and reality of the rating systems align to prompt probable sustainability improvement. In addition, the ease of use and the applicability of the rating systems in the market place are addressed.

It is important and potentially most helpful to the reader to begin by mentioning what this study cannot address before discussing the aspects included in this report. This study is not a comprehensive assessment of every category, sub-category, and methodological underpinning associated with each system. It is the culmination of approximately three months of intensive analysis of the make-up and administration policies and practices of LEED and Green Globes based strictly on publicly available information and the standards and guidelines published by each system's administrators. While the report includes an overview of the academic and trade literature on green building rating systems, it mainly focuses on a comparison of process and content. The systems comparison is completed by an assessment of the incorporation of life-cycle thinking into the two rating mechanisms, as well as a practical example of how a given building project might fare in LEED as well as in Green Globes.

As with any voluntary and independent certification system, it is important to disentangle the market-based and competitive nature of the systems from the roles these systems may eventually play in the development of public policy or a national standard. From a market-based perspective, specific differences between systems are emphasized by each rating system's management staff in an effort to maintain stakeholder support and position their system in a competitive marketplace. For example, Green Globes emphasizes its ease-of-use and integration of green principles and best-practices in every stage of the process, whereas LEED tends to emphasize its historical leadership and "consensus-based" process for the development of LEED standards. Obviously differences of opinion exist with regard to how each system fares along these dimensions: How consensus-based is a system that until recently excluded certain impacted organizations from gaining voting membership and restricted their input in developing the current standard? Similarly, can current best-practices drive adequate future green performance in building, and what basis should be used in discriminating between materials, products, and testing/modeling methodologies? While these questions cannot be conclusively answered in this report, it is important to re-iterate the fact that the market is expected to answer these questions through their acceptance, adoption, and implementation. As policy makers increasingly look toward market-based mechanisms in their development of public policy (procurement programs, strategic investment in innovation, influence of national standards development, etc.), market acceptance and implementation will too continue to play a larger role. Therefore, this report will focus largely on the way in which users are likely to interpret and implement the systems, as opposed to focusing on requirements of the systems overall.

From a process perspective, Green Globes' simpler methodology, employing a user-friendly interactive guide for assessing and integrating green design principles for buildings, continues to be a point of differentiation to LEED's more complex, and largely paper-based system. While LEED has recently introduced an online-based system, it remains more extensive and requires expert knowledge in various areas. Green Globes' web-based self-assessment tool can be completed by any team member with general knowledge of the building's parameters, and it provides both preliminary (after schematic design is assessed) and final ratings (based on the Construction Documents Stage) during the assessment. In contrast, LEED tends to be more rigid, time-intensive, and expensive to administer.

In total, the two systems are quite comparable in that both include a common set of potentially impactful design elements that contribute to the improvement of a building's green performance. Providing for the relatively small number of notable differences between systems (to be discussed subsequently), in total the systems are quite similar. It is estimated that nearly 80% of available points in the Green Globes system are addressed in LEED 2.2 and that over 85% of the points specified in LEED 2.2 are addressed in the Green Globes system. The comparison becomes more interesting, however, by examining the point allocations of each system based on a user's strategy of acquiring a certain level of certification within one system or another. Therefore, much of the discussion that follows refers to comparisons at various levels of certification – i.e. one, two, three, or four globes in the Green Globes system, and certified, silver, gold, or platinum in the LEED system.

LEED and Green Globes attach differing values to certain aspects of green building, expressed by moderately dissimilar point allocations. Both systems also feature several unique elements. In an attempt to minimize internal systematic biases associated with benchmarking a comparative study with either rating system, we developed a system of common categories, into which we reclassified the LEED and Green Globes elements. The objective comparison of process and content differences is facilitated by the introduction of eight generic categories of analyses: 1) Energy Use; 2) Water Use; 3) Pollution; 4) Material/Product Inputs; 5) Indoor Air Quality & Occupant Comfort; 6) Transport; 7) Site Ecology; and 8) Other Sustainable Design. Each system's credits or points were allocated to the category that best represented the "intent" of each point category an/or subcategory.

Cross-referencing the different credits and points in Green Globes and LEED shows that some categories are emphasized differently in the two systems, especially at the lower levels of assessment. For instance, Green Globes emphasizes Energy Use above all other categories. In contrast, LEED allocates comparatively more points to the Materials section. Another important difference between the two systems is the use of prerequisites. LEED requires a minimum performance level in categories such as energy use, erosion control and indoor air quality, among others. In contrast, similar action in Green Globes earns points towards certification. While this increases flexibility in the Green Globes system, it also allows for relative ease in attaining the one- and two-globe level certification. This is not necessarily a negative aspect of the Green Globes system, in that its increased flexibility and ease of use may stimulate more projects to incorporate better environmental design. It does, however, beg the questions of the comparability between projects as well as between rating systems. A final point of differentiation concerns the allocation of points for strategies and/or outcomes. Green Globes awards a number of points for implementing certain strategies, as well as for the outcomes themselves, whereas LEED primarily allocates points for achieving a certain performance level. Granting partial credit for strategies might reduce the risk of point-chasing, but it could in turn increase the likelihood that projects gain significant points towards certification, overall, with relatively minor performance gains in any particular category. Different strategies of point allocations thus translate into trade-offs between flexibility and prescription between the two systems.

Both Green Globes and LEED pursue a common goal of greening the building and design process in the US. Life-cycle assessment (LCA) has become a widely used tool to assess the overall environmental, energy, and health impacts of products, including building. A cursory review of rating criteria in LEED and Green Globes indicates that, in general, life-cycle assessment is not sufficiently addressed in either system. However, it should be noted Green Globes employs a rating criterion that reflects life-cycle thinking and covers the entire life-cycle of building materials, while LEED to date fails to explicitly address LCA. In addition, neither of the two systems successfully addresses functional relevance with regard to materials selection. Again, Green Globes partially addresses this issue through its separate criterion addressing LCA, durability, and adaptability; however, these metrics could be better linked. Finally, as to the environmental relevance of the systems, both rating systems incorporate environmental impacts associated with building sectors in their sets of criteria, but, the rationale for the weights given to each criterion is not transparent or necessarily consistent with LCA methods. This disconnection between the weight of each rating criterion and the relative importance of the life-cycle environmental impacts associated with it (as estimated by previous LCA studies) remains a flaw in both systems. Furthermore, many of the criteria are independently rated by cut-off values lacking an assessment of the tradeoffs between them. As a result, one may find two very different combinations of scores, both leading to a fulfillment of the same certification requirement, while their overall life-cycle environmental impact differs substantially.

The final section of this report describes an exercise which attempts to rate a previously published LEED certified building using the currently available on-line Green Globes tool. While this case study does not lead to directly comparable results (i.e. readers should be extremely cautious in directly comparing final certification levels), the process provided an exceptional opportunity to observe the operational (hands-on) differences between the systems, assess detailed differences between system characteristics at the category and sub-category level, and gain further understanding of the sensitivities associated with a number what-if scenarios on within category assumptions related to the Green Globes system. Overall, this process brought a significant amount of transparency to the current online Green Globes system, a significant criticism found in the literature. The case examined centers on a courthouse design developed in a 2004 GSA commissioned study. Specifically, we focused on the process in which this building is seeking LEED certified (base-level) certification, while utilizing what the study describes as a low-cost strategy (Steven Winter Associates 2004). Entering the available information from this building scenario, designed to achieve LEED certification utilizing the above mentioned strategy, into the Green Globes system provided us with a tool to scrutinize some of the findings from our comparison matrices. As previously indicated, the credits do not always directly overlap, be it for the use of different measures/models, performance levels or system requirements. Whenever the requirements matched, were reasonably similar, or could reasonably be assumed to constitute good practice, we checked a 'yes' in the Green Globes questionnaire. Whenever LEED did not include aspects assessed in Green Globes or whenever corresponding information did not exist in the GSA-study, we checked 'no'. Therefore, this modus operandi is expected to result in a conservative estimate of the Green Globes points attainable. While the mapping process is quite complex, given the fact that categories and subcategories are aligned differently between the systems (this mapping exercise is available in Appendix E), a number of interesting comparisons emerged. The case project performed quite similarly around the dimensions of indoor environmental quality, resources, and site in that the percentage of available points awarded by each system was roughly equivalent. However, the project obtained significantly fewer points in the Water category of Green Globes than its counterpart under the LEED system; but it is noted that these differences can be minimized under fairly conservative assumptions regarding water consumption estimates not provided in the GSA study. Potentially most striking is the project's high performance in the Energy area of the Green Globes system, as compared to the LEED system, obtaining 54% of the category's points under Green Globes and only 12% of the category's points under the LEED system.

While it is exceedingly difficult to directly compare the two systems, and even more difficult to draw any normative implications from such an activity, a number of trends are worth noting as concluding remarks. First, the Green Globes system appears to be doing a fairly good job in improving upon the delivery mechanisms employed by LEED which are so often criticized. The on-line approach to assessment not only improves efficiency and reduces costs, but also provides opportunities to influence the design and planning processes of the project through immediate feedback not available from a primarily paper-based system. Second, Green Globes better integrates life-cycle thinking into its rating system, specifically through sourcing of materials and the durability and adaptability of the structure itself. This appears to be a potential source of competitive advantage over LEED as both systems seek to better include LCA methodologies into future versions – however, it remains unclear whether the same LCA-based thinking will be applied to the overall category and/or priority setting mechanisms of either system. Finally, GBI being named as an accredited standards developer under the American National Standards Institute (ANSI), and the consensus-based process associated with creating an official ANSI standard for green building practices, will undoubtedly enhance Green Globes presence in the marketplace. This process has already begun, as evidenced by the newly created Green Globes Design v.1 criteria which represent a significant shift to greater transparency, increased prescription in methods, and greater focus being placed on performance-based outcomes. These improvements are expected to address many of the issues associated with the current Green Globes system evaluated in this report. However, greater emphasis needs to be placed on the development of the online questionnaire to integrate these changes without negatively impacting the system's ease of use.

2. INTRODUCTION

Many industrial sectors are beginning to recognize the impacts of their activities on the environment and to make significant changes to mitigate their environmental impact. The commercial building construction sector has recently begun to acknowledge their responsibilities for the environment, resulting in a shift in how buildings are designed, built, and operated. This shift in attitude has been driven in large part by a growing market demand for environmentally sound and energy efficient products and services, initiated primarily from the non-profit sector and federal, state, and municipal building projects. A central issue in striving towards reduced environmental impact is the need for an applicable and meaningful yardstick for measuring environmental and energy performance.

Two mechanisms are currently available to commercial architects, designers, and builders in the U.S. attempting to identify their products and services as "high performing" on environmental and energy dimensions. The LEED (Leadership in Energy and Environmental Design) Green Building Rating System® is a voluntary rating system introduced in 2000 for developing high-performance, sustainable buildings. Developed and maintained by the U.S. Green Building Council, the certification process assigns points along six assessment areas (Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Air Quality and Innovation). Green Globes^{TM}, a web-based green building performance tool from Canada, has recently been introduced to the U.S. market as an alternative to the LEED® Rating System. Green Globes is distributed by the Green Building Initiative in the US. It generates numerical assessment scores corresponding to a checklist with a total of 1,000 points listed in seven assessment categories (Project Management; Site; Energy; Water; Resources; Emissions, Effluents & Other Impacts; Indoor Environment). These scores can be used as self-assessments internally, or they can be verified by third-party certifiers.

Many similarities exist between the systems – i.e. each is based on four levels of achievement along performance categories that closely match at first view. However, significant questions remain around the degree to which content and process differences between the systems influence environmental performance outcomes. This project attempts to take the first step in addressing these questions by developing a comprehensive, and independent, comparative matrix of the two systems, identifying comparable and unique characteristics of both programs and proposing measures and constructs where direct comparisons are not possible.

The brief report that follows, along with accompanying comparative matrices, attempts to address the content and priorities specific to both rating systems, as well as the processes related to how the systems may be implemented in practice. Inherent in this discussion and in the absence of empirical building performance data, we attempt to address the extent to which each system addresses their common central missions – paraphrased as the "ability to enact change in building processes to improve energy and environmental performance." Therefore, issues associated with credibility (certification processes), flexibility (applicability and rigidity of point systems), and environmental relevance (the criteria chosen by the two programs from a life-cycle perspective) underlie much of the discussion.

Specifically, the objectives of this study are:

- The development of comparative matrices of measures and processes used in the two systems.
- An analysis of constructs pertaining to life-cycle stages (design, construction, use, dismantling, disposal), credibility (certification processes), flexibility (applicability and rigidity of point systems), and specific environmental impacts addressed by the systems (site, materials, energy, indoor air quality, etc.).
- A preliminary assessment of the "environmental relevance" of the criteria chosen by the two programs from a life-cycle perspective.

3. REVIEW OF RELEVANT LITERATURE

Green building practices are not new phenomena. A handful of buildings integrating environmental design aspects were erected as early as the late 19th and early 20th centuries (Cassidy 2003). After World War II, a stern belief in technical progress and the abundance of cheap fossil fuels resulted in a building style with little regard for energy efficiency or other ecological aspects. A unified green design movement did not begin to emerge until the 1970s, when design and building practices first became a focus of environmental advocates. In his seminal work *Design for the real world*, Victor Papanek (1972) advocated design practices embracing moral and social responsibilities and criticized design characterized by conspicuous consumption. The first attempts at introducing environmental considerations into the design process were characterized by hostility towards the design community and by a focus on developing countries (see Madge 1993). In consequence, the reception of Papanek's and colleagues' ideas was limited in the United States and other industrialized countries.

In the 1980s, the issue reemerged under the labels of sustainable development (Rees 1989) and sustainable design (St. John 1992) and this time, it proved more successful. During the last decade, a proliferation of publications on sustainable design and architecture have appeared. Some of these works focus on outlining target objectives, without quantifying their costs and benefits or going into much detail about strategies to attain them. For instance, Hawken, Lovins and Lovins (1999) discuss a number of green buildings, and then proceed to propose integrative design as a solution to ecological shortcomings, with retrofit insulation and installation of energy efficient appliances as second best solution. The 1990s also saw increasing efforts to give practical advice to design and construction professionals. The Minnesota Sustainable Design Guide (1997), for instance, is providing guidance on how to attain sustainability during the design and planning process. The American Institute of Architects' Environmental Resource Guide (Demkin 1999) provides information on sustainable building materials.

In parallel to these efforts, institutional structures began to emerge. Worldwide, a variety of assessment programs were developed. The first environmental certification system was introduced in 1990 in the UK: The Building Research Environmental Assessment Method

(BREEAM), and brought to Canada in 1996. In the U.S., the U.S. Green Building Council (USGBC) introduced its own rating system in 1998: Leadership in Energy and Environmental Design (LEED®) Green Building Rating System®. In 2004, the Green Building Initiative (GBI) adapted the Canadian version of BREEAM to create Green Globes™ and began distributing it in the U.S. market in 2005.

Most of the early building assessments were pursued by public agencies, but today, private demand for green buildings is catching on, too. Yudelson (2004) forecasts green building growth rates in the double digits until 2007. Despite this rapid growth and an estimated value of $ 7.4 billion in 2005, green building still remains a niche market, with only 2% market share in 2005 (NBN 2006). The existence of market barriers for green building is discussed in a recent string of publications concerned with the costs and benefits of ecological construction. The intent of these publications is to dispel doubts about the net costs and benefits of green building. Adding ecological aspects to a building is often believed to lead to higher construction costs and lower attractiveness for the investor, while any benefits are a public good. If the business case for green building cannot be proven, there is little incentive for businesses to invest in it (Thompson 2003).

Several authors have set out to demonstrate the net benefits of green buildings. Yates (2001) sees many economic advantages: Capital costs are not higher for many green construction elements and even where upfront costs are more elevated, they can often be offset by decreased operational costs. The author also mentions green construction as a way of risk and liability management: it may well help protect owners against future regulation changes and lawsuits. Indeed, ecological construction is being recognized increasingly as a means to managing risks. Improved construction practices associated with green design have been linked to some insurance companies providing lower premiums to owners of green buildings. Roodman and Lenssen (1995) discuss evidence that real estate values for green buildings appreciate faster than those of conventional buildings. They also point to shorter resale and release times, combined with longer tenant occupancy terms. Nevertheless, green building is not seen as being inevitably profitable. Matthiessen and Morris (2004) find that while overall cost savings are possible in green building, they depend on factors such as climate, topography, timing, credit synergies and local building standards.

Less visible benefits of green building are also garnering interest. For instance, Fisk (2000) seeks to establish a link between indoor environmental quality on the one hand and higher productivity and better health on the other hand. He estimates that in the United States, increased worker performance alone could amount to up to $ 160 billion in efficiency gains. Another $ 48 billion could be saved thanks to fewer occurrence of asthma, allergies and sick building syndrome. Daylighting is also a major focus of authors studying the effects of environmental design. Like indoor air quality, it has been linked to performance gains and health improvements (New Buildings Institute 2003, Nicklas and Bailey 1996).

Legislators' interest in green building is on the rise, too, as demonstrated by a number of studies commissioned by public authorities. Kats et al. (2003) examined the cost structure of 33 LEED projects for the Californian Sustainable Building Task Force. According to the authors (idem), the study "demonstrates conclusively that sustainable building is a cost-effective investment". They found that, on average, a capital investment increase of 2% compared to a conventional building was amortized by more than ten times this sum in savings over the lifetime of the building. Likewise, the U.S. Green Building Council (2003) concluded in its report to the U.S. Senate that increased upfront costs of green building can be regained over the lifecycle of a building and that numerous health and environmental benefits result from sustainable design. It recommended that the federal government, as the largest owner of facilities in the country, take a leading role in the green building movement.

Some other publications are more concerned with the practical aspects of applying green design in the construction of public facilities. Most of this literature focuses on LEED, the current market leader. The Portland Energy Office (2000) published a guide on applying LEED to city buildings. The U.S. Federal Facilities Council (2001) studied ways of integrating sustainable design into federal facilities. The U.S. General Services Administration (Stevens Winter Associates 2004) commissioned a study on the feasibility and costs of pursuing LEED certification in its new construction and renovation projects.

Another set of literature is concerned with identifying efficient ways of obtaining certification. Matthiessen and Morris (2004) examine which LEED credits are pursued most often and for what reason. From their overview of 61 LEED projects, they draw several conclusions:

a) Sites are not usually chosen for the LEED credits that can be obtained.
b) Some credits can be easily pursued, although they are of little practical significance. For example, the credit for installing an electrical car recharging station is not in line with the reality that there are almost no electric vehicles on the roads today.
c) Often, if consecutive credits are increasing performance requirements, only the easier stages are pursued (e.g., energy efficiency, minimal irrigation).
d) Still other credits are either obtained at minimum cost, or not at all (e.g., minimization of footprint). However, this permits no conclusion on the overall environmental performance outcome.
e) Credits perceived as conflicting with other interests tend to be unpopular. For instance, light pollution reduction is seen as a security concern.
f) Some credits are almost always taken (e.g., in the indoor environmental quality category). This indicates that they have already become common practice. In some cases, they are even incorporated in local building standards (e.g., materials).

In industry and trade association journals, a whole ensemble of literature has sprung up that deals with how to attain specific LEED credits (see for example Vangeem and Marceau 2002, Hermann 2005, Yoon and Moeck 2005, Davis 2005, Miranda 2005). The building industry is reacting to LEED by developing more environmental products and strategies, in this sense, the ‘market based approach’ forwarded initially by USGBC, and subsequently by GBI, seems to be having an impact. On the other hand, LEED has also attracted a significant amount of criticism, in particular for its onerous, costly certification process and the practice of chasing “easy” points rather than pursuing activities that lead to potentially more significant environmental and/or energy performance improvements (Rumsey and McLellan 2005, Schendler and Udall 2005). LEED has also come under scrutiny for its unscientific criteria selection, which is often inconsistent with a life-cycle perspective.

For instance, Bowyer et al. (2006) state that LEED designates materials as "environmentally preferable" without considering their overall life-cycle impact. The authors are also critical of the fact that bio-based products are not given preference over other building materials, and that wood is the only material for which certification is demanded. The National Institute of Standards and Technology (NIST) conducted another such critical report examining the comprehensiveness and comparability of the LEED system from a life cycle assessment perspective (Scheuer and Keoleian 2002). Due to the committee-based and stakeholder processes, as well as the lack of scientific influence in the development process, this report questions LEED's ability to achieve individual credit intentions and thus the system's ability to achieve its overall programmatic goals. This report is also critical of the comparability between LEED ratings and LCA-based results included in the study indicating a lack of consistency in attaining environmental goals. Finally, the report is critical of the LEED program's individual credit structure and the lack of balanced results associated with impact categories. They therefore conclude that LEED "does not fulfill its goal of providing a standard of measure."

Due to its relative newness and smaller market penetration, to date Green Globes has not aroused as much attention as LEED. However, it has certainly been noted as a potential competitor to LEED (N.N. 2005, Stranzl 2005). There are only two publications directly comparing both systems that we are aware of. The Athena Sustainable Materials Institute (2002) has compiled a detailed study on the harmonization of LEED and the Canadian version of Green Globes, BREEAM/Green Leaf. In addition, a brief report on the two systems has been prepared by the Natural Resources Defense Council (Bright 2005). The former concludes that there is a close relationship between the two systems in terms of contents, goals and weighting of categories and that harmonizing Green Leaf and LEED is possible. The latter tends to focus on the increased stringency and credibility of the LEED rating system over the flexibility and ease of use of the Green Globes system. In many ways, these reports indicate that along critical dimensions the two systems are quite comparable. However, it remains to be seen whether current developments in either system substantially address the concerns raised in the NIST study regarding comprehensiveness, comparability, and credit/point balance necessary to an effective standard of environmental performance.

4. DISCUSSION OF SYSTEMS AND COMPARATIVE MATRICES

Systems Overview

Given the recently conducted efforts elaborating on process differences between the two rating systems, as well as recent and significant changes impacting the approach and in some ways the underlying philosophies of the Green Globes system, we have chosen not to address process related constructs in a matrix fashion. Many of the findings identified in the Athena and NRDC reports continue to hold true. A summary comparison of process related characteristics of both systems can be found in Appendix A and is based almost entirely on the NRDC report (Bright 2005).

Green Globes' simpler methodology, employing a user-friendly interactive guide for assessing and integrating green design principles for buildings, continues to be a point of differentiation to LEED's more complex paper-based system. Green Globes' web-based self-assessment tool can be completed by any team member with general knowledge of the building's parameters, and it provides both preliminary (after schematic design is assessed) and final ratings (based on the Construction Documents Stage) during the assessment. In contrast, LEED tends to be more rigid, complex, and expensive to administer. Between registration, certification and documentation expenses a project can accrue significant costs. For instance, LEED's maximum fee for the certification process of a large commercial building (more than 500,000 sq. ft.) is $ 20,000 for non-members (members: $ 17,500), plus a fixed registration fee of $ 600 (members: $ 450). This compares to the flat registration fee of $500 for Green Globes with certification costs estimated to range between $ 4,000 and $ 6,000. Environmental certification also generates soft costs, i.e. for extra time spent planning and generating and submitting reports. For LEED, a recent GSA study (Steven Winter Associates 2004) estimates these costs at $ 0.40 to $ 0.80 per square foot, depending on the certification level pursued and the experience of the design team. With regard to time, LEED can also be quite costly with certification taking up to four months to complete. Applications are first assessed of anticipated, pending, and denied prerequisite/credit achievement followed by corrections and additions made by the project team. USGBC then proceeds with a final review, and finally acceptance/appeal processes are required. With respect to the cost of certification, as well as the process of applying the rating system, Green Globes at this point seems more in line with the real world conditions of scarce time and financial resources experienced by the building and design community.

However, both systems remain in a state of evolution. While USGBC introduced LEED 2.2 in fall 2005 and is expanding the use of a paperless submittal system, Green Globes is currently in the process of developing a new version of its program, Green Globes v.1. Green Globes web-based interview system (with its ability to host multiple users and assist in multiple stages of the design and commissioning process) is expected to continue with the implementation of Green Globes Design v.1, but much of the simple yes/no, layperson approach is anticipated to be replaced with greater rigidity and prescription of performance criteria. We were unable to assess the impact of Green Globes Design v.1 on the administration of the system in that the questionnaire provided on-line has not yet been updated to include these new standards.[2] This represents a significant potential point of confusion for users currently implementing the system. At the time of publication, all references to standards and point allocations communicated via the web site relate to the v.1 criteria. However, the questionnaire and reports generated for registered users of the system follow the Green Globes v.0 system of largely systems-based and interpretive assessments. In the following sections, we will refer to v.0 unless otherwise noted due to the fact that the v.1 criteria are not currently operable in the on-line interactive format.

Comparison of Green Globes and LEED 2.2 Criteria

At first sight, Green Globes v.0 and LEED 2.2 seem to compare quite closely on aspects such as achievement levels, performance categories and allocation of points to these categories. Both have four levels of performance and the percentage of total points to be attained for each level is not very far off between the two systems. 5 of the respective 6 (LEED) and 7 (Green Globes) categories seem to be closely aligned (Energy, Materials, Water, Indoor Environment, Sites). The allocation of points to most of these categories is only a few percentage points off when comparing the two systems.

[2] Based on telephone interview with Jiri Skopek, Technical Advisor to GBI and founder of ECD Energy and Environment Canada, May 18, 2006.

However, a closer look at the two systems reveals a number of significant differences worth noting for comparative purposes. For instance, the same elements sometimes appear in different categories in the two systems (e.g., Green Globes includes public transportation under "Energy", while LEED includes it under "Sustainable Sites"), making a direct point allocation comparison difficult. Therefore, to provide such a comparison and in an attempt to minimize internal systematic biases associated with benchmarking a comparative study with either rating system, we developed a system of common categories, into which we reclassified the LEED and Green Globes elements. This process is thought to allow readers to arrive at a more objective comparison. We explore each system based on eight (8) generic "sustainability" categories: 1) Energy Use; 2) Water Use; 3) Pollution; 4) Material/Product Inputs; 5) Indoor Air Quality & Occupant Comfort; 6) Transport; 7) Site Ecology; and 8) Other Sustainable Design. While these categories are not substantially different from those employed in either system, this process allowed us to more objectively cross-reference major and minor credits, as well as system-identified strategies, based on our interpretation of the intent of the item. Appendix B provides a harmonized comparison of the Green Globes and LEED rating systems. Given the newness and "draft" nature of Green Globes Design v.1, our comparison focuses on the v.0 Green Globes rating system and on LEED 2.2.

An immediate difference that warrants notice is the inclusion of prerequisite criteria in a number of categories within LEED,[3] requiring projects to adhere to certain aspects of green design and basic green building principles prior to consideration for credit approval. While point allocations between the two systems are explored in greater detail below, it is worthwhile to note that taking the same action required as prerequisite in LEED would earn points toward certification in the Green Globes system. These points are not trivial, in that it is estimated that 69 points could be earned in the Green Globes system by simply meeting LEED prerequisites. While 69 points are fairly benign in the scope of the 1000 possible points available through the Green Globes system, they represent nearly 20% of the points required for certification at the one globe level (350 points are required[4]). The researchers make no claim as to the appropriateness of these specific credits being identified as prerequisite and/or required basic elements of green design, but, this example highlights what has consistently emerged throughout our analysis – the increased flexibility provided by Green Globes facilitates relative ease in attaining the bottom rung of the four certification levels. No minimum level of performance in any specific area/category is required.

In a similar fashion, points are awarded in Green Globes v.0 for outcomes as well as the strategies for achieving those outcomes. In contrast, LEED primarily awards points on projected performance outcomes alone. This practice may have the intended effect of stimulating project teams to pursue some strategies where they might not otherwise be motivated to do so under LEED. As discussed in the literature review, the all-or-nothing approach to LEED has lead to

[3] The LEED prerequisites are: Fundamental Commissioning of the Building Energy Systems, Storage & Collection of Recyclables, Erosion and Sedimentation Control, Minimum Indoor Air Quality Performance and Environmental Tobacco Smoke (ETS) Control.

[4] In this case we assume that 350 points are required for the one globe level. However, Green Globes does not hold projects accountable for strategies that are not applicable, so the actual number of points available varies by project. In many categories a user can select "N/A" which removes those points from the total number available so as to not penalize the project. Projects are assigned Globe ratings based on the percentage of applicable points they achieve, therefore it is possible that these 69 points could actually contribute even more substancially than the 20% indicated.

significant point chasing of more easily accomplished credits and completely ignoring credits that are more difficult or more costly to obtain. Green Globes v.0 seeks to remedy this problem by granting the possibility to gain partial credit for implementing certain technologies, the underlying logic being that it is better to do something instead of nothing at all. While this approach may reduce this point-chasing effect, it also bears a significant risk – particularly at the lower assessment levels. Specifically, it may permit projects to gain significant points toward certification with minimal performance gains, potentially damaging the credibility of the system through what could be interpreted as double-counting (an issue that has been largely addressed in Green Globes v.1). In addition, the yes/no format of the questionnaire leaves significant room for interpretation and often asks that issues simply be "considered" as opposed to implemented or implemented with specificity as to the extent of its application in the project. While this approach may be beneficial in prompting designers to consider a greater number of aspects across multiple impact categories, the risk exists that "partial credit" across many categories could culminate in certification without sufficient commitment to any one category to significantly improve the overall performance of the building.

Finally, the possibility of earning significant numbers of points for lower levels of modeled performance is pronounced in the Energy Performance category of Green Globes. LEED provides points for exceeding the most stringent of either ASHRAE standard 90.1-1999 or the local energy code by 20% or more (2 points or 7.7% of basic certification). Green Globes provides up to 30 points (8.6% of One Globe certification) for 5-19% performance improvements over the 75% EPA target. Again, it is beyond the scope of this project to determine the comparability of methodologies employed by each system (i.e. to what extent is ASHRAE 90.1-1999 comparable to the 75% EPA Target), let alone whether a 5% improvement in one measure is similar in impact to a 20% reduction in modeled energy consumption in another. While these criteria are open to debate, on the surface, Green Globes appears to assign points to smaller incremental improvements. In any case, both the LEED and Green Globes systems should result in relatively higher performing buildings than average with regard to energy consumption. Further research is required to determine whether potentially smaller improvements across more categories can improve overall building performance.

Point Allocations and System Priorities

As mentioned earlier, both systems use similar aspects of sustainability in their rating system frameworks. However, significant differences exist with regard to the emphasis placed on various measures. We do not attempt to pass judgment on which approach results in a higher environmental performance. However, it is valuable to examine which elements of green building figure more or less prominently in each of the rating systems. By comparing the percentage of points allocated by LEED and by Green Globes to the harmonized categories described above, we can deduce which categories are emphasized by each system.

Appendix C provides a summary of the point percentages of each system and highlights areas where differences exist in the harmonized categories – particularly in the areas of Energy Use and Material/Product Inputs. Thirty percent (30%) of Green Globes points are allocated to the Energy Use category, whereas only 22% of LEED 2.2 credits fall into this category. This difference is exaggerated when comparing the influence of this category on specific certification levels. The harmonized Energy Use category represents 86% of the total points required to receive Green Globes certification at the One (1) Globe level. By comparison, this same category represents 58% of the credits required to obtain base-level certification under LEED 2.2. The larger share of points allocated to energy performance in Green Globes than in LEED might invite designers to concentrate on this category when pursuing certification. Answering the question whether more emphasis on energy savings to the detriment of other elements of green building will translate into a better performing building is again outside the scope of this study, but it is important to note that the more practical approach taken by green globes might explain the added emphasis.

In exploring the primary general categories of "green" or "sustainable" design and construction (energy, durability, air quality, and environmental impacts) and the ability to develop and specify requirements and standards of performance, measurement is a critical issue. Specifically, if you can't measure it, it is difficult to set up specific requirements and standards for it. Recently, Pat Huelman stated, "As easy as energy is to quantify, we still seem to be mystified by it and rarely get the performance predicted accurately. We don't totally understand durability, even though I would argue that it might be the most important item. Air quality continues to elude us from a quantitative standpoint. And we are just getting cranked up on the environmental front with LCA, etc. So maybe it is OK to have energy more heavily weighted for the time being."

It is interesting to note that the disparity in points allocated to energy converges somewhat at the highest levels of certification within both systems. The Energy Use category represents 35% of points needed for certification at the Four (4) Globe level and 29% for LEED Platinum certification. While both systems place the largest number of points in this category, it can be concluded that Green Globes gives greater weight to issues of energy use and performance than does LEED. As the share of the certification level points potentially obtainable by focusing on energy alone is very high in GG v.0, it could center the attention of design teams primarily on the energy section.

While energy seems at the center of interest in Green Globes, Material and Product Inputs are weighted lower than in the LEED rating system. 16% of LEED 2.2 total points are allocated to this harmonized category, whereas 9% of the total Green Globes point system fall into this category. Unlike in the Energy Use category, this relationship tends to hold up across all levels of certification. This category represents 42% LEED Certified points and 26% of One (1) Globe points; 33% of LEED Silver points and 16% of Two (2) Globes points; 28% of Gold points and 13% of Three (3) Globes points; and 21% of Platinum and 11% of Four (4) Globes. It is also noticeable that the two systems differ with regard to how they treat certain materials and certification system. For instance, while LEED accepts just the Forestry Stewardship Council (FSC) certification, Green Globes also permits certification by the Sustainable Forestry Initiative® or the American Tree Farm System® to be counted towards green building certification.

It is beyond the scope of this report to judge the level of sustainability provided by the forestry standards mentioned above, although the LEED credit for FSC certification appears to be among the most costly of all LEED credits to achieve (see for example cost estimates in Steven Winter Associates 2004) and remains one of the most contentious (Bowyer et al. 2006). On the one hand, the admissibility of a greater number of standards broadens the range of environmental products at the disposal of designers aiming to obtain green building certification. On the other hand, increased variation in standards may exasperate the issue of comparability between certified buildings often cited in the literature. Practical applicability and wide availability of products are the advantage of the first approach, while the second approach restricts the number of products in favor of creating a more restrictive and rigid rating system. While LEED is currently considering a proposal to establish a policy by which certification systems could be adopted, at this time it is not anticipated that the current preference of FSC wood products will be altered (Bowyer et al. 2006).

Other differences between the systems' point allocations exist, but tend to be more subtle. Water Use is given greater emphasis in the Green Globes system across all certification levels. While Indoor Air Quality and Occupant Comfort is given marginally more emphasis than in LEED at the lowest certification level, in the higher certification classes, this category comprises a substantially lower percentage of available points than in LEED. Although it is difficult to cast judgment on one system's point allocation versus another, this topic is addressed in greater detail in the *Incorporation of Life-Cycle Thinking* section of our report where suggestions are provided to better link system point allocations to environmental and health impacts.

As a final note to this section, it seemed timely to look at the changes from Green Globes v.0 to v.1, considering that Green Globes is in the process of a major transformation of its rating system. Appendix D provides a map of the Green Globes categories and point allocations currently employed in v.0 to those developed in v.1. A quick overview of the new and old version of Green Globes revealed that about a third of the questions in v.1 were changed or newly added in comparison to the current questionnaire. Generally spoken, v.1 employs more specific language and tends to replace the former yes/no questions with references to performance benchmarks. For instance, the v.0 questionnaire currently asks the design team, "Will the obtrusive aspects of exterior lighting such as glare; light trespass and sky glow be minimized?" regarding its consideration of light pollution in the Construction Document stage of the assessment. The answer options only include "yes", "no" and "not applicable". In v.1, the question remains the same, but the answer options are now split by the area in which the building is erected (e.g., rural setting; residential area; commercial/industrial; high density residential area; major city centre or entertainment district) and refer to cut-off points (illuminance value, lumens emittance and direction) specified by IESNA. Another good example for the magnitude of changes in store can be found in the energy section: not only does v.1 include two alternative paths according to building size (buildings over and under 20,000 GSF), but there are also major changes in the energy performance percentages and the points allocated to them.

A number of changes are worth mentioning more specifically:

a) The v.1 criteria are much more detailed than it is the case in v.0 and are being influenced significantly by the ANSI standard development process, resulting in much less ambiguity in the allocation of credits.
b) The total number of points currently identified in v.1 do not appear to equal the 1000 available points currently employed by the on-line Green Globes system. Through discussions with system developers, the future point allocations of v.1 will be determined through the ANSI development process.
c) The already heavy emphasis placed on Energy Use in the Green Globes system appears to be further emphasized in v.1 with a shift from 300 to 400 points available within this category (again, based on our harmonized comparison).

d) In the Pollution category, the total point allocations do not change significantly, however, how the points are determined within related sub-categories is quite different:
   - Sections D.3 (Reduce off-site treatment of water) and E.5 (Reduction, reuse and recycling of waste) have each doubled in point value under v.1.
   - Section E.6 (Recycling and composting facilities) in Green Globes no longer receives points under v.1.
   - Section F.4 (Pollution minimization) in Green Globes has been reduced from 25 points to 9 points in v.1 with two new sections formed - F.5 (Integrated Pest Management), 4 points; F.6 (Storage for Hazardous Materials), 5 points.

Related to the development of v.1 criteria and the ANSI standards development process are the significant efforts underway across both green building rating systems to improve the integration of Life-Cycle Assessment and life-cycle thinking into forthcoming versions. The following section has been developed to specifically address this issue.

5. INCORPORATION OF LIFE-CYCLE ASSESSMENT

Life Cycle Assessment – a short introduction

In addressing environmental impacts of products and services including building constructions, Life Cycle Assessment (LCA) has been widely acknowledged as an important tool. LCA provides a systematic view of the environmental aspects of a product from cradle to grave. This includes: (1) a description of the entire product's life-cycle, (2) key environmental impacts from production and use of the product and (3) the product's functional quality. Addressing these three aspects of a product, an LCA result is expressed typically in the form of certain quantifiable environmental impacts over its entire life-cycle per a certain function. When two products are compared, for instance, it is important to consider not only the environmental impacts and functional qualities (i.e., the strengths and weaknesses) attributable to each, but also the system boundaries on the basis of which the impacts are calculated. Subsequently, we will evaluate in how far the three LCA aspects named above are dealt with in the two major rating systems for building constructions, LEED and the Green Globes.

Method and data

The two rating systems are qualitatively evaluated by reviewing their rating criteria from a life-cycle perspective. Particularly, the following aspects are given attention:

a) Coverage of life-cycle phases: whether the entire product's life-cycle is considered;
b) Coverage of life-cycle impact categories: whether the criteria address major environmental impacts of the building sector that were previously identified by LCA studies;
c) Coverage of functional quality: whether the functional quality of materials is adequately considered together with their environmental aspects.

The reference materials used in this review are for LEED, section 2 “Individual LEED Credit Reviews” of the GSA study (Steven Winters Associates 2004) and for Green Globes, sections E and F of the “Green Globes Design v.1 – Post-Construction Assessment Questionnaires” (available for download on the Green Globes website).

It has to be noted that LCA is not a one-size-fits-all tool and that an LCA may not adequately capture some of the relevant issues for building constructions. For instance, LCA cannot capture central aspects of green building, such as indoor air quality or accessibility by public transportation or alternative transportation means. Although such elements figure in both rating systems compared here, they can of course not be reviewed in this LCA assessment.

Results

Coverage of life-cycle phases

To date, LEED does not refer explicitly to LCA, although collectively, the LEED rating criteria cover practically the entire life-cycle of buildings. Notable exceptions are (1) manufacturing of building materials and equipment and (2) recycling/reuse processes. Transportation of building materials is indirectly accounted for as well (by MR-5 Regional materials). More importantly, each of these criteria covers a specific life-cycle phase, and because points are given independently for each criterion, what is lacking are insights over possible trade-offs between life-cycle stages. Although the measures employed collectively cover a large portion of the entire life-cycle of a building product system, it is notable that there is no single criterion that explicitly covers the whole life-cycle.

Rating criteria in Green Globes collectively embrace the major components of a building product system’s life-cycle, but unlike LEED, Green Globes features a distinct rating criterion referring to LCA and covering the entire life-cycle of building materials (E.1). While E.1 requires LCA tools to be used in selecting materials, it does not verify whether designers actually use materials with lower life-cycle impacts identified by such tools.

Coverage of life-cycle impact categories

Previous LCA studies that compare different industrial sectors consistently have pointed out the significance of the building sector in the total environmental impacts of a national economy (Wilting, 1996; Tukker et al., 2005; Suh, 2005a; Suh, 2005b; Huppes et al., in press). At the national level, the building sector is one of the major contributors to (1) global warming, (2) natural resources consumption, (3) land occupation and transformation and (4) human health impacts. Main causes of these environmental effects of buildings identified in these studies include:

- for global warming: the use of iron and steel, hydraulic cements, lime, electricity and transportation fuel;
- for natural resources consumption: the use of iron and steel, sand and gravel, coal and other fossil fuels for heating and electricity generation for buildings;

- for land occupation and transformation: residential and commercial area development;
- for human health: air emissions, including particulate matter during the construction and demolition phases.

Much of these major environmental issues and their causes are directly or indirectly addressed by both LEED and Green Globes rating criteria. For instance, energy consumption and efficiency issues are a major direct focus of both systems (criteria C in Green Globes and EA.1 in LEED), while the use of energy intensive products and corresponding global warming impacts are addressed mostly indirectly by encouraging alternatives and recycling (criteria E in Green Globes and MR in LEED). Green Globes also addresses this directly, by prompting designers to use LCA tools in selecting materials.

The question remains how different problems are weighted considering their relative importance in overall life-cycle impacts of building product system. For instance, each criterion in LEED is worth 1 credit point, while the environmental relevance significantly varies between criteria. In contrast, Green Globes gives different weights across rating criteria, indicating that some effects are seen as more important than others to the overall environmental performance of a building in both systems. The rationale behind the weighting remains intransparent for the system user and is not justified from an LCA point of view in either of the systems.

Coverage of functional quality

A unique feature of LCA is that it allows for comparing products on the basis of the same functional quality, measured by a so called ‘functional unit’. A functional unit describes the quality of service of the product studied as well as its duration. Functional unit is an important component of an LCA and may substantially change the results if not carefully defined. For instance, the life-cycle environmental impact of a material that provides the same function but has a service life two times that of its alternative should be halved in order to be compared on equal footing.

Some of the criteria in both LEED and Green Globes completely lack such considerations. For instance, MR-6 of LEED requires the use of rapidly renewable materials such as bamboo flooring to reduce the use of long-cycle renewable materials. However, the benefits are questionable of using, for instance, a material 10 times more rapidly renewable than its long-cycle alternative, if it results in having to replace it 10 times more frequently. Other examples are the use of recycled materials in LEED (MR-4) and Green Globes (E.2.1 and E2.2). These criteria determine the minimum percentiles of recycled/reuse materials either in physical unit (LEED) or in monetary unit (Green Globes). Suppose that recycled/reused materials are functionally inferior to virgin materials and thus require more of them in absolute terms to fulfill the functional requirement. The pitfall, in that case, is as follows: Even if the environmental impacts of total material used per ton or per dollar may be reduced by increasing the share of recycled/reused materials, the overall environmental impacts to fulfill the same functional requirement may well be increased in absolute terms by using more of the materials. Note should be taken of the fact, however, that Green Globes addresses the functional quality, especially the durability issue as a separate criteria (E.4). LEED features no equivalent to this.

LCA Conclusions and discussions

The review of rating criteria in LEED and Green Globes shows that:

a) In general, life-cycle assessment is not sufficiently addressed in either of the systems, although the rating criteria of Green Globes may slightly better reflect life-cycle thinking than those of LEED. A merit of Green Globes is that it introduces designers to LCA tools, while LEED to date fails to explicitly address LCA.
b) In terms of life-cycle stages coverage, Green Globes employs a rating criterion that covers the entire life-cycle of building materials (E.1), while LEED lacks such a criterion, although, collectively, the set of criteria used covers a large part of the life-cycle stages.
c) As to the environmental relevance, both rating systems incorporate environmental impacts associated with building sectors in their sets of criteria. However, the rationale of the weights given to each criterion (1 for each for LEED) is somewhat questionable.
d) Regarding the functional relevance, neither of the two systems successfully addresses functional aspects in the ratings of materials selection. However, Green Globes partly reflects the functional quality as a separate criterion in addressing the issue of durability and adaptability.

Having reviewed the two rating systems, one important gap appears to exist: The disconnection between the weight of each rating criterion and the relative importance of the life-cycle environmental impacts associated with it (as estimated by previous LCA studies). Furthermore, many of the criteria are independently rated by cut-off values lacking an assessment of the tradeoffs between them. As a result, one may find two different combinations of scores, both leading to a fulfillment of the same certification requirement, while their life-cycle environmental impacts can substantially differ from each other.

As both systems continue to evolve, they may want to consider a top-down approach, where key life-cycle environmental impacts of buildings are identified and rating criteria are developed in such a way that these impacts are successfully reduced. Another direction of development that seems advisable is to appropriately reflect the relative importance of environmental issues in the rating system. Naturally, this would include making judgments on the comparative severity of impacts. Finally, the use of “less (or more) is better” criteria, instead of cut-off criteria, and integrating those criteria addressing life-cycle environmental impacts of building may further foster flexibility and efficiency in implementing these systems.

6. GSA CASE STUDY AND COMPARISON TO GREEN GLOBES

In 2004, the General Services Administration (GSA) commissioned a study to estimate the costs of constructing green federal facilities (Steven Winter Associates 2004). For new buildings and large-style renovations the GSA requires LEED certification. It thus has an interest in determining strategies to attain the lowest possible environmental impact at the lowest cost. Assuming GSA design standards, the study seeks to determine the price premium associated with different levels of LEED certification, under varying circumstances. The study describes in detail the strategies and pathways followed to obtain each LEED credit, as well as the associated costs. Two examples are analyzed, a new construction courthouse and an office building facade renovation. For each of these examples, three certification levels (baseline, silver, gold) and two cost scenarios (low cost, high cost) are described. We decided to examine the example of the mid-rise federal courthouse (see BOX I), because it is a new construction project. Appendix E contains a summary of the 6 scenarios, listed by LEED section and matched to the corresponding Green Globes credits.

BOX I. Mid-rise federal courthouse, new construction

Figure 1:

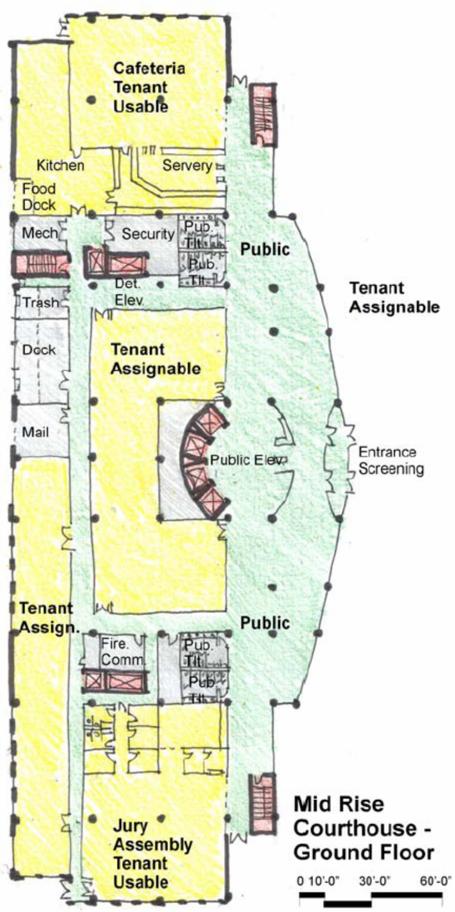
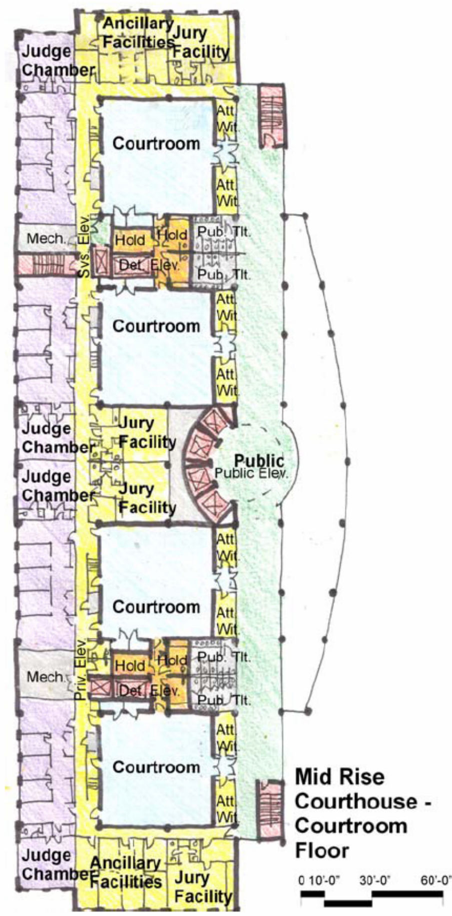


Figure 2:



Source: Steven Winter Associates 2004

GSF	262,000 (including 15,000 GSF of underground parking)
Base construction cost	$ 57,640,000
Base construction cost per GSF	$ 220
Total site area	3.1 acres
Location	Washington, D.C.
Stories	5

Subsequently, we are going to discuss in detail the baseline certification, low cost scenario. Our goal was to compare the LEED points obtained to those reached in Green Globes under the same assumptions. To this end, detailed information from the GSA study was entered into the Green Globes self assessment system. Naturally, such a method of comparison can only render a rough overview of how the two systems compare. We were not able to use the harmonized comparison method developed above, because Green Globes does not provide detailed ratings on-line. Rather, it displays the overall percentage rating as well as the overall rating for its seven sections.

Nonetheless, entering the LEED data into the Green Globes system provided us with a tool to directly compare the two systems based on a real world example. The level of detail in this comparison is higher than that of any other known comparative study. Furthermore, we used this case study to scrutinize some of the findings from our comparison matrices. However, several caveats should be noted. As previously explained, the credits do not always completely overlap, be it for the use of different standards, performance levels or system requirements. Whenever the requirements matched, were reasonably similar, or could reasonably be assumed to constitute good practice, we checked a ‘yes’ in the Green Globes questionnaire. Whenever LEED did not include aspects assessed in Green Globes or whenever corresponding information did not exist in the GSA-study, we checked ‘no’. Overall, this modus operandi likely resulted in a conservative estimate of the Green Globes points attainable.

Another limitation of our method results from the example used. GSA specifies its own design requirements. Thus, some of the cost assumptions only hold true within the context of the GSA project. In addition, the building examined here is a courthouse and some design choices arise from security requirements. A few credits were not pursued simply because they are not feasible in a courthouse (e.g., daylighting, parking for car-sharing). Caution is advised when making generalizations from this comparative case study. Finally, it should be noted that the GSA study is based on version 2.1 of LEED-NC. In the meantime, version 2.2 has been released and some changes have occurred. In addition, we used the Green Globes online questionnaire currently available. In the context of ANSI endorsement, Green Globes is preparing a major change in its system, including shifts in content and some modest point re-allocations. Again, our results should be considered with this in mind.

In the baseline scenario, the authors of the GSA study assumed that 28 LEED credits would be pursued. LEED requires only 26 credits to obtain baseline certification, thus providing a safety margin of two credits. The low-cost scenario has a total estimated cost impact of -0.4%. It is a best case scenario, where most credits are associated with no or only a small cost premium and some even lead to cost decreases. The explicit strategy here is to take advantage of ‘easy’ credits (e.g., credits obtained in any case due to site characteristics or GSA design specifications or credits gained through low-cost strategies).

Subsequently, we will analyze the results gained by entering the information from the GSA study into the Green Globes system. BOX II gives an overview of the credits pursued in the baseline certification, low-cost scenario for the GSA-Courthouse.

BOX II. LEED credits obtained in the Courthouse, baseline certification, low-cost scenario

Sustainable Sites: Site selection, Development density, Brownfield, Alternative transportation I, Reduced site disturbance I & II, Stormwater management, Heat island I & II, Light pollution reduction

Water Efficiency: Water efficient landscaping I & II, Water use reduction

Energy and Atmosphere: Energy performance I, Commissioning

Materials and Resources: Recycled content I & II, Regional materials I & II

Indoor Environmental Quality: Ventilation effectiveness, Low emitting materials I, II & III, Indoor chemical and pollutant source control, controllability of systems II, Thermal comfort I & II

Innovation : LEED accredited professional

In the 'Sustainable Sites' category, 10 (70%) out of 14 possible LEED credits were pursued. In Green Globes this translates into a very high percentage of points allocated to 'Sites': 96% and therefore 110 out of 115 possible points were obtained. The high ratings in both systems are not surprising – in a best case scenario, the site credits are easily obtained, because the site just happens to have sustainable characteristics. This does not necessarily mean that it was chosen with the certification in mind. The difference in percentages results from imperfect overlap of the categories in the two systems. The LEED site section is much larger than the Green Globes one; it includes transport, for instance.

In the 'Water Efficiency' category, 3 (60%) out of 5 possible LEED credits were pursued. In Green Globes, the GSA courthouse would have obtained 32% or 27 out of 85 available points in the 'Water' section. Again, part of the discrepancy in the rating is due to imperfect overlap of the categories and different point allocation. The extremely low rating in Green Globes is also caused by the fact that we had to check 'no water target set' for the question on water performance. The GSA-study did not specify the water consumption estimate (ga/GSF/y) asked for in Green Globes. It only referred to the percentage reduction target set in LEED, without mentioning specific target numbers. Just changing the questionnaire answer from 'no target set' to the most lenient consumption target choice offered (35 ga/GSF/y) resulted in a rating of 59%, an increase of 13 points compared to the original result. This is one of the instances where we opted to employ a conservative approach, instead of making unfounded assumptions.

In the 'Energy and Atmosphere' category, 2 (11.7%) out of 17 possible LEED credits, plus prerequisites were pursued. Credits for energy efficiency often have a higher up-front cost than other credits, which is why in the baseline/low cost scenario, few of these credits are pursued. Entered into Green Globes, the strategies employed resulted in a score of 54% of possible points in the 'Energy' section.[5] Considering that a One Globe certification can be obtained starting at 35% of total points, it is evident that the relatively small contribution toward LEED certification (2 out of 69 credits) translate into large point gains in Green Globes (205 out of 1000 points). The fact that Green Globes accords points for energy performance as well as for installing equipment plays a role here. Some of the difference is also accounted for by the lower performance requirements in Green Globes: Where it allocates 30 points (3% of overall points) for the 17% increased energy performance, LEED allocates only one credit (1.45% of all credits). In addition, one qualification has to be made: Green Globes includes transport into the energy category, which contributes to the comparatively high rating.

In the 'Materials and Resources' category, 4 (30.7%) out of 13 possible LEED credits were pursued. In comparison, the GSA courthouse would have been awarded 31% of the Green Globes points in the 'Resources' category, which amounts to 31 out of 100 points. The ratings thus seem almost congruent. However, the apparent likeness masks that two sections are in fact not easily comparable, as Green Globes includes two aspects here that do not exist in LEED: Life cycle assessment and building durability/adaptability. The GSA courthouse did not earn any points for these aspects, but it virtually took every other available point. This is another instance where a certain imbalance between the two systems becomes apparent: LEED allocates a total of 8 credits (11.9% of overall points) to aspects that all fall under the category 'Minimal consumption of resources' in Green Globes. The latter only allocates 15 points (1.5% of overall points) to this category, 1/10 of the LEED percentage. In return, of course, we have to count the 55 points awarded for LCA-aspects in Green Globes. We do not attempt to draw any conclusions as to which system results in lower environmental impact in this category.

In the 'Indoor Environmental Quality' category, 8 (53%) out of 15 possible LEED credits, plus prerequisites, were pursued. In Green Globes this resulted in 58%, or 116 out of 200 possible points for 'Indoor Environment'. The LEED section includes a lot more factors than the Green Globes section, although both award approximately 20% of total points to it. Thus, in this section, the LEED credits matching aspects of Green Globes obtained a lot of points; even though there were some credits that had no equivalent (e.g., controllability of systems).

In the 'Innovation' category, 1 out of 5 possible LEED credits was pursued. This section has no equivalent in Green Globes.

Although there is no management or design section in LEED, there are practices employed during the certification process that correspond to this category in Green Globes. For instance, Green Globes asks for an integrated design process, green product specifications and basic commissioning. All of these aspects are covered as part of other credits in LEED, although

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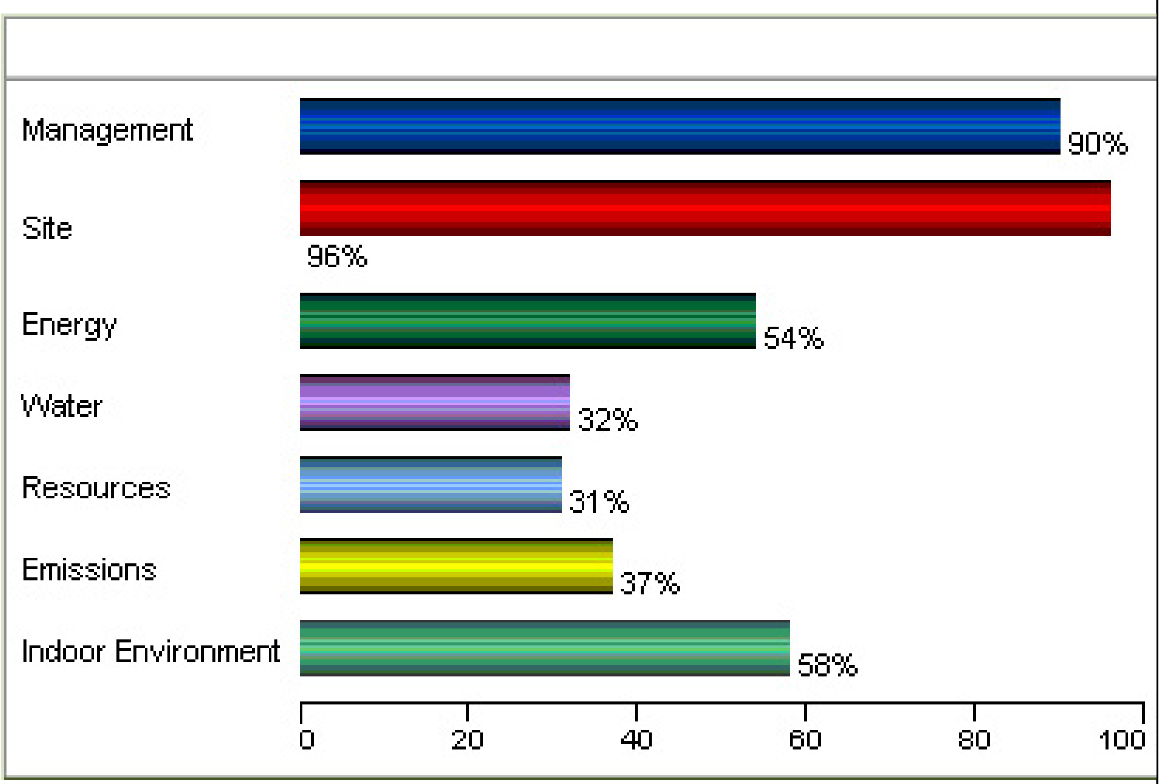
[5] This rating was calculated by entering the following in the Green Globes online system: 11,806,600 kBtu/yr annual energy use and 17% as the value of the projected energy savings as a percentage compared to the reference base building. The 17% number was used per the GSA report statement that the "building's annual energy cost was calculated to be 16.9 percent less than a "code compliant" energy model that meets the minimal requirements of ASHRAE 90.1–1999." It is difficult to ascertain how the questionnaire incorporates the EPA Target Finder model. Applying the EPA Energy Target Finder (247,000 sq. ft., 1100 occupants, 250 PCs [researchers' estimate], 40 operating hours/week [researchers' estimate], courthouse, in Washington DC), this project would nearly reach the 95% target (11,256,756 kBtu/yr), thus, could be expected to receive 90 of the available 100 points available in Green Globes v.1.

except for commissioning, none of them results in obtaining additional credits. The GSA-Courthouse obtained a rating of 94% in Green Globes' 'Management' category, with 47 out 50 points. This is another occasion where collecting points seems to be easier in Green Globes than in LEED.

Another category existing in Green Globes, but not in LEED is 'Emission, Effluents and other Impacts'. The only matching LEED credit is the one granted for refrigerant management, plus some aspects of the credit for indoor chemical and pollutant source control. Consequently, the design elements contained in this category were not described in the GSA study, even though they might have been included in the project. This resulted in a low rating of 37% or 26 out of 70 points in this category. This is another reason for us to believe that the overall rating obtained is conservative.

Box III depicts the ratings obtained for each of the categories in the Construction Document Stage under Green Globes, which is the relevant stage for third party certification. As noted earlier, under the LEED system, 28 points were pursued. Using Green Globes, overall, the GSA Courthouse achieved a rating of 59%, corresponding to Two Globes. Entering the information from the GSA LEED case study in Green Globes has shown that the two systems exhibit many differences in focus, content and point allocation. However, in the final analysis, while point allocations by category differ, both systems highlight environmentally beneficial aspects of building construction and material use.

BOX III Construction Documents Stage Report for GSA Courthouse



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Appendix A: Process comparison of Green Globes v.0 and LEED 2.2[1]

	Green Globes v.0 (U.S)	LEED-NC 2.2 (U.S.)
Certification Process	**Step 1:** Register a project by purchasing the Green Globes online assessment tool. One tool can be used by multiple users and can show all questions or highlight questions specific to one of the 21 areas of expertise within a team (architect, engineer, interior designer, etc.).	**Step 1:** Determine building eligibility under the standard specified for building type (i.e. commercial buildings are defined as—but are not limited to—offices, retail and service establishments, institutional buildings, hotels, and residential buildings of four or more habitable stories).
	Step 2: Login to online assessment tool, choose from one of the eight project stages—project initiation, site analysis, programming, **schematic design**, design development, **construction documents**, contracting and construction, commissioning. Each area of assessment contains relevant questions for each project stage. Once a project stage is chosen the team may begin answering the set questions—which are in lay terms (mostly general yes/no/not applicable)—about the building project attributes. Online assessment takes about two to three hours to complete.	**Step 2:** Register project to express company/organizations intent for future LEED certification and begin dialogue with USGBC. Also gives online access to LEED templates and credit interpretations. Process takes about 30 minutes to complete.
	Step 3: Once the schematic design stage is assessed--which should be conducted in conjunction with the planning approval--the project team will receive a preliminary rating from which they should evaluate steps for meeting the desired Green Globes rating.	**Step 3:** Document all necessary calculations and requirements needed to satisfy the prerequisites and any additionally desired credits. Procure a LEED Accredited Professional.
	Step 4: once the construction document stage is assessed—which should corresponds with the building permit approval—the project team will receive a final rating.	**Step 4:** Submit two copies of completed application—which includes LEED Letter Templates for each prerequisite and desired credit, registration information, project checklist showing estimated rating results, drawings and photos of the project.
	Step 5: Once the project team has completed the online questionnaire, Green Globes produces a report highlighting project achievements and suggesting areas for further improvement in building performance. Report also provides links to web and paper-based resources for sustainability.	**Step 5:** After checking each credit for compliance, USGBC issues administrative approval noting anticipated, pending or denied credit achievements within 30 days of submittal. Project team has 30 days to provide corrections or additional material. USGBC conducts the final review of the application within three weeks of the resubmittal and notifies the project contact with certification status.
	Step 6: To become Green Globes certified the project team must receive 35% of the total points in the Green Globes assessment and the assessment results must be verified by an independent third-party. A Verifier is either a licensed architect or building engineer with proven knowledge & experience of green building technologies & integrated design. Upon verification project team receives a certificate or plaque for display, proving the project's sustainability and environmental performance.	**Step 6:** Upon notification, the project team has 30 days to accept or appeal the awarded certification. After 30 days the awarded certification level is final and USGBC will present the team with a plaque and award letter.
Format of Distribution	**Online**	**Paper**
Associated Costs of Certification	**Registration Cost:** Online Assessment tool = $500 per project	**Registration Costs:** *NonMembers* - 1) Less than 75,000 square feet = $950.00, 2) 75,000 - 300,000 sq. ft. = $0.0125 per sq. ft. ($937.50 - $3,750), 3) More than 300,000 sq. ft. = $3,750; *Members* - 1) Less than 75,000 square feet = $750.00, 2) 75,000 - 300,000 sq. ft. = $0.01 per sq. ft. ($750 - $3,000),3) More than 300,000 sq. ft. = $3,000
	Certification Costs: Third party assessment verification costs depend on the building's square footage, but typically costs between $3,000 - $6,000 but depends on the building's square footage. Independent verifiers will specify their own fees.	**Certification Costs:** *NonMembers* - 1) Less than 75,000 square feet = $1,875.00, 2) 75,000 - 300,000 sq. ft. = $0.025 per sq. ft. ($1,875 - $7,500), 3) More than 300,000 sq. ft. = $7,500; *Members* - 1) Less than 75,000 square feet = $1,500.00, 2) 75,000 - 300,000 sq. ft. = $0.02 per sq. ft. ($1,500 - $6,000), 3) More than 300,000 sq. ft. = $6,000
Certification Appeals	**No:** However, building parameters can be updated for one year from the time of project registration. The option to update parameters can be extended past one year.	**Yes:** After receiving USGBC's Final Review of the project, a team has 30 days to file an appeal. A review of the appeal takes place within 30 days, after which time the applicants are informed of their appeal status.
Cost of Appeals	N/A - Building parameters can be updated for one year after registration; update cycle can be extended for an undisclosed fee.	$500 per credit appealed
Training for professionals	Yes - Various classes are conducted throughout the U.S. but the process of becoming a Green Globes verifier is unclear.	Yes - LEED Accredited Professionals must pass an examination on LEED methods/solutions/practices.
Maintained by:	The Green Building Initiative - is supported by groups and individuals interested in promoting energy-efficient and environmentally sustainable practices in residential and commercial construction	U.S. Green Building Council - coalition of leaders from across the building industry
Review Boards	1) Green Globes Technical Advisory Committee - Develops rules & procedures concerning the integrity of Green Globes ratings and verifiers. 2) In 2005 became the first green building organization to be accredited by the American National Standards Institute (ANSI). The Green Building Initiative Standards Development Committee (ANSI GBI-01/2005) is responsible for developing, maintaining, approving and achieving consensus on the Green Globes standard for the design, construction and upkeep of environmentally preferable buildings. Members of the ANSI GBI-01/2005 committee represent organizations, companies, government agencies, individuals, and others having a direct and material interest in developing and maintaining consensus standards for environmentally responsible buildings.	1) LEED Steering Committee - Standing committee whose principal responsibility is in the development and implementation of all versions of LEED. 2) LEED Steering Committee & Technical Science Advisory Committee - Provides support for each product and advice on topics assigned by the LEED Steering Committee, the USGBC Board of Directors and other topics deemed important by the TSAC.
Membership for organizations	Yes	Yes
Membership for individuals	**No**	**No**
Costs of Membership	Associate Membership - Free	Cost depends on member category and company's gross annual revenue. Varies from $300 - $12,500
Decision-making included in membership	**No**	**Yes** - Members may choose to join the corresponding associate committee of their choice.
Additional Membership Benefits	Inclusion GBI materials; seminar discounts; latest green building news, information and technologies;	Inclusion in membership directory; discounts for all employees; access to newsletters and information on leading green building technology; access to CIRs submitted by LEED projects.
Trade Association Relations	**Yes** - National Association of Home Builders & Local home building associations	**Yes** - Until recently, trade associations were not allowed to join USGBC as members, but that policy has changed. However, none of the current LEED versions in the marketplace reflect voting from this new membership segment.
When Organization Founded	Introduced to the U.S. in 2004	1993

[1] Information provided based primarily on the NRDC Report comparing the two systems (Bright 2005).

Appendix B: Harmonized comparison of Green Globes and LEED

= Major credits
= Subdivisions of credits or strategies employed
= No equivalent

Green Globes v.0 | LEED 2.2

	Green Globes v.0			LEED 2.2	
Energy use		**300.0**			**15.0**
			EA PR 2	**Minimum energy performance**	**0.0**
				Design building to comply with ASHRAE/IESNA Standard 90.1-1999 or local energy code, whichever is more stringent.	
C.1	**Energy performance**: Achieve levels of performance better than that of a building meeting the 75% target defined by the EPA energy target finder:	**100.0**	**EA-1**	**Optimize energy performance** - Choose applicable option	**10.0**
	- 5% or more	10.0			
	- 10% or more	20.0			
	- 15% or more	30.0			
	- 20% or more	40.0		- 20% reduction	2.0
	- 25% or more	50.0			
	- 30% or more	60.0		- 30% reduction	4.0
	- 35% or more	70.0			
	- 40% or more	80.0		- 40% reduction	6.0
	- 45% or more	90.0			
	- 50% or more	100.0		- 50% reduction	8.0
				- 60% reduction	10.0
C.2	**Reduced energy demand**	**114.0**		**In order to comply with EA-1, energy modelling including space optimization, orientation, opaque assembly, fenestration and building envelope, is necessary. Performance based credit - no points allocated**	**0.0**
	Space Optimization	*10*		*Space optimization*	*0.0*
	Design floor area efficiently to fulfill the building's functional and spatial requirements, including circulation and services. Identify spaces that can accommodate more than one function or can be adapted to more or less intensive occupancy.	8.0			

	Where a building design is based on future projections of increased occupant population, phase the construction process, distinguishing between immediate functional needs versus long-term projected needs. Provide adaptable structure and services, and load-bearing capacity for future building expansion.	2.0			
	Response to Microclimate and Topography	*24*			
	Use orientation and site features to optimize the effect of microclimatic conditions for heating or cooling.	8.0			
	Base decision on wind and snow control studies for areas where this could be a problem, develop strategies - including location, use of site topography and orientation - to minimize the exposure to wind and the accumulation of snow.	8.0			
	Develop a building form that, site permitting, can benefit from natural or hybrid ventilation to provide natural cooling during the time of year when outdoor air is cooler than indoor air.	8.0			
	Integration of Daylighting	*35.0*		*Orientation, opaque assembly and fenestration*	*0.0*
	Implement a fenestration strategy that maximizes daylighting through building orientation, window-to-wall size ratios - that maximizes daylighting.	15.0			
	Install window glazing which optimizes daylight (high visible transmittance, VT).	10.0			
	Integrate electrical lighting design with daylighting, with controls to adjust the electrical lighting in response to available daylight, taking into account daily and seasonal variations in each lighting zone of the building.	10.0			
	Building Envelope	*35.0*		*(EA-1 - Strategies => performance based, no points allocated for including the technology)*	*0.0*
	Design the building's thermal resistance of the exterior enclosure to exceed Federal and State Building Energy Codes for the walls by 25-30%.	5.0		- Opaque walls with high R-values	
	Design the building's thermal resistance of the exterior enclosure to exceed Federal and State Building Energy Codes for the roof by 25-30%.	5.0		- Roofs with R=23.8	
	Provide window glazing with a low U factor, and window treatments that enhance interior thermal comfort.	10.0		- High-performance glazing	
	Design the building to prevent groundwater and/or rain penetration into the building.	5.0			

	Best air and vapor barrier practices to assure integrity of buildings envelope with respect to:	2.0				
	- meeting the requirements of local and national building codes	1.0				
	- detailing of roof to wall air barrier connections.	1.0				
	- mock-ups and mock-up testing for air and vapour barrier systems.	1.0				
	- field review and testing for air and vapour barrier systems.	1.0				
	Prevent unwanted stack effect by appropriate sealing of the top, bottom, and vertical shafts of the building.	5.0				
	Integration of Energy Sub-metering	*10.0*		**EA-5**	**Measurement & verification**	**1.0**
	Provide sub-metering of major energy uses (such as lighting, motors, hot water heaters, boilers, fans, cooling and humidification plant, computers and catering facilities) in buildings greater than 50,000 ft^2	10.0			Comply with the installed equipment requirements for continuous metering per Option B, C or D of the 2001 International Performance Measurements & Verification Protocol (IPMVP) Vol. I: Concepts and Options for Determining Energy and Water Savings	
C.3	**Integration of energy efficient systems** - Specify energy efficient technologies, such as	**66.0**			*(EA-1 - Strategies => performance based, no points allocated for including the technology)*	
	- high-efficiency lamps, and luminaries with electronic ballasts.	6.0			Reduce power lighting densities (1.1watt/SF)	
	- lighting controls.	6.0			Occupancy sensor controls and daylight dimming system	
	- energy-efficient HVAC equipment.	6.0				
	- high efficiency or condensing type boilers or other higher-efficiency heating sys. (e.g. infrared heating in industrial buildings.)	8.0			Modulating Condensor Boilers (93% nom. effic.)	
	- high efficiency chillers.	6.0			High-efficiency Chillers (0.49 kw/ton)	
	- energy-efficient hot water service systems.	6.0				
	- building automation systems.	6.0				
	- variable speed drives.	6.0			Variable Speed Drive Fans at Air Handlers and Pumps, Variable Frequency Drive Cooling Tower Fans	
	- energy-efficient motors on fans/pumps.	6.0			Premium Efficiency Motors	
	- energy- efficient elevators.	4.0				
	- other energy-saving systems or measures (i.e. displacement ventilation, cogeneration, heat recovery etc.).	6.0			Underfloor air distribution, energy recovery	
					Waterside Economizer @ Air Cooling Towers	
					Wetbulb Reset at Cooling Towers	
					CO Control of Garage Ventilation Fans	
C.4	**Renewable energy sources** (solar, wind, biomass, or photovoltaics etc.) - select one of the 2	**20.0**		**EA-2**	**On-site renewable energy**	**3.0**

				Supply at least 2.5% of building's total energy use through on-site renewable energy systems (ie: roof-mounted photovoltaic system)	1.0
	- for more than 5% and less than 10% of the total load.	10.0		Supply at least 7.5% of building's total energy use	2.0
	- for more than 10% of the total load.	20.0		Supply at least 12.5% of building's total energy use	3.0
			EA-6	**Green power**	**1.0**
				Provide at least 50% of building's electricity from renewable sources by engaging in at least a two-year renewable energy contract.	
Water use		**75.0**			**4.0**
D.1	**Water performance -** Achieve water use targets of (select one of 3):	**30.0**	**WE-3**	**Water use reduction**	**2.0**
	- less than 35 gal / ft^2 / year or less than 66,000 gal / apartment / year, or less than 45 gal / student / year	18.0	*WE-3.1*	*Water Use Reduction - 20%*	*1.0*
	- less than 20 gal / ft^2 / year or less than 33,000 gal / apartment / year, or less than 25 gal / student / year	24.0		Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements.	
	- less than 10 gal / ft^2 / year or less than 11,000 gal / apartment / year, or less than 15 gal / student / year	30.0	*WE-3.2*	*Water Use Reduction- 30%*	*1.0*
				Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements.	
D.2	**Water conserving features**	**45.0**		*(WE- 3 - Strategies => performance based, no points allocated for including the technology)*	
	Integration of Water Efficient Equipment	*20.0*			
	Provide water sub-metering of water uses for high-water-usage operations or occupancies such as boilers, cooling tower make-up lines, water-cooled air conditioning units or special laboratory operations.	4.0		Strategies for WE 3.1	
	Increase the building water-efficiency through the use the following water-efficient equipment:			-Specifying 0.5 gpm faucets at bathroom lavatories.	
	- low flush (LF) toilets (less than or equal to 1.6 gallons/flush).	4.0		-Specifying 1.0 gpm faucets at bathroom lavatories and 1.5 gpm faucets at pantry sinks.	
	- water-saving fixtures on faucets (2.0 gallons/min.) and showerheads (2.4 gallons/min.)	4.0		Strategies for WE 3.2	
	- urinals with proximity detectors or waterless urinals where applicable (e.g. offices).	4.0		-0.5 gpm faucets at bathroom lavatories	
	- water efficient (H-axis) washing machines + low water dishwashers (8 gallons) where applicable (i.e. in MURBs)	4.0		-Infrared sensor controls on lavatory faucets (hard-wired system).	

				-0.5 gpf urinals (including hard-wired electronic controls).	
				-2.0 gpm showers	
	Strategies for Minimal Use of Water for Cooling Towers	*10.0*			
	Where applicable install features to minimize the consumption of make-up water for wet-cooling towers.	10.0			
			WE 1	**Water-efficient landscaping**	**2.0**
	Strategies for minimal use of water for irrigation (select ONE within 2.6 below, if applicable)	*15.0*	*WE-1.1*	*Water-Efficient Landscaping- 50% reduction in potable water use*	*1.0*
	Specify a water-efficient irrigation system (e.g. high efficiency technology, rain sensors).	5.0		-Limit turf grass to 15 percent of the site's total planting area.	
	Specify irrigation using a portion of non-potable water (captured rainwater or recycled site water).	3.0		-Employ timer and rain sensor controls for the pop-up sprinkler irrigation system.	
	Provide landscaping that can withstand extreme local weather conditions and require minimal irrigation.	5.0		-Specify groundcovers with low water consumption needs.	
			WE-1.2	*Water-Efficient Landscaping- Totally eliminate potable water use*	*1.0*
	Specify irrigation using all non-potable water (i.e. captured rainwater or recycled site water).	5.0		-Use only captured rain or recycled site water to eliminate all potable water use for site irrigation.	
				-Do not install permanent landscape irrigation systems.	
Pollution (emissions, solid waste, effluents)		**100.0**			**6.0**
D.3	**On-site treatment of water (greywater system, on-site wastewater treatment)**	**10.0**	**WE-2**	**Innovative wastewater technologies**	**1.0**
	Where feasible, integrate a graywater collection, storage and distribution system to collect, store, treat and redistribute laundry and bathing effluent for toilet flushing, irrigation, janitorial cleaning, cooling and car washing.	5.0		Reduce use of municipal potable water for buildings. sewage conveyance by min. 50% - OR treat 100% of wastewater on site to tertiary standards.	
	Where feasible, integrate a biological waste treatment system for the site and building such as peat mos drain field, constructed wetlands, aerobic treatment systems, solar aqatic waste sysems (or living machines), and composting or eco-logically-based toilets.	5.0			
E.5	**Reduction, reuse and recycling of demolition waste**	**5.0**	**MR-2**	**Construction waste management**	**2.0**
	Develop and implement a construction, demolition and renovation waste management plan.	5.0	*MR-2.1*	*Construction waste management, divert 50% from disposal*	*1.0*
				Develop a Construction Waste Management Plan (Costs vary based on project scope, site, experience of contractors, local landfill fees and recycling infrastructure, local laws)	

			MR-2.2	*Construction waste management, divert 75% from disposal*	*1.0*
				Extension of strategy for Credit 2.1 to cover 75% of construction waste	
E.6	**Recycling and composting facilities**	**10.0**	**MR PR 1**	**Storage & collection of recyclables**	**0.0**
	Provide adequate handling and storage facilities for recycling and composting for future occupants to recycle materials and compost organic waste.	10.0		Provide easily accessible areas for sorting, storing and collecting recyclables	
F.1	**Air emissions (low emission burners)**	**15.0**			
	Specify low-NO_x boilers and furnaces, which comply with ASME codes.	15.0			
F.2	**Ozone depletion**	**25.0**	**EA PR 3, EA-4**	**Refrigerant management**	**1.0**
	Select refrigeration systems that avoid the use of ozone-depleting substances (ODS) and potent industrial greenhouse gases (PIGGs).	20.0	*EA PR 3*	*Fundamental refrigerant management*	*0.0*
	Choose one of 2: - Select refrigerants that have an ozone-depleting potential (ODP) less than 0.05.	10.0		Eliminate use of CFC-based refrigerants in HVAC&R systems.	
	- Select refrigerants that have an ozone-depleting potential (ODP) equal to 0.	15.0	*EA-4*	*Enhanced refrigerant management*	*1.0*
	Ensure air-conditioning systems complies with the requirements of the Safety Code for Mechanical Refrigeration, ASHRAE 15 -1994.	5.0		Install base building level HVAC and refrigeration equipment and fire suppression systems that do not contain HCFC's or Halons.	
F.3	**Avoiding sewer and waterway contamination**	**10.0**	**SS-6.2**	**Stormwater design, quality control**	**1.0**
	Prevent storm or wastewater discharges of toxic or harmful materials (solids or sludge, floating debris and oil or scum) into public utilities.	10.0		Implement a stormwater management plan that results in treatment sys. designed to remove 80% of the ave. annual post-development total suspended solids (TSS), and 40% of the average annual post-development total phosphorous (TP), and use Best Management Practices (BMPs) in EPA's Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters (EPA 840-B-92- 002 1/93) or the local government's BMP document (whichever is more stringent).	
F.4	**Pollution minimization (storage tanks, PCBs, radon, asbestos, pest management, hazardous materials)**	**25.0**			
	Integration of Compliant Storage Tanks	*2.0*			

	Ensure compliance with the nationally recognized standards such as those developed by the Underwriters Laboratory (U.L.) the American National Standards Institute (ANSI), the American Petroleum Institute (API), the American Society for Testing and Materials (ASTM), the American society of Mechanical engineers (ASME), the Street Tank Institute (STI) , the National Association of Corrosion Engineers (NACE), or the National fire Protection Association (NFPA).	2.0				
	Control of other pollutants (PCBs, Asbestos, Radon)	*3.0*				
	In the case of a retrofit, regulatory comply with regulations for all PCBs present in the building.	1.0				
	In the case of a retrofit, contain, remove, or eliminate asbestos and asbestos-containing materials in compliance with all applicable state and local regulations?	1.0				
	Prevent the accumulation of harmful chemicals and gases such as radon and methane in spaces below the substructure, and their penetration into the building.	1.0				
	Integrated Pest Management	*10.0*				
	Protect components, materials and the protection of structural openings to avoid infestation by pests (rodents, insects, termites and other pests).	10.0				
	Storage and control of hazardous materials	*10.0*		**EQ-5**	**Indoor chemical & pollutant source control**	**1.0**
					- Employ permanent entry way systems (grills, grates, etc.)	
	Design secure and appropriately-ventilated storage areas for hazardous and flammable materials.	10.0			- Where chemical use occurs (e.g., janitor and copying rooms), provide segregated areas with separate outside exhaust and maintain a negative pressure.	
					- Provide drains plumbed for appropriate disposal of liquid waste in spaces where water and chemical mixing occurs.	
Material/Product Inputs		**90.0**				**11.0**
A.2	**Environmental purchasing (incl. energy efficient prod.)**	**10.0**				

	Apply environmental purchasing criteria or incorporate aspects of green specifications such as the EPA Comprehensive Procurement Guidelines and/or GreenSpec®	3.0			
	Specify energy-saving, high-efficiency equipment based on Energy Star and/or the GreenSpec® menu and/or the Reference Specifications for Energy and Resource Efficiency.	7.0		*(EA-1 - Strategies => performance based, no points allocated for including the technology)*	*0.0*
E.1	**Low impact systems and materials** - Select materials that reflect the results of a "best run" life cycle assessment for the following:	**35.0**			
	- foundation and floor assembly and materials	10.0			
	- column and beam or post and beam combinations, and walls.	10.0			
	- roof assemblies.	10.0			
	- other envelope assembly materials (cladding, windows etc.) .	5.0			
E.2	**Minimal consumption of resources**	**15.0**	**MR-3**	**Materials Reuse**	**2.0**
	- Specify used building materials and components.	3.0	*MR-3.1*	*Materials reuse, 5%*	*1.0*
				Specify salvaged or refurbished materials for 5% of building materials	
			MR-3.2	*Materials reuse,10%*	*1.0*
				Specify salvaged or refurbished materials for 10% of building materials.	
	- Specify materials with recycled content.	3.0	**MR-4**	**Recycled content**	**2.0**
			MR-4.1	*Recycled content, 10% (post-consumer + ½ pre-consumer)*	*1.0*
				Specify materials with recycled content such that the sum of post-consumer recycled content plus 1/2 of the post industrial content constitutes at least 10% of the total value of the materials of the project.	
			MR-4.2	*Recycled content, 20% (post-consumer + ½ pre-consumer)*	*1.0*
				Specify materials with recycled content such that the sum of post-consumer recycled content plus 1/2 of the post industrial content constitutes at least 20% of the total value of the materials of the project.	
	- Specify materials from renewable sources that have been selected based on a life-cycle assessment (LCA).	3.0	**MR-6**	**Rapidly renewable materials**	**1.0**
				Specify rapidly renewable building materials for 5% of total building materials.	
	- Specify locally manufactured materials that have been based on a LCA.selected	3.0	**MR-5**	**Regional materials**	**2.0**
			MR-5.2	*Regional materials, 10%*	*1.0*

					Specify materials extracted, processed and manufactured within a 500 mi radius for 20% of the building material	
				MR-5.2	*Regional materials, 20%*	*1.0*
					Specify materials extracted, processed and manufactured within a 500 mi radius for 20% of the building material	
	- Use lumber and timber panel products which originate from certified and sustainable sources— certified by SFI, FSC, ATFS, CSA International Standard. Avoid tropical hardwoods, unless certified.	3.0		**MR-7**	**Certified wood**	**1.0**
					Use a minimum of 50% of wood-based materials and products, which are certified in accordance with the Forest Stewardship Council's (FSC) Principles and Criteria, for wood building components.	
E.3	**Reuse of existing buildings** (select ONE among 3.1 / 3.2 / 3.3, if applicable)	**15.0**		**MR-1**	**Building reuse**	**3.0**
	Retain at least 50% of existing façades in fully renovated buildings.	5.0				
	Retain at least 75% existing façades in fully renovated buildings.	8.0		*MR-1.1*	*Building reuse, maintain 75% of existing walls, floors & roof*	*1.0*
	Retain 100% of existing façades in fully renovated buildings.	1.0		*MR-1.2*	*Building reuse, maintain 100% of existing walls, floors & roof*	*1.0*
	Retain a minimum 50% of the existing major structures (other than the shell i.e. walls, floors and ceilings)	5.0		*MR-1.3*	*Building reuse, maintain 50% of interior non-structural elements*	*1.0*
E.4	**Building durability, adaptability and disassembly**	**15.0**				
	Specify durable and low-maintenance building materials and assemblies that can withstand the following: sunlight, temperature and humidity changes, condensation, and war-and-tear associated with the amount and type of traffic expected.	5.0				
	Implement a building design that promotes building adaptability.	5.0				
	Specify fastening systems that allow for easy disassembly.	5.0				
Indoor air quality & occupant comfort		**200.0**				**13.0**
G.1	**Ventilation system**	**55.0**		**EQ-PR 1**	**Minimum IAQ performance**	**0.0**
	Provide ventilation in accordance with ANSI/ASHRAE 62.1 – 2004	10			Meet the minimum requirements of voluntary consensus standard ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality and approved Addenda (see ASHRAE 62-2001, Appendix H, for a complete compilation of Addenda) using the Ventilation Rate Procedure.	
				EQ-2	**Increased ventilation**	**1.0**

				FOR MECHANICALLY VENTILATED SPACES Increase breathing zone outdoor air ventilation rates to all occupied spaces by at least 30% above the minimum rates required by ASHRAE Standard 62.1-2004.	
				FOR NATURALLY VENTILATED SPACES Design natural ventilation systems for occupied spaces to meet the recommendations set forth in the Carbon Trust “Good Practice Guide 237” [1998].	
	Avoid entraining pollutants into the ventilation air path by:				
	- positioning air intakes and outlets at least 30 ft. apart, and inlets not downwind of outlets.	3			
	- locating air intakes more than 60 ft. from major sources of pollution and at least the minimum recommended distances from lesser sources of pollution.	3			
	- protecting air intake openings.	2			
	- specifying a ventilation lining that will avoid the release of pollution and fibers into the ventilation air path.	2			
	Verify that the ventilation system provides effective air exchange (that the outdoor air delivered to the space actually reaches the occupants).	10			
	Monitor indoor air quality either with CO_2 monitoring or digital electronic airflow monitoring.	10	**EQ-1**	**Outdoor air delivery monitoring**	**1.0**
				Monitor carbon dioxide concentrations within densely occupied spaces and provide a direct outdoor airflow measurement, as defined by ASHRAE 62.1-2004, in non-densely occupied spaces.	
	Provide mechanical ventilation systems that allow for the flushing-out of the building with 100% outside air at ambient temperatures above 32°F.	5	**EQ-3**	**Construction IAQ Management Plan**	**2.0**
			EQ-3.1	*During construction*	*1.0*
				During construction meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.	
				Protect stored on-site or installed absorptive materials from moisture damage.	
				Filtration media with a Minimum Efficiency Reporting Value (MERV) of 13 shall be used at each return air grille, as determined by ASHRAE 52.2-1999. Replace all filtration media immediately prior to occupancy.	
			EQ-	*Before occupancy*	*1.0*

			3.2		
				OPTION 1 - Flush-Out: Prior to occupancy perform a building flush-out by supplying a total air volume of 14,000 cu.ft. of outdoor air per sq.ft. of floor area while maintaining an internal temperature of at least 60 degrees F and relative humidity no higher than 60%. OR	
				OPTION 2 - Air Testing: Conduct baseline IAQ testing demonstrating that contaminant maximum concentrations are not exceeded.	
	Provide mechanical ventilation of enclosed parking areas.	5			
	Specify personal control over the ventilation rates, either through operable windows, personalized HVAC controls or, in naturally ventilated buildings, trickle vents on all windows.	5	**EQ-6.2**	**Controllability of systems, thermal comfort**	***1.0***
				Achieve Compliance with ASHRAE 55 - 2004 for thermal comfort.	
	Specify filters with a Minimum Efficiency Reporting Value (MERV) of 13 (80-90% atmospheric dust-spot efficiency) for air distributed to occupied spaces.	5			
G.2	**Control of indoor pollutants**	**45.0**	**EQ-4**	**Low-emitting materials**	**4.0**
	Implement design measures to prevent the growth of fungus, mold, and bacteria on building surfaces and in concealed spaces.	10.0			
	Ensure easy access to the air-handling units (AHUs), for regular inspection and maintenance.	5.0			
	Design a humidification system that is designed to avoid the growth of microorganisms.	5.0			
	Provide Carbon Monoxide (CO) monitoring in parking garages.	5.0			
	Provide measures to mitigate pollution at source such as physical isolation of the spaces, separate ventilation, or a combination of isolation and ventilation for areas that generate contaminants.	5.0			
	Design and locate wet cooling towers that are designed and located in such as way as to avoid the risk of Legionella.	5.0			
	Design a domestic hot water system that is designed to reduce the risk of Legionella.	5.0			
	Use interior materials, including paints, sealants, adhesives, carpets and composite wood products that are low-VOC emitting, non-toxic and chemically inert.	5.0	*EQ-4.1*	*Low-emitting materials, adhesives & sealants*	*1.0*
				Select adhesives and sealant that attain VOC content as specified in SCAQMD Rule #1168 and select sealants used as fillers that meet the requirements specified in the Bay Area Quality Management District	

				Regulation 8, Rule 51.	
			EQ-4.2	*Low-emitting materials, paints & coatings*	*1.0*
				VOC emissions from paints and coatings must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements.	
			EQ-4.3	*Low-emitting materials, carpet systems*	*1.0*
				Carpet systems must meet or exceed the requirements of the Carpet and Rug Institute Green Label Indoor Air Quality Test Program.	
			EQ-4.4	*Low-emitting materials, composite wood & agrifiber products*	*1.0*
				Composite wood or agrifiber products must contain no added urea-formaldehyde resins.	
G.3	**Lighting**	**50.0**	**EQ-8**	**Daylight and views**	**2.0**
	Daylighting	*10.0*	*EQ-8.1*	*Daylight 75% of Spaces*	*1.0*
	Provide ambient daylight to 80% of the primary spaces.	5.0		Achieve a minimum Daylight Factor of 2% (excluding all direct sunlight penetration) in 75% of all space occupied for critical visual tasks, not low occupancy support areas.	
	Achieve minimum daylight factor of 0.2 for work places or living/dining areas that require moderate lighting, and 0.5 for work areas requiring good lighting.	5.0			
	Views	*10.0*	*EQ-8.2*	*Views for 90% of Spaces*	*1.0*
	Provide views to the building exterior, or to atria from all primary interior spaces.	5.0		Direct line of sight to vision glazing from 90% of all regularly occupied spaces, not low occupancy support areas.	
	Specify solar shading devices to enable occupants to control brightness from direct daylighting.	5.0			
	Lighting Design	*30.0*	**EQ-6.1**	**Controllability of systems, lighting**	**1.0**
	Specify lighting controls that relate to room occupancy, circulation space, daylighting and the number of workstations in office areas.	10.0		Provide individual lighting controls for 90% (minimum) of the building occupants to enable adjustments to suit individual task needs and preferences.	
				Provide lighting system controllability for all shared multi-occupant spaces to enable lighting adjustment that meets group needs and preferences.	
	Provide light levels no less than those recommended in IESNA Lighting Handbook, 2000, for the types of tasks that are anticipated in the various building spaces (regardless of daylighting).	10.0			

	Avoid excessive direct or reflected glare, as per IESNA RP-5, 1999, Recommended Practice of Daylighting.	10.0			
G.4	**Thermal comfort**	**20.0**	**EQ 7**	**Thermal comfort**	**2.0**
	Achieve Compliance with ASHRAE 55 - 2004 for thermal comfort.	20.0	*EQ-7.1*	*Thermal comfort, design*	*1.0*
				Design HVAC systems and the building envelope to meet the requirements of ASHRAE Standard 55-2004, Thermal Comfort Conditions for Human Occupancy.	
			EQ-7.2	*Thermal comfort, verification*	*1.0*
				Agree to implement a thermal comfort survey of building occupants within a period of six to 18 months after occupancy. Agree to develop a plan for corrective action if more than 20% of occupants are dissatisfied with thermal comfort.	
G.5	**Accoustic comfort**	**30.0**			
	Site the building location and zone spaces within the building to provide optimum protection from undesirable outside noise.	5.0			
	Specify an appropriate sound transmission class rating of perimeter walls in response to external noise levels.	5.0			
	Provide noise attenuation of the structural systems, and measures to insulate primary spaces from impact noise.	5.0			
	Specify acoustic controls to meet the acoustic privacy requirements.	5.0			
	Specify measures to meet speech intelligibility requirements for the various spaces and activities.	5.0			
	Mitigate acoustic problems associated with mechanical equipment and plumbing systems noise and vibration.	5.0			
			EQ-PR 2	**Environmental tobacco smoke control**	**0.0**
				Zero exposure of non-smokers to ETS by prohibition of smoking in the building, OR, provide a designated smoking room designed to effectively contain, capture and remove ETS from the building	
Transport		**80.0**			**4.0**
C.5	**Energy efficient transportation**	**80.0**	**SS 4**	**Transportation**	**4.0**
	Public Transport	*60.0*	*SS-4.1*	*Alternative transportation, public transportation access*	*1.0*
	Provide access to public transport within 500 yards of the building, with service at least every 15 minutes during rush hour.	50.0		Locate buildings w/in 1/4 mile of commuter or light rail, subway station or 1/4 mile of 2 or more public or campus bus lines.	

	Designated preferred parking for car/van pooling, and shelter at pick-up and drop-off locations.	6.0	*SS-4.4*	*Alternative transportation, parking capacity*	*1.0*
				Parking capacity to meet but not exceed local zoning requirements AND provide preferrd parking for carpools.	
	Provide an alternative-fuel re-fueling facilities on-site or in the general vicinity.	4.0	*SS-4.3*	*Alternative Transportation, Low-Emitting and Fuel-Efficient Vehicles*	*1.0*
				Provide alternative fuel vehicles for 3% of the building occupants AND provide preferred parking for these vehicles - OR install alternative-fuel vehicle refueling stations for 3% of the total vehicle parking capacity of the site.	
	Cycling Facilities	*20.0*	*SS-4.2*	*Alternative transportation, bicycle storage & changing rooms*	*1.0*
	Provide safe, covered storage areas with fixed mountings for securing bicycles.	10.0		For commercial/institutional buildings: secure bicycle storage w. changing/shower facilities (within 200 yards of buildings) for more than 5% of building occupants.	
	Provide changing facilities or large washrooms for occupants to change from cycling wear to office-work apparel.	10.0			
Site ecology		**115.0**			**9.0**
B.1	**Development area (site selection, development density, site remediation)**	**30.0**	**SS-1**	**Site selection**	**1.0**
	Demonstrate on the site plan how any portions of the site identified as being a wetland or wildlife corridor, agricultural land, parkland, or an area notable for its scenic beauty, will be fully preserved. Carry out all required environmental assessments.	10.0		Do not develop buildings on portions of sites that meet any one of the following criteria: Prime farmland, habitat for any species on Federal or State threatened or endangered list, land within 100 ft of water (including wetlands), public parkland	
	Building Site Criteria (choose ONE of the 3 below):	15.0			
	Select an existing serviced site.				
	Existing minimum development density of 60,000 ft^2/acre.		**SS-2**	**Development density & community connectivity**	**1.0**
				Increase localized density by utilizing sites that are located within an existing minimum development density of 60,000 square feet per acre (2 story downtown development)	
	Remediated, previously contaminated site.		*SS-3*	*(Brownfield redevelopment => see below)*	
			SS-5.2	**Site development, maximize open space**	**1.0**
				Reduce development footprint (including building, access roads and parking) to exceed the local zoning's open space requirement for the site by 25%.	
	Minimize the disturbance of undeveloped areas of the site.	5.0	**SS-5.1**	**Site development, protect or restore habitat**	**1.0**

	Minimize the area of the site for the building, parking, and access roads, and locate new building on previously disturbed parts of the site. Preserve significant trees and natural slopes to maintain the existing direction of groundwater flow. Map all the exiting site vegetation.			On greenfield sites, limit site disturbance including earthwork and clearing of vegetation to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways, and main utility branch trenches, and 25 feet beyond pervious paving areas that require additional staging areas in order to limit compaction in the paved area; or, on previously developed sites, restore a minimum of 50% of the remaining open area by planting native or adapted vegetation.	
B.2	**Ecological impacts**	**30.0**			
	Provide a drainage and erosion/sediment control plan that includes measures such as limiting grading, leaving steeper slopes undisturbed, avoiding soil compaction, and protecting vegetative ground cover. Include measures for the construction stage.	9.0	**SS-PR 1**	**Construction activity pollution prevention**	**0.0**
				Create and implement an Erosion and Sedimentation Control (ESC) Plan for all construction activities associated with the project.	
			SS-7	**Heat island effect**	**2.0**
	Provide natural cover including trees that within with in 5 years will shade at least 30% of impermeable surfaces. At minimum there should be one tree for every 100 ft^2 of impermeable surface including parking, walkways and plazas. Where natural shading is not possible, install artificial shading such as covered walks, or light-colored, high-albedo materials (reflectance of at least 0.3) over the site's impervious surfaces	7.0	*SS-7.1*	*Heat island effect, non-roof*	*1.0*
				Provide shade (within 5 years) on at least 30% of non-roof impervious surface on the site, including parking lots, walkways, plazas, etc., OR, use light colored/ high-albedo materials (reflectance of at least 0.3) for 30% of the site's non-roof impervious surfaces, OR place a minimum of 50% of parking space underground OR use open-grid pavement system (net impervious area of LESS than 50%) for a minimum of 50% of the parking lot area.	
	Specify measures to reduce heat build-up on the roof (either high-albedo roofing materials - reflectance of at least 0.65 and emissivity of at least 0.9 for a minimum of 75% of the roof surface - OR a green roof, OR a combination of both).	7.0	*SS-7.2*	*Heat island effect, roof*	*1.0*
				Use ENERGY STAR® compliant (high-reflectance) AND high emmisivity roofing (at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of the roof surface; OR, install a "green" (vegetated) roof for at least 50% of the roof area. Combinations of high albedo and vegetated roof can be used providing they collectively cover 75% of the roof area.	
	Minimize the obtrusive aspects of exterior lighting (e.g. glare, light trespass and sky glow) as per the optical design recommendations of the Illuminating Engineering Society of North America (IESNA), such that no light is emitted above a horizontal plane passing through the bottom of the fixture; and less than 10% of the	7.0	**SS-8**	**Light pollution reduction**	**1.0**
				Do not exceed Illuminating Engineering Society of North America (IESNA) foot-candle level requirements as stated in the Recommended Practice Manual: Lighting for Exterior Environments, AND design interior and exterior lighting such that zero direct-beam	

	emitted light shines within 10 degrees below the horizontal plane passing through the bottom of the fixture.			illumination leaves the building site.	
B.3	**Watershed features (site grading, stormwater management, pervious cover, rainwater capture)**	**20.0**	**SS-6**	**Stormwater design, quantity control**	**1.0**
	Provide a stormwater management plan to prevent damage to project elements, including vegetation, on both the project site and those adjacent to it. Include an engineering design of the site drainage pattern, including volume calculations and site management strategies. Aim for no increase in run-off. Or, if the site already consists of more than 50% impervious surface in its pre-development state, aim for a reduction of 25% in stormwater run-off	10.0		Implement a stormwater management plan that results in no net increase in the rate or quantity of stormwater runoff from existing to developed conditions; OR, if existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate or quantity of stormwater runoff.	
	Provide measures to control run-off from the roof and direct it to a pervious area, or a green roof.	10.0			
B.4	**Site ecology enhancement**	**35.0**	*SS-5.1*	*(Site development, protect or restore habitat - see above)*	
	Specify a naturalized landscape using native trees, shrubs and ground cover, with minimal lawn.	10.0			
	Create a biophysical inventory of on-site plants to be retained or salvaged and re-planted.	10.0			
	Remediate a brownfield site.	15.0	**SS-3**	**Brownfield redevelopment**	**1.0**
				Develop a site that is documented as contaminated (by means of an ASTM E1903-97 Phase II Environmental Site Assessment) OR a site designated a Brownfield by authorities with jurisdiction. Effectively remediate site contamination.	
Other sustainable systems & processes		**40.0**			**6.0**
			ID-2	**LEED accredited professional**	**1.0**
A.3	**Commissioning**	**15.0**	**EA PR 1**	**Fundamental commissioning of the building energy systems**	**0.0**
	Engage an independent Commissioning Authority.	3.0		Engage a commissioning team not affiliated with the design/delivery team. Team will review design documentation, verify installation, functional performance, training, operation, and maintenance documentation and complete commissioning report.	
	Provide "Design Intent" and "Basis of Design" documentation.	3.0	**EA-3**	**Enhanced commissioning**	**1.0**

	Include commissioning requirements in the Construction Documentation.	3.0		Hire a secondary independent commissioning authority in addition to the Fundamental Building Commissioning prerequisite.	
	Develop a Commissioning Plan.	6.0			
A.4	**Emergency response plan**	**5.0**			
	Include the project's environmental goals and procedures with regard to emergency response in Division 1 of the specifications.	5.0			
			ID-1.1 to 1.4	**Innovation in design**	**4.0**
				Substantially exceed a LEED-NC performance credit such as energy performance or water efficiency. Apply strategies or measures that demonstrate a comprehensive approach and quantifiable environment and/or health benefits.	
A.1	**Integrated design process**	**20.0**			
	Use an integrated design process for the design development to identify functional and environmental priorities at the initiation of the project, evaluate options, and develop the design.	10.0			
	Solicit input from all members of the design team at each stage of the design process.	5.0			
	Use green design facilitation to support the integrated design process and involve team members throughout each stage of project delivery.	5.0			

Appendix C: Harmonized point comparison of Green Globes v.0 and LEED 2.2*

= Entry Level Certification (One Globe; Certified)
= Two Globes; Silver Certified
= Three Globes; Gold Certified
= Four Globes; Platinum Certified

Green Globes v.0

Harmonized Category	Pnts.	%	%1G	%2G	%3G	%4G
Energy use	300	30%	86%	55%	43%	35%
Water use	75	8%	21%	14%	11%	9%
Pollution (emissions, solid waste, effluents)	100	10%	29%	18%	14%	12%
Material/Product Inputs	90	9%	26%	16%	13%	11%
Indoor air quality & occupant comfort	200	20%	57%	36%	29%	24%
Transport	80	8%	23%	15%	11%	9%
Site ecology	115	12%	33%	21%	16%	14%
Other sustainable systems & processes	40	4%	11%	7%	6%	5%
Total Available/Required Points		1000	350	550	700	850

LEED 2.2

Harmonized Category	Pnts.	%	%C	%S	%G	%P
Energy use	15	22%	58%	45%	38%	29%
Water use	4	6%	15%	12%	10%	8%
Pollution (emissions, solid waste, effluents)	6	9%	23%	18%	15%	12%
Materials	11	16%	42%	33%	28%	21%
Indoor air quality & occupant comfort	14	20%	54%	42%	36%	27%
Transport	4	6%	15%	12%	10%	8%
Site ecology	9	13%	35%	27%	23%	17%
Other sustainable systems & processes	6	9%	23%	18%	15%	12%
		69	26	33	39	52

*Percentages refer to the percentage of points required at the respecitve certification level that could be attained based on the respective category alone

Appendix D: Comparison of Green Globes versus Green Globes v.0 Design v.1 - Post Construction Assessment

(grey) = No equivalent

Green Globes v.0		Pnts.	%	Green Globes Design v.1[1]		Pnts.	%	% Chang
Energy use		**300**	**30.0%**	**Energy use**		**400**	**36.5%**	**21.5%**
C.1	**Energy performance**: Achieve levels of performance better than that of a building	100	10.0%	C.1	Energy Consumption	110	11.0%	10.0%
C.2	**Reduced energy demand**	114	11.4%	C.2	Energy Demand Minimization	135	13.5%	18.4%
C.3	**Integration of energy efficient systems** - Specify energy efficient technologies, such as	66	6.6%	C.3	Right sized energy-efficient systems	110	11.0%	66.7%
C.4	**Renewable energy sources** (solar, wind, biomass, or photovoltaics etc.) - select one of	20	2.0%	C.4	Renewable Sources of Energy	45	4.5%	125.0%
Water use		**75**	**7.5%**	**Water use**		**70**	**6.4%**	**-14.9%**
D.1	**Water performance -** Achieve water use	30	3.0%	D.1	Water	30	3.0%	0.0%
D.2	**Water conserving features**	45	4.5%	D.2	Water conserving features	40	4.0%	-11.1%
Pollution (emissions, solid waste, ef		**100**	**10.0%**	**Pollution (emissions, solid waste, ef**		**96**	**9.6%**	**-4.0%**
D.3	**On-site treatment of water (greywater system, on-site wastewater treatment)**	10	1.0%	D.3	Reduce off-site treatment of water	20	2.0%	100.0%
E.5	**Reduction, reuse and recycling of**	5	0.5%	E.5	Reduction, reuse and recycling of waste	10	1.0%	100.0%
E.6	**Recycling and composting facilities**	10	1.0%	E.6	N/A	0	0.0%	N/A
F.1	**Air emissions (low emission burners)**	15	1.5%	F.1	Air emissions	15	1.5%	0.0%
F.2	**Ozone depletion**	25	2.5%	F.2	Ozone depletion and global warming	30	3.0%	20.0%
F.3	**Avoiding sewer and waterway**	10	1.0%	F.3	Contamination of sewer or waterways	12	1.2%	20.0%
F.4	**Pollution minimization (storage tanks, PCBs, radon, asbestos, pest management,**	25	2.5%	F.4	Land and Water Polution	9	0.9%	-64.0%
				F.6	Storage for Hazardous Materials	5	0.5%	N/A
Material/Product Inputs		**90**	**9.0%**	**Material/Product Inputs**		**97**	**8.8%**	**-1.8%**
A.2	**Environmental purchasing**	10	1.0%	A.2	Environmental purchasing	5	0.5%	-50.0%
E.1	**Low impact systems and materials** - Select materials that reflect the results of a "best run" life cycle assessment for the following:	35	3.5%	E.1	Materials with low environmental impact	40	4.0%	14.3%
E.2	**Minimal consumption of resources**	15	1.5%	E.2	Minimized consumption and depletion of material resources	30	3.0%	100.0%
E.3	**Reuse of existing buildings** (select ONE among 3.1 / 3.2 / 3.3, if applicable)	15	1.5%	E.3	Re-use of existing structures	10	1.0%	-33.3%
E.4	**Building durability, adaptability and**	15	1.5%	E.4	Building durability, adaptability and	12	1.2%	-20.0%
Indoor air quality & occupant comfo		**200**	**20.0%**	**Indoor air quality & occupant comfo**		**200**	**18.2%**	**-8.8%**
G.1	**Ventilation system**	55	5.5%	G.1	Effective ventilation system	60	6.0%	9.1%
G.2	**Control of indoor pollutants**	45	4.5%	G.2	Source control of indoor pollutants	45	4.5%	0.0%
G.3	**Lighting**	50	5.0%	G.3	Lighting design and integration of lighting	45	4.5%	-10.0%
G.4	**Thermal comfort**	20	2.0%	G.4	Thermal comfort	25	2.5%	25.0%
G.5	**Accoustic comfort**	30	3.0%	G.5	Accoustic comfort	25	2.5%	-16.7%
Transport		**80**	**8.0%**	**Transport**		**70**	**6.4%**	**-20.2%**
C.5	**Energy efficient transportation**	80	8.0%	C.5	Energy-efficient transportation	70	7.0%	-12.5%
Site ecology		**115**	**11.5%**	**Site ecology**		**115**	**10.5%**	**-8.8%**
B.1	**Development area (site selection, development density, site remediation)**	30	3.0%	B.1	Site development area	45	4.5%	50.0%
B.2	**Ecological impacts**	30	3.0%	B.2	Reduce ecological impacts	40	4.0%	33.3%
B.3	**Watershed features (site grading, stormwater management, pervious cover,**	20	2.0%	B.3	Enhancement of watershed features	15	1.5%	-25.0%
B.4	**Site ecology enhancement**	35	3.5%	B.4	Site ecology improvement	15	1.5%	-57.1%
Other sustainable systems & proces		**40**	**4.0%**	**Other sustainable systems & proces**		**49**	**4.5%**	**11.7%**
A.3	**Commissioning**	15	1.5%	A.3	Commissioning - Documentation	20	2.0%	33.3%
A.4	**Emergency response plan**	5	0.5%	A.4	Emergency response plan	5	0.5%	0.0%
A.1	**Integrated design process**	20	2.0%	A.1	Integrated design	20	2.0%	0.0%
				F.5	Integrated Pest Management	4	0.4%	N/A

[1] Total Points currently listed in GG v.1 documentation equal 1097. Percentage and percent change calculations under v.1 are therefore based on this total.

Appendix E: GSA courthouse case study - LEED 2.1 rating and corresponding Green Globes v.0 rating

Source: GSA LEED cost study. Steven Winters Associates 2004

Characteristics:

Construction type	new
Stories	5
GSF (including 15,000 GSF of underground parking)	262,000
Base construction cost $/GSF	$220
Base construction cost $	$57,640,000
Total site area	3.1 acres
Located in:	Washington, D.C.
Structural System:	Pile foundations/grade beams/cast-in place basement walls Cast-in-place structural slab system for basement level Structural steel floor framing for upper floors and roof. Steel deck w/concrete fill for floors.
Cladding System:	Limestone panels over c.m.u. for first two floors. Precast concrete panel system for upper floors.
Fenestration:	Combination of aluminum curtainwall system and aluminum punched window system. Insulated, tinted low-e glazings.
HVAC:	Three water-cooled chillers sized for 50%, 30%, and 20% of the cooling load Dual fuel (gas/oil) boilers Underfloor air distribution system with ceiling plenum return Humidification system

Scenarios:

GSA mandate/no cost	no cost/potential cost decrease
Low cost	< $ 50K
Moderate cost	$ 50K to $ 150K
High cost	> $ 150 K

Rating levels:

Certification	26 points
Silver	33 points
Gold	39 points

Energy & atmosphere

Credit #	Description	Credit	Strategy - low cost	Cost ($)	Included at	Strategy - high cost	Cost ($)	Included at	GG Credit	Description
EA Prereq 1	Fundamental Commissioning of the Building Energy Systems- Verify and ensure that fundamental building elements and systems are designed, installed, and calibrated to operate as intended.	Required	Engage a commissioning team not affiliated with the design/delivery team. Team will review design documentation, verify installation, functional performance, training, operation, and maintenance documentation and complete commissioning report.	no premium	All levels	-	-	All levels	A.3	Commissioning
EA Prereq 2	Minimum Energy Performance- Establish the minimum level of energy efficiency for the	Required	Design building to comply with ASHRAE/IESNA Standard 90.1-1999 or local energy code, whichever is more stringent.	no premium	All levels	-	-	All levels	C.2	Reduced Energy Demand- Building Envelope
EA Prereq 3	Fundamental Refrigerant Management- Reduce ozone depletion.	Required	Eliminate use of CFC-based refrigerants in HVAC&R systems.	no premium	All levels	-	-	All levels	F.2	Ozone Depletion
EA-1	Optimize Energy Performance- Reduce environmental impacts associated with excessive energy use.	1 to 10	**1cr**- High-Performance Glazing, Opaque Walls with High R-values; Roofs with R=23.8; Underfloor Air Distributions; Variable Speed Drive Fans at Air Handlers; Variable Speed Drive Pumps; Waterside Economizer @ Air Cooling Towers; Wetbulb Reset at Cooling Towers; CO Control of Garage Ventilation Fans	no premium	Certified	**3cr-** Reduce Power Lighting Densities (1.1watt/SF); Daylight Dimming Systems; Occupancy Sensor Controls; Premium Efficiency Motors	151,262	Cert., Silver	C.1, C.2, C.3, G.3	Energy Performance Lighting- Lighting Design Reduced Energy Demand- Integration of Daylighting Integrate Energy Efficient Systems
						5cr- Modulating Condens. Boilers (93% nom. effic.); High-efficiency Chillers (0.49 kw/ton); Variable Frequency Drive Cooling Tower Fans; Energy Recovery; Carbon Dioxide Sensors	756,101	Silver, Gold		
EA-2	On-Site Renewable Energy- Reduce environmental impacts associated with fossil fuel use.	1 to 3	-	-	not pursued	1cr- Supply at least 5% of building's total energy use through on-site renewable energy systems (ie: roof-mounted photovoltaic system)	778,586	Gold	C.4	Renewable Energy Sources
						2cr- Supply at least 10% of building's total energy use		Gold		
								Gold		

EA-3	Enhanced Commissioning- Verify and ensure that the entire building is designed, constructed, and calibrated to operate as intended.	1	Hire a secondary independent commissioning authority in addition to the Fundamental Building Commissioning prerequisite.	no premium	All levels	-	-	All levels		n/a
EA-4	Enhanced Refrigerant Management- Reduce ozone depletion and support early compliance with the Montreal Protocol.	1	Install base building level HVAC and refrigeration equipment and fire suppression systems that do not contain HCFC's or Halons. NOT APPLICABLE, SINCE LEED AND GSA HAVE CONFLICTING STANDARDS ON ACCEPTABLE REFRIGERANT ALTERNATIVES.	no premium	not pursued	-	-	All levels		n/a
EA-5	Measurement & Verification- Account for and optimize building energy and water consumption performance over time.	1	Install continuous metering equipment and develop a Measurement and Verification plan for end-uses that include the following: Lighting Systems and Controls; Constant and Variable Motor Loads; Variable Frequency Drive Operation; Chiller Efficiency at Variable Loads; Cooling Load; Air and Water Economizer and Heat Recovery; Air Distribution Static Pressures and Ventilation Air Volumes; Boiler Efficiencies; Building Related Process Energy Systems; Indoor Water Risers and Outdoor Irrigation	107058	Gold	-	-	All levels	C.2	Reduced Energy Demand- Integration of Energy Sub-Metering
EA-6	Green Power- Encourage development and use of grid source, renewable energy technologies on a net zero pollution basis.	1	Provide at least 50% of building's electricity from renewable sources by engaging in at least a two-year renewable energy contract. NOT APPLICABLE.	~$0.15/GSF, depending on energy use	not pursued	-	-	not pursued		n/a
		17								

Scenario	Cost premium	Credits pursued	Scenario	Cost premium	Credits pursued
Certified Low-Cost	0	2	Certified High-Cost	151,262	6
Silver Low-Cost	151,262	4	Silver High-Cost	907,363	8
Gold Low-Cost	863,159	1	Gold High-Cost	1,534,687	

Materials & resources

Credit #	Description	Credit	Strategy - low cost	Cost ($)	Included at	Strategy - high cost	Cost ($)	Included at	GG Credit	Description
MR Prereq 1	Storage & Collection of Recyclables	Required	Provide easily accessible areas for sorting, storing and collecting recyclables (here: 500 sqf)	no premium	all levels	see low cost strategy	none	all levels	E.6	Recycling and composting facilities
MR-1.1	Building Reuse, Maintain 75% of Existing Walls, Floors & Roof	1	n/a	n/a	n/a	n/a	n/a	n/a	E.3	Reuse of existing buildings
MR-1.2	Building Reuse, Maintain 100% of Existing Walls, Floors & Roof	1	n/a	n/a	n/a	n/a	n/a	n/a	E.3	Reuse of existing buildings
MR-1.3	Building Reuse, Maintain 50% of Interior Non-Structural Elements	1	n/a	n/a	n/a	n/a	n/a	n/a	E.3	Reuse of existing buildings
MR-2.1	Construction Waste Management, Divert 50% from Disposal: divert construction, demolition, land clearing debris from landfill disposal and redirect recyclable and reusable materials	1	Develop a Construction Waste Management Plan (Costs vary based on project scope, site, experience of contractors, local landfill fees and recycling infrastructure, local laws)	no premium	Silver, Gold	see low cost strategy	31,658	all levels	E.5	Reduction, reuse and recycling of demolition waste
MR-2.2	Construction Waste Management, Divert 75% from Disposal	1	Extension of strategy for Credit 2.1 to cover 75% of construction waste	21,105	Gold	see low cost strategy	21,105	Silver, Gold	E.5	Reduction, reuse and recycling of demolition waste
MR-3.1	Materials Reuse, 5%	1	-	-	not pursued	-	-	not pursued	E.2	Minimal consumption of
MR-3.2	Materials Reuse,10%	1	-	-	not pursued	-	-	not pursued	E.2	Minimal consumption of
MR-4.1	Recycled Content, 5% (post-consumer + ½ pre-consumer): Achieve 5% recycled content of the total value of materials	1	Follow EPA's Comprehensive Procuring Guidelines for carpets, insulation, concrete, paint, floor and ceiling tiles, steel, wood and paperboard etc. Steel frame buildings make it easy to achieve this credit (90% recycled content steel is available from mini-mills).	no premium	all levels	If industry average steel is used (30% recycled content), additional recycled content materials are needed, e.g., flyash in concrete, mineral fiber ceiling tiles, fiberglas insulation, spray-applied fire-proofing. The credit can still be achieved without a cost-premium.	none	all levels	E.2	Minimal consumption of resources
MR-4.2	Recycled Content, 10% (post-consumer + ½ pre-consumer): Achieve 10% recycled content of the total value of materials	1	Select high-recycled content products (in addition to strategy for Credit 4.1): carpets with recycled nylon or PVC, gypsum wallboard, mineral fiber ceiling tiles, ceramic tiles, biocomposite countertops, recycled paper wallcoverings, recycled cork/rubber/polymer flooring.	no premium	all levels	If the recycled content in the steel frame is limited to 30%, additional materials needed are: gypsum wallboard, nylon carpet tiles and mineral fiber ceiling tiles.	79,331	Silver, Gold	E.2	Minimal consumption of resources

MR-5.1	Regional Materials, 20% Manufactured regionally (within 500 mi radius)	1	Achieve threshold by focusing on "big ticket" construction materials normally available regionally: cast-in-place concrete, concrete masonry units, precast concrete panels, gypsum wallboard, millwork and casework items.	no premium	all levels	Target replacement materials if "big ticket" materials are ot available regionally: precast concrete wall panels instead of gypsum wall panels.	115,903	all levels	E.2	Minimal consumption of resources
MR-5.2	Regional Materials, 50% Extracted regionally (within 500 mi radius)	1	Achieve threshold by focusing on "big ticket" construction materials often extracted regionally: cast-in-place concrete, concrete masonry units, precast concrete panels.	no premium	all levels	-	-	not pursued	E.2	Minimal consumption of resources
MR-6	Rapidly Renewable Materials	1	-	-	not pursued	-	-	not pursued	E.2	Minimal consumption of
MR-7	Certified Wood	1	-	-	not pursued	Purchase 50% of the wood used from FSC-certified sources.	596,597	Silver, Gold	E.2	Minimal consumption of resources
		13								

Scenario	Cost premium	Credits pursued	Scenario	Cost premium	Credits pursued
Certified Low-Cost	0	3	Certified High-Cost	147,561	3
Silver Low-Cost	0	4	Silver High-Cost	844,594	6
Gold Low-Cost	21,105	5	Gold High-Cost	844,594	6

Sustainable Sites

NOTE: Project site selection is considered to be outside the scope of the GSA cost study. Typically, whether the credits in this section can be attained or not depends solely on the type of site selected prior to and independent of the LEED process (i.e., there are few active strategies to attain them AFTER site selection)

=> If the site characteristics happen to be sustainable, the opportunity is seized to obtain many credits (10 in low cost scenarios).
On the other hand, if the site is not sustainable, the GSA study assumes that credits are sought elsewhere instead of selecting another site.

Base case site for Courthouse model: 60 % of open site are dedicated to paved areas, 6% to turf, 34% groundcovers, perennials, shurbbery and trees
47 % paved areas, 3 % turf if Credit SS-5.1 is pursued
40% paved areas, 3% turf if Credit SS-6.1 is pursued

Credit #	*Description*	*Credit*	*Strategy - low cost*	*Cost ($)*	*Included at*	*Strategy - high cost*	*Cost ($)*	*Included at*	*GG Credit*	*Description*
Prereq 1	Erosion and sedimentation control	Required	Design a site sediment and erosion control plan conforming with EPA 832/R-92-005 or local erosion and sedimentation control standards, whichever is more stringent. Strategies: Silt fencing, buffer zones or vegetated filter strips, diversion ditches, storm drain inlet protection filters, stabilized construction entrances, temporary seeding, sediment basins	no premium	All levels	see low cost	no premium	All levels	B.2	Ecological impact - Erosion control: provide a drainage and erosion sediment control plan
SS-1	Site Selection	1	Avoid development of inappropriate sites (prime farmland, land with elevation 5 feet under elevation of 100 year flood, habitat of endangered species, land within 100 feets of water or wetland, public parkland) and reduce the environmental impact from the location of a building on a site.	no premium	All levels	not pursued (credit probably not attainable for all projects, thus not pursued in high cost scenario)	-	not pursued	B.1	Development area - avoid developing inappropriate sites
SS-2	Development Density & Community Connectivity	1	Channel development to urban areas with existing infrastructure (minimum development of 60,000 square feet per acre)	no premium	All levels	not pursued (credit probably not attainable for all projects, thus not pursued in high cost scenario)	-	not pursued	B.1	Development area - existing minimum development density of 60,000 sqft per acre
SS-3	Brownfield Redevelopment	1	Develop on a site documented as contaminated (by means of an ASTM E1903–97 Phase II Environmental Site Assessment) or on a site classified as a brownfield by a local, state, or federal government agency. Effectively remediate site contamination.	no premium	All levels	not pursued (credit probably not attainable for all projects, thus not pursued in high cost scenario)	-	not pursued	B.1 / B.4	Development area - develop a previously contaminated site / Site Ecology enhancement - develop a brownfield site
SS-4.1	Alternative Transportation, Public Transportation Access	1	Locate project within 1/2 mile of a commuter rail, light rail or subway station or 1/4 mile of two or more public or campus bus lines usable by building occupants.	no premium	All levels	see low cost	no premium	All levels	C.5	Energy efficient transportation

SS-4.2	Alternative Transportation, Bicycle Storage & Changing Rooms	1	Provide secure bicycle storage with convenient changing/shower facilities (within 200 yards of the building) for 5% or more of regular building occupants. Here: 300 sqft storage room with 48 bike racks; two 350 sqft shower rooms.	248,743		see low cost	248743	Gold	C.5	Energy efficient transportation
SS-4.3	Alternative Transportation, Low-Emitting and Fuel-Efficient Vehicles	1	Provide alternative fuel vehicles for 3% of building occupants AND provide preferred parking for these vehicles, OR install alternative fuel refueling stations for 3% of the total vehicle parking capacity of the site. NOT PURSUED: restricted access to parking because of security concerns, so credit is not attainable.	-	not pursued	see low cost	-	not pursued	C.5	Energy efficient transportation
SS-4.4	Alternative Transportation, Parking Capacity	1	Size parking capacity not to exceed minimum local zoning requirements AND provide preferred parking for carpools or van-pools capable of serving 5% of the building occupants. NOT PURSUED: restricted access to parking because of security concerns, so credit is not attainable (Carpool parking).	-	not pursued	see low cost	-	not pursued	-	-
SS-5.1	Reduced Site Disturbance, Protect or Restore Open Space	1	On greenfield sites, limit site disturbance to 40 feet beyond the building perimeter, 5 feet beyond primary roadway curbs, walkways and main utility branch trenches, and 25 feet beyond constructed areas with permeable surfaces OR On previously developed sites, restore 50% or more of the area (excluding building footprint) by replacing impervious surfaces with native or adapted vegetation.	110,616	All levels	see low cost	-	not pursued	B.4	Site ecology enhancement
SS-5.2	Reduced Site Disturbance, Development Footprint	1	Reduce the development footprint (= entire building footprint, access roads and parking) to exceed the local zoning's open space requirement for the site by 25%.	no premium	All levels	not pursued (credit probably not attainable for all projects, thus not pursued in high cost scenario)	-	not pursued	-	-
SS-6.1	Stormwater Management, Rate and Quantity	1	If existing imperviousness is greater than 50%, implement a stormwater management plan that results in a 25% decrease in the rate and quantity of stormwater runoff. Strategies: Increased landscape areas, use of pervious paving areas, subsurface retention systems.	165,055	All levels	Strategy: Vegetated roof, 4 inch deep, covering 72 % of roof	578,170	Gold	B.3	Watershed features - Stormwater management plan, Run-off from roof

SS-6.2	Stormwater Management, Treatment	1	Construct site stormwater treatment systems designed to remove 80% of the average annual post-development total suspended solids and 40% of the average annual postdevelopment total phosphorous based on the average annual loadings from all storms less than or equal to the 2-year/24-hour storm. Do so by implementing Best Management Practices outlined in Chapter 4, Part 2 (Urban Runoff), of the EPA Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters, January 1993 (Document No. EPA-840-B-92-002) or the local government's BMP document (whichever is more stringent).	-	not pursued	Strategy: subsurface water quality inlets with sand filter	100,117	Gold	B.3	Watershed features - Stormwater management plan, Run-off from roof
SS-7.1	Heat Island Effect, Non-Roof	1	Reduce heat islands (thermal gradient differences between developed and undeveloped open areas). Here: Place a minimum of 50% of parking spaces underground or covered by structured parking (all parking is underground in the courthouse scenario anyway)	no premium	All levels	see low cost	no premium	All levels	B.2	Ecological impact - Reduced heat island effect, Ground
SS-7.2	Heat Island Effect, Roof	1	Reduce heat islands (Thermal gradient differences between developed and undeveloped areas). Here: Use ENERGY STAR compliant (high reflective) AND low emissivity roofing (emissivity of at least 0.9 when tested in accordance with ASTM 408) for a minimum of 75% of roof surface.	no premium	All levels	Install a "green" (vegetated) roof for at least 50% of the roof area.	495,353	Gold	B.2	Ecological impact - Reduced heat island effect, Roof
SS-8	Light Pollution Reduction	1	Meet or provide lower light levels and uniformity ratios than those recommended by the IESNA Recomm. Practice Manual; Lighting for Exterior Environments (RFP-33-99).	no premium	All levels	not pursued (credit probably not attainable for all projects, thus not pursued in high cost scenario)	-	not pursued	B.2	Ecological impact - Minimal light pollution
			Exterior lighting for plazas and sidewalks based on IESNA RFP–33–99							
			Exterior lighting for parking lots and parking garages based on IESNA RFP–20–98							
			Exterior lighting for on-site roadways based on IESNA RP–8–00							
			Select and specify shielded and full cutoff exterior luminaires.							
			Carefully select lighting fixtures for use at boundaries							
			Check interior lighting layouts along the building perimeter to ensure that luminaires							

14

Scenario	Cost premium	Credits pursued	Scenario	Cost premium	Credits pursued
Certified Low-Cost	524,414	10	Certified High-Cost	no premium	2
Silver Low-Cost	524,414	10	Silver High-Cost	no premium	2
Gold Low-Cost	524,414	10	Gold High-Cost	1,422,383	6

Indoor Envmtl. Quality

Credit #	*Description*	*Credit*	*Strategy - low cost*	*Cost ($)*	*Included at*	*Strategy - high cost*	*Cost ($)*	*Included at*	*GG Credit*	*Description*
EQ Prereq 1	Minimum IAQ Performance	Required	Meet the minimum requirements of ASHRAE 62-1999, Ventilation for Acceptable Indoor Air Quality, and approved Addenda using the Ventilation Rate Procedure (defines the amount of outside air to be supplied for a given occupancy type)	no premium	all levels		no premium	all levels	n/a	
EQ Prereq 2	Environmental Tobacco Smoke (ETS) Control	Required	Attain zero exposure of nonsmokers to Environmental Tobacco Smoke by prohibiting smoking inside the building or installing smoking rooms.	no premium	all levels	Attain zero exposure of nonsmokers to ETS by installing smoking rooms operated under negative pressure, exhausted directly to the outdoors and equipped with tracer gas testing.	26,381	all levels	n/a	
EQ-1	Carbon Dioxide Monitoring	1	Install a permanent CO2 monitoring system (here: 45 sensors) that provides feedback on space ventilation performance and is in accordance with ASHRAE 62-2001, Appendix D.	64,876	Gold	see low cost strategy	64,876	all levels	G.1	Ventilaton system - monitor indoor air quality (Co2 monitoring)
EQ-2	Ventilation Effectiveness	1	For mechanically ventilated buildings, design ventilation systems that result in an air change effectiveness $\geq$ 0.9 as defined by ASHRAE 129-1997. Here: Underfloor air distribution system	no premium	all levels	see low cost strategy	no premium	all levels	G.1	Ventilation system - Provide ventilation in accordance with ASHRAE 62.1-2004 + verify effectiveness
EQ-3.1	Construction IAQ Management Plan, During Construction	1	Develop Indoor Air Quality Management Plan according to SMACNA IAQ guideline: - seal of construction areas and provide local exhaust and filters (here: air handling units with MERV 8 filters) - cover ductwork openings during storage and sequence installation - sequence finish material installation - use low-emitting cleaning products	8,519	Silver	Additional labor costs to manage Construction IAQ Plan result if the construction team is inexperienced in these matters.	45,452	all levels	n/a	
EQ-3.2	Construction IAQ Management Plan, Before Occupancy	1	Develop Indoor Air Quality Management Plan for the preoccupancy phase. Conduct a 2-week building flush-out with new Minimum Efficiency Reporting Value (MERV) 13 filtration media at 100% outside air. After the flush-out, replace the filtration media.	21,330	Silver	see low cost strategy	21,330	all levels	G.1	Ventilation system - Provide a mechanical ventilation system that has the capability of flushing out the building with 100% outside air at temperatures above 32°. Specify filters with a MERV of 13.

EQ-4.1	Low-Emitting Materials, Adhesives & Sealants	1	Select adhesives and sealant that attain VOC content as specified in SCAQMD Rule #1168 and select sealanst used as fillers that meet the requirements specified in the Bay Area Quality Management District Regulation 8, Rule 51.	no premium	all levels	see low cost strategy	no premium	all levels	G.2	Control of indoor pollutants - Use interior materials, including paints, sealants, adhesives, carpets and composite wood products that are low VOC emitting, non-toxic, and chemically inert.
EQ-4.2	Low-Emitting Materials, Paints & Coatings	1	VOC emissions from paints and coatings must not exceed the VOC and chemical component limits of Green Seal's Standard GS-11 requirements. Select water/based latex acrylic paints .	no premium	all levels	see low cost strategy	no premium	all levels	G.2	Control of indoor pollutants - Use interior materials, including paints, sealants, adhesives, carpets and composite wood products that are low VOC emitting, non-toxic, and chemically inert.
EQ-4.3	Low-Emitting Materials, Carpet Systems	1	Carpet systems must meet or exceed the requirements of the Carpet and Rug Institute Green Label Indoor Air Quality Test Program. Most US carpet manufacturers comply with this standard	no premium	all levels	see low cost strategy	no premium	all levels	G.2	Control of indoor pollutants - Use interior materials, including paints, sealants, adhesives, carpets and composite wood products that are low VOC emitting, non-toxic, and chemically inert.
EQ-4.4	Low-Emitting Materials, Composite Wood & Agrifiber Products	1	-	-	not pursued	Composite wood or agrifiber products must contain no added urea-formaldehyde resins. Specify the following products so that they do not - millwork substrate boards - wood doors (wood or agrifiber material included in door assembly) - blocking or mounting panels	455,308	Silver	G.2	Control of indoor pollutants - Use interior materials, including paints, sealants, adhesives, carpets and composite wood products that are low VOC emitting, non-toxic, and chemically inert.
EQ-5	Indoor Chemical & Pollutant Source Control	1	Design to minimize pollutant cross-contamination of regularily occupied areas: - Employ permanent entry way systems (grills, grates, etc.) - Where chemical use occurs (e.g., janitor and copying rooms), provide segregated areas with separate outside exhaust and maintain a negative pressure. - Provide drains plumbed for appropriate disposal of liquid waste in spaces where water and chemical mixing occurs.		all levels			all levels	F.4 / G.2	Pollution minimization / Controll of indoor pollutants

EQ-6.1	Controllability of Systems, Perimeter Spaces	1	-	-	not pursued	-	-	not pursued	G.1	Ventilation system - specify operable windows or vents
EQ-6.2	Controllability of Systems, Non-Perimeter Spaces	1	Provide controls for airflow, temperature and lighting for at least 50% of occupants in non-perimeter, regularly occupied spaces.	no premium	all levels		no premium	all levels	G.3 / G.1	Lighting - Specify lighting controls / Ventilation system - Specify personal controls over the ventilation rates
EQ-7.1	Thermal Comfort, Compliance with ASHRAE 55-1992	1	Comply with ASHRAE standard 55-1992 Addenda 1995 for thermal comfort standards including humidity control.	no premium	all levels	see low cost strategy	no premium	all levels	G.4	Thermal Comfort - Provide compliance with ASHRAE 55-2004
EQ-7.2	Thermal Comfort, Permanent Monitoring System	1	Install a permanent temperature and humidity monitoring system	no premium	all levels	see low cost strategy	no premium	all levels	(G.2)	(Control of indoor pollutants - ensure access to air-handling units, design a humidification system)
EQ-8.1	Daylight & Views, Daylight 75% of Spaces	1	-	-	not pursued	-	-	not pursued	G.3	Daylighting
EQ-8.2	Daylight & Views, Views for 90% of Spaces	1	-	-	not pursued	-	-	not pursued	G.3	Daylighting
		15								

Scenario	**Cost premium**	**Credits pursued**	**Scenario**	**Cost premium**	**Credits pursued**
Certified Low-Cost	0	10	Certified High-Cost	158,039	13
Silver Low-Cost	29,849	12	Silver High-Cost	613,347	14
Gold Low-Cost	94,725	13	Gold High-Cost	613,347	14

Water Efficiency

Credit #	*Description*	*Credit*	*Strategy - low cost*	*Cost ($)*	*Included at*	*Strategy - high cost*	*Cost ($)*	*Included at*	*GG Credit*	*Description*
WE 1.1	Water-Efficient Landscaping- Limit or eliminate the use of potable water for landscape irrigation.	1	Reduce Irrigation by 50%: -Limit turf grass to 15 % of the site's total planting area. -Employ timer and rain sensor controls for the pop-up sprinkler irrigation system. -Specify groundcovers with low water needs.	no premium	All Levels	-	-	-	D.2	Minimal Use of Irrigation Water
WE 1.2	Water-Efficient Landscaping- Limit or eliminate the use of potable water for landscape irrigation.	1	No Potable Use or No Irrigation: -Use only captured rain or recycled site water to eliminate all potable water use for site irrigation. -Do not install permanent landscape irrigation systems.	no premium	All Levels	-	-	-	D.2	Minimal Use of Irrigation Water
WE 2	Innovative Wastewater Technologies- Reduce the generation of wastewater and potable water demand. Increase the local aquifer	1	-	-	not pursued	-	-	-	D.3	On-Site Treatment of Water
WE 3.1	Water Use Reduction. Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.	1	Employ strategies that in aggregate use 20% less water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements: -0.5 gpm faucets at bathroom lavatories. -1.0 gpm faucets at bathroom lavatories and 1.5 gpm faucets at pantry sinks.	no premium	All Levels	-	-	-	D.1 D.2	Water Performance Integration of Water Efficient Equipment
WE 3.2	Water Use Reduction- 30% Reduction. Maximize water efficiency within buildings to reduce the burden on municipal water supply and wastewater systems.	1	Employ strategies that in aggregate use 30% less water than the water use baseline calculated for the building (not including irrigation) after meeting Energy Policy Act of 1992 fixture performance requirements: -0.5 gpm faucets at bathroom lavatories -Infrared sensor controls on lavatory faucets -0.5 gpf urinals -2.0 gpm showers	$62,467	All Levels	-	-	-	D.1 D.2	Water Performance Integration of Water Efficient Equipment
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Scenario	Cost premium	Credits pursued	Scenario	Cost premium	Credits pursued
Certified Low-Cost	62,467	4	Certified High-Cost	-	-
Silver Low-Cost	62,467	4	Silver High-Cost	-	-
Gold Low-Cost	62,467	4	Gold High-Cost	-	-

Innovation & Design Process

Credit #	Description	Credit	Strategy - low cost	Cost ($)	Included at	Strategy - high cost	Cost ($)	Included at	GG Credit	Description
ID 1.1	Innovation in Design - Dedicated Ventilation System	1	Provide 100 percent outside air dedicated ventilation systems.	no premium	All Levels	-	-	-	-	-
ID 1.2	Innovation in Design - Exceed Local Materials Criteria (40%)	1	Exceed the requirements of credit MR-5.1 (Regional Materials, 20 percent Manufactured Regionally). The threshold to achieve an innovation credit is 40 percent.	no premium	Silver, Gold	-	-	-	-	-
ID 1.3	Innovation in Design- Educational Display	1	Provide educational signage throughout a building, and provide an educational case study brochure on the building's green features. Information	$38,912	All Levels	-	-	-	-	-
ID 1.4	Innovation in Design- Exceed Heat Island Effect, Non-Roof Criteria	1	-	-	-	-Provide 100 percent of the building parking underground. -Use light-colored paving materials (with an average albedo of 0.3 or higher) for over 75 percent of the on-site impervious paving areas. -Use tree plantings to provide shade for additional on-site	$235,337	Silver, Gold	-	-
ID 1.5	Innovation in Design- Exceed Certified Wood Criteria (75%)	1	-	-	-	Exceed the requirements of credit MR-7 (Certified Wood). The threshold to achieve an innovation credit is 75%.	$912,098	Gold	-	-
ID 2	LEED Accredited Professional	1	Design teams have at least one LEED accredited professional on their team.	no premium	All Levels	-	-	-	-	-
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Scenario	Cost premium	Credits pursued	Scenario	Cost premium	Credits pursued
Certified Low-Cost	38,912	3	Certified High-Cost	-	-
Silver Low-Cost	38,912	4	Silver High-Cost	235,337	1
Gold Low-Cost	38,912	4	Gold High-Cost	1,147,435	2