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LEED Certifications in Public Buildings

Since 2002 there has been a growing interest within state and city governments in requiring all public buildings to meet at least the minimum Leadership in Energy and Environmental Design (LEED) requirements. There has been an increase in the number of LEED certified buildings in both Vermont and the rest of the United States (US). In this report, the US Green Building Council's (USGBC's) LEED standards will be outlined and the energy performance of these buildings will be reviewed along with a cost-benefit analysis of new construction of a LEED certified building.

LEED Standards for New Construction

The USGBC is an organization comprised of multiple entities including: contractors, materials manufacturers, local, state and federal governments, insurance firms, as well as others involved in the building industry whose purpose is to promote environmentally responsible, healthy, and profitable buildings to live and work. LEED is the USGBC's internationally recognized green building certification system which provides third-party verification that a building is designed and built using materials and methods that prioritize energy savings, water efficiency, lowered CO₂ emissions, and improved indoor environmental quality. USGBC awards points on a 100-point scale with credits weighted according to predicted environmental impact. A minimum requirement of credits must be met in order to receive certification at one of the three levels: Silver, Gold, or Platinum. The minimum number to achieve certification is 40 points, with the Silver rating coming at 50+ points, Gold with 60+ points, and Platinum at 80+ points. Ten additional bonus points may be awarded for innovation in design or a building that addresses regional environmental priorities.¹

In 2001, Portland, Oregon became the first city in the nation to create a green building policy. As of September 24, 2010, 34 state governments established a requirement in legislation for LEED certification building standards. Also, the Department of the Armed Forces recently updated its sustainable design and development policy in 2006, which incorporates all new construction projects to meet the silver level of LEED certification regardless of the funding

¹ US Green Building Council. "Intro- What LEED Is." <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988> (accessed October 14, 2010).

source.²

Energy Programs and LEED Standard Programs across the Country

LEED Certified Buildings in Vermont

UVM Davis Center

The Dudley H. Davis center at the University of Vermont was completed in 2007 and was the first student center in the US to hold a LEED Gold rating. UVM has appointed a green building coordinator along with a new policy adopted in 2007 whereby all new construction must be at a minimum LEED Silver rating. The 186,000 square foot Davis Center has a 52% projected savings in electricity, heating, and cooling and a 41% predicted reduction in water usage. Additionally, 92% of construction waste was diverted from a landfill and reused or recycled.³

ECHO at the Leahy Center

The ECHO lake aquarium and science center at the Leahy Center for Lake Champlain is a 2.2-acre environmental campus on the Burlington waterfront. In 2003, ECHO became the first building in Vermont to receive LEED certification and the only lake aquarium in the country with such certification.⁴

Wind NRG Systems

NRG Systems, Inc. is a privately-owned business operating a LEED Gold facility in Hinesburg, VT. NRG Systems has been a local producer and supplier of wind measurement and calibration devices for the harvesting of wind energy. Their new headquarters, completed in 2004, was one of only five industrial facilities in the world to hold the LEED Gold certification at the time.⁵

Other LEED Certified Buildings in Vermont

There are currently 29 buildings in Vermont certified by LEED:

- Waterfront Housing, Burlington, Owned by Burlington Community Land Trust. LEED Certified.

² USGBC. "LEED Initiatives by State." U.S. Green Building Council: USGBC. 24 Sept. 2010.

www.greenbuildingcouncil.org/ShowFile.aspx?DocumentID=5030 (accessed November 10, 2010).

³ University of Vermont. "Environmental Stewardship." The University of Vermont.

http://www.uvm.edu/~davis/?Page=enviro_LEED.html&SM=enviromenu.html (accessed October 17, 2010).

⁴ ECHO Lake Aquarium. "LEED Certification." <http://www.echovermont.org/ourmission/leedcertification.html> (accessed October 17, 2010).

⁵ NRG Systems. "About Us-Tour Our Facilities" <http://www.nrgsystems.com/AboutNRG/TourOurFacilities.aspx> (accessed October 13, 2010).

- Wings/Davis/Wilks Residence Hall, Burlington, Owned by The University of Vermont. LEED Silver Certified.
- Terrill Hall Renovation, Burlington, Owned by The University of Vermont. LEED Gold Certified.
- Joseph E. Carrigan Wing, Burlington, Owned by The University of Vermont. LEED Silver Certified.
- Given Courtyard Project, Burlington, Owned by The University of Vermont. LEED Gold Certified.
- GMVS Library, Waitsfield, Owned by Green Mountain Valley School. LEED Certified.
- Franklin Environmental Center, Middlebury, Owned by Middlebury College. LEED Platinum Certified.
- Lake Champlain Chocolates, Burlington, Owned by L.C.C. LEED Certified.
- Nulhegan Administration/Visitor Contact, Brunswick, Owned by U.S. Fish and Wildlife Service. LEED Silver Certified.⁶

The Greening of Aiken

The Rubenstein School of the University of Vermont with the assistance of William Maclay Architects & Planners of Waitsfield, Vermont, has designed a look for the retrofitting of the George D. Aiken Center. The Rubenstein School plans to educate a new generation of ecologically minded people who understand the inherent “environmental costs” associated with age-old building practices. The newly rehabbed Aiken building will be a harbinger to a sustainable outlook on the future.

Some of the innovative features the new building will have include:

- Eco-Machine™ natural wastewater treatment system in a functional, multipurpose solarium;
- Waterless/low-flow fixtures with a projected 52% less water use over similar-sized conventional buildings;
- Green roof, designed for testing micro-watershed strategies for storm water management;

⁶ U.S. Green Building Council. “LEED Project and Case Studies Directory.” <http://www.usgbc.org/LEED/Project/CertifiedProjectList.aspx?CMSPageID=247> (accessed October 17, 2010).

- High performance building envelope and windows to maximize energy efficiency and occupant comfort;
- Enhanced natural ventilation and natural lighting;
- State-of-the-art green conference room to support experiential education and community service courses;
- Environmental/energy monitoring systems, providing efficiency data to all via the web;
- Local, renewable, recycled, and recyclable building materials and furnishings; and
- Potential LEED Gold building rating, signifying one of the greenest renovated buildings in the nation.⁷

Cost and Benefit of LEED Buildings

One of the primary deterrents to green building is the belief that these projects come at a significant initial cost increase to meet the LEED credit standards. A survey of 170 US buildings reported green premiums ranging from 0% to 18%, with a median of 1.5%. The large majority of buildings reported premiums between 0% and 4%. The figures presented translated into dollars per square foot (sf) put green buildings premiums at an additional \$3/sf to \$9/sf of a new building. The cost premiums ranged between LEED levels as well, suggesting that the cost premium depends more upon the skill and experience of the design and construction and choice of green strategies than on the level of greenness.⁸

Cost estimates for each LEED credit range from a slight reduction in cost to an 8% additional cost, depending on the level desired. A building projects' ability to utilize low-cost green methods that satisfy LEED credit requirements can also contribute to lower the green premium. Overall, green buildings have been found to cost approximately 2% more to construct than conventional buildings.⁹

A study done by the Capital-E group looked into 30 green schools built in 10 states over a 5-year period from 2001 to 2006. The data that was collected was provided to Capital-E from the architects of these buildings containing information on the costs and savings of these new designs. The study compared the costs and savings of conventional and green designed buildings. "Four of the green schools (in Georgia, Massachusetts, and Oregon) cost no more than conventional design, while several schools cost substantially more. The study found that green schools cost 1% to 2% more, with an average cost premium of 1.7%, or about \$3/ft squared."¹⁰ A study done by the Portland Energy Office found out through an evaluation

⁷ University of Vermont. "Greening of Aiken | The Rubenstein School of Environment & Natural Resources." The University of Vermont. 2010. <http://www.uvm.edu/rsenr/?q=greening-aiken> (accessed October 15, 2010).

⁸ Kats, Gregory. "Greening Our Built World: Costs, Benefits, Strategies." Washington, DC: Island, 2010.

⁹ Kats, Gregory. "Greening Our Built World: Costs, Benefits, Strategies." Washington, DC: Island, 2010.

¹⁰ Kats, Gregory. "Greening America's Schools: Costs and Benefits." USGBC: Research Publications. Oct. 2006. http://www.usgbc.org/DisplayPage.aspx?CMSPageID=77#economic_analysis (accessed November 1, 2010).

conducted, found that regional life cycle savings from adopting 15 individual green building technologies was over 8 times as large as the direct first cost of these measures.”¹¹

Recent studies from Davis Langdon, a global construction consultant in their most recent research project compared 83 building proposals with goals of becoming LEED certified compared to 138 buildings that didn’t have a goal for sustainable design. The studies done found that there were no differences in costs with building projects that had a goal of LEED certification compared to non-certified.¹²

However, some or all of the additional costs to build green can be offset from the savings resulting from the green elements in the building. Improved insulation can reduce the scale of heating and cooling systems, waterless urinals reduce plumbing requirements, increased daylight can reduce the density of installed lighting, and green roofs can eliminate the need for a water retention system required by many building codes. Any additional costs associated with building green should be considered along with the long-term net benefit of a LEED building in energy savings and reduced water consumption in lowering operating costs for the lifetime of a building’s occupancy.¹³

The greatest financial benefit that will resonate most is the energy savings of a green building. Direct energy savings resulting from an efficient building consuming less energy is the basis by which a net benefit is projected, generally over a 20-year period. The figures below illustrate a present value of 20 years of energy savings by building type and LEED level. Figure 1 indicates that health care buildings have the greatest net benefit by dollars per square feet over a 20-year period. Figure 2 depicts that the LEED Platinum level showed the greatest net benefit in dollars per square feet.¹⁴

¹¹ “Green City Buildings: applying the LEED Rating System,” Prepared for the Portland Energy Office by Xenergy Inc, and Sera Architects, June 18, 2000.

¹² Fuerst, Franz and McAllister, Patrick M. “Green Noise or Green Value? Measuring the Effects of Environmental Certification on Office Property Values” (July 15, 2008). <http://ssrn.com/abstract=1140409> accessed November 2, 2010.

¹³ Kats, Gregory. “Greening Our Built World: Costs, Benefits, Strategies.” Washington, DC: Island, 2010.

¹⁴ Kats, Gregory. “Greening Our Built World: Costs, Benefits, Strategies.” Washington, DC: Island, 2010.

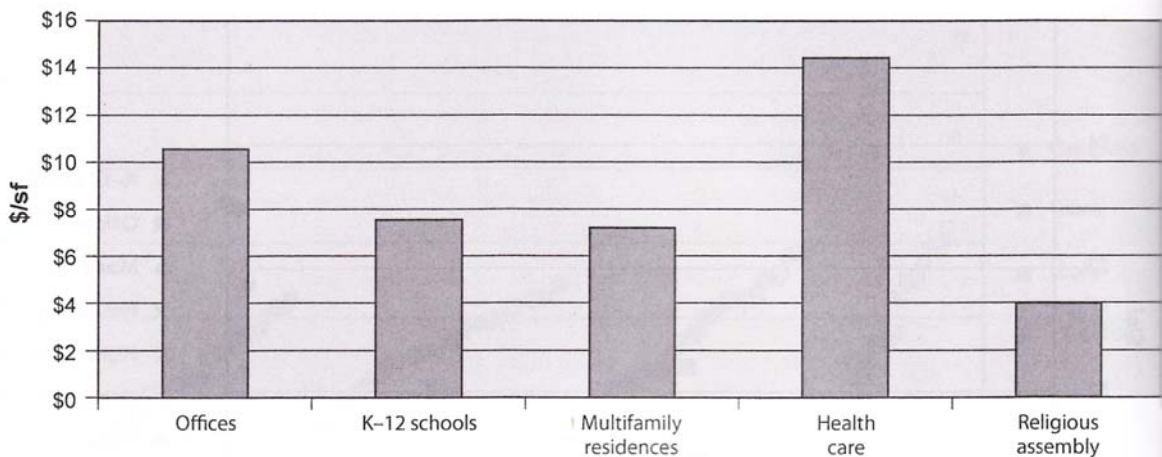


Figure 1. Twenty years of energy savings by building type at present value. Figure taken directly from Kats 2010.¹⁵

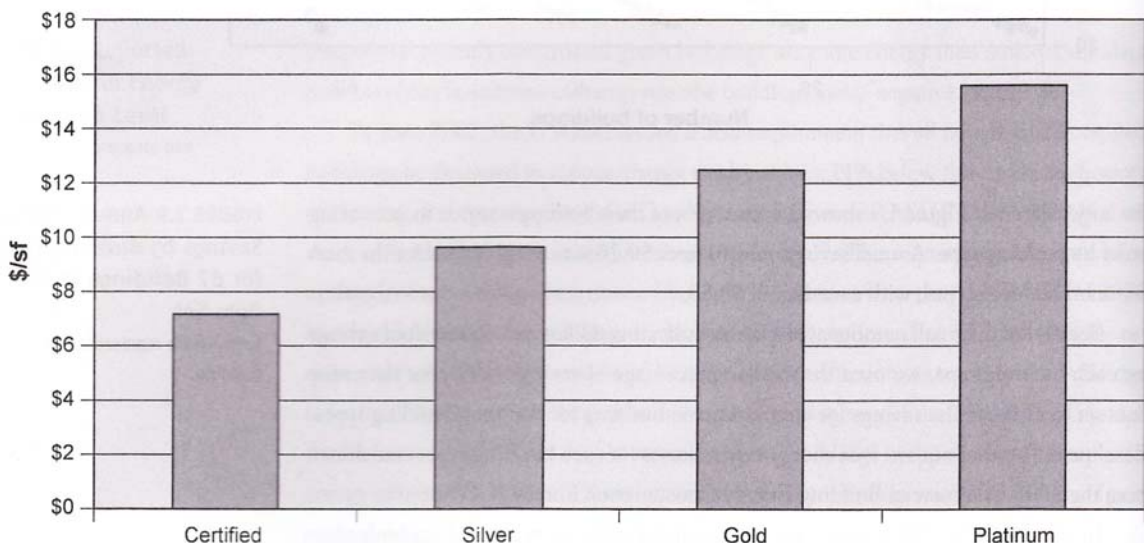


Figure 2. Twenty years of energy savings by LEED level in green offices at present value. Figure taken directly from Kats 2010.¹⁶

A study conducted in 2009 analyzed data from 100 LEED-certified buildings to determine if LEED buildings live up to their energy efficient standards. One problem with the design of LEED buildings is that the energy efficiency of a building is based on predicted performance and not actual performance. Actual energy efficiency is rarely measured after the building is built and

¹⁵ Kats, Gregory. "Greening Our Built World: Costs, Benefits, Strategies." Washington, DC: Island, 2010.

¹⁶ Kats, Gregory. "Greening Our Built World: Costs, Benefits, Strategies." Washington, DC: Island, 2010.

occupied, a test that is called post-occupancy evaluation. These tests would shed light on whether LEED buildings are as energy efficient as they claim to be.¹⁷

This 2009 study compared the energy use of LEED-certified buildings with conventional buildings. It evaluated whether correlation between certification level and energy efficiency occurred and if a building that achieved energy credits was as energy efficient as it should be.¹⁸

On average, LEED buildings are more energy efficient than conventional buildings and they use 18 to 35% less energy per floor area. However, this doesn't mean *all* LEED buildings are more energy efficient than conventional buildings. Approximately one third (28 to 35%) of LEED buildings actually use more energy than conventional buildings. This means that there are still kinks that need to be worked out with some of the LEED buildings and just because it is a LEED building it doesn't necessarily mean it is going to be energy efficient. But on average they are.¹⁹ Another study conducted in 2008 analyzed post-occupancy data of 121 LEED-certified buildings and also found that on average LEED buildings do save energy. In fact, LEED buildings use 25% less energy on average than other buildings. But unlike the previous study, this one did find a correlation between Gold and Platinum buildings achieving higher energy performance—using 45% less energy than commercial buildings in this study.²⁰

Both studies with relatively large sample sizes determined that there is room for improvement for some of the LEED buildings. Specifically, a quarter of the LEED buildings in the 2008 analysis used more energy than average building types. Analysts suggest that differences in equipment, operational practices and schedules, and other issues could account for the poorer outcomes but improvement is recommended.²¹

Conclusion

This document has outlined the U.S. Green Building Council's LEED certification system as a third-party method of verification that a particular building's design and construction was carried out according with methods and materials that prioritize energy savings and efficiency across all the parameters of a buildings' occupancy.

¹⁷ Newsham, Guy R., Sandra Mancini, Benjamin J. Birt. "Do LEED-certified buildings save energy? Yes, but..." *Energy and Buildings* 41 (2009): 897-905.

¹⁸ Newsham, Guy R., Sandra Mancini, Benjamin J. Birt. "Do LEED-certified buildings save energy? Yes, but..." *Energy and Buildings* 41 (2009): 897-905.

¹⁹ Newsham, Guy R., Sandra Mancini, Benjamin J. Birt. "Do LEED-certified buildings save energy? Yes, but..." *Energy and Buildings* 41 (2009): 897-905.

²⁰ Turner, Cathy and Mark Frankel. "Energy Performance of LEED for New Construction Buildings." *US Green Building Council*. Final Report March 4, 2008 <http://www.usgbc.org/ShowFile.aspx?DocumentID=3930> accessed November 1, 2010.

²¹ Turner, Cathy and Mark Frankel. "Energy Performance of LEED for New Construction Buildings." *US Green Building Council*. Final Report March 4, 2008 <http://www.usgbc.org/ShowFile.aspx?DocumentID=3930> accessed November 1, 2010.

- LEED certified buildings have a graduated scale with three levels above basic certification: Silver, Gold, and Platinum.
- A weighted point system determines LEED level based on a buildings' various green elements.
- The number of LEED buildings has risen significantly in recent years, in both Vermont and the rest of the US.
- Constructing new LEED certified green buildings may come at a cost increase, however, energy savings in heating and cooling, electricity, etc. and water efficiency create net benefit in monetary savings in the long term.
- LEED buildings have been verified as more energy efficient in general than a conventional of comparable size, however, some do use more energy than projected.

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Disclaimer: This report has been compiled by undergraduate students at the University of Vermont under the supervision of Professor Anthony Gierzynski. The material contained in the report does not reflect the official policy of the University of Vermont.