Demand for Green Buildings: Office Tenants' Stated Willingness-to-Pay for Green Features

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Abstract

In this study, we analyze the demand for green office building features among office tenants in the United States. An online survey of a random sample of office tenants in 17 major U.S. markets is employed. Respondents provided their perspective on green buildings and their willingness-to-pay (WTP) for green features. They have the highest WTP for improved indoor air quality and access to natural light. The results show that public firms, along with those in the energy and information technology industries are most likely to pay for green-labeled buildings. Regional and demographic preferences are shown in both WTP and attribute ranking. The findings provide implications for policymakers and property developers in terms of which green building features are considered to be most important for green building practices, and how demand for green features potentially differs across regions.

The importance of green buildings and the potential for revenue premiums in Leadership in Energy and Environmental Design (LEED) and ENERGY STAR buildings is well established, and several theories for those premiums have been put forward (Eichholtz, Kok, and Quigley, 2010; Fuerst and McAllister, 2011; and Das and Wiley, 2013). However, whether tenants pay for specific building-level amenities, such as access to natural light, efficient lighting systems, and proximity to public transportation, or simply for the branding effect of LEED or ENERGY STAR is relatively unexplored.

This study attempts to fill that gap in the literature by ''unpacking'' the green building premium into its component parts and examining office tenant demand for 18 specific green building features. The core questions addressed are which specific green building attributes tenants most value and demonstrate preferences. A random sample of over 3,000 leases in 329 office buildings in the United States in 17 geographically diverse MSAs[1] is sampled in an online survey. Survey design stems from seven focus groups in four geographically representative U.S. cities, the results of which are detailed in Simons, Robinson, and Lee, 2014.

Office tenants are asked to provide their perspective on green buildings, preferences for green building features, and their willingness-to-pay (WTP) for those features. The use of contingent valuation to estimate market preferences is well supported (Carson, 2012) and further detailed in the literature review. While all survey data have inherent limitations, the results of this survey provide the most current information with respect to tenant preferences. The literature on revealed preferences primarily uses average weighted rent for each building, which typically includes leases originated 3–10 years prior.

We introduce the initial findings of the survey, providing implications for real estate building designers and developers. The revealed attribute-level preferences may improve decision-making for practitioners and provide additional research opportunities for academics.

Literature Review

A growing number of studies suggest that green buildings provide economic, environmental, and social benefits through several mechanisms including lower operating costs, employees' improved productivity, tax credits, and buildings' positive images (Fuerst and McAllister, 2011). Kok, Miller, and Morris (2012) find that LEED-certified buildings have a 7.1% rental premium compared to non-certified buildings. Additionally, their study shows that buildings yield a higher rental premium with both LEED and ENERGY STAR certifications. Fuerst and McAllister (2011) suggest a rental premium of 5% for LEED-certified buildings and 4% for ENERGY STAR buildings; they also find a sale price premium of 25% for LEED buildings and 26% for ENERGY STAR buildings, with higher levels of LEED certification providing a higher premium.

Reichardt, Fuerst, Rottke, and Zietz (2012) track a rental premium for both ENERGY STAR and LEED-labeled buildings from 2000 to 2010. Their findings show that a significant rental premium for both voluntary green certified buildings increased steadily from 2006 to 2008, followed by a slight decline after 2008 due to the ''great recession.'' Empirical studies showing the differing premiums over time and across different size and regions include Das and Wiley (2013) and Robinson and McAllister (2015). To account for potential regional economic differences, this research follows those economic regions established by Crone and Clayton-Matthews (2005) in their configuration of economic regions that share similar industrial and social traits. This is selected over U.S. census regions and other schemes [(e.g., Malizia and Simons (1991) who use the Salomon Brothers configuration] because it is more recent and presumably a better measure of current economic relations.

Many commercial building tenants also consider buildings as a space to publicize their environmentally-friendly posture, consistent with a green or sustainable corporate policy. Corporate social responsibility (CSR) policies can incentivize

tenants to extract social benefits from green buildings, beyond the tenants' direct corporate profit (Eichholtz, Kok, and Quigley, 2009).

Lease structure can also affect which financial entity (owners vs. tenants) benefits from green building utility expenses (Jain and Robinson, 2015). In a Triple Net (NNN) lease structure, where tenants pay all utilities in addition to base rent, they may be motivated to pay an increased rent to earn ongoing benefits for certain cost-saving features. On the other hand, building owners, who pay all utility costs in a full service gross (FSG) lease, benefit more directly from those cost-saving features, questioning whether tenants would be willing to pay for them in this structure. The topic of lease structure-related premiums has received increased attention in regards to commercial real estate (Liu and Liu, 2013).

In addition to the empirical studies on the green premium, several researchers examine the effect of public policies on the market penetration of green buildings. Simons, Choi, and Simons (2009) demonstrate that public policies affect the green building market in different ways. For instance, they find that executive orders are a quicker method for encouraging green buildings, while state-level legislation is more related to politics, and slower to take effect.

As summarized above, interest in green buildings and their specific features, development of new space, retrofitting existing space, and return on investment in green features is growing (Aroul and Hansz, 2012). But how should developers proceed? Robinson and Sanderford (2016) find little statistical evidence that building attributes are good predictors of green building certification, which leads to the question: Which green building attributes are valued?

In this study, we use a method of rental premium estimation widely called contingent valuation analysis (CV), which has been generally accepted for over 30 years. As far back as 1982, Brookshire, Thayer, Schulze, and D'arge (1982) confirmed ''the validity of survey methods as a means of determining a public good,'' through their analysis of real estate values. Contingent valuation is a well-known approach to measure a consumer's stated preference for a good, service, or policy (Carson and Hanemann, 2005). CV is used to estimate an individual's stated WTP for a subject, attribute, or policy, such as a change in environmental amenities, using survey questions that elicit information on how much each sampled individual would be WTP to have the subject or policy implemented (William, Morey, and Lodder, 1998). As the name of CV indicates, survey research measures the contingent values revealed by respondents upon hypothetical or constructed projects or programs (Portney, 1994). A diverse group of economics and real estate journals have publications using stated WTP and/or contingent valuation (Simons, 2002). Stigka, Paravantis, and Mihalakakou (2014) use WTP to evaluate sustainable energy pricing. Simons and Winson-Geideman (2005) also use CV in estimating real estate values related to environmental contamination. Lu, Peng, Webster, and Zuo (2015) use survey-based CV to estimate WTP for waste disposal mechanisms. Although important in determining

the value of amenities, some incongruity may occur between the stated WTP and actual WTP (Lindsey and Knaap, 1999), thus caution should be used in interpreting CV results.

We examine a key research gap using CV: what specific building-level amenities, including location-related factors, drive the rental and sales premiums, from the tenants' perspective? Do tenants pay simply for green branding, and/or to achieve a corporate social responsibility (CSR) benefit, or are specific attributes desirable to tenants? What are they WTP for various specific green features? Furthermore, if specific green attributes are desirable, could developers/owners maximize the value of their own real estate holdings by adding these green features without necessarily achieving a LEED certification? We fill the research gap using an online tenant survey and report the results below.

Data Gathering Procedures

Survey Process

Data are collected using a web-based survey distributed to tenants occupying space in over 3,000 leases in 329 U.S. office buildings in 17 geographically diverse MSAs. All properties were managed by CB Richard Ellis (CBRE) during the summer of 2014, but are owned by a diverse set of institutional owners, each with their own management profile and preferences. Other than through property management, the tenants have no relationship with CBRE. The survey instrument is based on focus groups conducted as part of the Real Green Research Challenge (Simons, Robinson, and Lee, 2014). The focus groups explored which specific green features are valued by real estate market participants, and how to best collect data on preferences. Seven focus groups, with a total of 49 participants, were conducted in four major metropolitan areas: Chicago, Washington D.C., Denver, and the San Francisco Bay area. Participants included building managers, tenant representatives, project managers, researchers, and architects/engineers. The focus groups for each area are identical in content, but followed one of two formats: in person or remote webinar-based. Prior research has shown that virtual focus groups are qualitatively similar to their in-person counterparts (Reid and Reid, 2005).

The final survey instrument underwent rigorous pre-testing to account for completion time (target of 15–20 minutes), item clarity, functionality, and other issues commonly found in web-based surveying. Respondents receive the survey invitation via a preliminary email from their CBRE building manager. The invitation to participate came a day later, and contained a greeting, general introduction to the research study, including the opportunity to win one of two iPad® Air devices, and a survey link. The survey itself includes an informed consent page (required by the Cleveland State University IRB), where respondents are assured that their responses are confidential. The surveys were collected over

a four-month period, and respondents were reminded up to four times via email about the opportunity to participate. Overall, 3,015 tenants were invited to participate, and 708 provide complete responses, for a response rate of 23%.

Data Collected

Each respondent provided general information about their organization and themselves. Background information was acquired on the tenant company's total space within the building, primary industry (e.g., construction, food services, education, advertising, etc.), primary function (e.g., executive/administrative, manufacturing, sales, etc.), and number of employees at that location. Individual respondent demographics included position within the company, years with the company, education level, age, primary mode of transportation to work, self-reported knowledge of green building characteristics (categorized as low, medium, or high), and gender.

Respondents were asked about the driving forces behind the company's decision to locate in its current building by ranking the top three of 13 attributes, including green building features, prices, proximity to public transportation, LEED designation, and location.

Six items were employed to assess respondents' overall attitudes towards general green initiatives. These items are endorsed on a 5-point Likert scale from 1 (Strongly Disagree) to 5 (Strongly Agree). Sample questions included: ''I feel like green buildings can comfortably accommodate more people in the same space than a traditional building;'' and ''An ENERGY STAR building is more valuable than one without an ENERGY STAR Certification.'' Three additional specific factual questions pertain to the tenant's sustainability initiatives. For example, the first item was: ''Have sustainability initiatives, other than building-related, been discussed at a company meeting you have attended in the last six months?'' Two items are asked regarding the company's LEED and ENERGY STAR ratings. Both items simply asked whether the respondent knows the company's ranking/score respectively, and if so, to include it.

Two ways of estimating the economic value of WTP for specific green office building features are used. The first is an ordinal ranking and prioritization of each green item among 18 green features. The second is more direct: the respondents' stated WTP additional rent in exchange for specific green features, a revealed preference technique in the spirit of contingent valuation, discussed above in the literature review section. These survey data provide the most cutting-edge information in what real estate executives (in related interviews on green office buildings) call a fast-changing set of preferences. Building average rent, or individual lease rent, may reflect old information.

Based on this approach, we developed a series of questions to measure the office building tenant's stated WTP for each green building attribute. Respondents were presented with only the list of nine attributes (out of 18) they ranked as being

most important from earlier in the survey and asked to place a percentage value on each item, in the context of their actual current rent and lease structure. The root question was: ''How much more, in percentage terms, would you pay for each attribute?'' A sample question is: If you were comparing a building that has the feature listed below to a building that does not have the feature listed below, how much more, if any, do you feel your company would pay for that attribute? Their choices: percentage of the total rental price: less than −1%, −1%, 0%, 1%, 2%, 3%, 4%, or more than 4%.

Profile of Respondents

Exhibits 1 and 2 show a breakdown by region and job category of the 708 respondents, respectively. The sample is from throughout the U.S. Closely proportionate to the number of buildings and tenants, almost half (45%) of the respondents are from the Far West region, followed by Energy Belt (29%), Great Lakes (14%), and Southeast (9%). The Mideast region is under-represented (3%). No buildings from New England are available. Response rates by region are generally about 25%, except for the lower rate in the Mideast (11%).

About 15% of respondents are of leadership rank: president, vice president, chief executive officer, chief financial officer, or chief operating officer. Office managers comprise just over half the responses, and dominate the non-leadership group. Numerous statistical and qualitative measures of these data indicate leaders and office managers have similar opinions about green features (see Survey Validity section).

The median number of employees per each tenant company is 17, thus the average of 59 employees is inflated by several larger tenants. A total of 58% of respondents have a bachelor's or higher degree. Respondents have a generally stable employment history: 60% have worked for the company more than six years, while 35% of respondents have more than 10 years of work experience in the company. The age of survey respondents is evenly distributed among different age groups, but female respondents account for a relatively large portion (69%).

A total of 17% of the respondents (118 companies) belong to the finance and insurance industry sectors and 11% (78 companies) belong to the legal services sector. In terms of lease structure, a full service gross lease accounts for 53% (370 tenant companies) of the sample, triple net lease represented 33% (234 companies), with the balance being modified gross leases.

Survey Validity

The survey performed is the largest and most comprehensive survey to date on tenant stated WTP for commercial real estate building features. It involves a considerable national sample and was developed through a series of industry focus

Exhibit 1 | Distribution of Survey Participants by Region

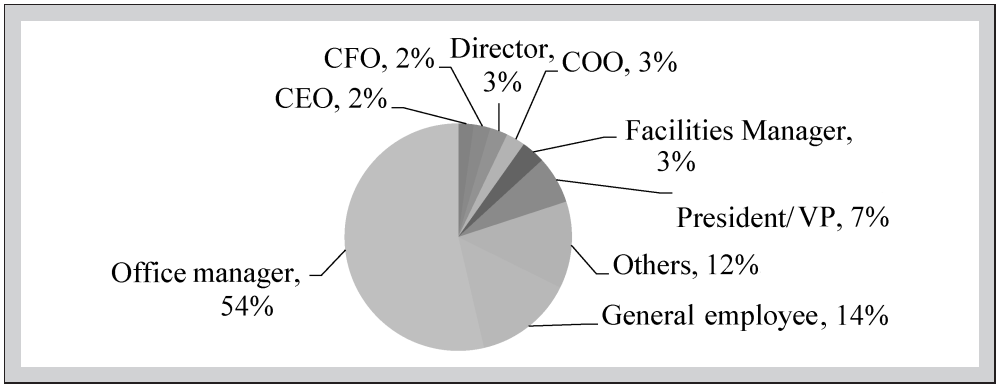
Region	# of Buildings	Building % Total	# of Tenants	Tenant % Total	# of Complete Responses	Respondent % of Total	Response Rate
Mideast	17	5%	202	7%	22	3%	11%
Southeast	28	9%	229	8%	61	9%	27%
Great Lakes	43	13%	398	13%	98	14%	25%
Energy Belt	79	24%	741	25%	205	29%	28%
Far West	162	49%	1445	48%	322	45%	22%
Total[a]	329	100%	3015	100%	708	10%	23%

Note:
[a]Difference-of-means tests show no statistically significant difference between population and sample.

groups. The survey is clearly representative of an institutionally managed portfolio, which should presumably contain more sophisticated tenants, compared with the population of all office tenants.

No statistical differences between respondents and population are found in base rent, geography (based on tenant data provided in Exhibit 1), or external factors (such as outdoor air quality). A statistical difference in mean tenant size is found due to the higher number of small tenants in the sample. However, smaller tenants' overall contribution to building rent is minimal. Among more corporate-oriented tenants with a standard space of 5,000 SF or above, no statistical difference between sample and respondents is found.

Exhibit 2 | Survey Respondents' Work Positions (N = 708)



Note: Other positions include human resource managers, property managers, partners, accounting managers, and finance managers.

Another potential bias is that tenants with more sustainability concerns may be more likely to answer the survey. Several tests including comparing sample and population for consistency of answers with respect to LEED, ENERGY STAR, and non-certified buildings suggest this is not a concern. Further, tenants are incented by the iPad to participate. The results provide confidence that the sample is representative of the population of tenants.

Another validity concern is that a relatively small portion (about 20%) of the respondents are ''leaders'' and that the aggregated results based largely on office manager responses may not reflect decision maker opinions. Foundational focus groups informed the research team that the primary respondents would be office managers; senior real estate executives uniformly indicated that office managers are usually involved in the decision-making process and would ''have the pulse of the boots on the ground.'' During that focus group process, respondents, including executives, leasing brokers, property managers, and office managers all indicated that ''office managers could effectively represent tenant decisions makers'' (Simons, Robinson, and Lee, 2014). They stated that for the subject sample, primarily small-to-mid-size firms, the office manager are often both aware of, and involved in, lease negotiations. Further, office managers regularly hear tenant complaints, and may be more in touch with what tenants want and do not want, than upper management, who may be more externally focused.

Nevertheless, responses of leaders and office managers are tested on several key questions, yielding almost identical results. Difference-of-means tests find few discrepancies between leadership and office managers' responses when comparing their knowledge of the presence of green attributes, stated WTP, and the overall ranking of the green attributes. In addition, a separate leader dummy variable is included in all probit regressions. In the multivariate regressions, the leadership

group is not statistically different than the general survey in any of the models. Furthermore, in individual tests of each attribute, the leadership group is found to be statistically insignificant nearly 90% of the time. In the multivariate regressions, the leadership group is not statistically different than the general survey in any of the four models shown below. Furthermore, in individual tests of each attribute, the leadership group is found insignificant nearly 90% of the time.[2]

To test for construct validity, a series of internal consistency checks including removing potential outliers and comparing green attribute rankings versus WTP estimations are conducted, and all suggest internal consistency. Survey design also maximized clarity with variable definitions, where plausible. In review of the 18 green office building features, most are clear. They include bike racks, electric car charging stations, fitness facility, green cleaning products, LEED designation, ENERGY STAR designation, recycling provided, and shower on site. Further, in the survey, economic value is defined for efficient HVAC, efficient lighting, and water conservation by asking the WTP proposition in the specific context of a 2.0% savings on rent, couched in the specific tenants' rent structure and annual costs. Indoor air quality, lease structure, and public transit definitions are provided to respondents, like ''better than the safe, breathable air required by standard building codes,'' ''Lease structure that financially rewards tenant conservation of resources,'' and ''within a five-minute walk,'' respectively.

The remaining three variables may be somewhat open to interpretation, including access to natural light, comfortable temperature control system, and walkability. However, in the building manager survey, specific definitions, like ''floor-to-ceiling windows'' and ''temperature zones of 500 square feet or less'' are used. For walkability, many respondents now may access websites like www.Redfin.com and apply their walkability score, which is becoming an industry standard for this term.

To conclude, numerous tests along a variety of dimensions suggest that the sample reasonably represents the population, that overall survey responses are consistent with tenant leadership, and that respondents' definitions of survey terminology are consistent.

Descriptive Survey Outcomes

Tenants' Perceived versus Actual Knowledge of Green Attributes

Tenants are asked to identify if an attribute is present in their building with Yes, No, and I Don't Know options provided. To corroborate tenants' perceptions, an external verification of the accuracy of their overall knowledge of the attributes is conducted. A separate data-gathering tool is administered for CBRE managers, who are asked to identify the presence or absence of the 18 green features. Data

Exhibit 3 | Respondent Knowledge of Green Building Attributes in Building (*N* = 547)

Attribute	Answered "Don't Know"	Correct When Identifying an Attribute as Present or Not[a]
LEED	60%	84%
ENERGY STAR	63%	30%
Natural light access	3%	70%
Walking access to services	3%	44%
Fitness Facility on Site	7%	85%
Public transit proximity	10%	59%
Recycling	12%	85%
Shower on site	16%	78%
Bike racks	32%	66%
Electric car charging	38%	86%
Efficient lighting	39%	70%
Improved indoor air quality	42%	76%
Efficient HVAC	48%	58%
Water conservation	48%	65%
Green cleaning	76%	75%
Average	33%	69%

Note: The responses shown are for the entire database. However, we also tested for any statistical difference between the leadership group and the general database. All tests showed no statistically significant difference between the answers of the two groups.
[a]% correct of those who answered.

are collected on the building level and matched to 547 tenant records (77% of the sample).

Exhibit 3 shows that respondents know, with considerable accuracy, whether almost all the building-level attributes are present at better than 50%, except for green cleaning. However, they do not know whether the green labels, LEED or ENERGY STAR, are present at a nearly two-thirds rate. This substantiates the assertion that tenants care more about building-level attributes than somewhat opaque and less observable building energy-related labels. Virtually all tenants, 84%, who answered whether they are in a LEED building correctly identified their building status. However, only 30% of those who answered they are in an ENERGY STAR building are correct. This may have something to do with annual recertification in the ENERGY STAR program and the timing of their lease, whereas LEED is a five year or permanent designation depending on certification type.

Diving further into awareness of green branding, only 29% of respondents agree or strongly agree that a LEED Platinum is more valuable than a simple LEED certified status. Although those in LEED buildings often know that they are, fully 84% could not identify their LEED level (Platinum, Gold, Silver, or Certified). For ENERGY STAR buildings, 58% agree or strongly agree that they are more valuable than non-certified buildings. The results suggest that a majority of tenants believe an ENERGY STAR certification adds value, and while LEED has value, the different gradations of LEED have little market clarity.

Also, proximity to transit and walking access to services are somewhat subject to interpretation, and the actual building measures used by managers may have been stricter than the tenant interpretation. The overall accuracy rate of 69% is also surprising, which may show that overall green awareness is not that high.

The relatively high levels of ''Don't Know'' responses may be somewhat surprising at first. But they are corroborated by the opinions of high-level executives in large institutional real estate firms (e.g., REITs, pension funds, opportunity funds, etc.). In another related effort, we interviewed these executives and specifically asked if they believe tenants ''care'' about green building features; executives answered that the majority of tenants do not, with the exception of large public firms and the federal government.

Finally, ordinary least squares (OLS) models isolating the stated WTP for a green attribute with the ''Yes'' and ''I Don't Know'' responses are examined against a reference category of ''Not Present'' (omitted here due to space constraints). The majority of categories show no statistical differences. However, respondents in buildings with high efficiency HVAC or efficient lighting are more likely to pay for maintaining those attributes. Also, as a demonstration of the positive impact of LEED and ENERGY STAR, respondents in buildings with those designations are more likely to pay a premium for them.[3] Those who are unaware of whether they had improved indoor air quality, a fitness facility or a shower are all less likely to want to pay for that amenity. Public transit users and those with high walkability metrics are more likely to pay a premium for continued access to those amenities. Those with strong natural light are also more likely pay for it in their office space.

Difference between Green Attributes Considered Most Important and Those Currently Available

As described earlier, the survey asked respondents to value attributes in two main ways. First, respondents were asked to delineate between the 9 ''Most Important'' and 9 ''Less Important'' attributes. Then, the respondents were asked to rank the relative importance of those nine top-ranked attributes from 1 to 9.[4] To consider both the selection of an attribute and its ranking, a weighted score reflecting the relative ranking of the attributes is generated; a ranking of 1 is given the most weight down to a zero score for unranked by that respondent. An attribute that is top-ranked by all respondents would receive a score of 100.

Exhibit 4 | Stated Demand for 18 Green Building Features

Building Feature	N[a]	% Total (N = 708)	Score[b]
Indoor air quality	659	93%	67.8
Access to natural light	627	89%	67.1
Recycling provided on-site	583	82%	39.2
Energy-efficient lighting	542	77%	40.0
Efficient electrical and gas use for heating and cooling	540	76%	43.7
Walking access to services and restaurant	526	74%	37.9
Comfortable temperature control system	518	73%	47.9
Public transportation nearby	425	60%	33.0
Fitness facility on-site	387	55%	25.9
Lease structure	304	43%	18.9
Green cleaning products	277	39%	15.0
Water conservation	274	39%	12.7
ENERGY STAR designation	254	36%	14.2
LEED designation	211	30%	10.4
Shower on-site	181	26.%	9.7
Bike racks at building	111	16%	5.9
Electric car charging station	54	8%	2.4
Green roof	53	7%	2.1

Notes:
[a]Respondents are asked to rank their top nine attributes, but some ranked 10 or more, this *N* includes those values.
[b]Score represents possible weighted ranking out 100. A variable that is ranked #1 by all respondents would be 100. This then measures both if it was ranked and the level of ranking.

By far, the attribute receiving the highest percentage of most important rankings is improved indoor air quality (IAQ) with 93%. Access to natural light is the next most valued attribute. Interestingly, some of the variables most frequently selected by respondents, such as recycling, show a slightly lower weight. It appears that although many people want or expect recycling at the building, it is not as important as other features. Exhibit 4 shows the list of 18 green building features and their relative importance to tenants. ENERGY STAR and LEED ranking, independent of any underlying features, are in the middle of the list.

On a ranking basis, improved indoor air quality, access to natural light, and on-site recycling are the highest. However, the information in Exhibit 4 does not show the presence of each green building feature in the tenants' building and rented space. To examine this, the survey asks whether the features are currently

Exhibit 5 | Difference between "Preferred Attribute" and "Perceived as Present" of Green Building Features

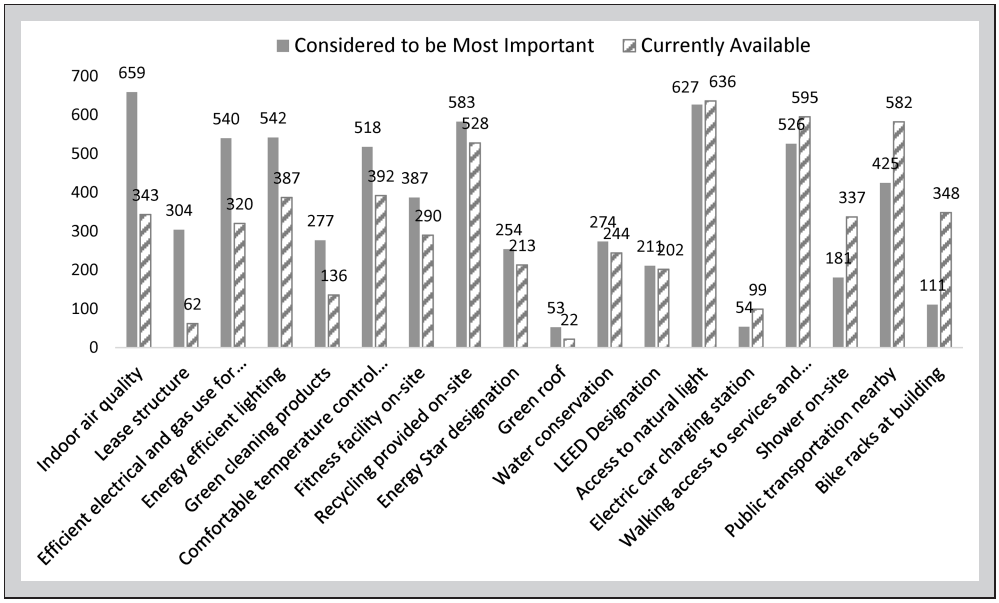
Green Building Features	Preferred Attribute (A)	Perceived as Present[a] (B)	Difference between Preferred Attribute and Perceived Present[b] (A–B)	Ratio[c] (A/B)
Indoor air quality	659	343	316	1.92
Lease structure	304	62	242	4.90
Efficient electrical and gas use for heating and cooling	540	320	220	1.69
Energy-efficient lighting	542	387	155	1.40
Green cleaning products	277	136	141	2.04
Comfortable temperature control	518	392	126	1.32
Fitness facility on-site	387	290	97	1.33
Recycling provided on-site	583	528	55	1.10
ENERGY STAR designation	254	213	41	1.19
Green roof	53	22	31	2.41
Water conservation	274	244	30	1.12
LEED designation	211	202	9	1.04
Access to natural light	627	636	−9	0.99
Electric car charging station	54	99	−45	0.55
Walking access to services and restaurant	526	595	−69	0.88
Shower on-site	181	337	−156	0.54
Public transportation nearby	425	582	−157	0.73
Bike racks at building	111	348	−237	0.32

Notes:
[a]On average, about 30% of the total respondents answered that they did not know if the listed green features are currently available for their employees.
[b]This table is sorted by this column.
[c]">1.0 ratio" indicates that there is a net demand for a preferred green building feature while "<1.0 ratio" indicates that there is a perception that the attribute is in over-abundance.

available in the building. Then, a ratio of desired and current availability for each green feature is created, shown in Exhibit 5.

Exhibit 5 reveals that tenants perceive a greater need for improved indoor air quality, lease structures that financially reward tenant conservation of resources, efficient electricity and gas use for heating and cooling, energy-efficient lighting, green cleaning products, and localized temperature control, than are currently supplied by the market. Presumably, installation of these features should be

Exhibit 6 | Eighteen Green Building Features from the Tenant Perspective



recognized in WTP higher rents. Also, there are several green building attributes where current availability exceeds stated demand. Those attributes include bike racks and public transportation nearby. Exhibit 6 shows the same data from Exhibit 5 in a bar chart.

In addition, we ran a series of regressions comparing the actual presence of an attribute to its perceived presence and the effect on WTP (results omitted to conserve space). In nearly all cases, the perceived presence of an attribute is highly correlated to its actual presence. Some that are not as highly correlated are less observable, such as ENERGY STAR, or rare (on a national level) like electric car-charging stations. In virtually all cases, WTP is statistically unrelated to the presence of an attribute. Thus, respondents appear to have independently and reliably estimated the economic impact of an attribute, per the survey design, regardless of its presence.

Stated Willingness to Pay for Green Building Features

Building tenants are asked to state their WTP for each green building attribute in terms of a percentage over their existing lease. Exhibit 7 shows the results. Office tenants show the highest WTP for access to natural light (additional 1.3% over their current rental rate), improved indoor air quality, individualized temperature controls, and lease structure that incentivized energy savings (all over 1.2%). Furthermore, over 30% of those respondents with positive responses for IAQ and

Exhibit 7 | Willingness-to-Pay for Green Building Features (*N* = 708)

	Overall Sample		Leadership Subsample	
	(A)	(B)	(A)	(B)
Building Attribute	Willingness-to-Pay (%)	% of Respondents (≥ 2% of WTP)	Willingness-to-Pay (%)	% of Respondents (≥ 2% of WTP)
Access to natural light in my work space	1.33%	243 (34%)	1.64%[b]	55 (42%)
Indoor air quality	1.29%	250 (35%)	1.30%	43 (33%)
Comfortable temperature control system	1.27%	187 (26%)	1.47%	43 (33%)
Lease structure	1.17%	111 (16%)	1.21%	20 (15%)
Efficient electrical and gas use for heating/cooling[a]	1.09%	175 (25%)	1.00%	31 (24%)
Walking access to services and restaurant	1.06%	158 (22%)	1.15%	31 (24%)
Public transportation nearby	1.06%	140 (20%)	1.08%	30 (23%)
Energy-efficient lighting*	1.03%	179 (25%)	1.06%	28 (22%)
Fitness facility on-site	0.98%	107 (15%)	1.08%	21 (16%)
Water conservation*	0.97%	79 (11%)	1.17%	12 (9%)
LEED designation	0.82%	47 (7%)	0.74%	7 (5%)
Shower on-site	0.78%	40 (6%)	0.94%	7 (5%)
Green roof	0.70%	11 (2%)	0.71%	2 (2%)
Recycling provided on-site	0.65%	110 (16%)	0.51%	14 (11%)
ENERGY STAR designation	0.63%	53 (7%)	0.55%	5 (4%)
Bike racks at building	0.54%	18 (3%)	0.68%	4 (3%)
Green cleaning products used on-site	0.42%	28 (4%)	0.53%	5 (4%)
Electric car charging station	0.41%	10 (1%)	0.83%	4 (3%)

Notes: Column (A) indicates the weighted average of stated WTP for each green building feature. Column (B) indicates the number of respondents who have greater than or equal to 2% of stated WTP for each feature (% in total respondents, 708).

[a]The assumption of 2% annual building operation savings is provided for efficient electricity and gas use for heating and cooling, energy-efficient lighting, and water conservation questions, based on the tenant's lease structure.

[b]Statistically significant difference between all sample and leadership sub-sample group. Comparing stated WTP between all sample and leadership sub-sample group, only one attribute is statistically different. This result supports the internal validity of the current survey data set.

natural light stated a WTP more than a 2% premium for those features. These findings are consistent with the ordinal ranking portion of this survey.

Interestingly, the extent to which respondents are WTP more for individual green building features generally corresponds to the stated demand (Exhibit 5), except for recycling and green cleaning products. This result reveals that office tenants consider both recycling and green cleaning products to be important green building attributes, but are not willing to incur additional costs for having those features. As further validity support, a side-by-side comparison of the WTP of the overall sample (N = 708) with the leadership group (N = 120) shows nearly all attributes are similarly ranked, with only one attribute (natural light) statistically different. Finally, the aggregate premium (the sum on Exhibit 7) for these 18 green office building attributes is 9.3%.[5]

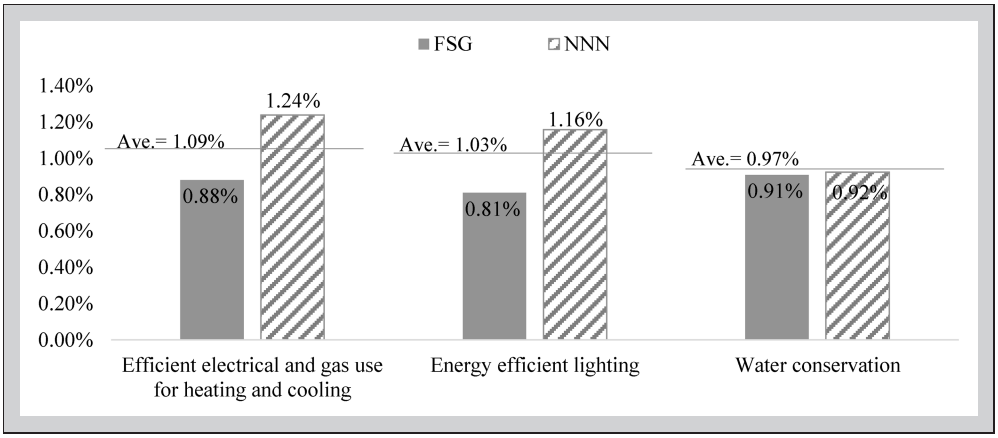
To better explore the impact of lease structure on green attribute, three questions (efficient heating/cooling systems, efficient lighting, and water conservation measures, noted with an * on Exhibit 7) remind the respondents that either they (NNN) or the building owner (FSG) would receive the benefit of 2% savings in utility costs. In an efficient market (and setting aside altruistic motives), a NNN lease holder should accept a 2% rental increase offset by a 2% expense decrease. Although the results do show a clear difference in WTP for the two lease structures for efficient light and gas, the difference (about 0.4%) is smaller than expected. Under a NNN lease, the respondents state that they are WTP an additional 1.24% of the current rental rate for efficient electricity and gas use building features, while they reveal only 0.88% of WTP with a FSG lease. The WTP for energy-efficient lighting also shows the same pattern as with efficient HVAC systems. Thus, the outcomes reveal that there is a difference between NNN and FSG leases consistent with theory, but that difference is smaller than expected. One possible explanation is that, despite repeated efforts to reinforce the idea, the respondents do not fully appreciate the difference between the lease types. An alternative explanation could be that other factors beyond the tenants' bottom line are in play. Exhibit 8 shows these differences by lease structure:

Surprisingly, even with stated savings, respondents are reluctant to pay for water conservation. Regionally, the results show that tenants from the Great Lakes region had the lowest average WTP for water conservation feature (0.33%), with the Far West (0.42%) and East regions (0.47%) noticeably higher. It may simply be that the stated savings of 2.0% on rent is not readily achievable from water savings.

Multivariate Regression

To better answer the core questions of who is interested in green buildings and what attributes significantly affect stated WTP, a series of regressions was developed. The first model expands on the well-documented existence of green building premiums by exploring what company, personal and regional variables

Exhibit 8 | Difference in Stated Willingness-to-Pay by Lease Structure



have a higher WTP for green-labeled buildings, such as LEED and ENERGY STAR. The second set of models individually regresses each of the 18 green building attributes on whether the respondent is willing to pay a 2.0% or greater premium (high WTP) for the attribute (from Exhibit 7). The third set of models replicates the second set with each of the 18 attributes, but with a dependent variable based on rank (from Exhibit 4) rather than WTP. Each of the preceding model structures have dummy dependent variables, and utilize a probit model format. The models are structured thus:

Probit Regression Model 1:

$$WTP_{greenlabel\_i} = \beta_{0i} + \beta_1 Region_i + \beta_2 Industry_i + \beta_3 Size + \beta_4 Company_i + \beta_5 Lease_i + \beta_6 Demograpics_i + \varepsilon_i. \quad (1)$$

Probit Regression Model 2:

$$WTP_{attribute\_ij} = \beta_{0i} + \beta_1 Region_i + \beta_2 Industry_i + \beta_3 Size + \beta_4 Company_i + \beta_5 Lease_i + \beta_6 Demograpics_i + \varepsilon_i. \quad (2)$$

Probit Regression Model 3:

$$Rank_{ij} = \beta_{0i} + \beta_1 Region_i + \beta_2 Industry_i + \beta_3 Size + \beta_4 Company_i + \beta_5 Lease_i + \beta_6 Floorplan_i + \varepsilon_i. \quad (3)$$

The dependent variables are: $WTP_{greenlabel\_i}$ is a binary variable with a value of one if a tenant *i* has a positive WTP for green buildings (LEED and/or ENERGY STAR) and zero otherwise; $WTP_{attribute\_ij}$ is a binary variable with a value of one if a tenant *i* has 2% or more of WTP for attribute *j* and zero otherwise; this regression is run separately for each of the 18 green building features. $Rank_{ij}$ is a dummy variable with a value of two if tenant *i* ranked attribute *j* as one of the their top three most important attributes, a value of one of it is ranked fourth through ninth, and zero if it is in the ''less important'' half; this regression is run separately for each the 18 green building features.

The independent variables are: $Region_i$ is a vector of regional categories including Far West, Great Lakes, Energy Belt, Southeast, and Mideast; $Industry_i$ is a vector of industrial sectors including the finance, insurance, real estate, legal, IT, and computer, and other sectors; $Office_i$ is a vector of building or lease variables including tenant square footage; $Company_i$ is a vector of a company's characteristics including whether the company's stock is publicly held; $Lease_i$ is a vector of lease structures including a FSG and NNN leases; $Demographics_i$ is a vector of a tenant's personal information including age, gender, education, and position in the current company; $Floorplan_i$ considers if the tenant's company uses traditional, flex, and/or hybrid floor plans; β_0 is a constant; and ε is the error term.

Exhibit 9 presents the descriptive statistics of the variables. The typical tenant occupies 17,600 square feet of space with 59 employees and pays $26.31 per SF/year in rent with a FSG lease structure. A total of 45% are located in the Far West region, and 16% are in the finance and insurance sector. Almost half of the tenants are in professional services. Over two-thirds have a traditional space layout and 44% of the respondents are 50–59 years old. Office managers and females comprise over half the sample. LEED or ENERGY STAR status reflects about 30% each (some with both designations).

Multivariate Model Results

The results of the models are presented in Exhibits 10–12. Model 1 (Exhibit 10) addresses WTP for a green building brand. Results show that out of 34 independent variables, only six are statistically significant. Energy and information technology industries, along with publically-traded firms are more likely to state a WTP for green building labels. The industry findings are largely consistent with

Exhibit 9 | Descriptive Statistics with Definitions (N = 708)

Variable	Definitions / Unit	Min.	Max.	Mean	Std. Dev.
Panel A: Continuous Variables					
Rent / SF	Rent per square foot	$8.00	$87.00	$26.31	$12.27
Total SF	Square footage of the tenant space	392	350,000	17,633	33,692
Employees	Employees in the tenant space	1	1,260	59	133

Variable	Definition	Frequency (%)
Panel B: Dummy Variables		
Lease NNN	Lease Structure: NNN, coded as a 1	234 (33.3%)
Lease modified	Lease Structure: MG	104 (14.7%)
Lease FSG[a]	Lease Structure: FSG	370 (52.2%)
Region Energy Belt	CO, LA, NM, OK, TX, UT, WY	205 (28.9%)
Region Mideast	DE, MD, NJ, NY, PA	22 (3.1%)
Region Southeast	AL, AR, FL, GA, KY, MS, NC, SC, TN, VA	61 (8.6%)
Region Lakes	ID, IL, MI, MN, OH, WI, WV	98 13.8%)
Region Far West[a]	AZ, CA, NV, OR, WA	322 (45.4%)
Industry Finance & Insurance	Finance and Insurance Industry	113 (15.9%)
Industry legal	Legal Industry	78 (11.0%)
Industry energy	Energy-related Industry	19 (2.7%)
Industry government	Government	20 (2.8%)
Industry real estate	Real Estate-related Industry	49 (6.9%)
Industry comp & IT	Computer and IT Industry	30 (4.2%)
Function executive	Function of Office Space: Executive	371 (52.3%)
Function professional	Function of Office Space: Professional Services	342 (48.1%)
Location decision flex	If a tenant selects "flexible floor" as a main reason of the current location then coded as 1	231 (32.6%)
Public stock	If a tenant company's stock is publically held, then coded as 1	162 (22.8%)
Sustainability initiative	If sustainability initiatives have been discussed at a company meeting in the last six months, then coded as 1	195 (27.5%)
Sustainable supplier	If a tenant company prefers to choose suppliers who market themselves as sustainable over those who do not, then coded as 1	331 (46.7%)
Layout hybrid	Open shared, common workspace areas with sunlight in the central core areas, combined with much smaller than typical private office or open plan cubicles	174 (24.5%)

Exhibit 9 | (continued)
Descriptive Statistics with Definitions (N = 708)

Variable	Definition	Frequency (%)
Panel B: Dummy Variables		
Layout flex	No permanent office space but have access to work stations or private offices by reservation	43 (6.1%)
Layout traditional*	A large variety of private offices line the outside area of the floor adjacent to the windows	484 (68.3%)
Position leadership	President, vice president, CEO, CFO, and COO	94 (13.3%)
Edu college	Education: Bachelor's degree	326 46.0%)
Use public trans	Use of Public Transportation (more than once a week)	94 (13.3%)
Age20s	Age group of 20s	58 (8.25%)
Age30s	Age group of 30s	114 (16.1%)
Age40s	Age group of 40s	186 (26.2%)
Age50s	Age group of 50s	312 (44.0%)
LEED certification	If a tenant's building is designated as LEED, then coded as 1	202 (28.5%)
ENERGY STAR Rating	If a tenant's building is ENERGY STAR-certified, then coded as 1	213 (30.0%)
LEED_CI	If LEED Commercial Interior (CI) certified, then coded as 1	55 (7.8%)

Notes: The coded as a 1 group is described above.
[a]Reference category

literature that found energy resource extraction firms amongst the highest users of green buildings; in this case, 2.34 times more likely ($e^{0.84}$), statistically significant at a level of 95%. This is often supported by their public corporate social responsibility (CSR) statements. The computer-IT sector also is significant (1.58 times more likely, significant at a 95% level). Not surprisingly, public companies, most of whom will have published CSR policies, are more likely to pay for green-labeled buildings (1.26 times more likely, significant at a 90% level). Those companies demonstrating some other commitment to sustainability through their supplier choice (1.43 times more likely, significant at >99% level) or a LEED commercial interior (LEED CI) designation on their internal space also show a significantly higher stated WTP.

Importantly, a dummy variable for leadership is not statistically different from the remaining respondents, lending validity that survey outcomes are reflective of decision makers. Somewhat surprisingly, college-educated professionals, those

Exhibit 10 | Probit Model 1: Factors Affiliated with WTP for Green Labeled Buildings

Variable	Estimate	Wald Chi-Square	Pr > Chi-Square
Intercept	−1.0558	7.334	0.0068
Total_SF	−2.3E-06	0.3933	0.5306
Rent_SF	−0.00325	0.2896	0.5905
Lease_Modified	0.1085	0.4274	0.5133
Lease_NNN	−0.0173	0.0153	0.9016
Region_Energybelt	0.1475	1.0367	0.3086
Region_Mideast	−0.073	0.0414	0.8387
Region_Southeast	−0.0784	0.1381	0.7102
Region_Lakes	−0.0413	0.0403	0.8409
Employees	0.0006	0.4387	0.5078
Industry_Finan_Insur	−0.1483	0.7549	0.3849
Industry_Legal	0.2033	1.0183	0.3129
Industry_Energy	0.8399	6.4584	0.0110
Industry_Government	0.3814	1.4045	0.2360
Industry_Realestate	0.1538	0.5034	0.4780
Industry_Computer_IT	0.5284	4.1203	0.0424
Function_Executive	0.1202	1.0082	0.3153
Function_Professional	0.1455	1.4865	0.2228
Location_Decision_Flex	0.0205	0.0298	0.8629
Public_Stock	0.2307	2.8588	0.0909
Sustainability_initiative	0.0919	0.5128	0.4739
Sustainable_supplier	0.3592	9.659	0.0019
Layout_Hybrid	0.1535	1.3114	0.2521
Layout_Flex	0.2278	0.9852	0.3209
Position_Leadership	0.177	1.0192	0.3127
Educ_college	−0.2164	3.5026	0.0613
Use_public_transport	−0.0838	0.2209	0.6383
Age20s	−0.271	0.805	0.3696
Age30s	−0.2189	0.6695	0.4132
Age40s	−0.2045	0.6538	0.4187
Age50s	−0.3186	1.7125	0.1907
Space_Number_Of_People	0.0156	0.0802	0.7771
LEED Certification	−0.1851	0.9147	0.3389
ENERGY STAR Rating	0.2922	2.2807	0.131
LEED_CI	0.4988	6.3735	0.0116
Likelihood of Global Null Beta=0		54.2041	0.0153

Notes: The binary dependent variable is a positive WTP for LEED and/or ENERGY STAR-certified buildings. The AIC is 761.142.

Exhibit 11 | Probit Model 2: Factors Affiliated with WTP for Green Labeled Buildings

Attribute	Attribute *N*	Variable	Estimate	Wald Chi-Square	Pr > Chi-Square	Model Fit Test AIC
Internal Air Quality	250	Region_Mideast	−0.7323	4.4783	0.0343	0.439 921
Internal Air Quality	250	Public_Stock	−0.2153	2.9831	0.0841	
Natural Light	243	Industry_Finan_Insur	−0.2370	2.7094	0.0998	0.005 913
Natural Light	243	Industry_Legal	−0.3076	3.2368	0.0720	
Natural Light	243	Public_Stock	−0.3634	8.0392	0.0046	
Natural Light	243	Educ_college	0.2704	6.7784	0.0092	
Indiv. Temp Control	187	Region_Mideast	−0.6624	2.9207	0.0875	0.439 819
Indiv. Temp Control	187	Region_Southeast	0.3495	3.5492	0.0596	
Efficient Lighting	179	Industry_Energy	0.5806	3.5464	0.0597	0.029 803
Efficient Lighting	179	Industry_Realestate	0.4648	5.4978	0.0190	
Efficient HVAC	175	Lease_NNN	0.2648	4.5704	0.0325	0.030 794
Efficient HVAC	175	Region_Southeast	0.4924	6.9742	0.0083	
Efficient HVAC	175	Industry_Government	0.5231	3.0056	0.0830	
Efficient HVAC	175	Industry_Realestate	0.4035	4.0384	0.0445	
Walkability	158	Region_Lakes	−0.3711	3.9296	0.0474	0.053 754
Walkability	158	Industry_Realestate	0.4332	4.6432	0.0312	
Walkability	158	Public_Stock	−0.2769	3.9060	0.0481	
Public Transit	140	Public_Stock	−0.2722	3.6462	0.0562	0.106 706
Public Transit	140	Educ_college	0.2031	3.0876	0.0789	
Lease Structure	111	Lease_NNN	0.3116	5.3797	0.0204	0.352 617
Lease Structure	111	Region_Energybelt	0.2417	3.0317	0.0817	
Recycling	110	Region_Energybelt	−0.3637	5.8024	0.0160	0.097 614
Recycling	110	Industry_Energy	0.7492	5.2257	0.0223	
Recycling	110	Position_Leadership	−0.5362	6.4584	0.0110	
Fitness Facility	107	Region_Energybelt	0.2827	3.9497	0.0469	0.091 603
Fitness Facility	107	Region_Southeast	0.4823	5.6471	0.0175	
Fitness Facility	107	Industry_Legal	−0.4365	3.9176	0.0478	
Water Conservation	79	Industry_Government	0.6766	4.5831	0.0323	0.219 497
ENERGY STAR	53	Educ_college	−0.3028	4.2678	0.0388	0.451 379

Notes: This table displays only coefficients significant at a 90% or better level from probit models on 13 of the 18 attributes with statistically meaningful WTP of 2.0% or more for the dependent attribute: Variables are the significant variables only (space constraints) from 13 separate regressions, the column Attribute shows the dependent variable. Attribute *N* shows how many times the dependent attribute had a WTP of $\geq$ 2.0%.

Exhibit 12 | Probit Model 3: Factors Affiliated with WTP for Green Labeled Buildings

Variable	Estimate	Wald Chi-Square	Pr > Chi-Square	Attribute	Rank 1–3	Rank 4–9
Public_Stock	−0.2873	6.8451	0.0089	attRank_natlight	410	207
Educ_college	0.1981	4.6123	0.0317	attRank_natlight	410	207
Region_Southeast	0.4240	6.8449	0.0089	attRank_tempcont	244	259
Region_Lakes	0.2612	3.4089	0.0648	attRank_tempcont	244	259
Position_Leadership	0.2492	3.6587	0.0558	attRank_tempcont	244	259
Industry_Finan_Insur	−0.2395	3.9994	0.0455	attRank_HVAC	193	337
Industry_Legal	0.2840	3.9493	0.0469	attRank_HVAC	193	337
Region_Energybelt	0.2947	8.0638	0.0045	attRank_walkability	156	344
Region_Lakes	−0.3393	5.6138	0.0178	attRank_walkability	156	344
Industry_Legal	0.3139	4.8169	0.0282	attRank_walkability	156	344
Position_Leadership	0.2151	2.7714	0.0960	attRank_walkability	156	344
Region_Energybelt	−0.2374	5.0871	0.0241	attRank_pubtrans	151	263
Position_Leadership	−0.2588	3.8243	0.0505	attRank_pubtrans	151	263
Region_Energybelt	−0.1778	2.7327	0.0983	attRank_Recycling	105	464
Region_Southeast	−0.4745	8.0998	0.0044	attRank_Recycling	105	464
Position_Leadership	−0.3863	8.2090	0.0042	attRank_Recycling	105	464
Region_Energybelt	0.3576	11.298	0.0008	attRank_fitfac	83	294
Region_Southeast	0.4614	8.1758	0.0042	attRank_fitfac	83	294
Industry_Legal	0.2591	3.0169	0.0824	attRank_tenantreward	59	226
Industry_Energy	0.5674	4.2812	0.0385	attRank_tenantreward	59	226
Industry_Governmen	0.4685	3.1107	0.0778	attRank_tenantreward	59	226
Industry_Comp_IT	0.5144	5.5782	0.0182	attRank_tenantreward	59	226
Lease_NNN	−0.2550	5.0223	0.0250	attRank_EnergyStar	38	199
Public_Stock	0.2011	3.0505	0.0807	attRank_EnergyStar	38	199
Educ_college	−0.1772	3.3443	0.0674	attRank_EnergyStar	38	199
Region_Energybelt	−0.2056	3.1385	0.0765	attRank_greenclean	37	221
Region_Southeast	−0.3986	4.5873	0.0322	attRank_greenclean	37	221
Industry_Finan_Insur	0.2245	3.1179	0.0774	attRank_greenclean	37	221
Industry_Legal	−0.4842	7.6074	0.0058	attRank_greenclean	37	221
Industry_Energy	0.7973	8.0358	0.0046	attRank_LEED	31	156
Industry_Realestate	0.5262	8.0756	0.0045	attRank_LEED	31	156
Industry_Comp_IT	0.4324	3.4242	0.0642	attRank_LEED	31	156
Region_Southeast	0.4159	5.5244	0.0188	attRank_Shower	27	136
Region_Lakes	−0.4721	6.4993	0.0108	attRank_Shower	27	136

Exhibit 12 | (continued)
Probit Model 3: Factors Affiliated with WTP for Green Labeled Buildings

Variable	Estimate	Wald Chi-Square	Pr > Chi-Square	Attribute	Rank 1–3	Rank 4–9
Industry_Realestate	−0.4648	3.9894	0.0458	attRank_Shower	27	136
Region_Energybelt	−0.3184	7.2850	0.0070	attRank_watercons	23	211
Region_Southeast	−0.6126	10.0267	0.0015	attRank_watercons	23	211
Region_Lakes	−0.3433	4.4832	0.0342	attRank_watercons	23	211
Industry_Legal	−0.4105	5.5556	0.0184	attRank_watercons	23	211
Industry_Governmen	0.4511	2.7233	0.0989	attRank_watercons	23	211
Industry_Comp_IT	0.4948	4.8176	0.0282	attRank_watercons	23	211
Educ_college	−0.1886	3.6620	0.0557	attRank_watercons	23	211
Lease_NNN	0.2893	4.7252	0.0297	attRank_Bikeracks	15	86
Industry_Finan_Insur	−0.4638	5.8159	0.0159	attRank_Bikeracks	15	86
Region_Energybelt	−0.6036	9.0515	0.0026	attRank_elec_carchg	8	41
Region_Lakes	−0.6709	4.4087	0.0358	attRank_elec_carchg	8	41
Industry_Legal	0.4003	3.4717	0.0624	attRank_elec_carchg	8	41
Educ_college	0.5220	9.0442	0.0026	attRank_GreenRoof	5	41

Notes: The table displays only coefficients significant at a 90% or better level from Probit models on all 18 building attributes with dependent variable set as 2 if ranked first through third, 1 if ranked fourth through ninth, or 0 if unranked. Variables are the significant variables only (space constraints) from 18 separate regressions, the column Attribute shows the dependent variable. Rank 1–3 shows how many times the dependent attribute was ranked in the top 3 by a respondent and 4–9 shows how many times it was ranked 4–9.

achieving a bachelor's degree or higher, are less WTP (1.25 times) for green-labeled buildings. The authors consider this a potential sign that specific building attributes may be more valuable to college-educated professionals than the aggregate baskets of attributes offered by LEED or ENERGY STAR as a brand. The probit model successfully converges, rejects the global null of zero beta at a 95% significance level, and reports an Aikake information criteria (AIC) score of 761.

Exhibit 11 presents the results from the series probit regressions run as Model(s) 2; 13 attributes with a statistically reliable *N* of more than 40 positive WTP > 2.0% responses are shown.[6] Due to space constraints, we do not show detailed results for all probit regressions on each individual green attribute, but their underlying format is the same as for Exhibit 12. Exhibit 12 shows only the variables that are statistically significant at the 90% level of confidence or better. Exhibit 11 is sorted by the attribute *N* column, which represents the number of

respondents who indicated a stated WTP of 2.0% or greater. Thus, 250 respondents indicate a WTP of 2.0% or more for improved indoor air quality.

The results show that the Mideast region and publically-traded companies are less likely to indicate a WTP for indoor air quality. This could be more indicative of generally higher air quality in the somewhat smaller Mideast cities relative to the Far West (e.g., Los Angeles) and Mideast (e.g., New York City and Washington, D.C.).

The finance and legal industries and publically-traded companies are less likely to pay for more natural light. This may relate to the traditional outside window offices and indoor cubicle layout of these more traditional industries. College-educated respondents are more likely to value natural light.

Individualized temperature control is less likely to be favored in the Mideast, while the Southeast is more likely to value it. Presumably, the relative ease of distributing heat versus air conditioning may be a factor in that distinction.

For the efficient lighting feature, only the energy and real estate industries appear as significant in their WTP for efficient lighting, and both are strongly positive in their stated WTP. Energy may be motivated by a focus on energy usage and product sales while real estate operators may benefit more often from savings.

High efficiency HVAC is favored by tenants in the Southeast region (high air-conditioning costs), real estate, and government tenants, and by NNN lease holders. This shows an awareness of cost savings associated with a NNN lease.

Without detailing each of the remaining variables, other notable results are that NNN lease holders are more likely to value a lease that rewarded them for conservation. The Energy Belt region and energy industry value recycling while the leadership position is less likely to pay for it.[7] Publicly traded companies have a negative WTP for both public transit and walkability. Each of the displayed models successfully converges, although with mixed model fit measures. Several of the models fail to reject the null of a global zero beta, suggesting that the nuanced differences within demographic strata may be small. That said, all models successfully converge and the significant variables do indicate some propensity towards WTP for the attribute. Future research could refine and aggregate these variables into factors or bundles of similar green attributes.

Model 3 results are shown in Exhibit 12, and represent results from a series of 18 probit regressions estimating the likelihood that an attribute is ranked as high (2) or ranked (1) relative to unranked (0) as described in equation 3. The higher the coefficient, the more likely that attribute is to be ranked in the top group (first through third). Similar to above, the table is sorted by the attribute with the most top three rankings. Since space is too restricted to show full results from all 18 probit regressions, only statistically significant variables are shown. However, all 18 attributes present enough *N* for statistically reliable results. The results shown in Exhibit 12 run parallel to those presented in Exhibit 11, but examine ordinal ranking as the dependent variable, rather than WTP.

Publically-traded companies are less likely to rank natural light highly, while college-educated professionals are more likely. Respondents in the Southeast region, similar to the WTP results, and also the Great Lakes region are more likely to highly rank temperature control. Tenant leadership is also more likely to rank temperature control highly. The results suggest that while the Great Lakes region and tenant leadership value individualized temperature control, they may not be WTP significantly more for it.

Other notable results include the respondents in the Energy Belt and Southeast regions relatively lower value of recycling compared to other attributes. Respondents in the legal, energy, government, and information technology fields are all more likely to value tenant reward structures in a lease. Those respondents with a NNN lease are less likely to value an ENERGY STAR certification, which at first seems somewhat counter to their stated WTP for high efficiency HVAC, but may indicate a lower value of the designation itself to respondents. Only respondents in the real estate, energy, and IT industries show a higher propensity to value LEED. Respondents in the Energy Belt, Southeast, and Great Lakes regions are all less likely to value water conservation.

The overall results of this series of regressions are generally consistent with those presented in Exhibit 11, and show definite regional preferences and indicate that attribute level preferences are not homogenous across the U.S. Any system that attempts to value green building attributes should incorporate some level of regional preference. As above, each of the displayed models successfully converged, although with mixed model fit measures. In this case, the majority successfully rejected the global beta null at traditional significance levels, but some attributes such as individualized temperature control and efficient HVAC failed to reject. This suggests some caution should be used in interpreting these results. Although reasonable to use as guidelines for policy, future aggregation of the attributes is necessary.

Conclusion

This paper adds to the body of literature in several key ways. First, we report initial results from the first major academic study focused on tenant demand for specific green building attributes beyond LEED or ENERGY STAR certification. The sample of 708 respondents (gleaned from over 300 buildings in 17 major U.S. markets) represents the overall population and potential internal sample bias (office mangers vs. tenant leadership) is shown to be minor. Second, this research begins the process of unpacking, which green building-level attributes are most important to tenants, to whom certain attributes are important, and how much more rent, if any, tenants say they are WTP for those attributes.

The aggregate stated WTP for green features show a 9.3% premium. This slightly exceeds the 4%–7% premiums (revealed preference) found by others (Fuerst and McAllister, 2011; Kok, Miller, and Morris, 2012) who measured LEED and

ENERGY STAR status alone. The current results show broad acceptance of sustainable building attributes in general, with some tenant preferences varying across demographic and regions. However, when compared against individual attributes, it shows a comparatively lower perception of value by tenants for the currently marketed LEED and ENERGY STAR brands. This suggests that more research is required in unpacking the bundle of optimal attributes. A regionally-differentiated green building scoring matrix may help shed light on the information gap in the sustainable space rental market.

Of the 18 green building features we examine, improved indoor air quality and access to natural light are the highest in perceived importance. High efficiency measures are most likely to be preferred by certain industries, such as energy and real estate tenants, or NNN lease holders that directly benefit from such measures. Public companies are among the most likely to pay for a LEED certification. These disparities demonstrate a need in the marketplace for third-party certified building sustainability metrics that companies can use in the context of their corporate sustainability missions, beyond just the LEED and ENERGY STAR brands.

Regional preferences such as limited interest in water conservation in the Great Lakes region or increased value of individualized temperature control in the warm Southeast region are revealed. Ideally, any scoring matrix or certification system including multiple building-level attributes should incorporate regional distinctions.

Finally, the presence of some building attributes leads to an increased perception of value for them. As a potential testament to the value of the ENERGY STAR and LEED certifications, tenants aware that they have a green certification are more likely to pay higher rent to maintain those certifications. Natural light, efficient HVAC, and energy-efficient lights also are building attributes that show a higher value to tenants already aware that their building or space has the attribute.

While the survey represents the largest and most comprehensive to date, there are some admitted weaknesses. The low level of actual decision maker responses is less than ideal. However, both qualitative and quantitative evidence demonstrate that the overall responses (i.e., office managers) are consistent with the responses of tenant leadership. The knowledge level of the responses is consistent with practitioner expectations. Thus, stated WTP outcomes should reasonably reflect prevailing market opinions. Despite efforts to create common language and clear definitions, respondents may have understood the attributes' effects or meanings differently. It should also be noted that stated WTP does not always translate directly to actual market prices. Additionally, in terms of green features, omitted variable problems are a concern in any large-scale analysis. However, the current survey is based on focus group input, pilot tested, and is designed to include as much relevant information as possible.

Further research already in progress with this database includes integrating the stated preferences from the survey with the revealed preferences from rent rolls

associated with these same buildings. Future research stemming from the results presented here includes further qualitative and quantitative examinations of green building demand drivers. Although not central to the findings herein, the initial results do suggest that productivity or people related qualities may be of additional academic interest. The heterogeneous results between regional, demographic, and industry preferences for sustainable features clearly demonstrate a need for further study. More research into lease structure and whether optimal green lease structures exist are also suggested by the data.

Endnotes

[1] We gratefully acknowledge support and funding by CBRE, Inc. as part of their Real Green Research Challenge. All buildings are institutionally managed by CBRE, but held by a diverse group of owners.

[2] A number of chi-square and other tests are performed to thoroughly test for survey bias. This issue is a critical issue for survey validity and reviewers are provided with extensive support. Further information is available upon request.

[3] Another potential explanation is self-selection bias of those who already prefer the labels.

[4] Although a few selected more, only their top nine features are used for most of the analyses.

[5] As another internal consistency check, the average attribute rankings and the average WTP are compared; in other words, the highest ranked attribute should generally be the highest mean WTP, which it is through the fourth highest-ranked attribute.

[6] Those omitted attributes include green roof, electric car charging, green cleaning products, bike racks, and shower on site. These are shown on Exhibit 7, center left column, with $N<41$.

[7] Note that this is the only model where leadership appears as significantly different in WTP from the rest of the survey in this analysis.

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