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Demand for Green Buildings: Office Tenants’ Willingness to Pay for Green Features

Robert Simons and Eunkyu Lee (CSU)
Spenser Robinson and Andrew Kern (CMU)

Aug 21th, 2014

This project was funded by the CBRE Green Research Challenge.
Overview

1. CBRE Green Building Research Project - Context
2. Background: Green Building by Numbers
3. Research Process: Focus Group and Survey
4. Analysis & Discussions
5. Q & A
Green Office Building Project - Context

- CBRE “Green Research Challenge” program
- Create a green office building scoring system (e.g. FICO credit score)
- Mix of demand and supply-side green office building measures

**Demand-Side**

- **Focus Group**
  - **Building Tenant Survey**

**Supply-Side**

- Hedonic Analysis: actual office building data

**Compare**

**Relate**

**Interpret**

**Green Office Building Scoring System**
Background - Buildings by numbers

- 41% U.S. energy use (EPA, 2012)
- 72% electricity consumption (EIA, 2008)
- 40% of CO2 emissions (DOE, 2012)
- 14% water consumption (US Geological Survey, 2000)

Turner and Frankel (2008); Kats (2003); GSA Public Building Service (2008); and USGBC
Diffusion of Green Office Building

Total Sqft: from 5.6% (2005) to 39.6% (2013)

Total #: from 1.5% (2005) to 13.2% (2013)

Rank 1st: Minneapolis, 77% of office space is green-certified (supported by financial incentive programs)

Source: CBRE (2014)
Literature Review & Research Gaps

EPA’s *Definition* of Green Building:
- Maximizing the efficiency of buildings’ resources (e.g. energy, water)
- Minimizing buildings’ impacts on the environment and human health

**Market Premium**
- 10% property value premium (Miller, Spivey, and Florance, 2008)
- 7-8% rental price premium (Kok, Miller, and Morris, 2012)

**Employee Productivity** (Miller, Pogue, Gough, and Davis, 2009)
**Occupant Satisfaction** (Paul and Taylor, 2007)
**Impact of Public Policies on diffusion** (Simons, Choi, and Simons, 2009)
**Green Building and Regional Economy** (Allen and Potiowsky, 2008)

“What specific green building attributes are preferred by tenants? Are tenants willing to pay for those attributes?”
Research Process

* Focus on the main findings of the survey

**Demand-side**
- Completed 7 focus groups (48 participants) (Chicago, Denver, D.C., and San Francisco Bay area)
- Identified 18 specific green building attributes
- Developed an extensive (online) tenant survey
- On-going; 620 responses (20% response rate as to today) from 100+ cities
Profile of Respondents

**Position**
- CEO, 2%
- CFO, 2%
- Director, 3%
- COO, 3%
- Facilities Manager, 3%
- Others, 12%
- President/VP, 7%
- General employee, 14%
- Office manager, 54%

**Age**
- 18-29: 9%
- 30-39: 16%
- 40-49: 26%
- 50-59: 32%
- 60+: 12%
- Prefer not to say: 5%

**Education**
- Highschool or GED: 15%
- Associate's: 18%
- Bachelor's: 47%
- Master's or higher: 20%
- Prefer not to say: 5%

**Industry**
- Finance and Insurance: 19%
- Legal Service: 12%
- Health Care and Social: 7%
- Computer_IT: 7%
- Architectural, Construction, Engineering: 7%
- Real Estate: 7%
- Energy-related: 4%
- Others: 37%
The Tenant’s Perception of Green Building Certifications

Perceived Value of the Energy Star-Certified Building Compared to the Non-Certified

Perceived Value of the LEED Platinum Compared to the LEED Certified

58% Positive

29% Positive
# Demand-Side

<table>
<thead>
<tr>
<th>Rank</th>
<th>18 Green Building Features</th>
<th>N</th>
<th>% Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Better indoor air quality</td>
<td>556</td>
<td>94%</td>
</tr>
<tr>
<td>2</td>
<td>Access to natural light</td>
<td>534</td>
<td>90%</td>
</tr>
<tr>
<td>3</td>
<td>Comfortable &amp; localized temperature control</td>
<td>436</td>
<td>74%</td>
</tr>
<tr>
<td>4</td>
<td>Efficient electrical and gas use for HVAC</td>
<td>459</td>
<td>78%</td>
</tr>
<tr>
<td>5</td>
<td>Energy efficient lighting</td>
<td>461</td>
<td>78%</td>
</tr>
<tr>
<td>6</td>
<td>Recycling provided on-site</td>
<td>491</td>
<td>83%</td>
</tr>
<tr>
<td>7</td>
<td>Walking access to services and restaurant</td>
<td>446</td>
<td>75%</td>
</tr>
<tr>
<td>8</td>
<td>Public transportation nearby</td>
<td>353</td>
<td>60%</td>
</tr>
<tr>
<td>9</td>
<td>Fitness facility on-site</td>
<td>323</td>
<td>55%</td>
</tr>
<tr>
<td>10</td>
<td>Lease structure</td>
<td>262</td>
<td>44%</td>
</tr>
<tr>
<td>11</td>
<td>Green cleaning products</td>
<td>240</td>
<td>41%</td>
</tr>
<tr>
<td>12</td>
<td>Energy Star designation</td>
<td>210</td>
<td>36%</td>
</tr>
<tr>
<td>13</td>
<td>Water conservation</td>
<td>227</td>
<td>38%</td>
</tr>
<tr>
<td>14</td>
<td>LEED designation</td>
<td>172</td>
<td>29%</td>
</tr>
<tr>
<td>15</td>
<td>Shower on-site</td>
<td>147</td>
<td>25%</td>
</tr>
<tr>
<td>16</td>
<td>Bike racks at building</td>
<td>95</td>
<td>16%</td>
</tr>
<tr>
<td>17</td>
<td>Electric car charging station</td>
<td>50</td>
<td>8%</td>
</tr>
<tr>
<td>18</td>
<td>Green roof</td>
<td>44</td>
<td>7%</td>
</tr>
</tbody>
</table>
## Demand vs. Supply

<table>
<thead>
<tr>
<th>Feature</th>
<th>Considered to be Most Important</th>
<th>Currently Available*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor air quality</td>
<td>556</td>
<td>281</td>
</tr>
<tr>
<td>Lease structure</td>
<td>459</td>
<td>122</td>
</tr>
<tr>
<td>Energy efficient lighting</td>
<td>461</td>
<td>262</td>
</tr>
<tr>
<td>Green cleaning products</td>
<td>320</td>
<td>266</td>
</tr>
<tr>
<td>Localized temperature control</td>
<td>436</td>
<td>240</td>
</tr>
<tr>
<td>Fitness facility on-site</td>
<td>319</td>
<td>117</td>
</tr>
<tr>
<td>Energy Star designation</td>
<td>423</td>
<td>229</td>
</tr>
<tr>
<td>Water conservation</td>
<td>491</td>
<td>210</td>
</tr>
<tr>
<td>Green Roof</td>
<td>534</td>
<td>227</td>
</tr>
<tr>
<td>Access to natural light</td>
<td>528</td>
<td>195</td>
</tr>
<tr>
<td>LEED Designation</td>
<td>452</td>
<td>44</td>
</tr>
<tr>
<td>Electric car charging station</td>
<td>500</td>
<td>18</td>
</tr>
<tr>
<td>Walking access to services and...</td>
<td>500</td>
<td>14</td>
</tr>
<tr>
<td>Shower on-site</td>
<td>172</td>
<td>95</td>
</tr>
<tr>
<td>Public transportation nearby</td>
<td>169</td>
<td>95</td>
</tr>
<tr>
<td>Bike racks at building</td>
<td>487</td>
<td>293</td>
</tr>
</tbody>
</table>

**Demand > Supply**

**Demand < Supply**
## Willingness to Pay for Green Buildings

“How much more do you feel your company would pay for each attribute?”

<table>
<thead>
<tr>
<th>Attribute</th>
<th>WTP (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor air quality</td>
<td>1.2%</td>
</tr>
<tr>
<td>Access to natural light</td>
<td>1.2%</td>
</tr>
<tr>
<td>Localized temperature control system</td>
<td>0.9%</td>
</tr>
<tr>
<td>▪ Efficient electrical and gas use for heating...</td>
<td>0.9%</td>
</tr>
<tr>
<td>▪ Energy efficient lighting</td>
<td>0.8%</td>
</tr>
<tr>
<td>Walking access to services and restaurant</td>
<td>0.8%</td>
</tr>
<tr>
<td>Public transportation nearby</td>
<td>0.6%</td>
</tr>
<tr>
<td>Fitness facility on-site</td>
<td>0.6%</td>
</tr>
<tr>
<td>Recycling provided on-site</td>
<td>0.5%</td>
</tr>
<tr>
<td>Lease structure</td>
<td>0.5%</td>
</tr>
<tr>
<td>▪ Water conservation</td>
<td>0.4%</td>
</tr>
<tr>
<td>LEED Designation</td>
<td>0.3%</td>
</tr>
<tr>
<td>Energy Star designation</td>
<td>0.2%</td>
</tr>
<tr>
<td>Shower on-site</td>
<td>0.2%</td>
</tr>
<tr>
<td>Green cleaning products</td>
<td>0.2%</td>
</tr>
<tr>
<td>Bike racks at building</td>
<td>0.1%</td>
</tr>
<tr>
<td>Green roof</td>
<td>0.1%</td>
</tr>
<tr>
<td>Electric car charging station</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

**9.3% WTP in total**
WTP by Lease Structure and Region

- **FSG, 0.63%**
- **FSG, 0.57%**
- **FSG, 0.36%**
- **NNN, 0.98%**
- **NNN, 0.96%**
- **NNN, 0.32%**

**Efficient electrical and gas use for heating and cooling**

**Energy efficient lighting**

**Water conservation**

WTP for Water Conservation:

- **Far West**: 0.42%
- **Great Lakes**: 0.33%
- **East**: 0.47%
Logistic Regression

• Intent is to profile tenant respondents/office managers “green-positive” activities
• Use same data base of 620 complete responses
• Green-positive activities include:
  – Willingness to pay for a green office location
  – Willingness to bid a high premium for specific green features
  – Self-reported “high” knowledge of green industry
  – Practice sustainable operations with green suppliers, etc.
Four Logistic Models

• Model 1: *Willingness-to-pay* for green buildings
• Model 2: “High” *WTP* (>2%)
• Model 3: The tenant’s *knowledge* of Green Buildings
• Model 4: The tenant company’s active promotion of *sustainability*

\[ Y_i = \beta_0 + \beta_1 \text{Region}_i + \beta_2 \text{Indusry}_i + \beta_3 \text{Demographics}_i + \beta_4 \text{Company Characteristics}_i + \beta_5 \text{Lease}_i + \beta_6 \text{Floor-plan}_i + \beta_7 \text{Location Decision}_i + \varepsilon_i \]

• Model pseudo R-squared values 0.14-0.32
### Summary of Outputs
(Statistically significant variables only)

<table>
<thead>
<tr>
<th>Model 1 (Willingness to pay)</th>
<th>Model 2 (High WTP)</th>
<th>Model 3 (Knowledge)</th>
<th>Model 4 (Sustainability)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young age (less 50)</td>
<td>Energy-related industry</td>
<td>Male</td>
<td>Architecture/Construction industry</td>
</tr>
<tr>
<td>Higher Edu (&lt;MA)</td>
<td>Government</td>
<td>Real estate-related industry</td>
<td>Large company (sqft and rental price)</td>
</tr>
<tr>
<td>Sustainable partners (e.g.) suppliers</td>
<td>Sustainable initiative</td>
<td>Sustainable partners (e.g.) suppliers</td>
<td>Publicly traded stock</td>
</tr>
<tr>
<td>Professional Service</td>
<td>South East regions (FL, GA)</td>
<td></td>
<td>Location Decision-Green Buildings Features</td>
</tr>
<tr>
<td>East regions (-) (NY, MD)</td>
<td>East regions (-) (NY, MD)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Discussion

• A slightly higher “stated valued (9.3% WTP)” of green buildings compared to the “revealed value (7-8% rental premium)” from prior literature

• Difference in WTP for green buildings by specific green feature, industry, region, and lease structure

• The highest willingness to pay for improved indoor air quality and access to natural light

• Low pseudo R square issue (0.14 – 0.32) tells a different story?
Future Research Plans

• Integrate the current survey results with more specific building characteristics and off-site information (e.g. local weather, air quality, energy price)

• Next studies will focus on:
  – the relationship between green buildings and employee productivity
  – the relationship between green building practices and the triple bottom line of sustainability (Profit-tenant, Profit-landlord, Planet, People)
Q & A