

Capital Markets and Sustainable Real Estate: What Are the Perceived Risks and Barriers?

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Abstract This paper examines the perceptions of the real estate capital market players regarding green buildings. Through an online survey of lenders, equity investors, and developers, the study collects and analyzes their opinions on the incremental costs and benefits of energy-efficient projects, as well as the importance of various risks and barriers. While the majority of the respondents believe green buildings should have higher value, they are also concerned that this expectation might not materialize if space users (i.e., tenants) are unwilling to pay extra rent for the benefits associated with green space. Generally, the respondents believe that the lack of consumer awareness of these benefits, along with lack of incentives, is a major barrier to the growth of green development.

“Going green” has been a popular trend in the real estate industry in recent years. This is reflected in the dramatic increase in the number of green buildings worldwide. As of September 2009, there were over 3,800 Leadership in Energy and Environmental Design (LEED) certified commercial projects worldwide, increasing from about 400 in 2005. During the same period of time, the term “Going green” has been a popular trend in the real estate industry in recent years. This is reflected in the dramatic increase in the number of green buildings worldwide. As of September, the number of properties that had registered with the U.S. Green Building Council (USGBC) had increased from approximately 3,300 to more than 25,600.¹ Additionally, many real estate professional groups and industry associations have featured this topic in their publications. Examples include the Counselors of Real Estate (CRE), the Commercial Real Estate Development Association (formerly known as the National Association of Industrial and Office Properties, or NAIOP), the Pension Real Estate Association (PREA), and the Urban Land Institute (ULI).² As sustainable real estate gains popularity in the industry, it has also started to draw the attention of academic researchers.³

The real estate business is highly capital intensive; therefore, a prerequisite of a successful project, either a development or acquisition, is its ability to obtain capital. One may argue that the primary purpose of building green is to reduce, or even eliminate, the negative environmental impacts; nevertheless, it is unlikely that lenders and equity investors would be willing to finance a green building if it is not expected to generate economic benefits. Does going green pay off?

Empirical research has revealed that LEED and ENERGY STAR⁴ buildings on average have higher value, rent, and occupancy than comparable conventional buildings (Miller, Spivey, and Florance, 2008; Dermisi, 2009; Fuerst and McAllister, 2009; Eichholtz, Kok, and Quigley, 2010; Wiley, Benefield, and Johnson, 2010). However, these studies do not compare the estimated benefits directly with incremental costs, if any. As empirical analyses do not provide a definitive conclusion on the profitability of building green, participants in the capital markets face uncertain outcomes when they lend or invest their money in a green project (Cochran, 2008; Vyas and Cannon, 2008; Jackson, 2009). Additionally, it is unclear whether current public policies provide necessary incentives to overcome the barriers (Simons, Choi, Simons, and Johnston, 2009). The purpose of this study is to understand how the real estate capital market participants (including lenders, equity investors, and developers) perceive the cost-benefit tradeoff of green development, and the risks and barriers associated with investing in energy-efficient buildings.

Research Methodology and Data

Because empirical data are unavailable, an online survey was constructed to collect opinions from various types of real estate capital market groups.⁵ The survey questionnaire had four sections. In addition to the general information, the survey asked a series of questions regarding the overall costs and benefits (in terms of property value) of energy-efficient buildings. Respondents were asked to provide their assessment regarding the cost: (1) Is it more expensive to build an energy-efficient building, and (2) If it is, how much higher is the cost? They were also asked to compare energy-efficient buildings to traditional buildings with otherwise similar attributes in terms of value: (1) Does an energy-efficient building have higher value, and (2) If it does, what are the reasons for the higher value? The final question asked whether they thought the higher value (if any) would be sufficient to offset the higher cost (if any).

The third section of the survey presented a list of risk factors that may affect the value of an energy-efficient building and/or the success of an energy-efficient development project. The respondents were asked to rate each risk factor based on how much they were concerned with the factor—from extremely concerned to not concerned at all. The final section focused on the barriers that might discourage the capital markets to provide financing for or invest in energy-efficient buildings/projects. The survey provided a list of perceived barriers and asked the respondents to assess the potential impact of each on their decision to get involved in an energy-efficient project. These barriers and risks were identified by participants in a series of stakeholder workshop held in the spring of 2008.⁶

In June 2008, email invitations to participate in the survey were sent to 900 randomly-selected NAIOP and PREA members.⁷ In total, 132 responses were collected, but 12 of them had missing data and therefore were excluded from the analysis.⁸ Nearly half of the survey respondents were equity investors (49%), with lenders and developers representing 34% and 17% of the sample, respectively. In terms of geographical location, 32% of the respondents were located in California,

followed by Colorado, Illinois, Texas, New York, and Florida (ranging from 7% to 9% each). Over 65% of the respondents had been involved in projects with either LEED certification or ENERGY STAR designation. The high percentage of respondents with experience may indicate a potential sampling bias (i.e., those with experience were more interested in being part of this research project and thus more willing to complete the survey).

Cost/Benefit Comparison

In terms of the cost of an energy-efficient building, relative to that of a traditional building with otherwise comparable features, the vast majority of the respondents believed the cost is higher (94%). More specifically, about one-third of the sample (38%) estimated the incremental cost to be 1% to 5%, and another third (35%) 5% to 10%. Additionally, 21% of the respondents thought that the incremental cost would be over 10%. Exhibit 1 presents the breakdown of the estimated incremental cost.

With regard to value, an overwhelming majority (91.5%) of the sample believed that an energy-efficient building has higher value than a comparable traditional building. Nearly 80% of the respondents considered lower operating costs as the primary reason for the higher value. Other possible reasons include higher rent, a lower vacancy rate, and lower tenant turnover. Exhibit 2 shows the importance of factors contributing to the higher perceived value of energy-efficient buildings.

Given that an energy-efficient building was considered more valuable but also more costly to construct, it would be helpful to know whether the additional value can fully offset the higher cost. The respondents' opinions on this issue were very diverse. Nearly 60% felt that the additional value would be sufficient to cover the incremental cost, with 16% responding "definitely yes" and 42% "probably yes." On the other hand, 22% of the respondents disagreed, with 18% answering "probably no" and 4% "definitely no." The remaining 20% of the participants said that they were not sure about the cost-value tradeoff (Exhibit 3).

Exhibit 1 | Perceived Incremental Cost of Energy-Efficient Buildings

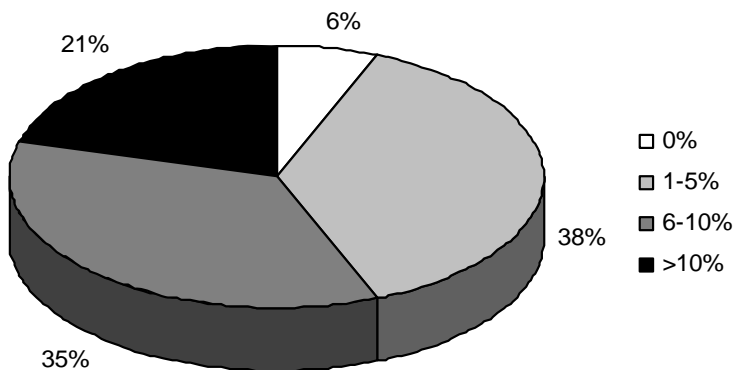


Exhibit 2 | Factors Contributing to Higher Value in Energy-Efficient Buildings

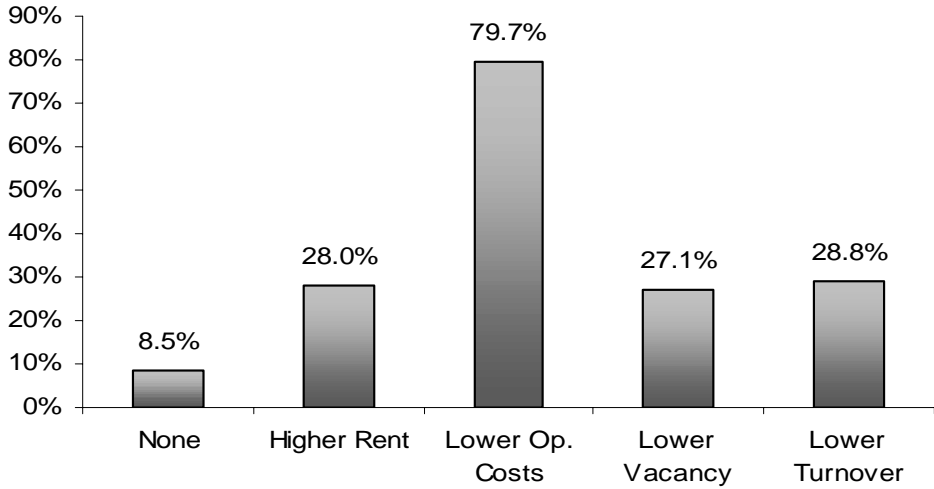
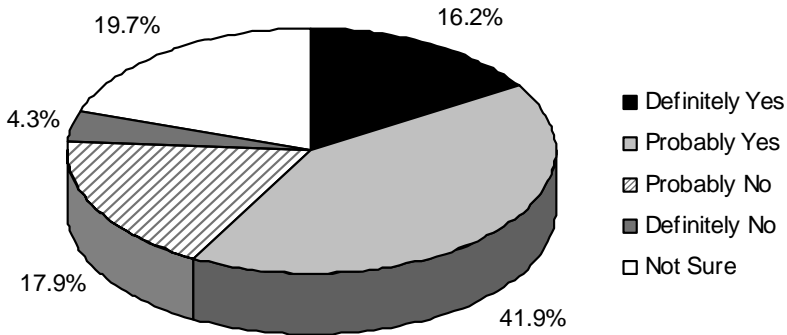


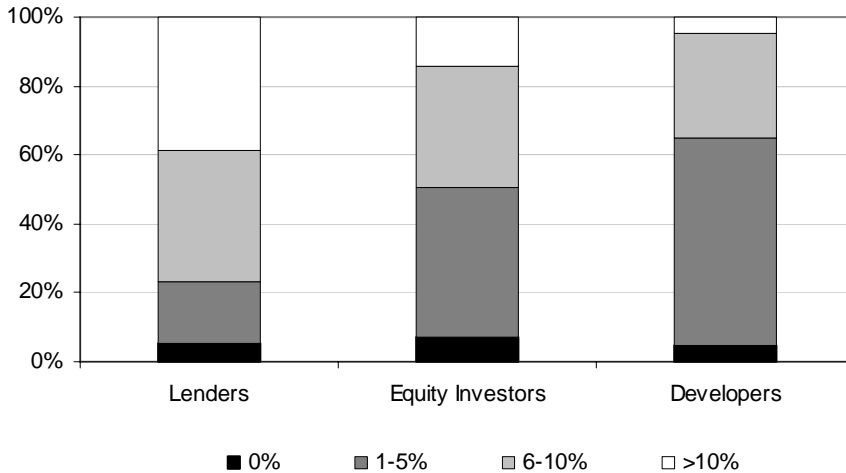
Exhibit 3 | Perception that Added Value is Sufficient to Offset Incremental Cost



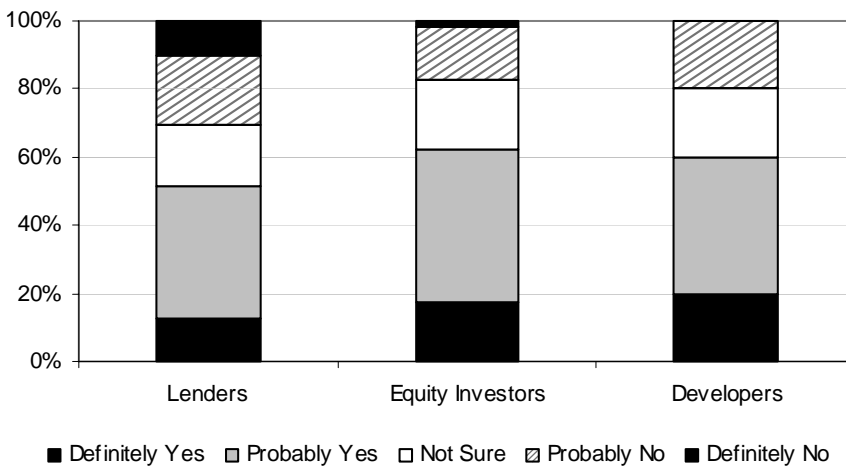
The opinions across different groups of respondents were also compared based on their primary line of business, location, and experience in energy-efficient projects. The comparison between types of capital market participants (i.e., lenders, equity investors, and developers) is quite interesting (Exhibit 4). While the percentage of respondents who believed energy-efficient buildings cost more was similar across the three groups (ranging from 93% to 95%), the opinion on the size of the incremental cost was very different. The chart shows that the majority of the equity investors (51%) and developers (65%) estimated the incremental cost to be 5% or less; in contrast, nearly 80% of the lenders felt that the incremental cost would be higher than 5%. Because of the higher perceived cost, more lenders believed that the additional value would not be sufficient to offset the incremental cost.

Exhibit 4 | Comparison across Types of Capital Market Participants

Perceived Incremental Cost



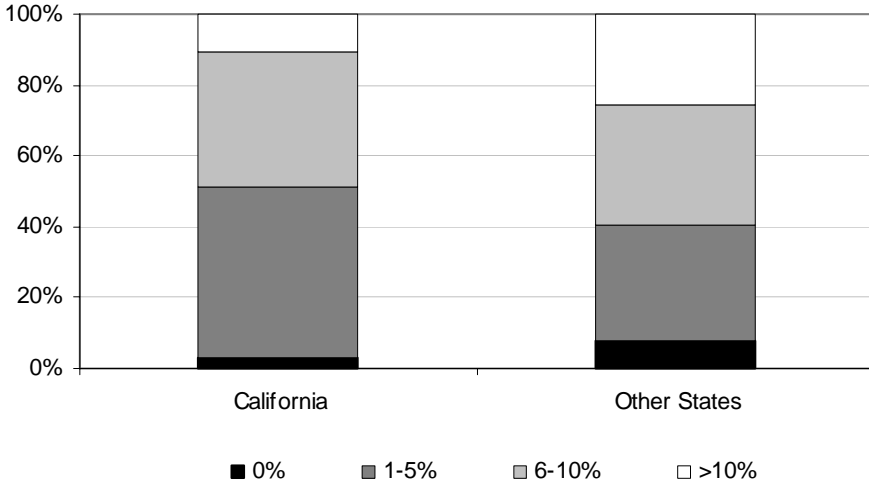
Perception that Added Value is Sufficient to Offset Incremental Cost



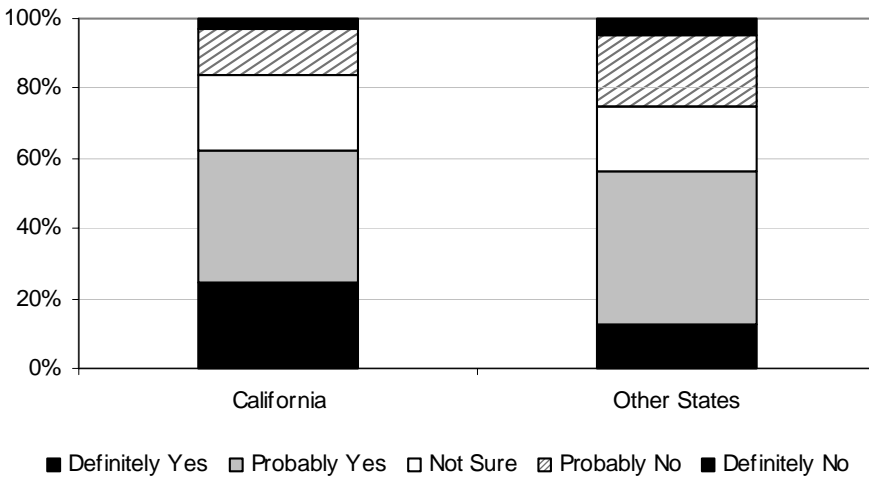
California has arguably the highest standards and regulatory requirements related to environmental impacts and concerns in the nation.⁹ Therefore respondents in California were compared with the rest of the United States to determine if government policy would affect the opinions. The data shows that the incremental cost estimated by respondents in California was lower than others (Exhibit 5). Given that projects in California need to meet higher minimum regulatory

Exhibit 5 | Comparison by Geographical Location (CA vs. Other States)

Perceived Incremental Cost



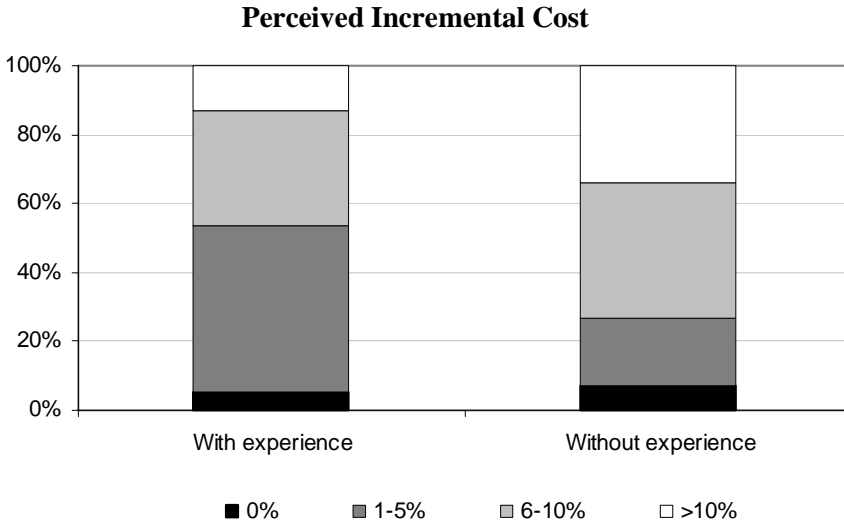
Perception that Added Value is Sufficient to Offset Incremental Cost



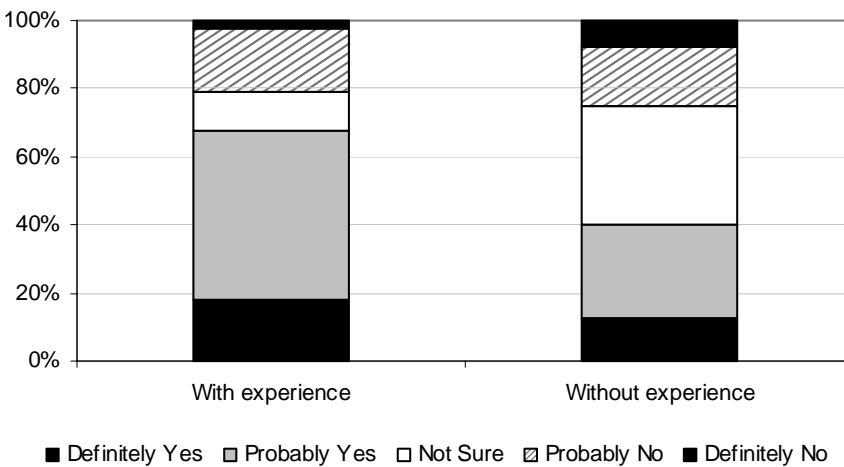
standards to begin with, the additional cost of achieving any kind of green label becomes smaller.

In terms of prior experience in energy-efficient projects, there exists a considerable difference between the two groups. Respondents who had not been involved with energy-efficient projects previously considered the incremental cost to be much higher, and consequently, fewer of them believed that the added value of an

Exhibit 6 | Comparison by Respondent's Experience in Energy-Efficient Projects



Perception that Added Value is Sufficient to Offset Incremental Cost



energy-efficient building would be sufficient to offset the perceived higher cost (Exhibit 6). The result is not surprising since this perception might well be the reason these respondents had not yet become involved in green projects.

It is possible that the three factors (i.e., type of capital market participant, location, and experience) are interrelated in the survey sample. Therefore further analyses were conducted to assess the impact of each factor with all three being considered simultaneously. Two logistic models were estimated.¹⁰ The first one had the

estimated incremental cost (based on the four survey categories) as the dependent variable and used survey participants' line of business, location, and experience as explanatory variables. The value of the dependent variable is 1 if the estimated incremental cost is 0%; 2 if the cost is 1%–5%; 3 if the cost is 6%–10%; and 4 if the cost is greater than 10%. Two binary variables were used to represent a survey respondent's line of business, with equity investors being the reference group. If the respondent was a lender, *LENDER* was equal to 1, otherwise it was 0; if the respondent was a developer, *DEVELOPER* was equal to 1, otherwise 0. *CALIFORNIA* and *EXPERIENCE* were also binary variables, which represented the survey respondent's location and prior experience in energy-efficient projects, respectively.

The parameter estimates presented in Exhibit 7 show that there was no significant difference between the perceptions of developers and equity investors; in contrast, the perceived cost by lenders was significantly higher than equity investors.¹¹ Respondents who had been involved in energy-efficient projects estimated a significantly lower incremental cost than those without prior experience. Interestingly, after controlling for the type of respondent and experience, being in California no longer had a significant effect on the respondent's opinion.

The second model used the same set of independent variables to explain the likelihood of the higher value being sufficient to offset the incremental cost.¹² The signs of parameter estimates were consistent with the previous analyses (Exhibit 8). The results suggest that developers and equity investors had similar opinions, but lenders in general were more pessimistic than the other two groups about the net outcome of building green. Respondents with experience in energy-efficient projects had more confidence that the higher cost would be offset by the added value. Again, the respondent's location did not have a significant effect.

Perceived Risks

The survey respondents were asked to rate seven risk factors according to the level of concern they had as to how each risk could affect the success of an energy-efficient building. The risk factors were rated using the following scale: extremely concerned (4), moderately concerned (3), mildly concerned (2), not concerned (1), and not sure (NA). A concern factor was calculated as the weighted average of the ratings (excluding those who were not sure about the impact). Exhibit 9 ranks the risk factors based on the mean value of concern factor.

Overall, the survey sample was most concerned about not being able to benefit from the higher value of energy-efficient buildings, either because tenants would not be willing to pay a higher rent (a concern factor of 2.75) or because the added value would not be recognized by others, such as lenders or appraisers (2.62). The concern factor of these two risks was significantly higher than others, but there was no significant difference between them.¹³ On average, the survey participants were least concerned about the possibility that the entitlement process might take longer (1.63), and there is a significant gap between this risk factor and all others.

Exhibit 7 | Estimation Results of Incremental Cost Model

	Estimate	Chi-Square	p-value
Intercept1	-1.54	5.91	0.015
Intercept2	1.19	4.51	0.033
Intercept3	3.10	24.20	0.000
LENDER	-1.26	9.49	0.002
DEVELOPER	0.27	0.27	0.599
CALIFORNIA	0.63	2.50	0.113
EXPERIENCE	1.02	7.27	0.007

Notes: The dependent variable is the estimated incremental cost. The value is 1 if the incremental cost is 0%; 2 if the cost is 1%–5%; 3 if the cost is 6%–10%; and 4 if the cost is greater than 10%.

Exhibit 8 | Estimation Results of Net Pay-off Model

	Estimate	Chi-Square	p-value
Intercept1	-4.27	35.27	0.000
Intercept2	-2.37	16.62	0.000
Intercept3	-1.40	6.43	0.011
Intercept4	0.67	1.51	0.218
LENDER	0.60	2.44	0.097
DEVELOPER	0.30	0.37	0.540
CALIFORNIA	-0.59	2.37	0.123
EXPERIENCE	-0.73	4.13	0.042

Notes: The dependent variable is the perception that added value is sufficient to offset incremental cost. The value is 1 if answer is "Definitely Yes," 2 if "Probably Yes," 3 if "Not Sure," 4 if "Probably No," and 5 if "Definitely No."

Exhibit 10 compares the perception of risk factors by the different types of capital market participants, with the mean value of concern factor and the ranking (in parentheses). All three groups were most concerned about the possibility that tenants might not be willing to pay higher rent for "green" space. For lenders and equity investors, the next most important risk was the possibility that the benefits of an energy-efficient building might not be reflected in value, whereas developers ranked this risk factor third. Developers were more concerned about additional requirements and fees involved in energy-efficient projects; in contrast, this factor was ranked third by lenders and fifth by equity investors.

Exhibit 9 | Perceived Risks of Energy-Efficient Projects

Risk	Concern Factor ^a
Tenants might not be willing to pay higher rent for green space.	2.75
The benefits of an energy-efficient building might not be reflected in value (by lenders, appraisers, etc.).	2.62
The owner might be unable to benefit from the higher value when selling the building.	2.28 ^b
There might be additional requirements and/or fees involved.	2.26
As technology continues to change, the building might become functionally obsolete soon.	1.97
The design process might take longer due to the lack experienced teams.	1.93
The approval/entitlement process might take longer.	1.63 ^b

Notes:

^aEach respondent rated the risks using the following scale: extremely concerned (4), moderately concerned (3), mildly concerned (2), not concerned (1), and not sure (NA). The concern factor is the weighted average of the ratings, excluding those who were not sure about the impact.

^bThe concern factor is significantly different from the one above at the 5% level.

Exhibit 10 | Comparison of Risks across Different Types of Capital Market Participants

Risk	Lenders	Equity Investors	Developers
Tenants might not be willing to pay higher rent for green space.	2.87 (1)	2.66 (1)	2.72 (1)
The benefits of an energy-efficient building might not be reflected in value.	2.72 (2)	2.63 (2)	2.33 (3)
The owner might be unable to benefit from the higher value when selling the building.	2.18 (4)	2.41 (3)	2.17 (4)
There might be additional requirements and/or fees involved.	2.29 (3)	2.15 (5)	2.53 (2)
As technology continues to change, the building might become functionally obsolete soon.	1.74 (6)	2.22 (4)	1.78 (6)
The design process might take longer due to the lack experienced teams.	1.95 (5)	1.91 (6)	1.94 (5)
The approval/entitlement process might take longer.	1.70 (7)	1.54 (7)	1.78 (6)
Average	2.21	2.22	2.18

Note: Value in parentheses is the ranking of the risk factor.

When the opinion of respondents with prior experience in dealing with energy-efficient projects was compared with those without experience, the rankings of risk factors were very similar (Exhibit 11). However, capital market participants who had not financed or invested in this type of project were much more concerned about the various risks. Overall, the concern factor is 2.59 for those without experience, compared with 2.01 for those with experience. Additionally, the difference is statistically significant across all seven risk factors.

Perceived Barriers

Survey respondents were also asked to assess the impact of five barriers that were believed to influence financing/investment decision-making regarding energy-efficient buildings. They rated each barrier using the following scale: great impact (4), moderate impact (3), little impact (2), no impact (1), and not sure (NA). An impact factor was then calculated as the weighted average of the ratings (Exhibit 12). The top barrier was that consumers and space users (such as homebuyers, apartment renters, and commercial tenants) were not aware of the benefits of green buildings, and thus would not be willing to pay more for it (with an impact factor 2.67). The next two were the lack of incentives, from both the public sector [i.e., state and local governments (2.65)] and the private sector [e.g., utilities and financial institutions (2.58)]. The results indicated less of a concern relative to building codes and the availability of experienced professionals. There were no statistically significant differences among the top three barriers in terms of their ratings by the survey respondents; on the other hand, the last two barriers were significantly less important.

Exhibit 11 | Comparison of Risks Based on Respondent Experience

Risk	With Experience	Without Experience
Tenants might not be willing to pay higher rent for green space.	2.53 (1)	3.13 (1)
The benefits of an energy-efficient building might not be reflected in value.	2.36 (2)	3.08 (2)
The owner might be unable to benefit from the higher value when selling the building.	2.12 (3)	2.63 (4)
There might be additional requirements and/or fees involved.	1.99 (4)	2.78 (3)
As technology continues to change, the building might become functionally obsolete soon.	1.88 (5)	2.18 (6)
The design process might take longer due to the lack experienced teams.	1.77 (6)	2.24 (5)
The approval/entitlement process might take longer.	1.40 (7)	2.08 (7)
Average	2.01	2.59

Note: Value in parentheses is the ranking of the risk factor.

Exhibit 12 | Perceived Barriers of Energy-Efficient Projects

Barrier	Impact Factor ^a
Consumers / space users are not aware of the benefits of green buildings.	2.67
State / local governments do not provide sufficient financial incentives.	2.65
The private sectors (such as lenders, utilities, among others) do not provide sufficient incentives.	2.58
Experienced design teams are difficult to find.	2.25 ^b
Local building codes are out-dated, so green building may violate many codes.	2.21

Notes:

^aEach respondent rated the barriers using the following scale: great impact (4), moderate impact (3), little impact (2), no impact (1), and not sure (NA). The impact factor is the weighted average of the ratings, excluding those who were not sure about the impact.

^bThe impact factor is significantly different from the one above at the 5% level.

Exhibit 13 presents the average rating of each barrier, as well as its ranking among the barriers (in parentheses), across the entire sample and by different capital market participants. Equity investors considered the lack of consumer awareness of the benefits of green buildings as the biggest barrier; lenders and developers, in contrast, perceived the lack of government incentives as the top barrier. The top three barriers also included the lack of incentives from the private sector, such as utilities and financial institutions. All three groups agreed that neither the local building codes nor capable design teams were barriers with great impact.

Exhibit 13 | Comparison of Barriers across Different Types of Capital Market Participants

Barrier	Lenders	Equity Investors	Developers
Consumers / space users are not aware of the benefits of green buildings.	2.68 (2)	2.70 (1)	2.53 (2)
State / local governments do not provide sufficient financial incentives.	2.71 (1)	2.53 (3)	2.88 (1)
The private sectors (such as lenders, utilities, among others) do not provide sufficient incentives.	2.58 (3)	2.63 (2)	2.38 (3)
Experienced design teams are difficult to find.	2.31 (4)	2.26 (4)	2.06 (5)
Local building codes are out-dated, so green building may violate many codes.	2.31 (4)	2.14 (5)	2.18 (4)
Average	2.52	2.45	2.40

Note: Value in parentheses is the ranking of the barrier.

Exhibit 14 | Comparison of Barriers Based on Respondent Experience

Barrier	With Experience	Without Experience
Consumers / space users are not aware of the benefits of green buildings.	2.51 (2)	2.95 (1)
State /local governments do not provide sufficient financial incentives.	2.60 (1)	2.74 (3)
The private sectors (such as lenders, utilities, among others) do not provide sufficient incentives.	2.49 (3)	2.75 (2)
Experienced design teams are difficult to find.	2.14 (4)	2.43 (4)
Local building codes are out-dated, so green building may violate many codes.	2.10 (5)	2.42 (5)
Average	2.37	2.66

Note: Value in parentheses is the ranking of the risk factor.

Exhibit 14 compares the impact factor of barriers between respondents who had been involved in energy-efficient projects with those who had not. Respondents with experience considered the lack of government incentives as the biggest barrier to energy-efficient projects, followed by the lack of consumer awareness of the benefits of green space. In contrast, respondents who had not been involved in LEED or ENERGY STAR projects felt that the lack of consumer awareness had the greatest impact on their decision-making; the lack of incentives offered by the private sector and the public sector were ranked second and third, respectively. Regardless of their experience, the respondents agreed that local building codes and a capable design team would have much less impact than the other three barriers. Similar to the concern factor of risks, the impact factors of barriers for respondents without experience were significantly higher than those with experience across all barriers.

Conclusion

This study examines the perceptions of the real estate capital markets regarding energy-efficient buildings. An online survey was conducted to collect the views and opinions of market participants (including lenders, equity investors, and developers) in terms of costs and benefits, risks, and barriers. Analyses of the survey responses reveal diverse opinions across the entire sample. While more than half the respondents felt that the added value of energy-efficient buildings would be sufficient to offset the incremental costs, over 20% of the sample disagreed and another 20% were not sure. The results provide a better understanding of how capital market players perceive the cost-benefit tradeoff of green buildings. The mere fact that the survey respondents had remarkably different opinions leads to the conclusion that uncertainties exist. In terms of

specific risk factors, the respondents considered the possibility that: (1) tenants are not willing to pay higher rent; and (2) benefits are not reflected in value as the top two concerns. On the other hand, lack of consumer awareness of the benefits of green buildings and lack of incentives (provided by both the public and private sectors) were perceived as the main barriers.

The comparison between the different types of capital market participants revealed interesting differences. While the perceptions of equity investors and developers were more comparable, lenders were less positive about the financial payoff of green buildings. All three groups were most concerned about the possibility that space users might not be willing to pay extra for the benefits associated with green space. After that, their opinions differ substantially. For example, the additional requirements and fees factor was ranked second by developers, but fifth by equity investors. In terms of barriers, equity investors considered lack of consumer awareness the biggest barrier, whereas developers and lenders felt that the lack of government incentives would have more impact on their decisions.

This study fills a void in the existing literature in that few studies have examined the risks and barriers related to green buildings, particularly from the capital market perspective. Several studies have assessed the performance of existing buildings and, in some manner, found that green properties have higher value, rent, and occupancy. Despite these findings, green buildings still represent only a small portion of the real estate stock. Additionally, studies have reviewed public policies related to green building and sustainability, but it remains to be seen whether capital market players believe that the federal, state, and municipal governments have created the correct and necessary incentives, and have set up the appropriate policies to overcome the barriers and mitigate the risks. The findings of this study provide some insights regarding those issues.

This study is the first step toward a better understanding of the capital market perceptions regarding sustainable real estate and green buildings, and further research is needed in this area. Since the marketplace is changing rapidly due to market factors and newly enacted green building policies and laws, new research may continue to update the viewpoint of capital market players. Other research may investigate in more detail the type and impact of risk caused by building green. Additionally, the scope of the barriers may be identified, discussed, and quantified. Most importantly, further research may be conducted pertaining to the current incentives to determine whether they have been properly designed and successfully implemented from the perspective of the capital market players, and whether any additional incentives should be brought into the marketplace.

Endnotes

- ¹ See U.S. Green Building Council (2010). For information about USGBC and the LEED rating system, visit www.usgbc.org.
- ² In 2008, CRE published a special issue of *Real Estate Issues*, focusing on “green” development and building. The main purpose was to illustrate the importance of introducing risk into the sustainability equation (Cochran, 2008; Vyas and Cannon,

2008). “Green” was the feature story of the 2007 Spring issue of *Development*, the official publication of NAIOP (Rand, 2007). In the summer of 2007, PREA dedicated an entire edition of the *PREA Quarterly* to “green development” and “green building,” (Anderson, 2007). ULI launched a quarterly publication entitled *Urban Land Green*, with cover stories, featured articles, special sections, and columns all dedicated to “green development.”

- ³ For example, at the 2009 American Real Estate Society (ARES) annual meeting in Monterey, CA, two paper sessions and a panel discussion focused on green and sustainable real estate. Also, the Homer Hoyt Institute (an independent research and educational foundation) focused on green and sustainable real estate in its May 2009 meeting.
- ⁴ While there exist numerous green building rating systems, LEED and ENERGY STAR are most commonly referred to in the U.S. (Fowler and Rauch, 2006).
- ⁵ The online survey was created on <http://www.surveymonkey.com>.
- ⁶ The workshops were part of the Chula Vista Research Project (CVRP), a study that was sponsored by the U.S. Department of Energy and the California Energy Commission. Workshop participants included representatives of the: (1) real estate development transaction chain, including investors, lenders, developers and builders, design professionals, and brokers; (2) environmental organizations and community advocacy groups; and (3) local and state government agencies.
- ⁷ NAIOP, the Commercial Real Estate Development Association, is the leading organization for developers, owners, and related professionals in office, industrial, and mixed-use real estate. PREA is a non-profit trade organization for the global institutional real estate investment industry.
- ⁸ The response rate is relatively low, compared with several recent studies utilizing the survey approach. Their response rates range from 20% to 35% (Gibler, Sah, and Chen, 2008; Manning, Harrison, and Webb, 2009; Worzala and Tu, 2010). The response rates themselves, however, “do not necessarily differentiate reliably between accurate and inaccurate data” (American Association for Public Opinion Research, 2010).
- ⁹ For example, California Assembly Bill 32: Global Warming Solutions Act of 2006 requires that the state’s greenhouse emissions be reduced to the 1990 level by 2020 (Air Resources Board, 2010). In January 2010, California announced the first-in-the-nation statewide green building code that would take effect on January 1, 2011 (Office of the Governor, 2010).
- ¹⁰ The logistic procedure is used to fit linear regression models with binary or ordinal response data using the method of maximum likelihood. When the dependent variable Y has one of a number of ordinal values $(1, \dots, k, k + 1)$, the procedure fits a set of parallel lines based on the cumulative distribution probabilities (Pr):

$$\Pr(Y \leq i|x) = \alpha_i + \beta'x, 1 \leq i \leq k.$$

Where $\alpha_1, \dots, \alpha_k$ are k intercept parameters, β is a vector of slope parameters, and x are the explanatory variables.

- ¹¹ The negative parameter estimate indicates a lower cumulative probability of low-cost categories. In other words, lenders are more likely to select a higher incremental cost.
- ¹² The value of the dependent variable is 1 if the answer is “Definitely Yes,” 2 if “Probably Yes,” 3 if “Not Sure,” 4 if “Probably No,” and 5 if “Definitely No.” That means the

higher the value, the less likely the respondent thought that the added value would be sufficient to offset the incremental cost.

- ¹³ Two risk factors are considered “significantly different” if the gap between their means is statistically different from 0 at the 5% significance level. The same analysis was also applied to the impact factor of barriers.

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