

If You Build It Green, They Will Come

As the popularity of sustainable or green building continues to grow into a bona fide trend, convincing developers, building owners and facility managers to invest in green building is getting easier. Powering this trend are mandates from colleges and universities, cities and municipalities as well as state and federal governments that buildings will be designed and built to meet US Green Building Council's (USGBC) LEED Green Building Rating System™ requirements (Zoning Practice 2005). Also powering the trend is clear evidence that the economics of green building are not as prohibitive as once thought. In many cases, the economics are advantageous, especially if improvements in building occupant comfort and productivity are taken into account and green building goals are incorporated as early as possible into the design process.

The numbers tell the story. As of May 2005, there are nearly 2,000 registered projects, with an additional 216 having completed certification. Another LEED metric of note is 229 million square feet of commercial building space have been registered or certified under LEED. Industry data further demonstrates how green building has become a market force. The USGBC reports that in 2003 the annual market for green building in products and services was \$5.8 billion, a 34 percent growth over 2002 (Green Building Fact Sheet May 2005).

Jerry Yudelson, PE, chair of the steering committee for the 2004 and 2005 USGBC Greenbuild Conferences, predicts that the total number of LEED-registered projects will grow from about 1,760 at the end of 2004 to nearly 10,000 at the end of 2009 (November 29, 2004 press release). He also notes there is a strong interest among developers in incorporating green building goals into their projects, even among those who have no plans to officially register their projects with LEED. He estimates at the end of 2004, the number of these projects was as much as two to three times that of LEED projects, leading him to project that green buildings have penetrated 5 percent of private-sector and 15 percent or more of public-sector projects (Yudelson, EDC-Structure 2005).

But questions about first costs and return on investment remain a stumbling block for many developers, building owners and facility managers. Among their primary concerns are potential increases in upfront costs and a full return on their investment (ROI). Other concerns are the impact of commissioning and strategies for minimizing indoor pollutants on project schedules and budgets. This paper will address these issues.

First Costs: Money Talks

As the old saying goes, "Money talks." If the cost of green building adds too much to the budget or if the ROI is not seen as advantageous, the talk will be against green building. This perspective is embraced by those who may acknowledge some benefits associated with green buildings, especially benefits that can be precisely measured such as savings associated with lower energy use, waste reduction and water conservation. Often undervalued or ignored are other significant benefits that do not fit as neatly into ROI calculations, such as those associated with productivity and health. This view also does not take into consideration improvements in the process of green building design and construction during the past few years.

In addition, critics cite reports that LEED buildings cost as much as 10 percent to 25 percent more than conventional construction. This may be true if a design team does not incorporate green building goals into an integrated design early in the process. A review of LEED's database of costs associated with LEED buildings found that in general design teams are achieving LEED certification with up to 2 percent higher first costs than in non-LEED buildings (Reed 2003).

The US General Services Administration (GSA), which requires all new federal building construction and major renovations comply with LEED, typically allocates 2.5 percent green premium to cover building costs. This allocation was validated in a recent study of two GSA buildings using six LEED cost scenarios for each building (GSA LEED Cost Study 2004).

Two comprehensive reports on first costs (green premium) and financial benefits of green building, including extensive literature reviews, support the above findings and agree that any potential added costs are not as prohibitive as once thought for both LEED buildings and green buildings not applying for LEED certification. The costs can be lowered and effectively managed if green building goals are incorporated as early as possible into the design process. They also agree that as more design firms gain experience, first costs can be lowered even further (Kats et al 2003, Davis Langdon 2004).

The California Sustainable Building Task Force, for example, contacted several dozen building representatives and architects to determine the cost of 33 green buildings, which were then compared with conventional designs for those buildings. In its 2003 report to the California state legislature, the task force offered the following results of its analysis.

Assuming conservative, relatively high California commercial construction costs of \$150 to \$250 per square foot, a 2 percent green building premium is equivalent to \$3 to \$5 per square foot. Use of lower, more average construction costs in these calculations would tend to increase the cost effectiveness of green construction (Kats et al 2003).

The task force also concluded that the majority of the green premium is due to the increased architectural and engineering design time to integrate sustainable building practices into projects. In general, the earlier green building goals are incorporated into the design process, the lower the cost (Kats et al 2003). It follows, as noted above, that as these firms become more experienced and efficient in integrating these practices into projects it will take less time and thus the cost would be reduced even more. Also of note is that products used to build green buildings do not cost any more or less than products used in conventional construction.

In its analysis of green building costs for the USGBC, Davis Langdon, a consulting firm for the construction, engineering and mining industries, compared the construction costs of 45 library, laboratory and academic classroom projects that were designed with a goal of meeting some level of the USGBC's LEED-NC (new construction) with 93 similar buildings where LEED was not considered during design.

This analysis showed that projects were able to achieve LEED within the same cost range as the non-LEED buildings. Davis Langdon is careful to point out, however, that

this finding “does not necessarily follow that a specific individual building will be able to achieve LEED at no added cost. Rather, the data suggest that there are many factors affecting cost of a building and that LEED tends to have a lesser impact than other factors” (Davis Langdon 2004).

Further, Davis Langdon found that more than one-half of the projects had original budgets that were set without regard to sustainable design and yet received no supplemental funds to support green building goals. Of those that did receive additional funding, the supplement was usually provided for specific enhancements or requirements, such as photovoltaic systems. The range of the supplements, for those few that required it, was up to 3 percent of the initial budget (Davis Langdon 2004).

One more example: The City of Portland, Oregon analyzed three buildings to determine what costs and benefits would have occurred if these buildings had been designed and built to meet LEED requirements for commercial buildings. Built prior to LEED becoming available, the buildings were a seven-story office building (143,200 sq. ft.); a building designated as mixed use, police station and community space; and a fire station.

The study used two economic criteria: lowest first cost to determine how construction costs might have been impacted and lowest life cycle cost to ascertain future benefits derived from green buildings. As might be expected, all three buildings failed to achieve basic LEED certification as constructed, but they could have been designed to meet the requirements for a relatively small (if any) increase in first costs (Portland Energy Office 2000).

Commissioning: Cost Additive or Cost Saving?

In addition to concerns about higher first costs and lower returns on investment, many developers, building owners and facility managers also have reservations about building commissioning. Many view commissioning as an optional step that has no economic benefit. If planned and implemented properly, however, building commissioning is an effective way to verify that the planning, design, construction and operation of the building are achieving set goals, regardless of whether or not the plan is to use sustainable building practices. Further, a well-designed and executed commissioning plan saves money, both in terms of direct operational costs and indirect costs associated with employee productivity, tenant turnover, vacant office space and building repairs (LEED-NC 2.1).

The State of Oregon Office of Energy study of direct energy savings for two buildings after completing a commissioning plan offers encouraging news on the economic benefits of commissioning. The study also estimated indirect costs associated with complaints about temperature and lighting, two very common indoor environmental complaints. The results showed that commissioning increased energy efficiency by 5 percent to 10 percent. In the 110,000 sq. ft. office building, energy savings of \$12,276 per year (\$0.12 per square foot) were realized. In a 22,000 sq. ft. office building, the energy savings were \$7,630 per year (\$0.35 per square foot) (LEED-NC 2.1).

With respect to indirect personnel costs, the Oregon Office of Energy study estimated that if 20 percent of building occupants expended 30 minutes per month complaining about lightening or temperature conditions, the employer would lose \$0.10 per square

foot in annual productivity. For a 100,000 sq. ft. building, this equates to a loss of \$10,000 per year. This estimate only relates to time spent complaining and not to costs from lost time due to employee illness, tenant turnover, vacant office space, liability associated with poor indoor air quality (IAQ) and building repairs (LEED-NC 2.1).

Estimated cost of commissioning as a percentage of construction costs varies with building size and is typically viewed as a higher percentage for smaller buildings. There is evidence, however, that resulting savings more than pay for the cost of commissioning for both green and non-green buildings (Kats et al 2003).

A recent report, for example, found that costs of commissioning, including travel expenses, ranged from 2 percent to 4 percent for buildings costing less than \$5 million, down to 0.5 percent to 1 percent for buildings costing more than \$50 million. The study used nine case studies to illustrate why savings from commissioning exceeded the cost of commissioning even before the projects were complete (Dorgan, Cox, Dorgan 2002 as reported in Kats et al 2003).

In addition, commissioning:

- Helped eliminate costly change orders
- Reduced requests for cost information
- Helped ensure proper system/component selection
- Improved performance of building systems
- Reduced callbacks

Another study of six LEED office buildings and schools found that the average cost of the fundamental building systems commissioning was equal to about 0.3 percent to 0.6 percent of construction costs (Reed 2002 as reported in Kats et al 2003).

Strategies for Reducing Indoor Pollutants: Benefits Outweigh Costs

Although creating a safer and cleaner indoor environment is a vital part of any green building plan, developers, building owners, facility managers and members of the design/build team sometimes are conflicted about how to achieve this goal. As with building commissioning, their concerns focus on the cost and potential adverse impact on the project schedule. What is often overlooked, however, is a coordinated approach that is planned for during the design phase and carried out through the project's completion can yield significant benefits.

The US Environmental Protection Agency's Research Triangle Park (RTP) campus is an excellent example of how these strategies can be employed, without adversely affecting project schedules or budgets. The campus is comprised of several high-tech research and development facilities, totaling 1.2 million square feet and costing \$273 million (Nelson 2003).

Among these buildings is the EPA's National Computer Center, which was recently awarded a LEED Silver certification. This 100,000 sq. ft. building was completed in 2001 and was built for around \$18 million (approximately \$150 per square foot). The project

has an added distinction in that it was designed and constructed without additional money being added to the budget to meet the EPA's sustainable building requirements (Nelson 2003, Rogoski 2005).

Several effective strategies were used during the construction of the RTP buildings to minimize the levels of indoor pollutants during construction and after occupancy, including:

- Continuous flushing out indoor spaces with 100 percent outdoor air
- Sequencing installation of products that may emit VOCs to allow sufficient time for off gassing before installing products that may soak up VOCs (sometimes called "sinks") and re-emit them later
- Installing building products, finishes, furnishes and office equipment that emit low levels of VOCs
- Confirming low VOC and formaldehyde emissions by requiring environmental chamber testing of select materials, furnishings and finishes used in the buildings
- Conducting ambient air testing to ensure low levels of indoor pollutants, including VOCs, formaldehyde, particulates and fungi, prior to clearing the building for occupancy (Schubert and Lafferty 2005)

Pete Schubert is a LEED accredited professional, a project engineer with the EPA and the project manager for the National Computer Center. According to Mr. Schubert, in 1997 the EPA set forth these strategies in general guidelines. These specifications were among the very first sustainable (green) building guidelines ever developed. The USGBC later used them as a resource in developing indoor environmental requirements for the LEED New Construction and Major Renovation Projects (LEED-NC) rating system (Schubert and Lafferty 2005).

Air Quality Sciences Building Consulting Group (AQS) conducted ambient air testing at the Research and Administration Facility, located in the same complex. The testing was done during the fall of 2001 and monitored the following indoor air contaminants:

- Total VOCs
- Formaldehyde
- Carbon dioxide
- Temperature / relative humidity
- 4-Phenylcyclohexene
- Ozone
- Particulates
- Fungal spores

During the first two site visits, elevated levels of several of the contaminants alerted the design/build team about potential problems. This was actually good news as it allowed

the design/build team to resolve possible indoor environmental issues prior to the final site visit in December 2001 and before the building was occupied. The results of the final site visit indicated that all of the contaminants were within acceptable levels and the building was clear for occupancy. AQS also conducted ambient air testing at the National Computer Center in December 2001.

With some projects, it may not be practical to continually flush out the building during construction as in the case of the RTP buildings. In these cases, a sound green building practice is to reduce the flush out time to two weeks at the end of the project. According to AQS, the energy costs associated with a two-week flush-out period using 100 percent outside air vary based on building size and ventilation method, but usually run about \$0.13 per square foot. Other effective strategies include:

- Selecting and using low-emitting materials, such as those certified by the GREENGUARD Environmental Institute (www.greenguard.org), which can minimize the need and potentially shorten the time needed for flushing out the building
- Sampling indoor air as a part of the commissioning process to confirm low levels of indoor contaminants, which often can be done for less than the energy costs of flushing out the building – as noted, the EPA used this strategy along with others in its RTP buildings

Taking these steps not only results in savings, but being able to compress the construction schedule at the very end of a project can be invaluable added benefit, especially when time is tight and the owner or tenants are anxious to occupy the new or renovated facility.

Life Cycle: Financial Benefits Can Offer Big Paybacks

While first costs are important, the full value in green building becomes apparent when considering the financial benefits during the full life of a building. Critics of green building claim there are multiple methods that can be used to measure financial benefits as well as a large range of values that can be assigned to them, thus such analyses are not particularly helpful. The California Sustainable Building Task Force acknowledged that in most cases there is no single “right” answer, but argues that even so, it is possible to determine reasonable, conservative estimates of these benefits for a range of green building attributes (Kats et al 2003).

In fact, the task force reported that financial benefits of green buildings are more than 10 times the average initial investment required to design and construct a green building. Energy savings alone exceed the average increased cost associated with building green. In addition, the relatively large impact of productivity and health gains reveals the direct and indirect cost of employees is far more than the cost of construction or energy. Thus, even small changes in productivity and health translate into large financial benefits (Table 1).

Table 1. Financial Benefits of Green Buildings – Summary of Findings per Square Foot*

Category	20-Year Net Present Value
Energy Value	\$5.79
Emissions Value	\$1.18
Water Value	\$0.51
Waste Value (construction only) – 1 year	\$0.03
Commissioning O&M Value	\$8.47
Subtotal Above Values	\$15.98
Productivity and Health Value (LEED Certified and Silver)	\$36.89
Productivity and Health Value (LEED Gold and Platinum)	\$55.33
Less Green Cost Premium	(\$4.00)
Total (LEED Certified and Silver)	\$48.87
Total (LEED Gold and Platinum)	\$67.31

*Adapted from Figure ES-1. Financial Benefits of Green Buildings (Kats et al 2003)

The City of Portland also looked into the financial benefits of green building and found that taking into account only the hard future costs, such as utilities, and maintenance, future savings over 25 years (the life cycle chosen for this study) would have more than offset initial investment costs. But the largest potential payoff would likely have been higher productivity from better lighting, airflow and indoor air quality. The increase in productivity would have come from improved worker comfort and reduced complaints, absenteeism and health problems. Because (as previously discussed) the buildings studied were built prior to LEED, it was not possible to measure actual productivity changes. Consequently, the investigators based their calculations on conservative estimates from prior research. They determined that for all three buildings, the life cycle savings would have been about 15 percent of the original construction costs (Portland Energy Office 2000).

A very large body of research, reviewed in the California Sustainable Building Task Force's report, demonstrates significant and causal correlation between improvements in

building comfort/control measures and worker health/productivity. The costs of poor indoor environmental and air quality, including higher absenteeism and increased respiratory ailments, allergies and asthma, are hard to measure and have generally been “hidden” in sick days, lower productivity, unemployment insurance and medical costs (Kats et al 2003).

Using 2002 data from California Department of General Services, the task force concluded that there was a 1:10 ratio between increased employee costs and associated building costs. In other words, if green building can increase productivity by 1 percent, this would, over time, have a fiscal impact roughly equal to reducing building costs by 10 percent (Kats et al 2003).

“Economics of IAQ: A Tough Sell or Is It?” available on the Aerias – AQS IAQ Resource Center website (www.aerias.org) under the Premium Content section, offers an overview of productivity and indoor environmental quality and many of the major studies reviewed in the California Sustainable Building Task Force report.

Perhaps one of the strongest arguments for embracing green buildings is building tenants believe indoor environmental quality (IAQ, lighting and comfort) are among the most important components of job satisfaction. Further, some tenants are willing to pay more in rent to obtain benefits from intelligent buildings, including enhance building controls, ventilation and IAQ.

The study, *What Office Tenants Want: 1999 BOMA/ULI Office Tenant Survey Report*, analyzed 1800 office tenant surveys in 126 metropolitan areas. The study, conducted by the Building Owners and Managers Association (BOMA) and the Urban Land Institute (ULI), found that 95 percent of those responding to the survey ranked comfortable air temperature and 94 percent ranked indoor air quality as among the “most important” tenant comfort features. The study also found that the number one reason tenants move out is problems with keeping the indoor temperature comfortable (BOMA 1999).

The results of a series of national opinion surveys taken in 2000 to 2002 consistently showed that overall concern for indoor air quality is at an all-time high. With respect to office workers, 75 percent of people who are employed fulltime ranked the quality of air at work as very important, another 20 percent believed it is somewhat important, but only a little over 3 percent said that it was not important (Chelsea Group 2000).

Insurance companies also have embraced the concept that helping employees stay healthy and productive is good for business. The insurance industry, for example, estimates that corporate wellness programs can give employers a 50 percent to 400 percent return on investment on health care costs. Most employers with more than 50 workers have some kind of program, saving \$1.49 to \$4.91 on each dollar spent (Kiplinger Letter 2003). These figures clearly illustrate the financial value of encouraging employees to live healthier life styles while helping to manage chronic disease. As indoor air pollutants can significantly impact chronic diseases, such as allergies and asthma, it makes sense for building owners, developers and facility managers as well as employers to invest in good indoor environmental quality as a part of overall green building strategy.

If You Build It Green They Will Come

At this time, developers, building owners and facility managers who plan to own and operate their buildings over the long-term are embracing green building more readily than those who are looking for quick returns on investment (less than five years). Even so, the trend is well underway and market share will go to those that respond to the call for green building.

More and more, tenants, building owners and facility managers will want buildings that operate to the highest level and that will promote comfort and higher productivity. Developers must look beyond the short-term and realize the marketing benefit of offering green building options. They also must realize that buildings with vacant space or with unhappy occupants ultimately will cost more than creating an attractive, healthy building at the start.

Air Quality Sciences Building Consulting Group offers more than 15 years of experience and expertise in supporting owners, developers, and design and construction professionals in their efforts to create buildings with healthy indoor environments. Whether seeking to earn the LEED certification or simply trying to create a building that supports good indoor environmental quality, AQS can assist with entire process, from blueprint review to pre-occupancy clearance testing.

Visit us at www.aqs.com to learn more about selecting low-emitting building materials, furnishes and finishes, building commissioning and flushing out indoor spaces, or call us at (770) 933-0638 and ask for Building Consulting. Also visit the Aerias AQS IAQ Resource Center to learn more about VOCs and other indoor pollutants. Aerias may be accessed from the AQS website or at www.aerias.org. For a listing of products that are certified to emit low levels of VOCs, visit the GREENGUARD Environmental Institute website at www.greenguard.org.

References

Building Owners and Managers Association and Urban Land Institute. 1999. What Office Tenants Want: 1999 BOMA/ULI Office Tenant Survey Report. Building Owners and Managers Association. Washington, D.C.

Chelsea Group, Ltd. (Press Release July 31, 2000). People are willing to spend money to improve indoor air quality. Available at www.safetyonline.com/content/news. Accessed September 2000.

Davis Langdon. Examining the Cost of Green. Davis Langdon & Seah International. Boston, Massachusetts. October 2004. Available at www.davislangdon.com.

Dorgan C, Cox R and Charles Dorgan C. The Value of the Commissioning Process: Costs and Benefits. Farnsworth Group, Madison Wisconsin. Presented at the 2002 US Green Building Council Conference, Austin, Texas. As reported in Kats et al 2003.

GSA LEED Cost Study Final Report. Prepared by Steven Winter Associates, Inc. US General Services Administration. Washington, DC. Order No. P-00-02-CY-0065. October 2004.

Green Building Fact Sheet May 2005. US Green Building Council. Washington, DC. Available at <http://www.usgbc.org/DisplayPage.aspx?CMSPageID=97&>. Accessed June 10, 2005.

Kats G, Alevantis, L, Berman A et al. The Cost and Financial Benefits of Building Green: A Report to California's Sustainable Building Task Force. October 2003.

The Kiplinger Letter – Forecasts for Management Decisions. 80:42. pp 2. October 17, 2003.

LEED-NC Version 2.1 Reference Guide. US Green Building Council. Washington, DC. Available at www.usgbc.org.

Nelson, KT. Model design helps EPA computer sustainability into savings. Environment Design + Construction. July / August 2003.

Oregon Office of Energy. Building Commissioning Savings. Salem, Oregon. June 2004. Available at <http://www.energy.state.or.us/bus/comm/commcost.htm>. Accessed June 15, 2005.

Portland Energy Office. Green City Buildings: Applying the LEED™ Rating System. Prepared by Xenergy, Inc. and SERA Architects. Portland Energy Office. Portland, Oregon. June 2000.

Reed WG. The cost of LEED green buildings. Natural Logic. 2003. Available at http://www.natlogic.com/Articles/BillReed_CostOfGreen.pdf. Accessed June 15, 2005.

Reed WG. Personal communication, December 2002 as quoted in Kats et al 2003, Citation 271.

Rogoski R. EPA proves a 'building on budget' can still be green. Triangle Business Journal. Triangle Park, North Carolina. June 27, 2005.

Schubert P and Lafferty S. US Environmental Protection Agency. Research Triangle Park, North Carolina. Personal communication. July 27 and July 28, 2005.

Yudelson J. Perspective: Forecasting market demand for green buildings 2004 – 2007, Environmental Design + Construction Magazine. December 2004. Available at www.edcmag.com. Accessed June 10, 2005.

Zoning Practice. Building green: onus or bonus. Zoning Practice. American Planning Association. Chicago, Illinois. April 2005. Available at <http://www.planning.org/zoningpractice/pdf/ZPApr05Matrix.pdf>. Accessed July 22, 2005.