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Green Building: LEEDing the Way to Sustainability?

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EXECUTIVE SUMMARY

Rising gas prices, threats of global oil shortages, and the increasing rate of land lost to urban sprawl[1] have raised the issue of sustainability to a level of national importance and have many looking for possible solutions. Many cities and states are attempting to adapt existing building construction regulations to reflect the need for more energy efficient buildings with reduced environmental impacts. This includes impacts not only produced during and after construction, but those produced during the manufacturing of building products. Because of its focus on environmental impacts this design process has been termed "green building."

According to the U.S. Green Building Council (USGBC), green building is the utilization of design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas: sustainable site planning; safeguarding water and water efficiency; energy efficiency and renewable energy; conservation of materials and resources; and indoor environmental quality.

In this paper, I will provide a detailed examination of the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system used to certify green buildings. I will present current policies that utilize the LEED system. I will also introduce McDonough and Braungart's Cradle to Cradle philosophy[2] that illustrates the difference between eco-effectiveness and eco-efficiency. Ultimately, I will answer two main questions: First, does the LEED system represent an eco-effective or eco-efficient strategy? Second, is the LEED system a significant strategy for the process of sustainable development? If so, what policy approaches can the public sector use to facilitate its spread?

To answer my research questions, I conducted an extensive literature review to identify current trends, uses, and policies relating to sustainable development. I critically evaluated various state, city, and county adopted policies that promote green building to determine their ability to facilitate sustainable development. I focused on the LEED rating system because it is internationally known and recognized as the leading standard in green building. I conducted a case study analysis of four certified LEED-New Construction projects to represent the four levels of certification. Using the Cradle to Cradle philosophy, I analyzed specific practices used by the certified projects to determine the level of eco-effectiveness and eco-efficiency that was achieved for each level of certification. Eco-effectiveness differs from eco-efficiency in that it does not merely slow down the existing system, but creates an entirely new system. The Cradle to Cradle philosophy gives thought to the type of waste a product will create, not just its primary purpose.

After reviewing existing policies and case studies, I believe that while the LEED system is helping promote sustainable development, the process is mostly eco-efficient with its focus on recycled materials and utilizing more efficient forms of existing practices. As we've learned, this is does not always result in an environmentally healthy building. The idea behind LEED was to promote sustainable development. Up until

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[1]Urban sprawl happens when farmland, forestland, or open space converts to low-density development that spreads across the landscape with little identifiable form (LULC, 2003)

[2] McDonough and Braungart, 2002

now, that has meant developing more efficient buildings, but the system is not limited to only eco-efficiency. I believe there is enough evidence to support the use of the LEED rating system or an equivalent in the sustainability process, though a formal policy needs to be adopted to require its use.

Many initiatives promoting green building exist at all levels of government, but most merely offer incentives and suggest buildings follow LEED guidelines. Very few actually require certification. If there is going to be a significant change in the building industry, it is going to require a change to the regulatory framework, in addition to the building materials. It is up to the regulators to set a benchmark that the industry must meet. Currently, policies ask for reductions, but they still allow pollution to occur. It is going to take a major change in how we do things to make any significant difference. Sustainable development on its own is a great idea, but there needs to be more than a monetary incentive to move people toward it. Even though builders have said that they build green because it is the right thing to do, there are still many industries that continue to make money off of products and practices that pollute the environment. In order to impact the industry, policies must be made at the state and federal level. Local policies will assist local communities to reduce their environmental footprint, but not eliminate it. If the cradle to cradle philosophy is ever completely adopted, communities may even be able to repair their environment, not just protect it.

When held to Cradle to Cradle standards, most green building practices of today qualify as eco-efficient, but not eco-effective. It is important to note that the LEED system does make a difference; however, if we hope to begin to slow down the negative environmental impacts that are changing the global climate, an eco-effective system is necessary. The promotion of eco-effective products versus eco-efficient products needs to be brought into the mainstream. McDonough and Braungart have shown that the demand and ability is there for eco-effective products. Companies designing more effective products need to be supported and rewarded.

Overall, the LEED rating system is helping communities be more sustainable. Be it through actively designing more efficient buildings or inspiring other green building programs. With the spread of local and state wide policies requiring LEED, could a federal policy be far behind? Whether or not the federal government decides to enter the green building race, it appears that many states and communities are realizing the importance of planning for the future and are attempting to make a difference today. In the end, I believe it will still be necessary to use incentives to realize sustainable development, but with the help of legislation, it no longer seems like an impossible idea.

INTRODUCTION

Rising gas prices, threats of global oil shortages, and the increasing rate of land lost to urban sprawl[3] have raised the issue of sustainability to a level of national importance and have many looking for possible solutions. One such solution being considered is development that considers the long term health of human and ecological systems, known as sustainable development.[4]

The most widely used definition comes from the United Nations' World Commission on Environment and Development (WCED). "Sustainable development ensures that it meets the need of the present without compromising the ability of future generations to meet their own needs."[5] This definition has been criticized as being too vague or open to interpretation. The following quote comes from the same Commission and provides a more detailed definition:

> In essence sustainable development is a process of change in which exploitation of resources, the direction of investments, the orientation of technological developments and institutional change are all in harmony and enhance current and future potential to meet human needs and aspirations.[6]

Calling sustainable development a process suggests that it is not an end goal but a condition that changes over time. Traditional development is sometimes viewed as a zero sum process, what is good for the economy is bad for the environment and vice versa.[7] Whereas, sustainable development acknowledges the need for cooperation and

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[3]Urban sprawl happens when farmland, forestland, or open space converts to low-density development that spreads across the landscape with little identifiable form (LULC, 2003)
[4]Wheeler, 2004
[5] Kates et. al., 2005
[6] WCED, 1997
[7] Brandon and Lombardi, 2005

compromise among those with differing views and promotes practices that are beneficial to the environment, economy, and society.

Sustainable development practices have been shown to help reduce automobile reliance, slow the rate of urban sprawl, and protect valuable farmland and open space.[8] A sustainable community aims at long term cultural, economic, and environmental health and vitality. Sustainable development can help secure a community's future by creating good jobs, improving the environment and quality of life, saving money, and strengthening the local economy.[9]

In this paper, I will provide a detailed examination of the United States Green Building Council's (USGBC) Leadership in Energy and Environmental Design (LEED) rating system used to certify green buildings. I will present current policies that utilize the LEED system. I will also introduce McDonough and Braungart's Cradle to Cradle philosophy[10] that illustrates the difference between eco-effectiveness and eco-efficiency. Ultimately, I will answer two main questions: First, does the LEED system represent an eco-effective or eco-efficient strategy? Second, is the LEED system a significant strategy for the process of sustainable development? If so, what policy approaches can the public sector use to facilitate its spread?

METHODOLOGY

To answer my research questions, I conducted an extensive literature review to identify current trends, uses, and policies relating to sustainable development. I critically evaluated various state, city, and county adopted policies that promote green building to determine their ability to facilitate sustainable development. I focused on the LEED

[8] Portney, 2003
[9] Ibid
[10] McDonough and Braungart, 2002

rating system because it is internationally known and recognized as the leading standard in green building. I conducted a case study analysis of four certified LEED-New Construction projects to represent the four levels of certification. Using the Cradle to Cradle philosophy, I analyzed specific practices used by the certified projects to determine the level of eco-effectiveness and eco-efficiency that was achieved for each level of certification.

ENVIRONMENTAL HISTORY

While the term sustainability may be relatively new, the idea behind it is not. The United States has a long history of environmental problems. The industrial cities of the late 1800s and early 1900s had to deal with air and water pollution from toxic factories and raw sewage from overcrowded neighborhoods. The 1920s and 1930s saw the loss of vast amounts of open space and habitat degradation from construction of the interstate highway system.[11] However, it wasn't until the 1960s and 1970s that the status of the environment took center stage with the public and government alike.

In the 1970s, the United States established many land mark environmental protection acts, such as the Clean Air Act, National Environmental Policy Act, and the Clean Water Act. These acts inspired the adoption of similar acts around the world making the United States a leader of the global environmental movement. Unfortunately, the rapid economic and industrial expansion over the next 20 years that solidified the U.S. position as a world superpower also created a corporate culture of ecological irresponsibility. This laissez-faire mentality is apparent today in the nation's continued

[11] Gillham, 2002

dependence on coal and oil for energy and fuel, as well as the rapid rate of consumption of open space via urban sprawl.[12]

In 2001, a study of the U.S. construction market found that commercial, residential, and industrial buildings use one third of the country's total energy, two-thirds of the electricity, one-eighth of the water, and transform land that provides valuable ecological services with the generation of over 136 million tons of construction and demolition debris each year.[13] Atmospheric emissions from the use of fossil fuels contribute to increased levels of acid rain, ground-level ozone, and smog all of which impact the global climate.[14] The results of this and other studies have many cities and states attempting to adapt existing building construction regulations to reflect the need for more energy efficient buildings with reduced environmental impacts. This includes impacts not only produced during and after construction, but those produced during the manufacturing of building products. Because of its focus on environmental impacts this design process has been termed "green building."[15]

GREEN BUILDING

So, what exactly is green building? According to the U.S. Green Building Council (USGBC), it is the utilization of design and construction practices that significantly reduce or eliminate the negative impact of buildings on the environment and occupants in five broad areas:[16]

- Sustainable site planning
- Safeguarding water and water efficiency

[12] Wade, 2005
[13] U.S. Department of Energy, 2003
[14] U.S. Department of Energy, 2001
[15] Portney, 2003
[16] USGBC, 2005

- Energy efficiency and renewable energy
- Conservation of materials and resources
- Indoor environmental quality

In his *Site Planning and Design Handbook*, Thomas Russ writes that "...buildings once reflected an elegance of design, a thoughtful construction based on awareness of the environment. Buildings in this tradition were active working machines."[17] Green building is "active" building that reminds us of our connection to a world larger than ourselves, a world to be inherited by our children. Our responsibility today is to create and maintain sound environmental, social, and fiscal legacies. In the practice of sustainability, green building is a crucial pillar of that responsibility.

With green building, the local as well as global environment benefits from improved air and water quality, and protection of ecosystems and biodiversity. Building occupants benefit from improved indoor air quality and increased natural light provided in these healthy and efficient work and living environments.[18] With the escalation of energy prices and increasing cost of land due to the loss of open space to development, the economic benefits of building green have drawn greater attention than the environmental and social benefits. These economic benefits come in the form of improved building operations, increased asset value, and enhanced worker productivity. Green building projects that are well integrated and are comprehensive in scope can result in lower project development costs, while the rehabilitation of an existing building can lower infrastructure and materials costs.

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[17] Russ, 2001
[18] USGBC, 2005

Through design integration, paybacks from some green strategies may be used to pay for others. For example, energy-efficient building envelopes can reduce equipment needs by allowing the downsizing of equipment, such as chillers, or the elimination of equipment, such as perimeter heaters. The use of pervious paving materials and other runoff prevention strategies can reduce the size and cost of stormwater management structures. Studies have shown that energy and water efficient buildings have been able to significantly reduce their operating costs.[19] For example, a 2003 study of certified green buildings in California found that an upfront investment of 2% in green building design, on average, resulted in life cycle savings of 20% of the total construction costs.[20] Other studies have shown that increased lighting can result in improved sales and employee productivity.

High-performance green buildings are changing the way businesses look at their portfolio of facility assets. Their environmental sensitivity resonates with shareholders and key constituents. Their improved working environments resonate with employees and visitors. And their economic impact resonates with everyone concerned with profitability.[21] While it would be easy to assume that the financial benefits are the driving force behind the increase in green buildings, a 2005 study found that although energy costs and consumer demands play into the decision, the leading reason cited for building green buildings was "because it is the right thing to do."[22]

Whatever the reason, be it financial, social, or environmental, a market transformation has been occurring and green buildings are no longer just expensive

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[19] USGBC, 2005
[20] Kats, et. al., 2003
[21] von Paumgartten, 2003
[22] Pressly Jr, 2006

structures for the ultra-environmentalist. Savvy owners and operators from every industry are beginning to demand green buildings.[23] Undertaking green building projects demonstrates a commitment to quality, permanence and stewardship that often improves an owner or developer's reputation in the community and the industry as a whole. Those involved with sustainability are beginning to be viewed as innovators and leaders in their field.[24]

Early attempts at green building often focused mainly on energy efficiency or use of recycled materials. Architects in the 1980s and 1990s began to realize that the integration of practices related to sustainable site planning, safeguarding water supplies, and indoor air quality would produce a "high performance" green building.[25] By designing, constructing, and maintaining buildings to decrease energy and water usage and costs, longevity of building systems will improve in efficiency and decrease the burdens that buildings impose on the environment and public health.[26] Recognizing the need to provide the building industry with consistent, credible standards for what constitutes a green building, the U.S. Green Building Council (USGBC) created the Leadership in Energy and Environmental Design (LEED) Green Building Rating System.

LEADERSHIP IN ENERGY AND ENVIRONMENTAL DESIGN

The LEED system created a standard form of measurement to: promote sustainable design practices; recognize environmental leadership in the building industry, stimulate green design; raise consumer awareness about the benefits of sustainable

[23] von Paumgartten, 2003
[24] Urban Catalyst, 2005
[25] Dauncey, 2004
[26] Urban Catalyst, 2005

development; and transform the building market.[27] LEED system standards provide a comprehensive framework for evaluating building performance and meeting sustainability goals. These standards are based on scientific principles and promote modern strategies for sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. The LEED system acknowledges achievements in sustainable development by offering project certification, professional accreditation, and educational resources and training.[28]

There are four levels of certification: certified; silver; gold; and platinum. The LEED system rates buildings on a point system where every building and construction practice is given a certain number of points. The more points a building earns, the higher it is ranked in the certification process. There are design standards for:

- New Commercial Construction and Major Renovation projects (LEED-NC)
- Existing Building operations (LEED-EB)
- Commercial Interiors projects (LEED-CI)
- Core and Shell projects (LEED-CS)
- Homes (LEED-H) – Pilot program
- Neighborhood Development (LEED-ND) – Pilot program
- Retail – Pilot program
- Schools – under development
- Guidelines for Multiple Buildings and On-Campus Building projects

[27] USGBC, 2005
[28] USGBC, 2005

LEED Certification Process

The first step to certifying a building is to register the project. Early registration maximizes the potential for project certification. Registration allows developers to establish contact with the USGBC and gain access to important information, software tools, and communications. Project contacts receive an orientation letter, which explains the official LEED certification process.[29] It is useful to have a LEED accredited professional as the project contact helps to ensure that the individual has a thorough understanding of the LEED system resources, requirements, and processes. An accredited professional is someone who has passed the LEED accreditation exam given by USGBC.

Registration is just the first step to certification; fewer than 400 projects nationwide are fully certified, thus forfeiting their registration fee.[30] A common complaint has been the length of time it takes to certify a project. To streamline the certification process, the USGBC created a web-based certification process under LEED version 2.2. In the previous version, most document submissions occurred at the end of the process. Version 2.2 allows project teams to submit design phase credit documentation before construction starts. Comments have already been received praising the new process and the increased electronic transmission capabilities.[31] The web-based certification process was designed to make the documentation process easier and more efficient, speeding up the entire certification process. While initial responses to the system have been favorable, the system is too new to accurately gauge the impacts on

[29] USGBC, 2005
[30] Greer, 2006
[31] Greer, 2006

cost and paperwork burden concerns.[32]

Once the registration process is complete, the developer can begin preparing documentation to satisfy the prerequisites and credit submittal requirements. This documentation should continue throughout the project. In case there is a question or a problem arises, the USGBC has established a review process called Credit Interpretation Requests (CIRS). If a developer has a problem they should review the LEED Reference Guide and examine the LEED CIRS website page for previously asked questions concerning relevant credits. If these aforementioned solutions fail to answer any questions, the developer can submit a new CIRS using an online form.[33]

The certification review process includes an application submittal and technical reviews (Table 1). The application submittal must include a printed LEED letter and requested submittals for each prerequisite and credit, LEED registration information, the LEED project checklist/scorecard indicating projected credits and totals for the project, and drawings and photos of the project area. The technical review process depends on which version of LEED standards is being used. This includes: LEED-NC version 2.0, LEED-NC version 2.1, LEED-NC version 2.0/2.1 Combination review, LEED-EB Version 2.0, or LEED-CI 2.0. Though each of these reviews is slightly different, all application submittals are reviewed and within a month the USGBC will issue a preliminary LEED review. If necessary, the project team has 30 days after the preliminary review to provide corrections and/or additional supporting documentation. The USGBC then conducts a final LEED review within three weeks of receiving the resubmitted application and notifies the project team.

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[32] Greer, 2006
[33] USGBC, 2005

Once the team is notified of the LEED certification, they have 30 days to accept the award or appeal the determination of credit. There is a fee of $500 dollars per credit appealed. A review of the appeal will occur within 30 days at which time an Appeal LEED Review will be issued.[34] If the initial certification is not appealed in 30 days it becomes final.

Table 1: LEED Certification Process

Steps	Activity
Determine Eligibility	Commercial Buildings Unique Buildings use LEED Rating System checklist
Register Project	Perform during early phase of project design Establish contact with USGBC
Documentation	Compile three ring binder and/or compact disc Submit two copies and fee
Credit Interpretations For Questions	Consult LEED Reference Guide Review LEED Credit Interpretations Rulings page Submit new Credit Interpretations Request online
Certification	Satisfy prerequisites and minimum points for desired LEED rating

A variety of notable benefits are being realized through design practices and adoption of LEED standards. A study done for the California Sustainable Buildings Task Force showed that LEED-certified green buildings cost on average four dollars more per square foot to build, but that they returned a dividend 10 to 15 times greater, $49 to $68 per square foot, primarily because of the increased productivity and health of their occupants.[35] These reasons have contributed to the more than 1600 LEED ongoing registered projects worldwide (mostly in the United States) with over 300 of them LEED certified. This represents over 200 million square feet of building space with a reduced impact on the earth and an improved impact on humans.[36]

[34] USGBC, 2005
[35] Dauncey, 2004
[36] Dauncey, 2004

A LEED certification label also provides a prestige factor that carries value in itself. As a marketing strategy, LEED labeling carries a price premium because the label implies a certain quality guarantee. A building that carries a silver or gold LEED certification may be able to charge higher rent simply because of the LEED label. An employer in a LEED certified building may be able to attract higher quality employees without having to pay a premium on salaries.[37] Marketing surveys would need to be conducted to determine the actual prestige value of the LEED label.

Since 2000, USGBC LEED-certified buildings have captured nearly twenty-five percent of the entire new building market in the United States and the number of projects registering for certification continues to grow.[38] Table 2 illustrates how expansive and varied the market for LEED buildings is. Green buildings are located in all 50 states and appear in all building categories with commercial offices and educational buildings representing one-third of all LEED certified buildings. As these eco-efficient buildings continue to draw attention in the building industry and as their range of benefits are better understood, demand should continue to grow.[39]

[37] Kwong, 2004
[38] USGBC, 2005
[39] USGBC, 2005

Table 2: LEED Building Owners and Users[40]

Owner Industry	Registered & Certified (%)	Building Use	Registered & Certified (%)
For Profit	25	Mixed Use	25
Non Profit	19	Commercial Office	16
Local Govt.	24	Higher Education	8
State/Federal Govt.	22	K-12	6

LEED Inspired Initiatives and Adaptations

As dependence on fossil fuels and petrochemicals continues and energy consumption increases worldwide, polluting carbon dioxide (CO_2) emissions are expected to increase 1.2 percent per year.[41] While scientists may argue as to the specific environmental consequences of global warming, there is a consensus the risks posed to humans and the environment are real. As more knowledge is gained on the effects of global warming, questions are being raised as to the soundness of current energy policies. In a recent report, the International Energy Agency concluded, "If governments stick with current policies, global energy needs in 2030 will be more than 50 percent higher than today. THIS IS NOT SUSTAINABLE!" (emphasis original)[42] As the global population increases, so will the demand on the already strained world oil supply; driving up prices.

The United States in particular is highly dependent on foreign oil. The average American currently uses three gallons of oil per day for transportation, electricity, even medicine. Recognizing the need for greater energy independence, states are beginning to develop policies promoting alternative energy sources, improved conservation efforts, and new technologies. State and local governments are promoting consistency with the

[40] USGBC, 2004
[41] Taylor, 2006
[42] International Energy Agency, 2005

guidelines of the LEED rating system through incentives, executive orders, and even enforceable legislation[43].

The following examples were chosen because they utilize legislative initiatives that effectively promote green building by incorporating LEED system standards, or variations thereof, in their local ordinances or master plan.

Michigan

In April 2005, Michigan Governor, Jennifer M. Granholm, issued an executive directive to make state government more energy efficient and save taxpayers millions of dollars in energy costs. Executive directive No. 2005-4 directs the Department of Management and Budget (DMB) to reduce energy use in all state-owned and operated buildings by 10 percent by December 31, 2008 and to reduce grid-based state energy purchases by 20 percent by 2015. This requires the immediate adoption of an array of energy conservation improvements in lighting, heating, ventilation and air conditioning. Beyond mechanical improvements, this directive also requires that all new buildings for state agencies, universities, and community colleges with a cost of $1 million or greater meet the standards for LEED-certified status.[44] While LEED certification is not required, the directive does show a commitment to producing state facilities that are energy efficient in operation and maintenance, and designed to have minimal impact on the environment.

[43] See Appendix
[44] Executive directive No. 2005-4

Colorado

The City of Boulder, Colorado's Office of Environmental Affairs[45] oversees the Green Points Program, which is similar to the LEED system in that it operates on a ranking system with points awarded for specific construction practices. The Program requires residential building permit applicants to earn green points for all new construction, additions, or remodeling projects greater than 500 square feet. Points are earned for practices exceeding the existing standards in Boulder's current building code. The practices are grouped into ten main categories: Construction, Demolition, Use of Recycled Materials; Land Use, Water Conservation; Framing; Plumbing; Electrical; Windows, Insulation; Heating, Ventilating, and Air Conditioning (HVAC); Solar; Indoor Air Quality and Indoor Finishes; and Innovation Product or Design Points.[46]

California

Santa Monica, California's Green Building Program[47] outlines both recommended as well as required green building practices. The required practices apply to all institutional and commercial offices, light industrial buildings, commercial retail buildings, multi-family residences, hotels and motels. These requirements are outlined in two different City Ordinances, as well as the Municipal Code. The required and recommended practices were created to reduce life-cycle environmental impacts associated with the construction and operation of both commercial and municipal developments and major remodel projects in Santa Monica. They provide specific "green" design and construction strategies in the following topic areas: Building Site and

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[45] For more information contact the City of Boulder's Office of Environmental Affairs http://www.ci.boulder.co.us/environmentalaffairs/green_points/index.htm

[46] City of Boulder, 2004

[47] For more information contact the Santa Monica Green Building Program http://greenbuildings.santa-monica.org/index.html

Form, Landscaping, Transportation, Building Envelope and Space Planning, Building Materials, Water Systems, Electrical Systems, HVAC Systems, Control Systems, Construction Management, and Commissioning.[48]

Arizona

In March 2005, the City Council of Scottsdale, Arizona unanimously approved Resolution No. 6644, which established the Green Building Policy for new city buildings and remodels.[49] The policy requires all new city buildings to be designed and built to achieve LEED Gold certification. This action made Scottsdale the first city in the nation to adopt a LEED Gold policy.[50]

To address residential developments, the city developed a Green Building Program[51] to encourage environmentally responsible and energy efficient residential developments in the Sonoran Desert region. The Program uses various incentives to encourage participation such as hosting lecture series, workshops, and special events; recognizing builders and designers on the city website; and expediting the development planning process.[52] The Green Building Program is similar to the LEED system in that it is voluntary and uses a green building point rating system to qualify projects. The program rates building projects in the following six environmental impact areas: Site Use, Energy, Indoor Air Quality, Building Materials, Solid Waste, and Water. With over 150 building options, Scottsdale's Green Building Program offers a great deal of flexibility in design for residential developments.[53]

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[48] City of Santa Monica, n.d.
[49] See Appendix
[50] City of Scottsdale, 2005
[51] For more information: http://www.ci.scottsdale.az.us/greenbuilding/
[52] City of Scottsdale, 2005
[53] City of Scottsdale, 2005

New York

Public policy for the promotion of green or LEED certified buildings in the private sector has largely come in the way of incentives. In May 2000, the State of New York became the first state to offer a tax incentive package to developers who build environmentally sound commercial and apartment buildings. This innovative tax law -- or "green building credit" -- is aimed at encouraging the housing materials and construction industries to adopt green practices on a large scale by providing tax credits to building owners and tenants who invest in increased energy efficiency, recycled and recyclable materials and improved indoor air quality.[54]

The green building credit allows builders who meet energy goals and use environmentally preferable materials to claim up to $3.75 per square foot for interior work and $7.50 per square foot for exterior work against their state tax bill.[55] To qualify for the credit, a building must be certified by a licensed architect or engineer and must meet specific requirements for energy use, materials selection, indoor air quality, waste disposal and water use. In new buildings, this means energy use cannot exceed 65 percent of use permitted under the New York State energy code; in rehabilitated buildings, energy use cannot exceed 75 percent. Ventilation and thermal comfort must meet specified requirements and building materials, finishes and furnishings must contain high percentages of recycled content and renewable source material and cannot exceed specified maximum levels of toxicity. Waste disposal and water use must also comply with criteria set forth in the new law.[56] As I will illustrate later, these requirements

[54] Car et al., 2005
[55] Car et al., 2005
[56] Car et al., 2005

address many issues of concern raised by McDonough and Braungart's Cradle to Cradle theory.

Virginia

Other creative legislation has been implemented in Arlington County, Virginia.[57] To encourage projects to achieve formal LEED certification from the U.S. Green Building Council, Arlington County has established a green building density incentive program. The program allows developers to request a slightly larger building than would normally be allowed by County Code if the project receives official LEED certification from the USGBC at one of the four LEED award levels. The extra space allowed varies depending on the project and on the LEED award sought. Originally adopted in October 1999, the green building density incentive program was revised and enhanced in December 2003. The program applies to all types of building projects (office, high rise residential, etc.) achieving any one of the four LEED awards. The density bonus ranges from a minimum of .15 floor area ratio (FAR) for a LEED Certified project to a maximum of .35 FAR for a platinum project.[58]

Standard 189

The U.S. Green Building Council (USGBC); the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE); and the Illuminating Engineering Society of North America (IESNA) announced that the three organizations have agreed to co-sponsor the development of a new minimum standard for high-performance green building called Standard 189.[59] The purpose of the standard will be to specify the minimum criteria for high-performance green buildings. The standard will

[57] Arlington County, 2005. For more information visit: http://www.arlingtonva.us/
[58] Arlington County, 2005
[59] ASHRAE, 2006

also be accredited by the American National Standards Institute (ANSI) which coordinates the development and use of voluntary consensus standards within the United States. According to ASHRAE president Lee Burgett, P.E., the partnership with USGBC will assure that the needs of those who create sustainable buildings are met; while ASHRAE and IESNA will provide design guidance for more energy-efficient buildings.[60]

Scheduled for completion in 2007, Standard 189 will apply to new commercial buildings and major renovation projects. It is designed to provide the minimum design requirements to balance environmental responsibility, resource efficiency, occupant comfort and well-being, and community sensitivity. Going off the fact that the LEED rating system addresses the top 25 percent of building practices, Standard 189 is designed to provide the remaining 75 percent with a baseline that will take green building practices into the mainstream.[61] By being an ANSI-accredited standard the standard can easily be incorporated into existing building codes. While Standard 189 is not a rating system like the LEED system, it is anticipated that the standard will eventually become a LEED prerequisite and as with the LEED system, spark the adoption of similar standards in other countries.[62]

International Adaptations

The LEED system is recognized as a user-friendly, proven system with variations being utilized throughout the world.[63] Over 20 countries utilize an adapted form of the U.S. LEED system. Many of these countries do not have the regulations and resources of the United States to create their own system, so they are able to benefit from the research

[60] ASHRAE, et. al., 2006
[61] Schneider (a), 2006
[62] ASHRAE (a), 2006
[63] Galadza, 2006

the LEED system provides. However, since the LEED system was designed for the United States building market, it is necessary to adapt the system to make it more locally appropriate. The USGBC licensing process used for adaptation allows for the continuation of the "standard form of measurement" that was the original goal of the U.S. LEED system. Through this licensing process, countries modify the system to suit the varying country specific needs. For example, India offers points for worker safety, since they don't have a body like the Occupational Safety and Health Administration. China offers points for moving out of the city to alleviate overcrowding as opposed to the U.S. LEED system that encourages developers to build within existing cities.[64]

Rob Watson, senior scientist and director of the Natural Resources Defense Council and founder of LEED believes it "...is probably the fastest growing green standard in the world, certainly in terms of the number of square feet being added each year".[65] Canada alone has registered more than 200 LEED-certified buildings since the Canadian program's launch in December 2004. India has three Platinum-level buildings, with three more underway.[66] China has 10 projects, with a total construction area of 5 million square feet, for LEED certification.[67] When countries actively utilize a LEED-type system to improve building efficiency, the impacts on the global environment are limitless especially when you consider that China, alone, is currently home to the half of the globe's building construction.[68]

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[64] Galadza, 2006
[65] Galadza, 2006
[66] USGBC, 2005
[67] USGBC, 2005
[68] Galadza, 2006

CRADLE TO CRADLE

The term "eco-efficiency" is often considered to be a desirable goal of green building. The practices are based on using more ecologically aware products to conserve energy, water, etc. All LEED system building practices focus on improving a project's ecological efficiency. Internationally recognized architect, William McDonough, and chemist, Michael Braungart, suggest that, at times, eco-efficiency may cause more problems than benefits. On its face, eco-efficiency means "doing more with less." While there are economic and environmental benefits from reducing resource consumption, emissions, and waste, the system is still the same one that caused the problems in the first place; only made "less bad".[69] Reducing, reusing, and recycling merely slows down the rate pollution and contaminants are emitted, it does not stop the process. McDonough and Braungart argue that while recycling does create new materials, they are often poor quality mixtures of materials that eventually end up in landfills. In addition, the actual recycling process may actually create dangerous by-products. For example, furnaces that recycle steel for building materials are now a large source of dioxin emissions. Because the product was not originally designed to be recycled, it may take more effort and result in more harmful chemicals being used.[70]

Today, many products are built with little thought given to where it will end up when it is no longer useful. This linear one way system of waste disposal is known as the Cradle to Grave life cycle. Many products are simply not designed to be reused or recycled. In fact, many of today's technological products such as computers, DVD players, and television sets, are "built in obsolescence" to encourage people to buy a

[69] McDonough and Braungart, 1998
[70] McDonough and Braungart, 2002

newer version instead of trying to repair the original item. There is also a one size fits all mentality that has resulted in products containing unnecessary chemicals. For example, laundry detergent isn't designed to recognize how soiled clothing is or the type of water it is being used in. So chemicals are added to allow the detergent to clean in even the hardest water.[71] Therefore, if you have lightly soiled clothing and are washing them in softened water, these unnecessary chemicals are released into the environment and ultimately find their way into natural streams and groundwater.

In their 2002 book, *Cradle to Cradle*, McDonough and Braungart promote a system modeled after the "eco-effectiveness" of the natural environment where "waste equals food."[72] Eco-effectiveness differs from eco-efficiency in that it does not merely slow down the existing system, but creates an entirely new system. Using the cherry tree as an example, McDonough and Braungart illustrate how the generation of thousands of blossoms to potentially germinate a tree would not be viewed efficient by the industry standards of today. However, the tree's abundance of blossoms does not deplete its surrounding environment, but actually contributes nutrients to the soil. In that vein, eco-effectiveness is regenerative, not depletive. According to McDonough and Braungart, eco-effective products would either be designed to completely biodegrade or retain their high quality and be continually circulated.[73] The Cradle to Cradle life cycle gives thought to the type of waste a product will create, not just its primary purpose.

The Cradle to Cradle life cycle eliminates the unintended consequences of many of today's products. For example, energy efficient buildings are often achieved through better insulation and leak proof windows. This decreases the amount of air coming into

[71] McDonough and Braungart, 2002
[72] McDonough and Braungart, 2002
[73] McDonough and Braungart, 1998

the building from outside. By reducing this air exchange rate, these energy efficient buildings may actually decrease the indoor air quality by keeping in the pollution that comes from poorly designed materials, such as carpeting and paints that emit volatile organic compounds (VOC).[74] When you consider that the average American spends more than 90% of their time indoors, where air quality can be two to five times worse than outdoor air quality, this becomes a significant health risk.[75] Even the most benign product, like the average shoe, releases tiny particles of potentially harmful substances with each step. These particles, in turn, are transported via rain to nearby plants and soil, thus adding another burden to the environment.[76]

To advance the use of eco-effective products, McDonough and Braungart founded McDonough Braungart Design Chemistry (MBDC) which is a product and process design firm that uses a Cradle to Cradle Design paradigm.[77] Using the Cradle to Cradle principles, McDonough and Braungart designed a fabric so free of contaminants that one could literally eat. The process was not an easy one. Initial presentations from the chosen textile company included many "natural" and "recycled" materials such as cotton mixed with recycled plastic bottles. On the surface, the fiber appeared environmentally benign, but upon closer inspection, it was discovered that when the fabric was abraded it emitted tiny particles of PET (polyethylene terephthalate) which were not designed to be

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[74] Volatile organic compounds are secondary petrochemicals which evaporate readily into the atmosphere at normal temperatures. They include light alcohols, acetone, trichloroethylene, perchloroethylene, dichloroethylene, benzene, vinyl chloride, tolulene, and methyl chloride. These potentially toxic chemicals are used as solvents, degreasers, paint thinners, adhesives, and fuels and contribute significantly to photochemical smog production and certain health problems. Signs and symptoms of VOC exposure may include eye and upper respiratory irritation, nasal congestion, headache, and dizziness. McDonough and Braungart, 2002

[75] U.S. EPA Office of Air and Radiation (1989)

[76] McDonough and Braungart, 2002

[77] www.mbdc.com

inhaled.[78] In addition, the plastic would prevent the fiber from completely biodegrading and would eventually end up in a landfill. After extensive research and trial products, a completely biodegradable fiber was created; Climatex® Lifecycle™.

After the fabric was in production, the director of the mill shared a surprising story. When regulators visited the mill to test the effluent, they thought their instruments were broken because the water coming out of the factory was as clean as the water leaving.[79] Apparently, in true Cradle to Cradle fashion, the manufacturing process was also acting as a water filtration process.

McDonough and Braungart acknowledge that not all products can or should be completely biodegradable. Those that can would be made of "biological nutrients", but those that cannot, would be made of "technical nutrients" such as plastics, metals, and glass[80]. The cradle to cradle difference would be that these technical nutrients would be high quality materials designed to be continuously reused, not recycled into something else. The MBDC is currently working with many large companies, such as Nike, British Petroleum, and one of the world's leading chemical producers, BASF, to design environmentally sound products that make economic sense[81].

CASE STUDIES

The following four buildings represent each level of LEED certification. All projects are in the United States and all are certified LEED New Construction.

[78] McDonough and Braungart, 1998
[79] McDonough and Braungart, 1998
[80] McDonough and Braungart, 2002
[81] Lubell, 2003

LEED New Construction

The LEED Green Building System for New Construction (LEED-NC) was first published in 1999. Since its inception, it has helped developers improve the quality of buildings and their impact on the environment. These standards help to reduce the amount of energy, water, and electricity buildings use while promoting land use practices that preserve open space.[82] LEED-NC has a total of 69 possible points available to qualifying projects. To achieve basic certification requires 26-32 points, the silver status 26-32 points, gold 39-51 points and platinum 52-69 points.[83] Before any credits can be obtained a list of prerequisites must be met by developers. These items are not worth any points and must be done for every project (Table 3).

Table 3: LEED-NC Prerequisites[84]

Construction Activity Pollution Prevention	Reduce pollution from construction activities by controlling soil erosion, waterway sedimentation and airborne dust generation.
Fundamental Commissioning of the Building Energy Systems	Verify that the building's energy related systems are installed, calibrated and perform according to the owner's project requirements, basis of design, and construction documents.
Minimum Energy Perfomance	Establish the minimum level of energy efficiency for the proposed building and systems.
Fundamental Refrigerant Management	Reduce ozone depletion.
Storage & Collection of Recyclables	Facilitate the reduction of waste generated by building occupants that is hauled to and disposed of in landfills.
Minimum IAQ Performance	Establish minimum indoor air quality (IAQ) performance to enhance indoor air quality in buildings, thus contributing to the comfort and well-being of the occupants.
Environmental Tobacco Smoke (ETS) Control	Minimize exposure of building occupants, indoor surfaces, and ventilation air distribution systems to Environmental Tobacco Smoke (ETS).

[82] USGBC, 2005
[83] Ibid
[84] USGBC, 2005

Table 4: LEED-NC Project Checklist

Sustainable Sites — 14 Possible Points

Prereq 1	**Construction Activity Pollution Prevention**	Required
Credit 1	**Site Selection**	1
Credit 2	**Development Density & Community Connectivity**	1
Credit 3	**Brownfield Redevelopment**	1
Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
Credit 4.3	**Alternative Transportation**, Low Emitting & Fuel Efficient Vehicles	1
Credit 4.4	**Alternative Transportation**, Parking Capacity	1
Credit 5.1	**Site Development**, Protect or Restore Habitat	1
Credit 5.2	**Site Development**, Maximize Open Space	1
Credit 6.1	**Stormwater Design**, Quantity Control	1
Credit 6.2	**Stormwater Design**, Quality Control	1
Credit 7.1	**Heat Island Effect**, Non-Roof	1
Credit 7.2	**Heat Island Effect**, Roof	1
Credit 8	**Light Pollution Reduction**	1

Water Efficiency — 5 Possible Points

Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
Credit 2	**Innovative Wastewater Technologies**	1
Credit 3.1	**Water Use Reduction**, 20% Reduction	1
Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Energy & Atmosphere — 17 Possible Points

Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Prereq 2	**Minimum Energy Performance**	Required
Prereq 3	**Fundamental Refrigerant Management**	Required
Credit 1	**Optimize Energy Performance**	1–10
Credit 2	**On-Site Renewable Energy**	1–3
Credit 3	**Enhanced Commissioning**	1
Credit 4	**Enhanced Refrigerant Management**	1
Credit 5	**Measurement & Verification**	1
Credit 6	**Green Power**	1

Materials & Resources — 13 Possible Points

Prereq 1	**Storage & Collection of Recyclables**	Required
Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
Credit 1.2	**Building Reuse**, Maintain 95% of Existing Walls, Floors & Roof	1
Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
Credit 3.1	**Materials Reuse**, 5%	1
Credit 3.2	**Materials Reuse**, 10%	1
Credit 4.1	**Recycled Content**, 10% (post-consumer + 1/2 pre-consumer)	1
Credit 4.2	**Recycled Content**, 20% (post-consumer + 1/2 pre-consumer)	1
Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regionally	1
Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regionally	1
Credit 6	**Rapidly Renewable Materials**	1
Credit 7	**Certified Wood**	1

Indoor Environmental Quality — 15 Possible Points

Prereq 1	**Minimum IAQ Performance**	Required
Prereq 2	**Environmental Tobacco Smoke (ETS) Control**	Required
Credit 1	**Outdoor Air Delivery Monitoring**	1
Credit 2	**Increased Ventilation**	1
Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
Credit 5	**Indoor Chemical & Pollutant Source Control**	1
Credit 6.1	**Controllability of Systems**, Lighting	1
Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
Credit 7.1	**Thermal Comfort**, Design	1
Credit 7.2	**Thermal Comfort**, Verification	1
Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1

Innovation & Design Process — 5 Possible Points

Credit 1.1	**Innovation in Design**	1
Credit 1.2	**Innovation in Design**	1
Credit 1.3	**Innovation in Design**	1
Credit 1.4	**Innovation in Design**	1
Credit 2	**LEED Accredited Professional**	1

Project Totals — 69 Possible Points

Certified 26–32 points **Silver** 33–38 points **Gold** 39–51 points **Platinum** 52–69 points

Patrick H. Dollard Health Center[85]

The Patrick H. Dollard Health Center is a diagnostic and treatment facility that serves those with profound neurological and developmental impairments who need primary and specialty medical and dental care. It is 28,300 sq. ft. and located in Harris, New York. The two story building was completed in March 2003 and received a certified LEED-NC v-2 rating. It houses 250 full-time residents that require constant and specialized medical care. Though it is a new construction located in a rural setting, the site selection avoided prime agricultural land, opting instead to infill on a previously abandoned industrial agricultural site.

The building is 48 percent more efficient than a building compliant with traditional building standards due to a ground-source heat-pump system; a tight, high-performance envelope; extensive daylighting; and efficient products and equipment. Based upon 2002 electricity prices, it was estimated that the design of the ground-source heat-pump system in conjunction with the building envelope would save the Center approximately $19,225 annually in electricity. This savings directly equates to paying for the construction cost of the ground-source system in a little over six years.

The Center was designed to have a pedestrian emphasis and the property was assessed for integration with local community and regional transportation corridors. It also contracts to purchase 100% of its supplemental grid-source electricity for basic service from a wind-powered electrical company. Zero volatile organic compound (VOC) acrylic latex interior paint and low-VOC resilient flooring were used to improve the building's indoor air quality.

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[85] http://LEEDcasestudies.usgbc.org/overview.cfm?ProjectID=233

Figure 1: Dollard Health Center

Seattle Justice Center[86]

The Seattle Justice Center is a 14-story building within the three-block Civic Center area of downtown Seattle, Washington. It houses Seattle's municipal courts and police headquarters in a dense urban setting. The 288,000 sq. ft. building was completed in October 2002 and received a silver LEED-NC v-2 rating. The downtown setting of the building encourages alternative means of transportation. Storage space for bicycles is included onsite, and the nearby parking facility includes space for carpools and electric-car charging. As much as possible, recycled materials were used, such as structural steel and glass tile, 90 percent and 100 percent recycled, respectively.

The principal roof areas of the building were designed "green" with drought-resistant and low-maintenance plants. This concept adds an insulating layer of soil and removes solar heat gain through photosynthesis. It also absorbs and stores rainwater and filters pollutants out of the air while returning some oxygen to the atmosphere. While

[86] http://LEEDcasestudies.usgbc.org/overview.cfm?ProjectID=225

high VOC sources were used during construction, efforts were made to ensure good ventilation during application.

Figure 2: Seattle Justice Center

Herman Miller Building C1[87]

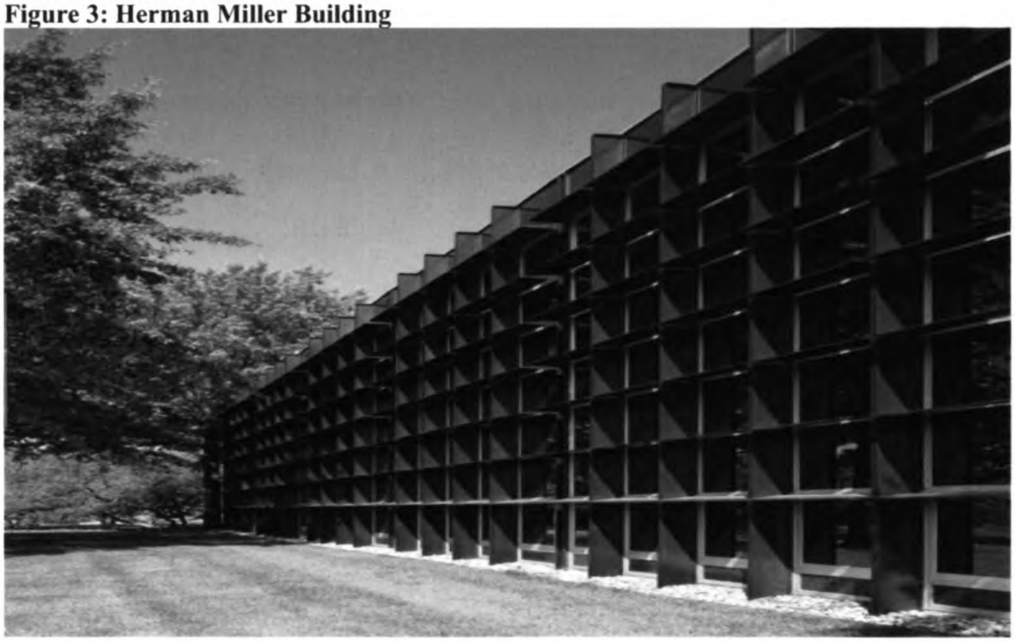
The Herman Miller Building C1 is a two story office building located on the Main Site's 121 acre campus in Zeeland, Michigan. The 19,100 sq. ft. building was completed in January 2002 and received a LEED-NC v-2 gold rating. Though Building C1 is located in a suburban setting, housing is within walking distance and a public bus stop is within 200 feet of the building. Less than one-third of the building's energy comes from municipal utilities. This energy security is provided by an on-site biomass-powered central plant, which provides both the building and Main Site with 100 percent of its cooling and heating load and 12.5 percent of its electricity. In the event of a power outage or failure of the central plant, approximately 75 percent of Building C1 could continue to operate.

[87] http://LEEDcasestudies.usgbc.org/overview.cfm?ProjectID=270

Consistent with Herman Miller's policy to support the regional economy, 57 percent of the project material content was produced within 500 miles of the site. More than 50 percent of the fit-up materials contain at least 20 percent post-consumer recycled content and the furniture contains more than 50 percent recycled content. In addition, the demolition and construction process recovered 75 percent of its waste.

A conscious effort was made to use only very-low-VOC carpet adhesives and zero-VOC interior latex paints to improve indoor air quality.

Figure 3: Herman Miller Building



Audubon Center at Debs Park[88]

The 5,020 sq. ft. Audubon Center at Debs Park is located just outside of downtown Los Angeles, California. The Center provides educational programs for the 50,000 schoolchildren who live within two miles of the park. It was completed in November 2003 and was the first building in the U.S. to achieve a Platinum rating under LEED-NC v- 2 Rating System. The Center is operated entirely using only power

[88] http://LEEDcasestudies.usgbc.org/overview.cfm?ProjectID=234

generated on site. The photovoltaic system generates just enough power to meet demand during December and about 40 percent more than is required during the summer months. It is expected to use only 25,000 kWh of energy each year (around five kWh per square foot).

The Center is designed to use 70 percent less water than a comparable conventional building, and to treat all wastewater on site. The Center also has no connection to the public sewer, meaning that 100 percent of the wastewater will be treated on site. During construction, more than 50 percent of the materials used on the project were locally manufactured, and more than 25 percent were locally harvested, both within 104 miles of the site. Also, more than 97 percent of the debris accumulated during construction was recycled.

An active effort was made to ensure that all adhesives, sealants, paints, and carpets were selected for their low content or lack of volatile organic compounds. Overall, the Center's green features make it only 5-7 percent more expensive than a conventional building.

Figure 4: Audubon Center

Case Study Comparison

All levels of certified projects used LEED Accredited Professionals. In the Indoor Environmental Quality Category, the top practices were Low Emitting Materials: Adhesives & Sealants; Paints & Coatings; and Carpet Systems. There was minimal use of the Composite Wood Low Emitting Materials. Other top practices include: Indoor Chemical& Pollutant Source Control; Construction IAQ Management Plan (During Construction and Before Occupancy); Daylight & Views (90% of Spaces); and both Thermal Comfort practices.

All projects earned at least one Innovation in Design point for practices such as sustainable education programs, green housekeeping, and organic landscaping. As the project rose in certification level, so did the Innovation points. All Platinum projects earned the maximum four points, while the Certified projects averaged two points.

In the Sustainable Sites Category, the practices that were used most consistently were Site Selection; Alternative Transportation (Public Transportation Access, Bicycle Storage & Changing Rooms, and Parking Capacity & Carpooling); Non-Roof Landscape & Exterior Design to Reduce Heat Islands; and Light Pollution Reduction.

Water Efficiency practices that earned the most points included: Water Efficient Landscaping (Reduce by 50% and No Potable Use or No Irrigation) and Water Use Reduction (20% and 30%).

In the Energy and Atmosphere Category the following practices were used most consistently in the projects studied: Enhanced Commissioning; Ozone Depletion; and Optimize Energy Performance. While the majority of the projects studied used the Optimize Energy Performance practice, the Certified and Silver projects averaged 2.5 and 3.7 points respectively out of the 10 points available. Gold and Platinum projects earned averages of 6.6 point and 9.6 points, respectively.

The practices most used in the Materials and Resources Category were: Construction Waste Management (both Divert 50% and 70% from Disposal); Recycled Content (both 10% and 20% post-consumer + ½ post-industrial); and Regional Materials, 20% Extracted, Processed and Manufactured Regionally.

Table 5: Case Study Comparison

Project Name	Patrick Dollard Health Center Harris, NY	Seattle Justice Center Seattle, WA	Herman Miller Zeeland, MI	Audubon Center Los Angeles, CA
Rating (Point Range)[89]	Certified (26-32)	Silver (33-38)	Gold (39-51)	Platinum (52-69)
Building/Setting	New/Rural	New/Urban	Existing/Suburb	Existing/Urban
Sustainable Sites	7 of 14 points	9 of 14 points	6 of 14 points	10 of 14 points
Water Efficiency	2 of 5 points	2 of 5 points	2 of 5 points	5 of 5 points
Energy and Atmosphere	4 of 17 points	7 of 17 points	10 of 17 points	15 of 17 points
Materials and Resources	3 of 13 points	4 of 13 points	8 of 13 points	6 of 13 points
Indoor Environmental Quality	7 of 15 points	8 of 15 points	11 of 15 points	12 of 15 points
Innovation and Design Process	4 of 5 points	3 of 5 points	4 of 5 points	5 of 5 points
Total Project Points	27	33	41	53

ANALYSIS

After reviewing the case studies, it becomes apparent that the LEED system is very eco-efficient. As Table 4 shows, the majority of the Materials & Resources and Indoor Environmental Quality credit earning practices focus on creating efficient buildings with recycled and low-emitting materials. As we've learned, this is does not always result in an environmentally healthy building. However, if the products were developed according to the cradle to cradle philosophy, the recycled materials would not be poor quality hybrids that continue to emit toxins. Looking at the LEED-NC practices through the eyes of McDonough and Braungart, it becomes apparent that the system would be able to easily incorporate cradle to cradle designed products. The idea behind LEED was to promote sustainable development. Up until now, that has meant

[89] Based on LEED-NC, v2

developing more efficient buildings, but the system is not limited to only eco-efficiency. The Sustainable Sites, Water Efficiency, and Energy & Atmosphere categories would readily accept eco-effective practices. Optimizing energy performance and creating a stormwater management practices through design practices would be easily achievable.

The most eco-effective category would be Sustainable Sites. The alternative transportation, open space and habitat oriented site development, and stormwater design credit elements allow for the use of new product designs; which, if you follow the cradle to cradle philosophy, is necessary to be more than eco-efficient. The Water Efficiency element would also be able to integrate a new design system with its water efficient landscaping and innovative water technologies credit elements. The Energy & Atmosphere element would need to be adapted more to allow for effective practices. While there are credits for optimizing energy performance and on-site renewable and green power, these practices are more suited to making existing products less bad than promoting entirely new ones. Once more effective practices are introduced; the element could be easily updated to accommodate the change. The Materials & Resources and Indoor Environmental Quality elements would require the most changes in the move toward eco-effectiveness. The majority of the credit elements for Materials & Resources involve reusing existing materials and using recycled materials. Both existing and recycled materials may emit toxic compounds or be poor quality hybrids incapable of biodegrading. The Indoor Environmental Quality element relies on using low-emitting materials and monitoring what may already be poor indoor air quality. Both elements perpetuate the use of flawed materials and do not provide any incentive to design new

materials. These elements would need to be completely revamped to reflect the use of more eco-effective products.

An example of how eco-effectiveness can be used in modern industry would be the Ford Motor Company's River Rouge Plant. William McDonough's architecture and design firm was hired to design an eco-effective plant. The result is a factory that not only provides an attractive workplace, with its open design and large skylights, but a 450,000 square foot living roof that provides habitat and produces oxygen. The seeded roof offers natural stormwater management, insulation, and eliminates the need for gutters. The parking area utilizes permeable asphalt that reduces runoff and allows for the filtering of contaminants. The plant is also studying the use of phytoremediation; plants that absorb and neutralize toxins from the soil. Ford is using the plants near the coke ovens that were once used during steel manufacturing. In the end, McDonough's eco-effective design saved Ford more than $10 million by eliminating the need for three proposed chemical treatment and stormwater management plants.

McDonough did not design the River Rouge Plant using the LEED guidelines; however, all of the innovative, effective practices incorporated in the design of the Rouge Visitors Center did allow it to receive LEED Gold level certification.[90] This proves that the LEED system would allow for the incorporation the cradle to cradle philosophy in the creation of more eco-effective buildings.

Traditional "to code" design and construction too often separates experts during the building process resulting in increased architectural and engineering design time needed to integrate sustainable building practices into project plans, which in turn increases the overall construction cost. Studies have shown that sustainable buildings are

[90] USGBC, 2005

more cost effective when developed as a whole rather than piecemeal.[91] The integration of people, processes, and technologies along with breakthroughs in building science and operations enables designers, builders and owners to maximize both economic and environmental performance while delivering sustainable, eco-effective buildings.[92]

By reducing the cost of building green through design coordination, increased energy efficiency, and the use of eco-effective products, the reasons for using 'traditional' construction methods are becoming fewer and fewer. Studies have shown that energy savings alone usually cover the increased construction costs.[93] Couple this with an average productivity increase of 1.5 percent[94] and rising energy costs and you begin to increase the obsolescence risk of not building green.

Many states are acknowledging the economic sense behind building green. The initiatives studied provide an overview of the variety of local and state regulators are promoting the use of more efficient building practices. The main point to be made, though, is that most initiatives simply promoted the use of these practices or provided incentives. Arizona was the only one that actually required actual certification and gold level at that. Unfortunately, it has become apparent that simply following LEED standards may only lead to a more eco-efficient community. For actual sustainable development to occur there needs to be more of a focus on creating eco-effective communities. Standard 189 provides the framework to accomplish this. By focusing on the bulk of the building community, Standard 189 has the potential to restructure the entire building industry and spark the creation of new products and practices.

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[91] Suttell, 2006
[92] von Paumgartten, 2003
[93] Suttell, 2006
[94] Suttell, 2006

RECOMMENDATIONS

I believe there is enough evidence to support the use of the LEED rating system or an equivalent in the sustainability process. While some builders have said that they voluntarily use the standards because it "is the right thing to do,"[95] a formal policy needs to be adopted to require its use. We have been relying on people's better judgment since the environmental crises of the early 1970s and have been repaid with ever increasing levels of pollution and habitat destruction. I would recommend the adoption of local level policies requiring developments to achieve LEED certification, to at least the silver level, to ensure the furthering of sustainable development. Studies have shown that green buildings result in less impact to the environment, safer living/working environments for inhabitants, and significant savings from reduced energy costs. Green building requirements can be added to existing building codes so environmental issues are addressed up front and will not be seen as a restriction. With continued use, green building could become second nature and future generations will marvel that any other method of development was ever used.

After reviewing existing policies and the case studies, I believe that while the LEED system is helping promote sustainable development, the process is mostly eco-efficient with its focus on recycled materials and utilizing more efficient forms of existing practices. When held to Cradle to Cradle standards, most green building practices of today qualify as eco-efficient, but not eco-effective. It is important to note that the LEED system does make a difference; however, if we hope to begin to slow down the negative environmental impacts that are changing the global climate, an eco-effective system is necessary. McDonough and Braungart offer many examples of how

[95] Pressly Jr. 2006

products can be designed to be both beneficial for the environment, as well as the industry producing them.

Current policies offer some help, but many are merely offering incentives and suggesting buildings follow LEED guidelines. Very few actually require certification. If there is going to be a significant change in the building industry, it is going to require a change to the regulatory framework, in addition to the building materials. It is up to the regulators to set a benchmark that the industry must meet. Currently, policies ask for reductions, but they still allow pollution to occur. It is going to take a major change in how we do things to make any significant difference. Sustainable development on its own is a great idea, but there needs to be more than a monetary incentive to move people toward it. Even though builders have said that they build green because it is the right thing to do, there are still many industries that continue to make money off of products and practices that pollute the environment. In order to impact the industry, policies must be made at the state and federal level. Local policies will assist local communities to reduce their environmental footprint, but not eliminate it. If the cradle to cradle philosophy is ever completely adopted, communities may even be able to repair their environment, not just protect it.

Standard 189 appears to be a good start. While some may complain about government involvement, it is the job of government to protect public health and welfare. McDonough and Braungart have shown that the demand and ability is there for eco-effective products. It is heartening to also see that major industries are beginning to listen and take action. It is time for everyone to take responsibility for the state of the environment. There is no one to blame. It is our lifestyle that has become the major

polluter and while it will take a change of lifestyle, there are plenty of examples how it can be done economically and effectively. It does not have to be a painful process and before long, the old way of life will seem unthinkable.

CONCLUSION

Whether you are using LEED standards or an adaptation, green building positively contributes to the process of sustainable development. A 2005 study of the central Michigan community of Williamstown Township examined the possibility of adopting a Township wide policy requiring LEED certification for all new development, residential and commercial, public and private. Research showed that such a policy would help preserve the rural integrity of the Grand River Avenue corridor that was receiving extreme development pressure from neighboring Meridian Township.[96] The Township Board adopted the policy recommendations in 2006.[97]

Overall, the LEED rating system is making a difference. Be it through actively designing more efficient buildings or inspiring other green building programs. With the spread of local and state wide policies requiring LEED, could a federal policy be far behind? Is Standard 189 just the beginning? Whether or not the federal government decides to enter the green building race, it appears that many states and communities are realizing the importance of planning for the future and are attempting to make a difference today.

McDonough and Braungart's cradle to cradle philosophy and promotion of eco-effective products offers a new way to look at green building. At first, the idea of a carpet that you could actually eat seems like a outlandish and impossible idea, but when

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[96] Car et al., 2005
[97] LaMore, personal conversation, 2006

you stop to think about the vast amount of waste generated today, the idea begins to make sense. Top executives from all industries are not laughing at the idea of creating an entirely new industrial system. In fact, many of them are leading the way and creating products to achieve a more eco-effective way of life.

The promotion of eco-effective products versus eco-efficient products needs to be brought into the mainstream. Companies designing more effective products need to be supported and rewarded. In the end, I believe it will still be necessary to use incentives to realize sustainable development, but with the help of legislation, it no longer seems like an impossible idea.

APPENDIX

USGBC 2006 List of LEED-based Legislation

LEED is either required or recommended in the jurisdictions listed below. In some cases, they require that LEED specifications be met, but they don't require actual LEED certification. Note that regulations and laws may have been updated since this list was compiled. Check for the latest information in any jurisdiction where you will be performing work.

Federal

- **Air Force** - The Air Force has developed a LEED Application Guide for Lodging projects and has conducted LEED training seminars for its design and construction personnel. The Air Force encourages the use of LEED for new or major renovations for MILCON projects and has created an online design guide for sustainable development structured after LEED. An online Sustainable Training course is also being developed.
- **Army** - The Army has adopted LEED into its Sustainable Project Rating Tool (SpiRiT).
- **EPA** - All of EPA's significant new facility construction and new building acquisition projects must meet the U.S. Green Building Council's LEED silver standard in 2005 and beyond.
- **EPA Energy Star** - Energy Star is an LEED-recognized benchmarking tool created by the EPA to compare a building to other buildings throughout the country. Up-to-date descriptions of the many energy efficiency programs and incentives are available under the umbrella of Energy Star.
- **GSA** - Beginning in Fiscal Year 2003, all new GSA building projects had to meet criteria for basic LEED certification.
- **Navy** - The Navy continues to pursue sustainable development in its facilities, requiring all applicable projects to meet the LEED Certified level, unless justifiable conditions exist that limit accomplishment of the LEED credits necessary for achieving the Certified level. Submission to the USGBC for LEED certification is not a requirement, but it is recommended for high visibility and showcase projects.
- **State Department** - The Department of State has committed to using LEED on the construction of new embassies (180) worldwide over the next 10 years.

States

- **Arizona** - Arizona currently uses LEED on public projects and intends to seek certification.
- **California** - On December 14, 2004, California Governor Arnold Schwarzenegger signed an executive order **requiring LEED Silver for all new state-funded buildings**. Declaring that "the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) [is] the nation's leading green building rating system," the Governor is requiring LEED Certification for state-owned buildings as a key part of his plan "to reduce grid-based energy purchases for state-owned buildings by 20% by 2015, through cost-effective efficiency measures and distributed generation technologies."
- **Connecticut** - Legislation requiring LEED certification of capital projects was stalled in the House Finance Committee. New legislation introduced into both houses in the current legislative session was to be reconsidered in 2005.
- **Illinois** - The State of Illinois Capital Development Board is considering requiring LEED certification of public projects.
- **Maine** - Governor John Baldacci issued an executive order in November 2003 directing all new or expanding state buildings to incorporate LEED guidelines provided that standards can be met on a cost-effective basis.
- **Maryland** - Maryland's governor issued an executive order calling for all capital projects greater than 5,000 gsf to earn LEED certification in October 2001. Legislation was introduced in 2003 to codify this policy. The state also approved a green building tax credit for commercial developers. Maryland's Green Building Council has created a green building program based on LEED model.
- **Massachusetts** - Massachusetts is considering LEED adoption for all state projects as well as a green building tax credit program.

- **Michigan** - The state of Michigan requires that all state-funded capital projects over $1 million, including state agencies, universities, and community colleges, be constructed to a LEED Certified level.
- **Missouri** - Missouri is currently using LEED on public projects and intends to seek certification.
- **New Jersey** - Governor James E. McGreevey signed Executive Order # 24 in July 2002 **requiring all new school designs to incorporate LEED guidelines**. The New Jersey Economic Schools Construction Corporation is encouraging the use of LEED but not requiring certification of new projects built under its $12 billion public school construction program.
- **New York** - New York Governor Pataki issued Executive Order #111 in June 2001 encouraging, but not requiring, state projects to seek LEED Certification. New York State Energy Research and Development Authority will be offering an incentive for design teams of any New York State building that achieves a LEED rating. NYSERDA's New Construction Program offers a 10% increase on incentives for energy efficiency measures that reduce the use of electricity. NYSERDA provides low interest loans (4% below market rate) for energy efficiency measures and building materials that meet LEED or other generally accepted green building standards. The New York State Green Building Tax Credit Program provides a tax incentive to commercial developments incorporating specific green strategies informed by LEED.
- **North Carolina** - Guidelines are thorough and a must-have for anyone specifying job-site recycling. They are available free online.
- **Oregon** - Oregon's 35% Business Energy Tax Credit for sustainable buildings is tied to the LEED certification level achieved. A **LEED Silver rating is the minimum standard to obtain the tax credit for sustainable buildings** and applies to LEED NC, CI, and CS certified buildings. For example, a 100,000 square foot building that is LEED-NC Silver certified is eligible for $140,000 tax credit and a 100,000 square foot building that is LEED-NC Gold certified is eligible for $177,485 tax credit.
- **Pennsylvania** - Buildings currently under construction on behalf of the Department of Environmental Protection and the Department of Conservation and Natural Resources are seeking LEED Silver certification. A draft bill requiring LEED certification of state projects was released for review in March 2002. House Bill 993 (2003), including a High Performance Green Building Tax Credit, was under review.
  www.legis.state.pa.us/WU01/LI/BI/BT/2003/0/HB0993P1166.HTM
  House Bill No.125 included financial incentives for school buildings achieving LEED certification. Four state funds including the $20 million Sustainable Energy Fund provide grants, loans and "near-equity" investments in energy efficiency and renewable energy projects in Pennsylvania.
- **Utah** - The Beehive State is considering LEED.
- **Washington** - Legislation requiring the use of LEED on state projects is pending.
- **Wisconsin** - Currently using LEED on public projects and intend to seek certification.

Counties

- **Alameda County CA** - All county projects initiated after July 1, 2003, had to be LEED "Silver" certified. This ordinance added chapter 4.38 to Title 4 of the Administrative Code of the County of Alameda. The County passed a green building ordinance which requires County construction projects to be built to a LEED Silver standard. Materials procured for construction as well as furniture, fixtures, and other interiors will be recyclable, durable, and have a low-environmental impact.

- **Arlington County, VA** - Arlington County allows commercial projects and private developments earning LEED Silver certification to develop sites at a higher density than conventional projects. All site plan applications for commercial projects are required to include a LEED Scorecard and have a LEED Accredited Professional on the project team regardless of whether or not the project intends to seek LEED certification. All projects must contribute to a green building fund for county-wide education and outreach activities. The contribution is refunded if projects earn LEED certification. Arlington sponsors a voluntary green home program that encourages builders of new single-family homes to incorporate energy efficient and other green building components in their projects. The County offers "front-of-the-line" plan review, site signs, and publicity to program participants who achieve a given number of points as outlined by Arlington's Green Home Choice program.
- **Cook County IL** - Cook County Commissioner Mike Quigley proposal for an ordinance requiring LEED certification of all county building projects passed. The ordinance called for projects to earn a minimum of eight credits in the Energy & Atmosphere category to ensure best life-cycle returns.
- **Dane County, WI** - Dane county developed a Green Building Policy which is primarily guided internally by the LEED rating system.
- **King County, WA** - King County Executive Order FES 9-3 (AEP) requires all new public construction projects to seek LEED certification and encourages the application of LEED criteria to building retrofits and tenant improvements. There is a LEED supplement for King County projects.
- **San Mateo County CA** - San Mateo County adopted a Sustainable Building Policy in 2001. The policy requires new projects and additions that are built by the County and greater than 5,000 sq. ft. to achieve certification at the highest practicable LEED rating level. Smaller projects are encouraged to follow LEED standards but are not required to submit documentation for certification.

Cities

- **Arlington, MA** - In May 2003, the town of Arlington voted in favor of requiring all new buildings and major renovation projects to achieve a LEED Silver rating at a minimum. The state approved the measure to be included into the Town Bylaw.
- **Atlanta GA** - The city passed Ordinance #03-0-1693 in December 2003 **requiring all city-funded projects over 5,000 square feet or costing $2 million to meet a LEED Silver rating level.** Projects exempt from this policy are required to complete a LEED checklist to assess any sustainable design techniques.
- **Austin TX** - The Austin City Council passed a resolution in June 2000 requiring LEED certification of all public projects over 5,000 gsf.
- **Berkeley, CA** - The Berkeley City Council passed a resolution that requires municipal buildings over 5,000 ft2 to achieve the LEED Certified rating in 2004 and 2005 and a LEED Silver rating in 2006 and beyond.
- **Boulder, CO** - All new or significantly renovated city facilities are built to a LEED Silver standard. Also considering requiring certification of commercial projects or developing a LEED-based incentive program.
- **Bowie, MD** - The city council passed Resolution #R-15-03 requiring all municipal projects to follow green building criteria and to use LEED guidelines on a project by project basis.
- **Chula Vista, CA** - Offers priority permit processing to residential builders and developers who participate in the program.
- **Dallas, TX** - The City of Dallas issued a resolution requiring all city buildings larger than 10,000 square feet to have at least LEED Silver certification. The city is exploring ways to encourage LEED buildings in the private sector.
- **Eugene, OR** - The city of Eugene uses LEED NC as a guideline for all new city-funded construction. Additionally, the city is using LEED EB as an assessment tool and looking to certify certain buildings that have already gone through building retrofits. Buildings apply as many EB prerequisites and credits as possible whether or not they achieve EB certification.

- **Frisco, TX** - The City of Frisco passed Ordinance #04-05-41 to be in effect for one year beginning September 1, 2004, that requires all non-single-family residential developments over 10,000 ft2 to submit a LEED checklist to the city. The checklist must be filled out by a LEED Accredited Professional, must document which points can and cannot be earned, and must include an estimated cost for each point. The city passed Ordinance #01-05-39 on May 1, 2001 creating a Green Building Program for all single-family residential buildings.
- **Houston, TX** - The city adopted Green Building Resolution #2004-15 on June 23, 2004, stating that all city owned buildings and facilities over 10,000 sq ft shall use LEED to the greatest extent practical and reasonable with a target of LEED Silver certification.
- **Kansas City, MO** - Kansas City requires that all new city buildings be designed to meet LEED Silver at a minimum as per Resolution #011739.
- **Los Angeles CA** - On April 19, 2002, the Los Angeles City Council voted in favor of requiring LEED certification of all public works construction projects 7,500 gsf or larger. As of July 2003, all building projects funded by the city of LA are required to be LEED certified. Contact: Deborah Weintraub, City Architect; (213) 847-6370. In March 2002, LEED certification of new construction projects was approved as part of the $1.6 billion bond proposition funding building projects on the nine campuses of the LA Community College District.
- **New York, NY** - New York, NY developed its own comprehensive guidelines. High Performance Building Guidelines.
- **Omaha, NE** - All new Metropolitan Community College construction projects and sites must meet the minimum level of LEED certification.
- **Phoenix, AZ** - The City of Phoenix is emphasizing green building design and pursuit of LEED certification at various levels for new buildings.
- **Pleasanton, CA** - The City Council adopted Ordinance #1873 in December 2002 requiring all commercial construction projects over 20,000 square feet to follow guidelines to meet a LEED "Certified" rating. Formal certification with USGBC is encouraged but not required.
- **Portland OR** - Portland passed a resolution requiring LEED certification of all public projects (new and major retrofits) and has developed Portland LEED supplement. A new LEED Business Energy Tax Credit (BETC) is being administered by the state Office of Energy
- **San Diego, CA** - San Diego Mayor Dick Murphy included requiring LEED Silver certification of all municipal projects among his 10 goals for the year in his 2002 State of the City Address. The city has subsequently adopted LEED for all public projects. The city has also developed a sustainable building expedite program that uses LEED criteria and provides significant plan review and construction incentives.
- **San Francisco, CA** - On May 18, 2004, the Board of Supervisors of the City and County of San Francisco, CA adopted an ordinance (Chapter 7 of the Environment Code) requiring all municipal new construction, additions and major renovation projects over 5000 square feet starting conceptual design on or after September 18 to achieve a LEED Silver certification by the USGBC. It also requires that a LEED Accredited Professional be a member of each design team and achievement of the LEED Additional Commissioning Credit for all projects.
- **San Jose CA** - San José requires LEED certification of all municipal projects over 10,000 gsf.
- **Santa Monica, CA** - All new city projects must achieve LEED Silver certification as per an ordinance.
- **Scottsdale, AZ** - Offers various incentives to home builders for participation in the program. Aims at strengthening consumer awareness and interest.
- **Seattle WA** - All facilities and buildings over 5,000 gross square feet of occupied space shall meet a minimum LEED Silver rating.
- **Vancouver, BC** - On July 8, 2004, The City of Vancouver officially announced the adoption of green building standards – LEED for British Columbia (LEED-BC) for all new civic buildings greater than 500 square meters. New public buildings must achieve the Leadership in Energy and Environmental Design (LEED) Gold certification. The City also mandated specific energy points in the LEED Rating System to ensure a 30% energy reduction in all new civic buildings.

Scottsdale LEED Resolution

RESOLUTION NO. 6644
A RESOLUTION OF THE MAYOR AND CITY COUNCIL OF THE CITY OF SCOTTSDALE, MARICOPA COUNTY, ARIZONA, ADOPTING THE CITY OF SCOTTSDALE GREEN BUILDING POLICY.

Section 1. That the Scottsdale City Council hereby adopts the "City of Scottsdale Green Building Policy." This policy reflects the City's commitment to encouraging environmentally sensitive construction practices in the City of Scottsdale by adopting construction practices inspired by both the Leadership in Energy and Environmental Design (LEED™) certification process and the City of Scottsdale Green Building Program.

Section 2. That the Scottsdale City Council hereby declares that all new, occupied (as defined by the City's building code) city buildings, of any size, will be designed, contracted and built to achieve the LEED™ Gold certification level, and to strive for the highest level of certification (currently Platinum) whenever project resources and conditions permit.

Section 3. That the Scottsdale City Council hereby declares that all future renovations and non occupied (as defined by the City's building code) city buildings will be designed, contracted and built to include as many principles of both the LEED™ program and the City's Green Building Program as are feasible.

Section 4. That the Scottsdale City Council, to maintain tight control over the cost of city building projects, qualifies the above Section 2 of this Green Building Policy to require a pay back period of no more than five (5) years for projects designed to the LEED™ Gold Standard. Where the payback is anticipated to be more than five (5) years, City staff is directed to recommend to the City Council which level of LEED™ certification is appropriate for that particular project. If no level of LEED™ certification is feasible, then the project under consideration shall include as many principles of both the LEED™ program and the City's Green Building Program as are feasible.

Section 5. The City Council may grant exceptions to this Policy when it deems appropriate.

http://www.ci.scottsdale.az.us/greenbuilding/LEED/LEED_ResNo6644.pdf

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