

A COMPARATIVE ANALYSIS OF LEED

CHRISTINE LIN

A SHORT HISTORY

The LEED (Leadership in Energy and Environmental Design) Green Building Rating System is a program developed by the U.S. Green Building Council (USGBC), a voluntary nongovernmental organization composed of representatives from all segments of the building industry who are interested in promoting environmentally responsible building in the U.S. According to the USGBC, LEED was created to:

- provide a standard of measurement for “green building” and prevent false or exaggerated claims
- raise awareness and recognition of green building while stimulating green competition
- promote integrated design processes from a whole-building perspective

The LEED 1.0 pilot program for New Construction (LEED-NC) was released in 1998, followed by LEED 2.0 in March 2000 which incorporated extensive revisions. Version 2.1 was established in November 2002. So far, 19 buildings have been certified under LEED 1.0 and 74 buildings under version 2. Over 600 projects across the U.S. are currently registered to seek certification.

LEED is based on a 69 point system divided into 6 different categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovation & Design Process. The threshold for Certified is set at 26 points. 33 to 38 points earns a Silver rating; 39 to 51 points earns Gold; and over 52 points earns Platinum. Documentation by the project team for every prerequisite and credit is submitted and reviewed for compliance. Completion of the LEED program can cost anywhere from \$2250 for a building less than 75,000 square feet to over \$10,000 for one more than 300,000 square feet.

In the building industry, LEED has great significance because of its national scope and acceptance by private organizations as well as local and federal governmental bodies. The increasing U.S. market for environmentally responsible products has created a need for regulation to prevent false claims. It also serves as a guideline for architects to incorporate green building into the design process from the very beginning. However, as the popularity of LEED as a national standard increases, its criteria for certification must also increase in rigor. If the methods used for evaluation do not accurately and consistently reflect a building's environmental impact, buildings of similar ratings could have very different ramifications, thus undermining not only the purpose of green building, but also broader environmental policies.

THREE BUILDINGS

This study compares 3 buildings (see table 1), each of which obtained a LEED Version 2 Certification Level of Silver with 33 points out of a possible 69. As shown in table 2, each building concentrated on and earned the most points for a different category.

The PNC Firstside Center is located in Pittsburgh, Pennsylvania and is the largest commercial building to receive the LEED Silver rating.

BASIC FACTS	PNC Firstside Center	Clackamas High School	Boulder Community Foothills Hospital
<i>Completion Date</i>	November 2000	April 2002	September 2003
<i>Cost</i>	\$108 million	\$30.95 million	\$54 million
<i>Floor Space</i>	647,000 square feet	265,355 square feet	221,000 square feet
<i>Occupancy</i>	1800	1800	60 beds, unknown staff and outpatients
<i>Green Agenda</i>	PNC Realty Services- to reduce employee cost in terms of productivity and retention.	North Clackamas School District- to create a cost effective and "excellent educational environment".	Boulder Community Hospital Administration- to improve the health of the community.

table 1

In the sustainable sites category, it earned the following credits: Site Selection; Urban Redevelopment; Brownfield Redevelopment; Alternative Transportation; Public Transportation, Bicycle Storage & Changing Rooms, Alternative Fuel Refueling Stations, Parking Capacity; Reduced Site Disturbance, Development Footprint; Stormwater Management, Treatment; Landscape & Exterior Design to Reduce Heat Islands, Non-Roof; Light Pollution Reduction.

Seventeen sites were considered before the selection of a brownfield site along the Monongahela River, just outside downtown Pittsburgh. The former B&O railroad station site provided existing infrastructures such as roads, sewers, and bus stops. A light rail transit stop adjacent to the site was installed to serve the nearby courthouses as well as PNC employees. Similarly, the parking authority built a nearby municipal parking garage for 1200 cars. The Eliza Furnace Trail for bicycles was extended to the edge

of the building. Space for 60 bicycles and 8 hybrid-powered vehicles was also provided.

Clackamas High School, located in Clackamas, Oregon, is one of the greenest schools in the nation. It was designed using performance based fees, which are earned by the architects and engineers depending on the savings in energy by efficient design.

Most of its points were earned in the Energy & Atmosphere category for Optimizing Energy Performance (tiered system with 8 points for 50%), Measurement & Verification, and Green Power.

Through computer and physical modeling, the total energy cost was expected to be 44 percent less than the Oregon Energy Building Code requirements (which are stricter than those of ASHRE). Two full-scale classroom mockups were built to test daylighting and electric lighting design, and natural ventilation components of the heating

LEED CREDIT BREAKDOWN	PNC Firstside Center	Clackamas High School	Boulder Community Foothills Hospital
Sustainable Sites [14]	11	6	7
Water Efficiency [5]	1	1	1
Energy & Atmosphere [17]	5	10	5
Materials & Resources [13]	4	6	5
Indoor Environmental Quality [15]	8	5	10
Innovation & Design Process [15]	4	5	5
Total Points Earned [69]	33	33	33

table 2

intakes are remote from any vehicular traffic and optimized to mitigate re-circulation of contaminants. Positive building pressurization is used to eliminate infiltration. The air diffusion performance index was applied for maximum air mixing within occupied spaces. Central station double-wall air handlers with walk-in access promote routine disinfection of the cooling coil drain pan and other interior surfaces. Materials and ducts were protected from contamination during the construction process. Air was flushed through the building for 2 weeks prior to occupancy to eliminate airborne contaminants.

and cooling design. According to the architect, the most cost-effective measures considered were building orientation, window size and placement, shading, and space planning. The electricity load is limited by sensors and dimmer controls. Air conditioning is provided only in spaces such as the media center, administration, theater, etc. Most areas rely on natural ventilation by convection with fan coil backup units. The building is organized along an east-west axis for optimal natural lighting and ventilation.

Boulder Community Foothills Hospital in Colorado was the first hospital in the nation to receive LEED certification. In the Indoor Environmental Quality category, it received points for the following: Carbon Dioxide Monitoring; Increasing Ventilation Effectiveness; Construction IAQ Management Plan, During Construction, Before Occupancy; Low-Emitting Materials, Adhesives & Sealants, Paints, Carpet; Indoor Chemical & Pollutant Source Control; Thermal Comfort, Comply with ASHRAE 55-1992, Permanent Monitoring System.

Code-required operable patient room windows are interlocked with the mechanical system in order to maintain air pressures and energy efficiency. The VAV boxes are turned off when the windows are opened, and the monitoring system alerts if too many open windows are causing the system to run inefficiently. Over 90 percent of partitions are full height, minimizing distribution of contaminants. All

AN ASSESSMENT

Although it is commendable that the PNC Firstside Center provides for every type of alternative transportation, there is no guarantee that the facilities will be utilized, especially in regards to bicycles and alternative fuel vehicles. The only submittals necessary to receive credit for the two mentioned is to show accommodations for 5% of the building occupants and 3% of the total vehicle parking capacity, respectively. It is also important to note that a 1200 car municipal parking garage was specially built for a 1800 person occupancy building. A survey conducted by PNC prior to selecting the site revealed that a large majority of employees used public transportation to get to work; however, the building of such a large garage would seem to encourage more people to drive. It would be interesting to know the current number of

of people who use public transportation to get to the Firstside Center. Another issue of sustainability in the building's siting is its location on the waterfront. It is questionable whether an office building occupied solely during daytime hours and for a limited number of years is the best first step in revitalizing the area.

Buildings account for over one-third of U.S. energy consumption so it only makes sense that the most points (10) of any LEED credit are earned by optimizing energy performance. The energy costs for Clackamas High School was estimated to be 50% less than the budget defined in ASHRAE/IESNA 90.1-1999 and 44% less than the Oregon Energy Building Code. Here we see a discrepancy between standards that perhaps indicates that the energy standards from which savings are estimated should be revised. Also, even under ideal conditions, whole building energy simulations are notorious for being inaccurate. A credit (Measurement & Verification) is awarded for installing continuous metering equipment to provide accountability and optimization of energy performance. This optional system of accountability, which should be mandatory and not extra credit, suggests that a building can achieve up to 10 points in its LEED certification without actually performing as specified.

Green power is much cleaner than using fossil fuels, but its potential as an environmental measure is limited by the the minimum two-year contract required for a credit. A tiered system similar to the one used for energy performance could possibly take advantage of using cleaner fuel while expanding the market for renewable sources of energy

An additional concern that should be addressed is the lack of difficulty in obtaining certain credits. A comparison involving a large number of buildings is more desirable, but three is sufficient to see a trend. Some of the credits earned by all three buildings include:

- Optimize Energy Performance, 20%-- This may indicate that the standard from which it is measured is to low.
- Recycled Content, 50%-- Based on a report prepared for NIST by the University of Michigan, cost based calculations for recycled content are not reflective of environmental benefits. It was also recommended that baselines be created for different materials based on industry standards.
- Thermal Comfort, Comply with ASHRAE 55-1992- - Perhaps this should be a prerequisite. A study on the percentage of buildings that comply with this standard without any extra effort would be useful.
- Alternative Transportation, Public Transportation Access-- Prerequisite possibility.
- LEED Accredited Professional-- The intent is to support and encourage design integration, but having one does not necessarily mean that the building will be environmentally effective.

CONCLUSION

Although all three buildings have the same rating, it is clear that an emphasis on different categories have varying impacts on the environment. Sustainable sites and indoor environmental quality appear to be the least affective of the three and the most difficult to measure. Energy and atmosphere is easily held accountable through measurement, and because of the huge concern over energy sources, it could be considered the most environmentally important. From this view, Clackamas High School would have the least environmental impact despite its having the same rating as the others.

However, importance is also somewhat relative to what condition of sustainability is most relevant for the building. For the three buildings studied, each earned the most points in the category that was necessary for the program of the building. For example, a hospital must be clean in order to do its job, so it only makes sense that indoor environmental quality was a focus. Studies show that people concentrate better in spaces with the

least artificial lighting and mechanical air systems, thus justifying Clackamas High School's number of points for Energy & Atmosphere. Employee happiness is a priority with PNC, and because survey results showed a majority use public transportation, siting was a focus.

As shown here, there are many areas that need to be further refined in the LEED system to provide a better measure of sustainability. In order for green building to work successfully and obtain widespread acknowledgement, LEED must push the boundaries of design and go far beyond what could be considered standard in practice.