The Operations and Management of Green Buildings in the United States

by

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Introduction

Green is not a fad, but a future way of doing business. We expect the term "green" to fade as it becomes mainstream, but for now we remain early in the process of conversion. A large part of this conversion will involve existing buildings since we typically build no more than 2 percent of the existing stock in any one year. While we do not have the luxury of replacing all existing buildings with new, green construction overnight, we do have a tremendous opportunity to incorporate green practices into the management of existing buildings. This approach will actually move us forward faster in the sustainability sphere since the operation of a building can prove even more critical than its design in making a difference.

Yet the research so far has been lacking on the operations and management of green buildings, leaving building owners and managers, who are driven by economics, not altruism, to wonder what the actual costs are and how their bottom line would be impacted. This study begins to fill that gap by comparing the operating performance and sustainability-related practices of a group of Energy Star/LEED buildings with those that do not have such labels.[1] Specifically, we look at their operating expenses (including electricity, gas, water and waste removal), cleaning practices, use of energy-saving devices, and other building operation procedures.

The remainder of the paper is organized as follows. The next section reviews recent studies on sustainable real estate and green buildings. We then discuss the data used in

[1] LEED stands for Leadership in Energy & Environmental Design and was created by the U.S. Green Building Council (USGBC). Energy Star is a label verified by the U.S. Environmental Protection Agency (EPA) based on meeting a set of ongoing energy saving standards.

this study, including the source and summary statistics. The section after that presents the results of comparative analyses between buildings with and without green labels, in terms of operating expenses and green practices. The conclusions are discussed in the final section.

Recent Studies on Sustainable Real Estate

The academic research community has made continued efforts to study the impact of green buildings on rents, values and more, focusing mostly on Energy Star and LEED as the standard bearers.[2] Studies using data from 2005 through late 2009 have consistently found that green buildings on average have higher rental premiums, higher occupancy levels and higher values than buildings with otherwise similar characteristics. Examples include Miller, Spivey and Florance (2008); Fuerst and McAllister (2009); Eicholtz, Kok and Quigley (2010); and Wiley, Benefield and Johnson (2010), all of whom found premiums in rents and occupancy rates for green buildings. Rental premiums and higher occupancy rates should lead to higher values generally by more than the extra costs to go green; however, data on LEED-certified property sales has been particularly difficult to come by as there have been few sales over the past few years. The same holds true for Energy Star-labeled properties. This may imply that owners of green buildings are oriented more toward the long term and less likely to sell as quickly as merchant builders who care less about long-term values.[3]

[2] While recent studies have focused primarily on Energy Star and LEED, there are other standards of green features out there, including BREEAM, CASBEE, Green Star, Green Globes, and many more which we do not review here (see Reed, Bilos, Wilkinson and Schulte, 2009).

[3] On those few sales that have occurred, we estimate about a 50 basis point lower cap rate compared with similar non-green sales. As of October 29, 2009, there were 3,608 LEED or Energy Star Class A or B office buildings in the CoStar database and of these, only 43 were for sale. With sales activity low, it is

Other studies have investigated the cost of going green. Bubny (2009) asserts that there are no significant incremental costs at all for new construction to hit the Silver level of certification, as long as the developer starts early and has an experienced team. In a recent review study, Kats (2009) suggests that "Green buildings cost roughly 2% more to build than conventional buildings," which is quite nominal compared to the benefits found in the empirical studies. In a report prepared for the Urban Green Council, Langdon (2007) looks at construction costs for 38 high-rise multifamily buildings and 25 commercial interiors in New York City. He finds that the cost differential is less than 1% for new buildings, and for commercial interiors, the cost for LEED construction is actually 6% lower than for non-LEED. The report concludes that, "We must prioritize greening our cities, and cost is not the barrier some have made it out to be."[4]

But if the cost differential to produce better buildings is modest, why is the overall office stock percentage of green buildings—not to mention other property types—so low? Blame this on the fact that real estate lasts a long time. As we see existing building owners ramp up with retrofits, the percentage will grow rapidly. The iconic Empire State Building, for example, is receiving a $20 million energy-efficiency retrofit, which is expected to save $4.4 million in annual energy costs, reduce its energy consumption by

unlikely that all for sale will sell quickly; therefore, it is a challenge to provide a significant sample of LEED or Energy Star property sales in 2009.

[4] We acknowledge that there remain some certification processing costs, which may deter some owners from applying. For example, in 2010 the cost of new construction certification fees for a 100,000 square foot building will be $5,500, plus $10,000 for an expedited process for design and construction review along with fees for a LEED consultant to assist in the process, which could run several thousand dollars.

close to 40%, repay its net extra cost in about three years, and cut its overall carbon output.[5] Perhaps the Empire State Building retrofit will serve as an inspiration for others.

A number of studies have examined the relationship between worker productivity and the work environment, and certain improvements such as better lighting, cleaner air and the lack of volatile organic compounds (VOCs) are shown to improve employee productivity or reduce sick time.[6] But few studies focus on the impact of green buildings. Kats (2003) reviews a sample of 33 green building projects and suggests present value benefits of US$37 to US$55 per square foot as a result of productivity gains from less sick time and greater worker productivity. These results stem primarily from better ventilation, lighting and the general environment. Miller and Pogue (2009) conduct a survey of over 500 tenants in green buildings and find present value benefits that could equal hundreds of dollars, depending on the time horizon for discounting. These early results beg the question why more corporations are not putting greater effort into insisting upon better worker environments.

A paper by Eicholtz, Kok and Quigley (2009) identifies four determinants of the penetration of Corporate Social Responsibility in real estate decision-making. They develop six propositions about which firms or industries are willing to rent green space and to pay a rental premium. The results show that the oil industry is a major consumer of green office space, indicating that firms in environmentally sensitive industries will actively incorporate sustainability in strategic decisions, such as headquarters selection.

[5] See http://www.greenrightnow.com/kabc/2009/04/07/empire-state-building-will-be-retrofitted-into-a-green-giant/.
[6] For a comprehensive review of the literature on worker productivity, see Miller and Pogue (2009).

Firms in the legal and financial services industries lease a substantial share of green office space as well. For some of these firms, further investigation shows support for the notion of productivity benefits from green buildings; however, the authors conclude it is likely that many firms lease green space simply because green buildings are usually higher-quality buildings.

The study at hand examines green buildings from the operations and management perspective, an area that has not been addressed in the growing literature of sustainable real estate. The purpose is to compare the operating performance and green practices between buildings with and without green labels.

Data

The data utilized in the current study was collected from a spring 2009 survey of a portfolio of office properties managed by CB Richard Ellis (CBRE). The property manager of each building filled out an online questionnaire. In addition to descriptions of the property (such as its location, submarket, class, rentable area, etc.), the manager was also asked questions regarding the building's operating performance and sustainability-related practices. A copy of the questionnaire is presented in the Appendix.

The portfolio surveyed includes 154 buildings with the Energy Star label (four of them also have LEED certification) and 105 without a green label. Some of the property managers started but did not complete the questionnaire, or chose not to answer all of the questions. Surveys without valid information have been removed from the dataset. A

subject group of 139 green buildings and a peer group of 103 properties are included in the analyses. These properties are located across the country in 10 different geographical areas, with Southern California having the most observations.[7] Exhibit 1 shows the distribution of both green and traditional buildings across geographical locations.

[Exhibit 1]

Overall, the green buildings in the sample are larger and of better quality. The average size of green buildings is slightly over 360,000 square feet (SF), while the peer group of traditional buildings is approximately 260,000 SF. The majority of the green buildings (73%) are Class A properties; in contrast, 60% of the peer group are Class A. The average occupancy is 87% for green buildings and 84% for the peer group. The average current Energy Star score of the subject group is 84.0;[8] in the peer group, 63 buildings have an Energy Star score, with an average of 71.9.[9]

In a number of recent empirical studies, LEED and Energy Star labels are both used as proxies for green buildings, in contrast to traditional buildings. However, these two rating systems have very different emphases. Energy Star focuses almost exclusively on a building's energy performance. A building that is among the nation's top 25% in terms of energy efficiency and maintains a healthy indoor environment can qualify as an Energy Star building. The U.S. Green Building Council's (USGBC) LEED designation,

[7] In this study, the Southern California region includes Los Angeles, Orange and San Diego counties.
[8] The range of the current Energy Star score for the subject group is 45 to 96. Five of the buildings with the Energy Star label currently have a score below the certification requirement of 75.
[9] In fact, 35 of the 63 properties have an Energy Star score equal to or greater than 75. For whatever reasons, however, they have not been certified as Energy Star buildings.

on the other hand, measures a building's greenness based on a wider variety of features, including site planning, energy, water management, indoor environmental quality and material use. Based on its overall score, the building may qualify for one of the four levels—Certified, Silver, Gold or Platinum.

Of the 139 Energy Star buildings in the sample, only four currently have LEED certification.[10] Among the non-LEED buildings, 52 have registered with the U.S. Green Building Council, and 64 have completed a gap analysis to assess what needs to be done to achieve LEED certification (see Exhibit 2).[11] A considerable number of Energy Star buildings in the sample (62, or 44%) are neither LEED-certified nor working toward LEED certification.

[Exhibit 2]

Analyses of Survey Results

Operating Performance

With the survey data, we first compare the performance of the subject group of green buildings with the peer group in terms of their operating expenses. Because a building with Energy Star certification is by definition more energy-efficient than an average building, we expect the electricity and gas costs of green buildings to be lower than the peer group. Exhibit 3 shows the expenses per square foot (PSF) of the subject group and

[10] One of them was certified as Core & Shell (CS) at the Gold level; the other three were certified as Existing Buildings Operations & Maintenance (EBOM), with one Certified, one Silver, and one Gold.
[11] Of the gap analyses, 17% targeted the LEED Certified level, 42% LEED Silver, and 19% LEED Gold (with the remaining unspecified).

the peer group, including electricity, gas, water, waste removal and the total. As expected, Energy Star buildings have significantly lower electricity ($1.84 PSF vs. $2.19 PSF) and gas expenses ($0.14 PSF vs. $0.22 PSF). Water consumption and waste removal costs are also lower for the subject group, but the difference is not statistically significant.

[Exhibit 3]

When we compare the total operating expenses between the two groups, the results show that the green buildings have higher overall operating expenses ($10.73 PSF vs. $10.34 PSF), albeit insignificantly. This finding suggests that Energy Star buildings may incur additional non–energy-related expenses. Further investigation is necessary to explain this unexpected result.

As many of the buildings in the peer group have an Energy Star score higher than the minimum certification requirement of 75, we further analyze the data by separating the sample into three subgroups: Group 1 includes all properties with the Energy Star label; Group 2 includes buildings without the label but with an Energy Star score of 75 or higher; and Group 3 includes all other properties. Exhibit 4 presents the average operating expenses PSF of the three groups. When Groups 1 and 2 are compared, the results show that Group 1 has lower electricity costs, but Group 2 has lower total expenses. Neither difference is statistically significant. This suggests that there is no significant difference in the operating performance between Groups 1 and 2, even though

one has the Energy Star label and the other one does not. Group 3, however, has significantly higher energy costs (including electricity and gas) than Group 1.

[Exhibit 4]

To assess which factor—Energy Star label or Energy Star score—is a better indicator of a property's energy performance, we run correlation analyses between each factor and operating expenses.[12] Both the Energy Star label and score are negatively correlated with a building's electricity and gas costs, although the correlation coefficient is higher and more significant for the Energy Star score. This is because some of the buildings without the Energy Star label are quite energy-efficient. In terms of total operating expenses, the correlation with the Energy Star label is positive but insignificant, while it is significantly negative with the Energy Star score. These results further confirm that the Energy Star score is a better indicator of a building's energy efficiency.

[Exhibit 5]

Green Practices

In terms of operations and management, one of the measures of a building's greenness is the utilization of green leases, which are becoming more common. The U.S. General Services Administration (GSA) requires prospective landlords to deliver a structure that satisfies LEED Silver standards. Many states, such as California, have similar, if not

[12] Whether a building has an Energy Star label is represented by a binary variable, which has a value of 1 if it is an Energy Star building, or 0 otherwise.

more stringent requirements. Green lease provisions may require a tenant to separate trash for recycling, maintain operational limits for thermostat temperature controls, use occupancy sensors for lighting, use window blinds, limit water or electrical consumption per square foot, and require landlords to have cleaning staff use only green-certified products. Consequences for failure on the part of the tenant or the landlord to live up to these provisions are not always clear, and enforceability will be determined by the courts in cases yet to be heard. Awareness of the provisions and communication of green management requirements and/or tenant obligations is an evolving process.

Although we cannot directly measure whether a building's management has implemented green leases, several related factors are taken into account. Among the Energy Star buildings in the sample, 19 (including two LEED buildings) have established a policy that requires new tenant improvements to be constructed to meet the LEED Commercial Interiors (CI) standards. In the meantime, 15 Energy Star buildings currently have interior space receiving LEED CI certification, ranging from 6,000 SF to 180,000 SF (or approximately 2% to nearly 60% of the rentable area in the building). It is interesting that there is not much overlap between the two factors, given that 11 of the 15 LEED CI buildings do not currently have a tenant improvement requirement.

We then compare the Energy Star buildings in the sample with non-Energy Star buildings based on a number of other features. Exhibit 6 shows the comparison in terms of cleaning practices. Janitorial staff in almost 90% of the Energy Star buildings have utilized green cleaning practices, compared with 85% in non-Energy Star buildings.

Since the difference is not statistically significant, we investigate further based on the Energy Star score (i.e. Groups 1, 2, and 3 as defined previously). It turns out that a much higher percentage of Group 2 buildings have put green cleaning into practice than Group 1, while a lower percentage of Group 3 buildings have done so. A very small number of properties have implemented day cleaning, so a meaningful comparison between day and evening cleaning cannot be made.

[Exhibit 6]

We consider two green devices—restrictive plumbing and motion-controlled lighting—in the survey.[13] The patterns are very similar to that of green cleaning. When the subject group is compared with the peer group—regardless of the Energy Star score—a higher percentage of Energy Star buildings have installed these inexpensive devices. However, when the subject group (i.e. Group 1) is compared with the subgroups of non-Energy Star buildings, these devices have been installed in slightly more Group 2 buildings and significantly fewer Group 3 buildings.

[Exhibit 7]

Three building operation procedures are also compared between the subject and the peer groups, including: 1) an integrated pest management program to reduce/remove toxic chemical pesticides, 2) a no-cost/low-cost best practices plan to conserve energy and

[13] Survey respondents were asked if motion-controlled lighting devices have been installed in all tenant spaces, and if restrictive plumbing devices have been installed in common area restrooms.

water; and 3) a recycling program. The patterns are similar to the comparative analyses of green cleaning and energy-saving devices. The only difference is that a higher percentage of Energy Star buildings have implemented a best practices plan than the peer groups (both Groups 2 and 3).

[Exhibit 8]

Conclusion

This research examines green buildings in the United States from the operations and management perspective—a perspective that has so far been lacking in the growing field of sustainable real estate research and one that is critical to commercial market participants who have expressed skepticism on the topic.[14] With a national sample, which was collected from a survey of office buildings managed by CBRE, we compare the operating expenses and management of 139 green buildings with 103 buildings that do not have a green label. Not surprisingly, our results show that green buildings are more energy-efficient—with savings on electricity, gas, and water costs—when compared with their non-green counterparts. What is surprising, however, is that the average total operating expenses of the green building group is higher than the non-green building group, albeit insignificantly. This suggests that Energy Star buildings may incur additional non–energy-related expenses—an unexpected result that merits further investigation.

[14] For example, NAIOP, the Commercial Real Estate Development Association, has been a leader in providing resources on sustainable development in the United States, but also has been an opponent to regulations and design burdens that impose new costs on building owners and tenants. See www.naiop.org/resourcecenter/gr.cfm.

Even more striking are the findings that point up the importance of the Energy Star score—over the Energy Star label—in judging the "greenness," or even the energy efficiency, of a building. Our results reveal that a building's operating performance is more highly correlated with its Energy Star score, and not the Energy Star label. Thus, the higher a building's score, the lower its operating expenses. It is essential, then, that tenants searching for green space or investors interested in buying a green building look beyond the plaque on the wall when making their decisions.

Likewise, in terms of green practices—implementing green cleaning, installing restrictive plumbing devices and motion-controlled lighting—we find that a higher percentage of buildings that meet the Energy Star standards but have no label have implemented green practices, compared with those that do carry the Energy Star label. This seems to suggest that the Energy Star label is not a good indicator of the "greenness" of a property and that all green buildings are not, in fact, created equal.

We further analyze the sample of Energy Star buildings that are not currently LEED-certified to find out if the management is working toward LEED certification. Slightly less than half of these buildings have completed a gap analysis, and about 40% have registered with the USGBC. We find no correlation between a property's current Energy Star score and its intention to pursue LEED status. A higher percentage of the buildings that have completed a gap analysis or registered with the USGBC have implemented green practices.

This research begins to shed light on the critical role that the operations and management of green buildings plays. Regardless of how many bells and whistles it has, a green building will not be green unless it is operated green. It is the manner in which the green features are utilized that makes all the difference.

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Exhibit 1 Geographical Distribution of Survey Sample

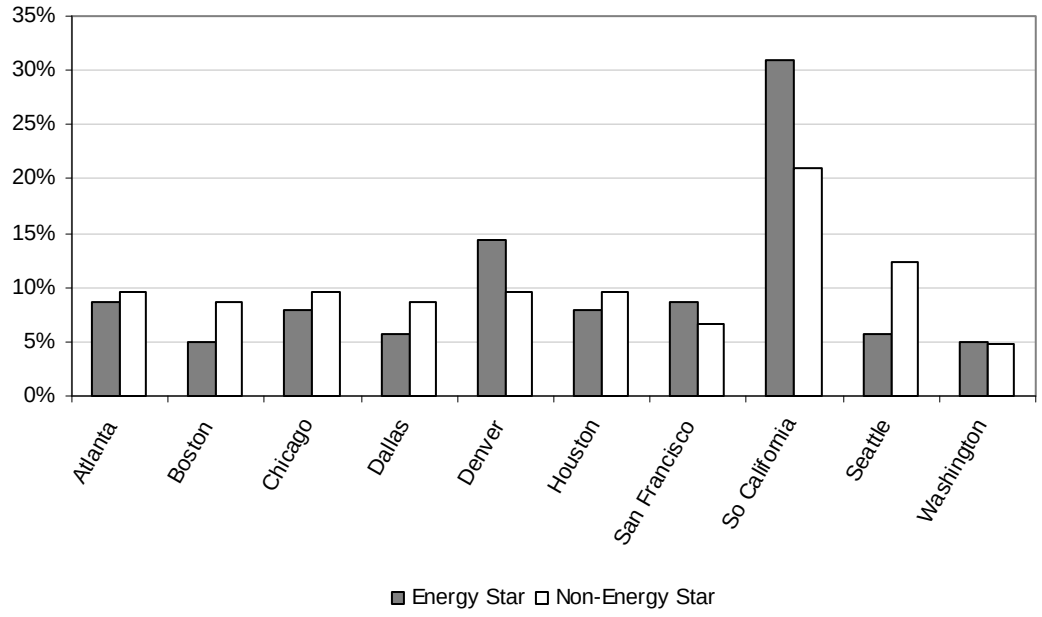
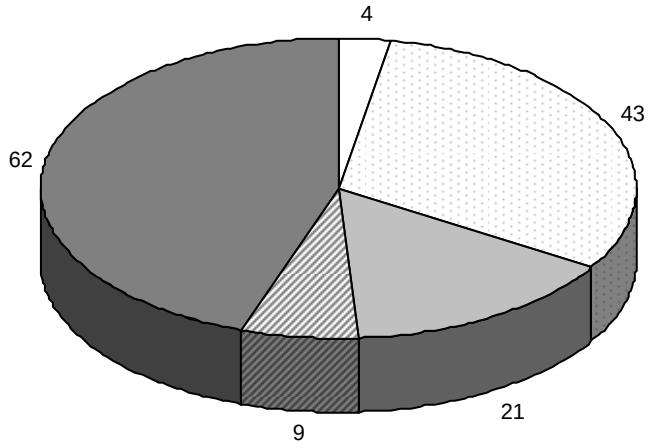


Exhibit 2



- Buildings that have LEED certification
- Buildings that have completed gap analysis and registered with USGBC
- Buildings that have completed gap analysis but not registered with USGBC
- Buildings that have registered with USGBC but not completed gap analysis
- Buildings that have not completed gap analysis or registered with USGBC

Exhibit 3 Comparison of Operating Expenses PSF between Energy Star and Non-Energy Star Buildings

Operating Expense	Electricity	Gas	Water	Waste Removal	Total
The Subject Group: Energy Star Buildings	1.84	0.14	0.13	0.07	10.73
The Peer Group: Non-Energy Star Buildings	2.19*	0.22*	0.15	0.07	10.34

* The number is significantly different from the Subject Group at the 10% level.

Exhibit 4 Comparison of Operating Expenses PSF Based on Both Energy Star Label and Score

Operating Expense	Electricity	Gas	Water	Waste Removal	Total
Group 1: Energy Star Buildings	1.84	0.14	0.13	0.07	10.73
Group 2: Non-Energy Star Buildings with Score≥75	2.07	0.14	0.13	0.06	10.28
Group 3: Non-Energy Star Buildings with Score<75	2.26*	0.25*	0.16	0.08	10.38

* The number is significantly different from Group 1 at the 10% level.

Exhibit 5 Correlation Analyses

Operating Expense	Electricity	Gas	Water	Waste Removal	Total
Energy Star Label†	-0.14**	-0.18**	-0.05	-0.04	0.05
Energy Star Score	-0.28***	-0.23**	-0.02	-0.11	-0.13*

† Binary variable; the value is 1 if the building has the Energy Star label, or 0, otherwise.
* The number is significantly different from the Subject Group at the 10% level.
** The number is significantly different from the Subject Group at the 5% level.
*** The number is significantly different from the Subject Group at the 1% level.

Exhibit 6 Comparison of Cleaning Practices (% of Buildings)

	Green Cleaning Practices	Day Cleaning
The Subjective Group:		
Energy Star Buildings	89.9%	7.9%
The Peer Group:		
Non-Energy Star Buildings	84.8%	5.7%
With Score ≥ 75	97.1%*	3.0%
With Score < 75	78.6%**	8.6%

* The number is significantly different from the Subject Group at the 10% level.
** The number is significantly different from the Subject Group at the 5% level.
*** The number is significantly different from the Subject Group at the 1% level.

Exhibit 7 Comparison of Use of Energy-Saving Devices (% of Buildings)

	Restrictive Plumbing Devices	Motion Controlled Lighting Devices
The Subjective Group:		
Energy Star Buildings	84.9%	33.8%
Non-Energy Star Buildings	68.6%***	26.7%
With Score ≥ 75	91.4%	40.0%
With Score < 75	57.1%***	20.0%**

* The number is significantly different from the Subject Group at the 10% level.
** The number is significantly different from the Subject Group at the 5% level.
*** The number is significantly different from the Subject Group at the 1% level.

Exhibit 8 Comparison of Building Operation Procedures (% of Buildings)

	Integrated Pest Management Program	No-Cost/Low-Cost Best Practices Plan	Recycling Programs
The Subjective Group:			
Energy Star Buildings	64.0%	89.9%	95.7%
Non-Energy Star Buildings	59.1%	64.8%***	82.9%***
With Score ≥ 75	80.0%**	71.4%**	100.0%**
With Score < 75	48.6%**	61.4%***	74.3%***

* The number is significantly different from the Subject Group at the 10% level.
** The number is significantly different from the Subject Group at the 5% level.
*** The number is significantly different from the Subject Group at the 1% level.