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Introduction

The Economics of Green Retrofits by Kok, Miller, and Morris: This is the first study focused on the economics of green renovations. With existing building renovation surpassing new construction in recent years, we now have sufficient data to perform reasonable national level analysis on the economic impacts of retrofitting existing buildings. The findings are focused on Leadership in Energy and Environmental Design (LEED) buildings that have become certified within the Existing Building: Operations and Maintenance (EBOM) category over the 2005–2010 period. Rents and occupancy rates are compared, along with the types of improvements undertaken as well as the investment required. A survey among building owners on the typical improvements and attitudes towards the benefits and costs of upgrade investments is included. The findings show that investments in “green” retrofits are incorporated by the market, which is consistent with past studies that focused mostly on new construction. These findings indicate that such sustainable efforts are economically viable. Renovation of the existing stock is likely to continue and even accelerate.

LEED in the U.S. Commercial Office Market: Market Effects and the Emergence of LEED for Existing Buildings by Blumberg: In 1998, the United States Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) system as a certification program for sustainable building standards in new developments. Since that time, the LEED system has garnered a great degree of attention from owners and developers in the U.S. commercial real estate sector, who look to improve the sustainability of their portfolios, as well as the bottom line of their income statements. Numerous studies on the effects on market premiums for LEED-certified buildings have been conducted. This paper examines those studies, as well as the emergence of LEED for Existing Buildings (LEED-EB), a LEED subsystem that certifies sustainable buildings by evaluating operations and maintenance practices.

The Key Drivers and Barriers to the Sustainable Development of Commercial Property in New Zealand by Bond and Perrett: In 2011, research was conducted to identify the key drivers and barriers to the sustainable development of commercial property in New Zealand by surveying a cross-section of these market participants. The overall aim of the research was to identify any barriers that need to be overcome so that progress can be made towards advancing the sustainable building agenda in New Zealand’s commercial property sector that will help improve building energy performance and reduce greenhouse gas emissions. The results indicate there are key issues for the property industry to resolve. The most significant is the commercial property sector’s view of the cost premium for green buildings versus conventional buildings.

Sustainability and Income-Producing Property Valuation: North American Status and Recommended Procedures by Austin: The valuation of property with “sustainability” aspects is not a new property type nor does it call for a deviation
from the traditional valuation methods for the appraisal of income-producing properties. However, there can be numerous and significant differences between sustainable and traditional properties that must be considered, researched, and addressed by appraisers. This paper provides a systematic procedure for evaluating sustainable property aspects with practical guidance and advice for the integration of this procedure into the valuation process for appraisers, developers, building owners, real estate investors, lawyers, and other consumers of appraisal services. The proposed procedure is consistent with the “valuation process” promulgated by the Appraisal Institute, while being consistent with the Uniform Standards of Professional Appraisal Practice, and the methodological and conceptual valuation literature.

**Colorado’s High-Performance Commercial Buildings: An Index and Market Evaluation** by Gripne, Martel, and Lewandowski: Real estate industry leaders remain skeptical about the business case for high-performance commercial buildings. To compare these buildings with conventional buildings, Colorado CoStar, LEED, and ENERGY STAR data were analyzed to evaluate financial outcomes. A survey and index were developed to assess leaders’ views of supply/demand, barriers, and incentives. The results indicate a modest rent premium for LEED and ENERGY STAR buildings, and that price and operating costs are the top factors influencing decision making. The evaluation of state-level business cases is challenging due to the lack of available performance data, the trend to not seek certification, and small sample sizes.

**Comparative Analysis of Housing in Conservation Developments: Colorado Case Studies** by Hannum, Laposa, Reed, Pejchar, and Ex: Conservation development (CD) is an approach to the site design of a development property that combines residential development and land conservation. CD has been heralded as an environmentally-friendly development alternative and a means to finance land conservation. This study combines economic modeling with landscape ecology to address gaps in applied research on home sales in CDs by combining unique and extensive datasets—a sample of CD projects throughout Colorado and residential secondary market transactions. This research demonstrates significant sales price premiums for houses located in regulated and unregulated conservation developments relative to comparable non-CD developments.

**Sustainable Management of Real Estate: Is It Really Sustainability?** by Warren-Myers: This paper investigates what building owners and managers of commercial real estate are actually doing in the guise of sustainability. This research investigates key owners of real estate portfolios in Australia and New Zealand, and examines what they perceive sustainability to mean to their commercial real estate portfolios and their level of implementation. The findings identify that owners perceive sustainability to be very important to the longevity of their portfolios. However, at present, sustainability factors are limited to resource efficiency measures in their real estate portfolios.

**Landscape Restoration and Stewardship Funded in Perpetuity through Home-Site and Golf Course Development** by Smith, Brownfield, Harlan,
Shepard, Laird, and Genereux: A challenge for sustainable development on restored landscapes is to secure funding in perpetuity for restoration. The authors report on a project that has achieved these goals: housing, a golf course, and other amenities coexisting on a restored landscape. Private funding supports prairie and wetlands restoration efforts through a contractual sales-transfer fee and homeowners’ dues. At the restored site, grazing and a dam system had degraded hydrology and vegetation. Ecological metrics now indicate a fivefold increase in spawning trout and the doubling of bird species. A naturalist coordinates restoration and land stewardship. The project provides a model for restorative-development projects supported in perpetuity.

Sustainability for Suburbs by Cowan: The purpose of this paper is to encourage dialogue on what is viewed by the author as unsustainable suburban sprawl. The study examined whether funding from the private sector could replace the need for public sector funds as a means to provide more sustainable development patterns. One finding is that some new public policy applications and private investment vehicle adaptations are necessary to accommodate private investment and mortgage funding requirements. Changes and innovations in enabling statutes and codes are proposed as part of the path to more sustainable suburbs.

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The Economics of Green Retrofits

Authors
Nils Kok, Norman G. Miller, and Peter Morris

Abstract
This is the first study focused on the economics of green renovations. Our findings are focused on Leadership in Energy and Environmental Design (LEED) buildings certified under the Existing Building: Operations and Maintenance (EBOM) certification scheme during the 2005–2010 period. We compare rents and occupancy rates, and investigate the types of improvements undertaken, as well as the amount of investments required. We survey building owners on the typical improvements and their attitudes towards the benefits and costs of upgrades. The findings indicate that investments in “green” retrofits are incorporated by the market, which is consistent with past studies that mostly focused on new construction. The findings indicate that, on average, investments in the sustainability of commercial buildings are economically viable.

During the past several decades, the average new annual construction within the office market has been about 2.1% of the existing stock (Eichholtz, Kok, and Quigley, 2010). If all of this new construction were to be “green,” and if no renovation took place, it would thus take several decades to improve the energy efficiency and sustainability performance of the existing building stock.

There have been several studies focused on the sustainability of new office construction, as measured by the Leadership in Energy and Environmental Design (LEED) scheme, developed by the U.S. Green Building Council. The certification scheme for Existing Building: Operations and Maintenance (EBOM) is of more recent vintage and with the dearth of new construction in the post-2007 commercial market downturn, certification of existing building renovations is now surpassing new construction certification rates. Exhibit 1 provides some evidence of the growth of LEED-certified space in the marketplace and the role of existing buildings. There has been an explosive growth in LEED certification (Panel A), with about 10% of the U.S. commercial office market certified at the end of 2010 (by square footage). Panel B shows that since 2009, LEED certification for existing buildings outpaces LEED certification for new construction.

This is the first study to address the economic implications of LEED certification (following a retrofit), extending the rapidly growing literature on the effects of “green” building in the marketplace. The data in this study are from CoStar and includes 374 LEED-certified properties (EBOM) and nearly 600 control properties for comparative purposes and empirical analysis. We also include some results from a survey on the benefits and costs of retrofits. Many of the buildings in our
Exhibit 1 | Growth in Green Buildings

Panel A: LEED-Certified Space as a Fraction of Total Office Space (Kok et al., 2011)

Panel B: Composition of LEED-Certified Commercial Space

- New Construction (NC)
- Existing Buildings (EB)
sample were in the process of renovating to become more sustainable at the time the EBOM system was published. We identify the renovation period as generally starting in 2005–2009, with certification received from 2008 to 2011.

The results show that the average rents on the EBOM-certified buildings were below those of the control buildings prior to 2006, but have exceed the average rents of the control buildings since 2006. Vacancy rates within EBOM-certified buildings were 7% higher than the control group in 2005. Since 2005, the EBOM group has gained occupancy relative to the control buildings, but still lags slightly behind, primarily due to the soft real estate market since 2007. Using a regression analysis to control for class, age, location, size, and distance to transit, we find a 7.1% rental premium for LEED-certified buildings versus non-LEED buildings. When the ENERGY STAR label is included, we continue to find a significant premium for both ENERGY STAR and LEED certification. The quantitative results, in combination with the survey evidence, provide important information for building owners and investors. There seems to be a tangible financial effect from LEED certification, which outweighs the costs of a retrofit.

**Literature Review**

Prior published literature on the financial implications of green certification mostly focuses on new construction within the U.S., and results generally indicate a positive relationship between environmental certification and financial outcomes in the marketplace. Eichholtz, Kok, and Quigley (2010) document large and positive effects on market rents and selling prices following environmental certification of office buildings. Relative to a control sample of conventional office buildings, LEED or ENERGY STAR-labeled office buildings’ rents per square foot are about 2% higher, effective rents are about 6% higher, and premiums to selling prices per square foot are as high as 16%. Other studies (Miller, Spivey, and Florance, 2008; Fuerst and McAllister, 2011) confirm these findings.

Importantly, these results appear robust over the course of the financial crisis, as Eichholtz, Kok, and Quigley (2011) document for a recent dataset of 3,000 green buildings that both energy efficiency and “greenness” of buildings are capitalized into rents and sales prices. Moreover, this effect is not dented by the recent downturn in property markets. Other studies suggest positive economic benefits from faster absorption, higher occupancy rates, lower operating expenses, higher residual values, as well as greater occupant productivity (Fuerst and McAllister, 2009; Miller, Pogue, Gough, and Davis, 2009; Chau, Tse, and Chung, 2010).

To date, there are no academic studies investigating the market performance of green renovations. There are numerous case studies of single buildings that have been retrofitted for the owner-occupant, but less so in the private rental market.¹

Anecdotal evidence suggests that the move of tenants towards green real estate is due to enhanced reputation benefits, corporate social responsibility mandates, and employee productivity (Nelson and Rakau, 2010). Such a shift in tenant preferences suggests that tenants are using the buildings that they occupy to
communicate their corporate vision to shareholders and employees. The literature on corporate social responsibility (CSR) has generally investigated this link between corporate social performance, reputation benefits, and employer attractiveness (Turban and Greening, 1997; Margolis and Walsh, 2003). In a recent broader study, Pivo and Fisher (2010) suggest higher rents and returns for those engaged in CSR.

Another frequently invoked rationale for occupying green office space is tenant productivity. Miller, Pogue, Gough, and Davis (2009) document using a survey that over half of the occupants of environmentally-certified buildings found their employees to be more productive. Interpretation of these results is problematic, though, as these responses cannot control for management style and individual employee characteristics. However, surveys of tenants in London indicate that there is indeed a shift in corporate preferences. A 2008 research report documents that 58% of tenants find energy efficiency “essential” and 50% find green attributes “essential.” A 2012 survey of Corenet members suggests that tenants want natural light, and better ventilation and temperature control. These features are consistent with more sustainable and greener space.

Improving the bottom line through energy efficiency in buildings is often reported as one of the direct economic benefits for real estate investment companies when considering energy efficiency and sustainability in their portfolios. Jones Lang LaSalle reports that of 115 office properties in its portfolio for which the energy efficiency was improved in 2006, the average realized savings for 2007 and 2008 were $2.24 million and $3 million, respectively. British Land reports that across its portfolio, there is a reported 12% decrease in energy use, amounting to $1.12 million in annual savings in energy, and a decrease of 11.1 million kWh of energy used in 2009.

Another stimulus for demand of sustainable space is government regulation. In many markets such as New York City, San Francisco or Washington, D.C., we see increased government pressure both on the regulatory side (through mandatory disclosure) and from direct government office demand of the government services offices (the federal GSA as well as the California GSA) that require ENERGY STAR or LEED-labeled space for most new leases.

**Data**

We collect data from CoStar on those markets where we observe the largest number of EBOM-certified office buildings, as of the first quarter of 2011. We apply the following filters: built prior to 1990; at least 15,000 square feet; multi-tenant; multiple floors; and Class A or B. This resulted in 374 certified office buildings, distributed over 14 markets, where there were at least 12 or more observations in any one market. The 14 markets are: New York City, Washington, D.C., San Francisco, Houston, Los Angeles, Chicago, Seattle/Puget Sound, Boston, Orange County, East Bay/Oakland, Denver, Atlanta, Dallas/Fort Worth, and Minneapolis/St. Paul.
The 374 buildings are managed by 317 property managers (with some managers overseeing more than one building). Structured surveys were sent to these managers, inquiring into the types of improvements that were made to achieve LEED certification.

CoStar data on property details are used in the empirical analysis and to select a control sample group. The control group is matched in terms of the above-mentioned filters, but we also adjust the selection such that the ages and sizes of the treated and untreated samples are as similar as possible. The control sample includes some 600 properties, after applying the filters on location, age, and size.

Exhibit 2 summarizes the information available on the samples and reports the means and standard deviations for a number of hedonic characteristics of the green and control buildings, including their size, quality, and number of stories, as well as indexes for building renovation and proximity to public transport. Compared to earlier studies on the economics of green building, the sample characteristics are quite similar. Green buildings are slightly younger and have a higher renovation propensity, but the differences are clearly limited through the data selection procedure.

### Survey Results

The survey resulted in a response of 13%, or 41 respondents, all of which registered buildings for and achieved LEED certification. We analyzed the survey responses to understand better the real-life challenges and perceptions of commercial building retrofits. Of course, retrofits also take place to simply...
improve the quality of a building, so we first ascertained what percentage of the improvements were related to sustainability and which were simply necessary to update otherwise obsolete buildings. We asked the following question: “Of the improvements made when you retrofit this building, what percentage was sustainable-related, as opposed to merely updating the building to remain competitive?” Exhibit 3 provides a breakdown of the answers. Just 14% of the respondents indicate that all the improvements were related to sustainability, and over 18% indicate that this is impossible to separate. But for a significant fraction of the respondents, the improvements were related to sustainability, and the most common improvements are provided in Exhibit 4. Not surprisingly, most respondents have implemented what many in the industry refer to as “the low hanging fruit”—for lighting, paybacks are generally very fast. Other popular improvements relate to HVAC, followed by water flow systems (low-flush toilets, etc.) and recycling containers. Motion detectors, automatically switching systems on/off, were also implemented by the majority of respondents. More expensive improvements, like replacing roofs, installing PV solar cells, and changing floors, insulation, and operable windows and better glazing also took place.

The renovation investments ranged in size from just over $400,000 to more than $2 million, with the average LEED building being just over one half million square feet. Expected paybacks are provided in Exhibit 5. This simple measure of financial performance is quite common among the engineers and contractors engaged in building renovations. The most typical payback period is fairly quick, at less than five years. This reflects the preference of commercial building owners for “quick wins,” rather than most aggressive, deep retrofits. About one-third of the respondents expect a payback period of 5–10 years, whereas the financial implications of the investments are unclear for some 13% of the respondents.
**Exhibit 4 | Survey Results**

Major Improvements During Retrofit

- Windows: 0%
- Insulation: 0%
- Floors: 10%
- Roof: 20%
- Irrigation systems/irrigation capture: 40%
- Motion detectors: 60%
- Recycling containers: 80%
- Water flow systems: 100%
- HVAC: 100%
- Lighting: 100%

**Exhibit 5 | Survey Results**

Expected Payback in Years on Sustainability-related Improvements

- < 5 years: 31.8%
- 5-10 years: 31.8%
- > 10 years: 13.6%
- Impossible to estimate: 45.4%
We asked respondents to compare the current rental level in their LEED-certified building, as compared to the rental level prior to the renovation. The results in Exhibit 6 show that 56% perceived no change. (Given that the survey was executed during a period of declining rents, “no change” is not necessarily bad news). Twenty-one percent of the respondents estimated the change in rents to be 1%–5%. And a small number of respondents noticed rent increases of more than 10%.

**Digging Deeper: Analytical Results**

**Aggregate Trends in Rents and Occupancy Rates**

Of course, we can also measure changes in rents and occupancy rates directly. Aggregate rental indices are provided in Panel A of Exhibit 7 and average occupancy rates are provided in Panel B of Exhibit 7 for both the EBOM and control samples. The period prior to renovation is before 2005 and depicted in red. Most improvements were completed after 2005 (although some improvements continued throughout the time period after that) and this period is depicted in green. Note that the rents on the renovated property were lower as compared to rents in the control sample prior to the renovation. Similarly the occupancy rates prior to the renovations were lower than for the control sample. Of significance is the fact that average rents increased faster than for the control group through 2008. While premiums were maintained for the buildings certified by LEED for existing buildings, the rents declined after 2008 at about the same rates as for the control sample. This result is similar to finding by Eichholtz, Kok, and Quigley (forthcoming). We document that the occupancy gap narrowed after the improvements but never completely dissipated during the rather soft rental period from 2007 through 2010.
Exhibit 7 | Rents and Vacancy Rates of LEED Sample and Control Sample  

Panel A: Rental Levels Prior to and After Renovation

Panel B: Occupancy Rates Prior to and After Renovation
Of course, rental and occupancy rates vary by market, and we provide more details on individual markets in Exhibit 8, for the 14 markets studied here. Significant rental premiums are observed in the major markets of Washington, D.C., New York City, and Boston. Occupancy rates strongly depend on when the LEED buildings came “on line;” with many of the LEED buildings being renovated during a period of decline, we continue to observe lower occupancy rates for green buildings in quite a few markets.

**Regression Analysis**

To more formally investigate how EBOM certification influences the rent and occupancy of commercial office buildings, we start with the standard valuation framework for commercial real estate. The sample of rated office buildings and the control sample consisting of nearby nonrated office buildings in the same city are used to estimate a semi-log equation relating office rents (or effective rents) per square foot to the hedonic characteristics of the buildings (e.g., age, building quality, amenities provided, etc.) and the location of each building:

\[
\log R_{in} = \alpha + \beta_i X_i + \sum_{n=1}^{N} \gamma_n c_n + \delta g_i + \varepsilon_{in}. \tag{1}
\]

In this formulation, \( R_{in} \) is the contract rent (or effective rent) per square foot commanded by building \( i \) in city \( n \); \( X_i \) is the set of hedonic characteristics of building \( i \), and \( \varepsilon_{in} \) is an error term. To control more precisely for locational effects, we include a set of dummy variables, one for each of the \( N \) cities. \( c_n \) has a value of one if building \( i \) is located in city \( n \) and zero otherwise. \( g_i \) is a dummy variable with a value of one if building \( i \) is rated by USGBC and zero otherwise. \( \alpha, \beta_i, \gamma_n \) and \( \delta \) are estimated coefficients. \( \delta \) is thus the average premium, in percent, estimated for a labeled building relative to those buildings in its geographic cluster.

Exhibit 9 presents the basic results for the sample, relating the logarithm of rent per square foot in commercial office buildings to a set of hedonic and other characteristics of the buildings. Results are presented for ordinary least squares regression models corrected for heteroscedasticity (White, 1980). Column (1) reports a basic model relating rent to building quality, measured by class designation, size, age, and distance to public transportation. The regression, based upon 956 observations on buildings, explains some 63% of log rent, which is comparable to similar studies in this field. Higher quality buildings, as measured by building class, command a substantial premium. Rent in a Class A building is about 12% higher than in a Class B building. Rent is not significantly higher in larger buildings, as measured by the logarithm of building size. Distance to public transport, which represents an important element of sustainability, is negatively and significantly related to the rent commanded by an office building: For each mile increase to public transport, location rents decrease by about 11%. This corroborates evidence from other studies on sustainability in the property market.
Exhibit 8 | Aggregate Rents and Vacancy Rates of LEED Sample and Control Sample
[By Market, 2011:Q1]

Panel A: Rental Levels

Panel B: Occupancy Rates
### Exhibit 9 | Regression Results

**LEED Ratings and Rents**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED Certified (1 = yes)</td>
<td>0.071***</td>
<td>0.052**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td></td>
</tr>
<tr>
<td>ENERGY STAR (1 = yes)</td>
<td></td>
<td>0.056***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.020)</td>
<td></td>
</tr>
<tr>
<td>Building Class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class A (1 = yes)</td>
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<td>0.110***</td>
<td>0.101***</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.022)</td>
</tr>
<tr>
<td>Building Size (log)</td>
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<td>-0.024</td>
<td>-0.032</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.020)</td>
<td>(0.020)</td>
</tr>
<tr>
<td>Typical Floor Area (log)</td>
<td>0.030</td>
<td>0.034*</td>
<td>0.037*</td>
</tr>
<tr>
<td></td>
<td>(0.020)</td>
<td>(0.019)</td>
<td>(0.019)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.002</td>
<td>0.002</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Age² (years)</td>
<td>-0.000*</td>
<td>-0.000**</td>
<td>-0.000**</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Distance to Transit (miles)</td>
<td>-0.112***</td>
<td>-0.110***</td>
<td>-0.106***</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>City-Fixed Effects</td>
<td>Y</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Constant</td>
<td>2.941***</td>
<td>2.887***</td>
<td>2.932***</td>
</tr>
<tr>
<td></td>
<td>(0.279)</td>
<td>(0.278)</td>
<td>(0.277)</td>
</tr>
<tr>
<td>R²</td>
<td>0.636</td>
<td>0.640</td>
<td>0.643</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.629</td>
<td>0.632</td>
<td>0.635</td>
</tr>
</tbody>
</table>

**Note:** Standard errors in parentheses. There are 970 observations.

* p < 0.1
** p < 0.05
*** p < 0.01

that measured the impact of green aspects on building performance using density tools, like the Google “Walkability” Index. For the Dutch office market, Kok and Jennen (2012) document that a one-kilometer increase to a train station decreases rents by 13%. For the U.S. office market, Pivo and Fisher (2011) use an index to calculate distances from commercial facilities to prominent and important neighborhood amenities. Results indicate that for every 10-point increase in walkability, property values increase by about 9%, providing evidence that sustainability matters beyond the physical attributes of a building.

In column (2) of Exhibit 9, green certification is indicated by a dummy for LEED-certified buildings. Importantly, holding all other hedonic characteristics of the buildings constant, an office building with a LEED EBOM certification rents for a 7% premium, on average. Measured attributes of sustainability and energy
efficiency are incorporated in property rents, and this seems to have persisted through periods of volatility in the property market.

In column (3) of Exhibit 9, the green rating is disaggregated into two components: an ENERGY STAR label and a LEED certification. The coefficients of the other variables are unaffected when the green rating is disaggregated into these component categories. Importantly, the relationship between LEED and the rental premium remains significant when an ENERGY STAR rating is taken into account as well. These results imply that energy efficiency and other indicia of sustainability are complementary. The estimated premium for buildings registered with the EPA is not significantly higher than the premium for LEED-certified office buildings. A recent analysis of the thermal properties of a small sample of LEED-certified buildings indeed concluded that these buildings do consume less energy, on average, than their conventional counterparts. However, 18%–30% of LEED-certified buildings used more energy than their counterparts (Newsham, Mancici, and Birt, 2009). In our LEED sample, there are 299 buildings (87% of those with LEED certification at any level) with both LEED certification and an ENERGY STAR rating.

Exhibit 10 presents the results when the dependent variable is measured by the logarithm of effective rent. When endogenous rent-setting policies are taken into account (we may expect property owners to adopt differing asking rent strategies, ceteris paribus, landlords who charge higher rents will experience higher vacancy rates), the results suggest that the effect of a green rating is even larger. In column (2), the statistical results suggest that a green rating is associated with a 9% increase in effective rent. In the regression reported in column (2), which is exactly similar to results documented by Eichholtz, Kok, and Quigley (forthcoming) for a large sample of LEED-certified office buildings in 2009. Taken together, the results reported in Exhibits 9 and 10 suggest that the occupancy rate of green buildings is about 2% higher than in otherwise comparable non-green buildings.

**Incremental Costs and Benefits of Energy Savings Related Improvements**

On average, our empirical results suggest a rental premium of $2 per square foot a year for buildings certified by LEED for existing buildings (i.e., 7% times an average rent of some 29 dollars per square foot), which at a capitalization rate of 8% (Eichholtz, Kok, and Quigley, forthcoming) results in a value impact of $25 dollars per square foot.

We also note that more energy-efficient buildings may have significant energy savings, but do not count these as they may accrue to the benefit of the tenant, depending on the kind of lease and pass-through terms. This well-known issue is referred to as the “split incentive” problem, where landlords making investments in energy savings that primarily benefits the tenants who may or may not be willing to pay as much in additional rent as the suggested energy savings. Green lease provisions may be helpful in this regard, where a third-party auditor assists in determining how much the utility costs would be in the absence of specific


**Exhibit 10 | Regression Results**

Green Ratings and Effective Rents

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED Certified (1 = yes)</td>
<td>0.091***</td>
<td>0.058</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.035)</td>
<td>(0.037)</td>
<td></td>
</tr>
<tr>
<td>ENERGY STAR (1 = yes)</td>
<td>0.098***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Building Class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Class A (1 = yes)</td>
<td>0.155***</td>
<td>0.147***</td>
<td>0.132***</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>Building Size (log)</td>
<td>0.035</td>
<td>0.033</td>
<td>0.019</td>
</tr>
<tr>
<td></td>
<td>(0.032)</td>
<td>(0.032)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>Typical Floor Area (log)</td>
<td>0.033</td>
<td>0.038</td>
<td>0.044</td>
</tr>
<tr>
<td></td>
<td>(0.031)</td>
<td>(0.031)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>Age (years)</td>
<td>0.007***</td>
<td>0.007***</td>
<td>0.007***</td>
</tr>
<tr>
<td></td>
<td>(0.002)</td>
<td>(0.002)</td>
<td>(0.002)</td>
</tr>
<tr>
<td>Age² (years)</td>
<td>−0.000**</td>
<td>−0.000***</td>
<td>−0.000***</td>
</tr>
<tr>
<td></td>
<td>(0.000)</td>
<td>(0.000)</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Distance to Transit (miles)</td>
<td>−0.135***</td>
<td>−0.132***</td>
<td>−0.126***</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>Constant</td>
<td>1.907***</td>
<td>1.839***</td>
<td>1.915***</td>
</tr>
<tr>
<td></td>
<td>(0.436)</td>
<td>(0.435)</td>
<td>(0.434)</td>
</tr>
<tr>
<td>City-Fixed Effects</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>R²</td>
<td>0.487</td>
<td>0.491</td>
<td>0.496</td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.477</td>
<td>0.480</td>
<td>0.485</td>
</tr>
</tbody>
</table>

Note: Standard errors in parentheses. There are 952 observations.

*p < 0.1

**p < 0.05

***p < 0.01

improvements, and a portion of this is paid in additional rent. But we do not have sufficient detail to match up the energy savings with the rental changes to be able to draw any detailed conclusions beyond those provided by Eichholtz, Kok, and Quigley (forthcoming).

We can, however, estimate the energy-related savings and the strategies based on the work of Davis Langdon Global Construction Managers (see Exhibit 11 for an overview of commercial building energy cost and potential cost savings for five regions). There are several easy strategies to conserve on energy, and we note that even non-green buildings can be well managed and green buildings can be poorly managed. Among the easiest strategies discovered in studies by Miller, Pogue, Saville, and Tu (2010) are daytime cleaning and sub-metering where
Panel A. Energy Costs and ENERGY STAR Scores

Exhibit 11 | Energy Reduction Strategies and Costs
(www.DavisLangdon.com: see research reports)

Panel B. Cost Reduction from Meeting ENERGY STAR Target (From 50)

permitted. Davis Langdon lists the most common renovated related strategies, and each of these reduction strategies is discussed below.

Plug Loads: The typical office property consumes about 10 to 20 KBTus per square foot per year for plug load, but that can easily be improved to 4–10 KBTus, by replacing outdated appliances and equipment (printers, faxes, computer screens) and adding occupancy sensors that shutoff power when no there are no
occupants (after an appropriate delay). “Vampire kill switches” also shut down the entire suite or floor power when the last person leaves the premises. Importantly, the cost for these strategies is negligible.

**Lighting:** The typical office property consumes 10–15 KBTus per square foot per year for lighting, with the best practices at 4 to 7 KBTus. Simply replacing the lights with more modern T5/T8s and motion sensors, adding task lighting and day lighting controls, and moving to daytime cleaning will accomplish this energy reduction for a cost of $3–$5 per square foot. LED lighting is even more efficient and prices are rapidly dropping. LEDs are twice as efficient as most fluorescent fixtures, so even greater efficiency will soon be possible. Day lighting can be brought in by a variety of new skylights, some with reflectors and sun tracking, as well as light diffusers.

**Ventilation:** The ideal situation for indoor air quality and energy use reduction is operable windows, but that is considered a deeper retrofit. The typical office property requires 6–10 KBTus per square foot per year and can reduce that to 3–6 KBTus for a cost of $2–$5 per square foot. The work required includes sealing air ducts, optimizing air handlers and terminal units, and better balancing heating and cooling with integration, if possible, with shade controls and windows. In some cases, large fans are brought in and the maximum comfortable temperature can be raised prior to any cooling.

**Cooling:** Typical office buildings require 15–40 KBTus per square foot per year for cooling, except for those in cooler climate zones. The current best practices are 10–20 KBTus; it costs about $3–$7 dollars per square foot to reach these with a retrofit. The typical strategies include replacing primary equipment, drying the air prior to cooling, adding large fans, and better ventilation, so that the equipment capacity can be decreased. Shading windows also helps control heat gain or adding glazing, although this is considered a deeper retrofit.

**Heating:** The typical office property requires 5–15 KBTus per square foot per year for heat, while the best practices are at 2–8 KBTus. This can be accomplished for just $1–$2 dollars per square foot by replacing primary equipment, improving controls, optimizing terminal units, and balancing heating and cooling with more localized controls.

**Water Conservation:** Water flow equipment investments are economically justified when fixtures must be replaced, but there is no reasonable economic payoff at present as water prices are often too low for any kind of significant return on investment or reasonable payback.

**Deeper Retrofits:** For $10–$75 per square foot, deeper retrofits can be accomplished, including envelope sealing, improved glazing, additional insulation, chilled beams or some form of radiant cooling. Computer-controlled window shades may be considered, along with solar photovoltaic cells or wind turbines. Energy recapture systems can also be employed on elevators. Such strategies typically reduce the energy consumed by 10–25 KBTus and can add energy generation equal to that consumed in some cases.
The summary table below provides an overview of the renovation strategies, their costs, and estimated savings. Quite clearly, the capitalized benefits of a light retrofit (some $25 per square foot) outweigh the costs, ceteris paribus.

<table>
<thead>
<tr>
<th>Strategy</th>
<th>KBTU/SF/Yr (Reduction)</th>
<th>Cost / SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plug Load</td>
<td>6–15</td>
<td>Minor</td>
</tr>
<tr>
<td>Lighting</td>
<td>6–8</td>
<td>$3–$5</td>
</tr>
<tr>
<td>Ventilation</td>
<td>4–5</td>
<td>$2–$5</td>
</tr>
<tr>
<td>Cooling</td>
<td>10–15</td>
<td>$3–$7</td>
</tr>
<tr>
<td>Heating</td>
<td>3–10</td>
<td>$1–$2</td>
</tr>
<tr>
<td>Total</td>
<td>30–50</td>
<td>$10–$20</td>
</tr>
</tbody>
</table>

**Summary and Conclusions**

Existing building retrofits have accelerated over the past several years. Since 2008, achieving LEED certification for existing buildings has become an attainable goal and it now outpaces LEED certification for new construction. This paper is the first to address the financial implications of LEED EBOM certification in the U.S. commercial property market. Using a survey among the managers of 374 buildings, an empirical analysis of data on rents and occupancy, and anecdotal information on retrofit costs, we document that investments in sustainability features and strategies seem to result in value impacts likely to exceed costs. Our LEED EBOM sample, which included most of the renovated buildings in major cities from 2005 through 2010, exhibits significant rental premiums compared to a large, matched control sample. In addition, there are other operational cost factors that favor green buildings over conventional buildings. For example, some insurance firms now charge lower premiums once buildings have attained LEED certification.7

Our results are consistent with those findings observed on new construction of LEED-certified buildings. Most salient is the fact that the types of office space renovations observed here for improved productivity and energy efficiency apply to a much larger pool of candidate properties. These market developments will continue to affect the existing stock of non-certified office buildings, especially as regulatory trends are forcing greater energy consumption transparency upon the commercial real estate market and as tenants report on actions to achieve corporate social responsibility goals via portfolio sustainability reporting tools such as the Global Reporting Initiative and the Global Real Estate Sustainability Benchmark,8 and the plethora of building-level benchmarks now available for assessing the sustainability of commercial real estate.9

**Endnotes**

1 For example, one study on Australia, by Miller and Buys (2008), examined the benefits of retrofits from the perspective of tenants in a large office property. They found positive
sentiments that green retrofits would continue and were well received by tenants. No study we are aware of has examined the economics of retrofits based on a broadly selected sample.

3 See Corporate Occupier Sustainability Perspectives–2012 by Corenet Global, CBRE, and the University of San Diego.
7 For example, Fireman’s Fund charges about 5% lower insurance premiums for such buildings.
9 For example, LEED (global), BREEAM (global), ENERGY STAR (U.S.), CASBEE (Japan), HK BEAM (Hong Kong), Green Star (Australia), HQE (France), and DGNB (Germany).

References


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LEED in the U.S. Commercial Office Market: Market Effects and the Emergence of LEED for Existing Buildings

Author: David Blumberg

Abstract: In 1998, the United States Green Building Council (USGBC) developed the Leadership in Energy and Environmental Design (LEED) system as a certification program for sustainable building standards in new developments. The LEED system has garnered a great degree of attention from owners and developers in the U.S. commercial real estate sector, who not only look to improve the sustainability of their portfolios but the bottom line of their income statements. Numerous studies on the effects on market premiums for LEED certified buildings have been conducted. This paper examines those studies as well as the emergence of LEED for Existing Buildings (LEED-EB), a LEED subsystem that certifies sustainable buildings by evaluating operations and maintenance practices.

Demand for green office space in the United States is rapidly escalating (Bernstein, 2009). Consequently, office building owners, developers, and property managers are becoming increasingly interested in making their properties more “green.” Green building certification programs facilitate these efforts by guiding owners, developers, and property managers through the “greening” process, validating such efforts, and helping to market the properties after certification. The United States Green Building Council’s (USGBC) Leadership in Energy and Environmental Design (LEED) program has emerged as the predominant player in this green building certification field (Del Percio, 2005). While at first the USGBC limited their certification to new construction projects, the LEED program now includes a number of subsystems that govern certification processes for different phases of development and types of buildings.

One of these subsystems, LEED for Existing Buildings (LEED-EB), works to ensure that the operations and management practices of existing buildings meet certain sustainable standards. Considering the large stock of existing office buildings in the U.S. and the depressed state of the real estate construction sector, LEED-EB is fast becoming the most prevalent LEED certification subsystem in the commercial office sector (Guma, Pyke, and Miller, 2010). Within the already predominant LEED program, the LEED-EB subsystem has the largest potential certifiable office stock and therefore the ability to have the greatest influence on the green office market (Watson, 2009).
The reason for LEED-EB’s large potential reach stems from one somewhat obvious fact: the stock of the existing office space in the U.S. greatly outnumbers the new office stock that is added to the market each year. Other LEED subsystems focus on the certification of new developments or major renovation projects, whereas LEED-EB simply evaluates the performance of existing buildings. Because newly developed or significantly renovated assets represent only a fraction of our total commercial real estate stock, the LEED subsystems that are designed to certify them are also limited in their potential reach (DiPasquale, 1996). Compared to the 43 million square feet per year in new construction and significantly renovated office space, LEED-EB presides over a realm that includes more than seven billion square feet of commercial office space (Andrews, 2011). Consequently, LEED-EB is the LEED certification system with the greatest potential influence in the U.S. commercial office market and the system that the director of the USGBC, Rob Watson, is calling the emerging leader in LEED certification (Watson, 2009). This paper describes the LEED-EB system and provides an indication of its effects on the U.S. commercial office market.

**Background on the Green Office Market**

The greening of commercial office space is one of the most important emerging trends in the real estate sector (Miller, 2010). With the idea of the triple bottom line prominently featured in the board rooms of top corporations, sustainability and profit have become ever more intrinsically linked. In fact, about three-quarters of all public American companies view sustainability as consistent with their financial mission; 70% of these companies engage in at least three or more pro-sustainability activities (Bernstein, 2009). One of the most common of these green initiatives is the investment in and occupancy of green office space (Bernstein, 2009).

The U.S. market’s acceptance of sustainability has manifested itself in steadily increasing levels of green office demand. In response, over the past two decades, the growth of green office space has been unprecedented. According to a Siemens/McGraw Hill Construction joint report, by 2012, 42% of all firms’ office space portfolios will be at least 60% green (Bernstein, 2009). This prediction is echoed by the Urban Land Institute’s Emerging Trends in Real Estate report, which explains that “Green is here to stay since large corporations and government operations now demand it... every owner needs to be on top of the issue” (Miller, 2010, p. 30). The evolution of green space in the U.S. office market could not have been made possible, however, were it not for the establishment of green building architects, developers, non-profits organizations, and consultants. Of these green ancillary organizations, the one that catalyzed the proliferation of the green office market was the development of the green building accreditation groups.

**Green Building Certification Programs**

The current popularity of green office space arose with the emergence of green building accreditation groups. These green certification organizations provide
LEED in the U.S. Commercial Office Market

Researchers and practitioners have developed guidelines by which building owners can improve the sustainability of their properties. They also function as auditors of the green building process. Furthermore, the organizations educate the greater community on the virtues of green building and consequently build goodwill for their certification that marketers harness through the signaling effects of their labels.

The main U.S. green building accreditation systems include Green Globes, ENERGY STAR, and the Leadership in Energy and Environmental Design (LEED). Each of these systems certifies office properties according to different specifications and methodologies, and there is continued debate as to which one should be the standard bearer. While ENERGY STAR solely measures the energy efficiency of the buildings it certifies, Green Globes and LEED take into account other building components, such as water usage and construction materials, allowing them to evaluate a broader range of sustainable initiatives. When comparing LEED against Green Globes, the latter is criticized for its lack of regulation and self-reporting web-based methodology, as well as its historically slow adoption rate in the commercial office market (Best, 2010). LEED, on the other hand, imposes a rigorous third-party evaluation process and has certified more than one billion square feet of U.S. real estate (Shields, 2008). Consequently, LEED earns the title as the most prominent sustainable building certification system for developers, tenants, and real estate investors. As early as 2002, an industry magazine, Health Facilities Management, asserted that “LEED had become the common benchmark for sustainability” (Kats, 2003, p. 4). Furthermore, many state and local governments have adopted LEED in their commercial building codes, suggesting that the system’s authority is growing (Nelissen, 2002). Considering LEED’s depth and dominance in the green building accreditation arena, the remainder of the paper focuses on the LEED certification system, and within that, LEED-EB.

LEED and the USGBC

The USGBC pioneered the sustainable development accreditation process when they developed the LEED Green Rating System in 1998 (Del Percio, 2005). In general, LEED projects apply for certification and then submit documentation that validates their sustainability claims. Each application is reviewed throughout a number of categories, including: Materials and Resources, Water Efficiency, and Energy and Atmosphere. Applicants must fulfill the prerequisites in each category and are able to earn points for each additional credit that they satisfy thereafter. The final tally of points reveals the degree to which the project is sustainable. Total points achieved correspond to varying certification levels: Certified, Silver, Gold, and Platinum (in increasing order of merit). A project will be LEED Certified if it earns 26 to 32 points, LEED Silver if it earns 33 to 38 points, LEED Gold if it earns 39 to 51 points, and LEED Platinum if it earns 52 to 69 points (Corbett and Muthulingam, 2007).

Although LEED was originally designed with the commercial office market in mind, in order to facilitate the growth of the LEED program the USGBC has expanded its ability to certify all different types of developments, including everything from homes to hospitals. While programs like LEED for Schools and
LEED for Neighborhood Development certainly deserve attention in academic circles, it is the LEED systems that apply to the commercial office market that will be the focus of this paper. These subsystems include LEED for New Construction (LEED-NC), LEED for Core & Shell (LEED-CS), LEED for Commercial Interiors (LEED-CI), and LEED for Existing Buildings (LEED-EB).

**LEED Subsystems**

In early 2000, the first LEED certification subsystem, LEED for New Construction (LEED-NC), was released to the market. As the name suggests, LEED-NC assesses the degree of environmental responsibility taken in the planning and execution stages of a construction project for new developments and major renovations of existing buildings (when the renovation process displaces more than 50% of the building occupants). LEED-NC championed concepts like construction waste stream remediation and sustainable material sourcing, both of which reduce the negative impact on the surrounding environment and improve bottom lines (Kats, 2003). LEED-NC was so successful that only four years after its launch, 69 buildings, comprising more than eight million square feet, earned the LEED-NC label. With the success of its pioneering program, the USGBC entertained the idea of expanding its system to include certifications for other types of projects (Del Percio, 2005).

In 2004, the USGBC unveiled pilot programs for three new LEED Systems: LEED for Core & Shell (LEED-CS), LEED for Commercial Interiors (LEED-CI), and LEED for Existing Buildings (LEED-EB). Each system created a new realm in which certification could be pursued by targeting different types of real estate stakeholders. Two of the new systems, LEED-CI and LEED-CS, acted as complements to one another, meaning they broke out the interior and exterior aspects of the LEED-NC certification. LEED-CS targeted the building owner who designs the main building structure, but not the interiors of the individual leased spaces. The system focused on base building elements such as structure, envelope, heating, ventilation, and air conditioning. LEED-CI, on the other hand, enabled tenants in LEED-CS buildings (or buildings that meet minimum LEED energy efficiency and HVAC standards, but are not LEED certified) to take the initiative of pursuing LEED certification by focusing on the interior conditions of their own leased space. Because LEED-CS assures that those overall building criteria are met, it paves the way for LEED-CI certification. In this way, the two systems work together to allow for situations where tenants can chose whether they want their office space to be LEED certified for an additional cost.

The final LEED Certification subsystem that applies to the commercial office sector is that of LEED-EB. As stated earlier, LEED-EB is fast becoming the most prevalent LEED subsystem in the USGBC’s inventory.

**Detail on LEED-EB**

The LEED-EB subsystem (which also goes by the title of LEED-EBOM, to emphasize the operations and maintenance aspect of the certification) represents the most radical departure from the original LEED certification process. Rather
than focusing on the built to standards of the property in question, LEED-EB assesses the level of sustainability in the ongoing operations of the building. It allowed property managers, under the direction of building owners, to enhance the performance of their buildings to specified efficiency levels in order to gain LEED certification in an existing building. LEED-EB certification would be achieved, theoretically, through systematic changes to the operations of the building as well as small retrofits to hardware, rather than large design projects or major renovations. In fact, if, in pursuing certification, system retrofits displace more than half of the building’s occupants, the project no longer qualifies for LEED-EB. Examples of non-invasive upgrades include but are not limited to the installation of low flow faucets, drip irrigation systems, and a building-wide recycling initiative.

Submission of historical records for a specific performance period of between three months (for items such as irrigation rates) and two years (for items such as HVAC efficiency) serves to validate the sustainable operations for the building in LEED-EB. Examples of building information needed for the assessment include utility bills, equipment maintenance protocols, cleaning policies, current product provider inventory, landscaping plans, etc. Since these performance metrics, programs, and policies change frequently, LEED-EB certification must be renewed every five years, unlike other LEED systems whose certification lasts indefinitely. This verification procedure is what differentiates LEED-EB from LEED-NC and other systems, in the sense that LEED-EB oversees the continued performance of a building rather than its built to standards.

**LEED-EB Checklist**

The performance of LEED-EB buildings is assessed across six categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, Indoor Environmental Quality, and Innovations in Operations & Upgrades. Most categories include a prerequisite credit that must be attained in order to be considered for LEED-EB certification. For example, for Energy and Atmosphere a building must demonstrate that it preforms better than 69% of its peer group as determined by an ENERGY STAR rating of 69; for Indoor Environmental Quality a building must meet ASHRAE Standard 62.1–2007, which stipulates certain air flow and ventilation standards. Within each category there are also a number of items that can be assessed to accrue points towards certification. Exhibit 1 lists the six categories and provides examples of how checklist points are assessed and actions that would confer such points.

Exhibit 1 illustrates the diverse range of standards the USGBC tests for in the LEED-EB certification. Most checklist items, like water efficiency, are simply assessed via an improvement from past performance (e.g., a 20% reduction is worth two points). Others, like energy efficiency, are tested relative to the average market performance (e.g., performing at the 80th energy efficiency percentile, as documented by ENERGY STAR, is worth nine points). Still, some items, like alternative transportation (carpooling), only test that certain programs were initiated rather than their efficacy. Appendix A provides a detailed LEED-EB checklist of all point-earning categories and elements.
### Exhibit 1 | Example of LEED-EB Checklist Items

<table>
<thead>
<tr>
<th>Sustainable Sites</th>
<th>Water Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Island Reduction (Roof)</td>
<td>Place shrubbery around exterior of building</td>
</tr>
<tr>
<td>Alternative Transportation-Carpooling</td>
<td>Organize and advertise carpooling program for tenants</td>
</tr>
<tr>
<td></td>
<td>Upgrade to a drip irrigation system</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Energy &amp; Atmosphere</th>
<th>Materials &amp; Resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimize Energy Performance</td>
<td>Achieve ENERGY STAR rating of 60 or above</td>
</tr>
<tr>
<td>Renewable Energy Improvement</td>
<td>Introduce renewable energy platforms or renewable energy purchase credits</td>
</tr>
<tr>
<td></td>
<td>Purchase HEPPA safe vacuums</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Indoor Environmental Quality</th>
<th>Innovations in Operations &amp; Upgrades</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indoor Integrated Pest Management</td>
<td>Upgrade to pest management company’s “Green Package”</td>
</tr>
<tr>
<td>Occupant Controlled Lighting</td>
<td>Install light switches that allow for variable settings</td>
</tr>
<tr>
<td></td>
<td>Enact creative green program, e.g., on-site E-Waste Recycling service</td>
</tr>
</tbody>
</table>

Note: The sources are LEED-EB Checklist and LEED-EB Sample Scorecard for 355 Alhambra Circle Property (see Appendix A & B).

### Differentiating Across the Subsystems

While there are clear differences in the LEED certification subsystems (i.e., their requirements, certification methodologies, and even their missions), the general public takes a more general view of the certification process and lumps each disparate system under the LEED umbrella.

This mental amalgamation of the LEED systems could be attributed to the way the certification is marketed. At this point, building owners and leasing agents do relatively little to differentiate between the LEED subsystems. In fact, the USGBC does not require that the LEED subsystem by which each specific building is certified be designated in their marketing materials. Therefore a building could be certified under LEED-EB at the gold level and simply be advertised as a LEED Gold building. Leasing agents and property managers usually take advantage of this grace clause and drop the subsystem suffix in their marketing materials. Even the official LEED placards that are placed predominantly in building lobbies do not have the LEED subsystem displayed in the engraving.
Just as the leasing agents take the New Construction, Core and Shell, Commercial Interiors and Existing Building subsystems as one general LEED concept, so do the researchers who have studied the LEED building market. One of the most highly researched topics within the LEED space is that of LEED’s ability to generate market premiums on rent and occupancy through certification. Every study to date on the market impacts of LEED certification has either focused on LEED-NC specifically or amalgamated the subsystems in order to draw conclusions about the market premiums of LEED office buildings in general.

**LEED Market Premiums**

There is a large body of work published on the topic of LEED market premiums. The USGBC encourages studies of LEED certification presumably because the results, if positive, promote the proliferation of LEED certification across the country (Stribling, 2007).

**Market Premiums for LEED Buildings**

The market premiums for commercial real estate buildings are lease, occupancy rate, and sales price premiums. Market premiums associated with LEED certification could arise for a number of reasons. First, LEED buildings save on energy and water-related expenses that are usually passed on to the tenants. These savings may attract more tenants or entice them to pay more for office space (Eichholtz, Kok, and Quigley, 2009). Similarly, the improved indoor environmental quality of a LEED building increases productivity and decreases employee sick days, adding value to the businesses that occupy the building and presumably commanding higher market rates (Miller, 2010). Furthermore, tenants that occupy LEED buildings may enjoy a signaling effect from the superior social responsibility shown by virtue of renting such green office space. Eichholtz, Kok, and Quigley (2009, p. 6) suggest that, “Favorable reputations may enable firms to charge premium prices, to attract a better workforce, and to attract investors.” As a result, tenants may be more apt to occupy such a building, improving leasing and occupancy rates. Finally, if the market favors LEED buildings on the whole, this could increase the length of the buildings’ economic lives. Such properties could outlive other comparable buildings, potentially decreasing risk premiums and increasing valuations (Eichholtz, Kok, and Quigley, 2009). According to Corbett and Muthulingam (2007), the combined effects of these benefits are significant and can justify premiums in market rates.

**Comprehensive Studies on LEED Market Premiums**

Over the past ten years, there have been four groups of researchers that have attempted to answer the question: What are the market premiums associated with LEED certified buildings? While their results differ, the methodologies employed by each group are very similar. In general, these researchers followed the same general procedure. They selected specific commercial office buildings and grouped them into a control, non-green building set and a LEED-certified set. They used
historic market data for these buildings, which they gathered from the CoStar commercial real estate database. They compared their LEED-certified set to their control set in a hedonic model that attempted to account for variations in constituent characteristics like building age, size, and office class, among others. And they calculate LEED-related market premiums of lease, occupancy rates, and/or sales price premiums relative to the control group.

The researchers made certain decisions that differentiated their study from the others. They applied unique methodology and filters when selecting their control and LEED sample sets. They populated their sample set with data from different years and varying time periods. They attempted to mitigate for different variables in their hedonic models. And they estimated some or all of the market premiums considered in this study.

Wiley, Benefield, and Johnson. Wiley, Benefield, and Johnson (2010) chose their sample sets by focusing on a preselected list of 46 geographic markets across the U.S. and selecting buildings in those markets that had lease and occupancy rates available on CoStar. By selecting LEED and non-green certified buildings within the same group of markets, the researchers partially mitigated for the effect geography could have on market rates. However, the fact that these 46 geographic markets were large enough to produce sample sets of over 7,000 properties suggests that the markets selected were very large, and therefore the buildings may have been geographically dispersed.

Moreover, Wiley, Benefield, and Johnson (2010) populated their sample sets with data on lease and occupancy rate premiums as of January 8, 2008. Rather than choosing to look at market information over time, they chose one specific point in time, which made their analysis more susceptible to criticism about the general applicability of these results. Finally, the hedonic model the authors developed only accounted for two variables: the age of the buildings and the geography. Therefore, the reported premiums of this study, which suggest that LEED buildings are associated with lease rate premiums of 16% and occupancy rate premiums of 17%, are potentially driven by other variables besides LEED certification (e.g., the class or size of the building).

Miller, Spivey, and Florance. Miller, Spivey, and Florance (2008) examine the market premium differentials between LEED and conventional buildings, while attempting to mitigate for uncontrolled variables. The researchers created groups of 2,000 non-green certified buildings and 580 LEED certified buildings—the largest LEED certified sample set employed by any researchers. Furthermore, only buildings built since 1970, five stories or higher, greater than 200,000 sq. ft., that were multi-tenant Class A offices, were sampled. The groups of properties met minimum descriptive requirements such as age and property class before statistical analysis was performed.

When comparing the sales price premiums of the two data sets, Miller, Spivey, and Florance (2008) further mitigated for confounding variables by employing a hedonic model that incorporated variables like age, location, time of sale, and size. Moreover, they utilized CoStar transaction data from years 2003 to 2007, allowing for a generalized view of sales price premiums over the period. They concluded that LEED certified buildings commanded a 9.9% sales price premium.

Miller, Pyke, and Guma (2010) looked at the most recent sales price data in their
LEED in the U.S. Commercial Office Market

Sample sets, which yielded a revised sales price premium of 8.33%. However, these results included strong caveats, in that the sample size for LEED office sales was limited to 20 cases, as that was the number of LEED building sales made during the year.

Further detracting from the strength of the Miller, Pyke, and Guma (2010) methodology is the fact that in Miller, Spivey, and Florance (2008) as well as Miller, Pyke, and Guma (2010), the researchers did not utilize a hedonic model when looking at lease rate and occupancy premiums. Miller, Spivey, and Florance (2008) compared the averages for their sample sets, reporting 33.6% lease rate premiums and 4.2% occupancy rate premiums in 2008. These results may have been more modest if variables like size and year of construction (which LEED buildings generally benefit from) had been better accounted for. The same criticism arises when looking at Miller, Pyke, and Guma (2010), where the LEED sample was actually about a decade younger than the control sample and was not controlled for by simply comparing means. In this case, the fact that the LEED buildings were younger could have downwardly influenced the market premiums of the LEED set, resulting in premiums a third as large in Miller, Spivey, and Florance (2008). Miller, Pyke, and Guma (2010, p. 2) explained their reported 11.4% lease rate premium and the −4.50% occupancy rate premium by stating, “the delivery timing of many LEED buildings has resulted in higher than average vacancy rates.” Therefore, this modest lease rate premium and negative occupancy premium was not the product of the LEED label, but possibly attributed to the fact that the LEED sample was comprised of largely new buildings, an item that could have been accounted for in their analysis, had they utilized a hedonic model in the analysis of their sales and occupancy rate premiums.

Fuerst and McAllister. Fuerst and McAllister (2008) applied a hedonic model to the analysis of both LEED sales price and lease rate premiums. The researchers utilized filters similar to Miller, Spivey, and Florance (2008) and Miller, Pyke, and Guma (2010) when forming the sample sets that would be analyzed, so that the two groups (non-green certified and LEED certified) met minimum descriptive characteristics before statistical analysis was performed. Furthermore, the hedonic model that Fuerst and McAllister developed took into account a number of variables that could have confounded the analysis, including lot size, building size, height, geographic coordinates, building class, submarket, and age. By applying this model to CoStar data between the years of 1999 and 2007 for 110 LEED certified buildings and 2,070 conventional offices, the researchers found a lease rate premium of 9.2%. Furthermore, the hedonic model was also used by the researchers to compare 30 LEED certified building sales to 1,890 conventional office sales, yielding a sales price premium of 31.4%. This latter number was scrutinized because the LEED sample was about one-seventh the size of the conventional sample, raising questions about the general representativeness of that LEED sales price premium.

Fuerst and McAllister (2010) utilized the same methodology as Fuerst and McAllister (2008), but employed an expanded data set that included market rates from 1999 to 2008. This expanded data set included information on 122 LEED certified building sales, as opposed to the 30 in Fuerst and McAllister (2008). This update yielded a sales rate premium of 25%. The expanded data set also
increased the number of LEED buildings observed for rental rate premiums up to 197 from 110. This new sample set yielded a rental rate premium of 5%.

**Eichholtz, Kok, and Quigley.** Eichholtz, Kok, and Quigley (2009, 2011) improved the Fuerst and McAllister (2008, 2010) methodology by utilizing new techniques to account for confounding variables, expanded sample sizes, and more recent data sets. The Eichholtz, Kok, and Quigley methodology was groundbreaking in that the researchers utilized GIS technology to ensure that each pair of buildings was located within 0.2 square mile clusters of one another. This means that the LEED certified building was compared to a conventional set of buildings that contained a sister building no more than 1,400 feet away. No other methodology places such a stringent requirement on the pairing of data sets by geography. Furthermore, while Fuerst and McAllister shared similar hedonic models, Eichholtz, Kok, and Quigley incorporated two variables that the former study does not: employment growth of the market and building amenities, both of which certainly play a role in determining the market rate of office buildings. Lastly, Eichholtz, Kok, and Quigley further isolated the premium for green buildings by identifying only the most “comparable” LEED and non-green buildings in each 0.2 mile geographic cluster, only using buildings that were closely matched to LEED buildings (using a technique called propensity scoring).

When Eichholtz, Kok, and Quigley (2009) employed this methodology, the researchers compared data from 2004 to 2007 on 286 LEED certified buildings versus a set of 6,000 conventional buildings in the CoStar database, and reported a 5.2% lease rate premium and 11.3% sales rate premium. However, the results of the study with regard to LEED market premiums were not statistically significant at the 10% level and had to be discounted. However, Eichholtz, Kok, and Quigley (2011) included a data set with observations from 2004 to 2009, the most recent period of data that spans more than one year. For lease rate premiums, the researchers analyzed data from a group of 249 LEED certified buildings and found lease rate premiums of 5.8%. For sales price premiums, the researchers analyzed data from a group of 103 LEED certified building transactions and found sales price premiums of 11.1%. Both results were significant at the 1% level in this case.

**Summary of Existing Research**

The market premiums identified in all the studies listed above are included in Exhibit 2. The studies in the field of sustainable building indicate that green certifications are associated with significant market premiums in lease, occupancy, and sales rates. The results of these reports yield an average lease premium of 12.3%, and a median of 9.2%; an average occupancy rate premium of 5.6%, and a median of 4.2%; and, an average sales price premium of 16.2%, and a median of 11.2%. While these figures could provide a very loose estimation of LEED’s market effects on the whole, the results across these studies vary by more than 20 percentage points between maximum and minimum values in each market premium category, and each study utilized a different methodology.
**Exhibit 2 | LEED Market Premiums in Percentage Terms by Study**

<table>
<thead>
<tr>
<th>Study</th>
<th>Research Period</th>
<th>Lease Premium</th>
<th>Occupancy Premium</th>
<th>Sales Price Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wiley, Benefield, &amp; Johnson (2010)</td>
<td>2008</td>
<td>16.0</td>
<td>17.0</td>
<td>N/A</td>
</tr>
<tr>
<td>Eichholtz, Kok, &amp; Quigley (2009)</td>
<td>2004–2007</td>
<td>5.2*</td>
<td>N/A</td>
<td>11.3*</td>
</tr>
<tr>
<td>Miller, Pyke, &amp; Guma (2010)</td>
<td>2009–2010</td>
<td>11.4</td>
<td>–4.5</td>
<td>8.3</td>
</tr>
<tr>
<td>Fuerst &amp; McAllister (2011)</td>
<td>1999–2008</td>
<td>5.0</td>
<td>N/A</td>
<td>25.0</td>
</tr>
<tr>
<td>Eichholtz, Kok, &amp; Quigley (2011)</td>
<td>2004–2009</td>
<td>5.8</td>
<td>N/A</td>
<td>11.1</td>
</tr>
</tbody>
</table>

*Note: Authors, year(s) of research collection, and market premiums are displayed for each study.  
*Percent premium is not significant at the 10% level.*

**Shortcomings of Prior Studies**

Each study reviewed on the topic of LEED market premiums used a common methodology that compiled historical market rate data from CoStar and compared the LEED certified properties to a benchmark set of non-green certified properties. The trouble with such a methodology is that matching the LEED buildings to a set of other buildings with the exact same characteristics except for the LEED certification is very difficult. Using hedonic models may control for some of these confounding variables, but it does not capture all discrepancies. These issues are an important drawback of prior research, since the LEED certification variable is not entirely isolated. More importantly, the prior studies do not differentiate between the market effects of LEED-NC and other LEED subsystems, specifically the growing subsystem of LEED-EB. Since the certification subsystems are so different in implementation and cost, it is important to determine if they are viewed differently by the market, as reflected by rental and occupancy rates.

**Conclusion**

When actors vested in the commercial real estate market look to certify their buildings under the LEED system, they conduct a general cost-benefit analysis. The costs can be determined through estimates provided by general contractors or consultants, and are relatively accurate in outcome. The benefits, especially the market premiums that the investors will hope to recoup on the certification, are much more difficult to approximate. While there are data that support the general positive market premium associated with the LEED label, even these studies vary in their conclusions. Furthermore, no study has done an adequate job in determining the market effects of each LEED subsystem independently. This is important because each subsystem is unique with its own set of rules and
associated costs. The market benefits gleaned from prior studies generally focus on the LEED-NC certification, by virtue of their sample sets and timing. However, it is LEED-EB, not LEED-NC that is forecasted to become the largest LEED subsystem in the commercial real estate market. Therefore, further research is required in order to focus a market premium study on LEED-EB.

**Emerging Dominance of LEED-EB**

Historically, the most readily pursued LEED system was LEED-NC (Shields, 2008). LEED-NC’s prominence stemmed from the fact that it was the USGBC’s inaugural system. The commercial office construction boom of 2007 also fueled the proliferation of the LEED-NC label (Appendix C). However, late in 2008, when the effects of the economic downturn halted much of the U.S. commercial office construction, the rate of LEED-NC certifications likewise started to decline. In fact, although LEED-NC constituted 75% of all new LEED certified space in 2008:Q1 (Appendix C), in 2008:Q2, that number decreased to 48%, and in 2009: Q1 it dropped even further to 35% as development activity in general declined (Guma, Pyke, and Miller, 2010). With the precipitous demise of the office construction sector and the related decline of LEED-NC, a new champion in LEED’s certification efforts emerged: LEED-EB.

After a period of relative dormancy, LEED-EB is fast becoming the new leader of the USGBC LEED certification systems. While LEED-EB certified only 11 projects in 2005, 17 in 2006, and 27 in 2007, the system took off rapidly in 2009, certifying 275 projects across the U.S. (Zimmerman, 2010). The Green Building Market and Impact Report 2009 stated that, “in what could be a harbinger of the future, certifications of LEED-EB/EBOM of over 135 million square feet of projects are likely to significantly exceed NC project certifications of about 120 million square feet by the start of 2010” (Watson, 2009). This prediction came true, in fact, when LEED-EB certification eclipsed LEED-NC as the leader in quarterly certified square feet in 2009:Q3 (Guma, Pyke, and Miller, 2010). Although, LEED-NC still surpasses LEED-EB in cumulative certified square feet (499 million vs. 493 million), the phenomenal growth of LEED-EB in recent years warrants a closer look at this certification system.

**Recommendations for Further Research**

In order to determine the true value of the LEED-EB certification system, researchers in the field should isolate the LEED-EB subsystem and determine the market premiums in lease, occupancy, and sales rates for these buildings versus their market counterparts. Ostensibly, this could be achieved by utilizing a methodology similar to what has been employed in the past by leveraging the CoStar database. For this update, one need only improve the matching scheme and limit the LEED buildings analyzed to those certified under LEED-EB. This methodology would approximate the market advantage of LEED-EB buildings, attributed to the LEED-EB certification alone. In doing so, researchers would aid property managers and owners in conducting a true cost-benefit analysis of LEED-EB certification, potentially making a stronger case for certification across the U.S.
Appendix A
LEED-EB Checklist

LEED for Existing Buildings (LEED-EB) Project Checklist

### LEED 2009 for Existing Buildings: Operations & Maintenance

<table>
<thead>
<tr>
<th>Sustainable Sites</th>
<th>Possible Points: 26</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit 1</td>
<td>LEED Certified Design and Construction</td>
</tr>
<tr>
<td>Credit 2</td>
<td>Building Exterior and Landscape Management Plan</td>
</tr>
<tr>
<td>Credit 3</td>
<td>Integrated Pest Management, Erosion Control, and Landscape Management Plan</td>
</tr>
<tr>
<td>Credit 4</td>
<td>Alternative Commuting Transportation</td>
</tr>
<tr>
<td></td>
<td>Reduce by 10%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 13.7%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 17.5%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 21.25%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 25%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 31.25%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 37.5%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 43.75%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 50%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 56.25%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 62.5%</td>
</tr>
<tr>
<td></td>
<td>Reduce by 68.75%</td>
</tr>
<tr>
<td>Credit 5</td>
<td>Site Development—Protect or Restore Open Habitat</td>
</tr>
<tr>
<td>Credit 6</td>
<td>Stormwater Quantity Control</td>
</tr>
<tr>
<td>Credit 7.1</td>
<td>Heat Island Reduction—Non-Roof</td>
</tr>
<tr>
<td>Credit 7.2</td>
<td>Heat Island Reduction—Roof</td>
</tr>
<tr>
<td>Credit 8</td>
<td>Light Pollution Reduction</td>
</tr>
</tbody>
</table>

Source: USGBC website.

### Water Efficiency

<table>
<thead>
<tr>
<th>Possible Points: 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit 1</td>
</tr>
<tr>
<td>Credit 2</td>
</tr>
<tr>
<td>Credit 3</td>
</tr>
<tr>
<td>Credit 4</td>
</tr>
</tbody>
</table>

Source: USGBC website.
### Energy and Atmosphere

<table>
<thead>
<tr>
<th>Credit 1</th>
<th>Optimize Energy Efficiency Performance</th>
<th>1 to 18</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ENERGY STAR Rating of 71 or 21st Percentile Above National Median</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>ENERGY STAR Rating of 73 or 23rd Percentile Above National Median</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>ENERGY STAR Rating of 74 or 24th Percentile Above National Median</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ENERGY STAR Rating of 76 or 25th Percentile Above National Median</td>
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<td></td>
<td>ENERGY STAR Rating of 78 or 26th Percentile Above National Median</td>
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<td>ENERGY STAR Rating of 79 or 27th Percentile Above National Median</td>
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<td>ENERGY STAR Rating of 80 or 28th Percentile Above National Median</td>
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<td>ENERGY STAR Rating of 81 or 29th Percentile Above National Median</td>
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<td>ENERGY STAR Rating of 82 or 30th Percentile Above National Median</td>
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<td></td>
<td>ENERGY STAR Rating of 85 or 32nd Percentile Above National Median</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>ENERGY STAR Rating of 87 or 33rd Percentile Above National Median</td>
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<td>ENERGY STAR Rating of 95+ or 45th Percentile Above National Median</td>
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| Credit 2.1 | Existing Building Commissioning—Investigation and Analysis | 2 |
| Credit 2.2 | Existing Building Commissioning—Implementation | 2 |
| Credit 2.3 | Existing Building Commissioning—Ongoing Commissioning | 2 |
| Credit 3.1 | Performance Measurement—Building Automation System | 1 |
| Credit 3.3 | Performance Measurement—System-Level Metering | 1 to 2 |
| Credit 4 | On-site and Off-site Renewable Energy | 1 to 6 |
| Credit 5 | Enhanced Refrigerant Management | 1 |
| Credit 6 | Emissions Reduction Reporting | 1 |

Source: USGBC website.
### Materials and Resources

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<th>Credit</th>
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<tr>
<td>Preq 1</td>
<td>Sustainable Purchasing Policy</td>
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<td>Preq 2</td>
<td>Sustainable Purchasing—Ongoing Consumables</td>
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<tr>
<td>Preq 2</td>
<td>Sustainable Purchasing—Durable Goods</td>
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<td>Credit 3</td>
<td>Sustainable Purchasing—Facility Alterations and Additions</td>
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<td>Credit 4</td>
<td>Sustainable Purchasing—Reduced Mercury in Lamps</td>
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<td>Credit 5</td>
<td>Sustainable Purchasing—Food</td>
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<td>Credit 6</td>
<td>Sustainable Purchasing—Waste Stream Audit</td>
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<td>Solid Waste Management—Waste Stream Audit</td>
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<td>Solid Waste Management—Durable Goods</td>
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<td>Solid Waste Management—Facility Alterations and Additions</td>
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### Indoor Environmental Quality

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<td>Minimum IAQ Performance</td>
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<tr>
<td>Preq 2</td>
<td>Environmental Tobacco Smoke (ETS) Control</td>
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<tr>
<td>Preq 3</td>
<td>Green Cleaning Policy</td>
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<tr>
<td>Credit 1.1</td>
<td>Indoor Air Quality Best Management Practices—Indoor Air Quality Management Program</td>
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<tr>
<td>Credit 1.2</td>
<td>Indoor Air Quality Best Management Practices—Indoor Air Quality Management Practices—Increased Ventilation</td>
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<td>Credit 1.4</td>
<td>Indoor Air Quality Best Management Practices—Reduce Particulates in Air Distribution</td>
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<td>Credit 1.5</td>
<td>Indoor Air Quality Best Management Practices—Facility Alterations and Additions</td>
</tr>
<tr>
<td>Credit 2.1</td>
<td>Occupant Comfort—Occupant Survey</td>
</tr>
<tr>
<td>Credit 2.2</td>
<td>Controllability of Systems—Lighting</td>
</tr>
<tr>
<td>Credit 2.3</td>
<td>Controllability of Systems—Lighting</td>
</tr>
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<td>Credit 2.4</td>
<td>Daylight and Views</td>
</tr>
<tr>
<td>Credit 3.1</td>
<td>Green Cleaning—High Performance Cleaning Program</td>
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<td>Credit 3.2</td>
<td>Green Cleaning—Custodial Effectiveness Assessment</td>
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<tr>
<td>Credit 3.3</td>
<td>Green Cleaning—Purchase of Sustainable Cleaning Products and Materials</td>
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<tr>
<td>Credit 3.4</td>
<td>Green Cleaning—Sustainable Cleaning Equipment</td>
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<td>Credit 3.5</td>
<td>Green Cleaning—Indoor Chemical and Pollutant Source Control</td>
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<td>Green Cleaning—Indoor Integrated Pest Management</td>
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### Innovation in Operations

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<tr>
<td>Credit 1.2</td>
<td>Innovation in Operations: Specific Title</td>
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<td>Credit 3</td>
<td>Documenting Sustainable Building Cost Impacts</td>
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### Regional Priority Credits

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<td>Regional Priority: Specific Credit</td>
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<tr>
<td>Credit 1.2</td>
<td>Regional Priority: Specific Credit</td>
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<td>Regional Priority: Specific Credit</td>
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<td>Credit 1.4</td>
<td>Regional Priority: Specific Credit</td>
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### Total

Certified 40 to 49 points  Silver 50 to 59 points  Gold 60 to 79 points  Platinum 80 to 110

Source: USGBC website.
Appendix B

LEED-EB Scorecard

355 Alhambra LEED-EB Project Scorecard for Gold Certification

<table>
<thead>
<tr>
<th>Sustainable Sites</th>
<th>12 Points</th>
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<tbody>
<tr>
<td>Credit 1</td>
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<td>Credit 2</td>
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<td>Credit 3</td>
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<td>Credit 4</td>
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<tr>
<td>Credit 7.1</td>
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<tr>
<td>Credit 7.2</td>
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</tr>
<tr>
<td>Credit 8</td>
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</tr>
<tr>
<td>Credit 4.1</td>
<td>1</td>
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<td>Credit 4.2</td>
<td>1</td>
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<tr>
<td>Credit 4.3</td>
<td>1</td>
</tr>
<tr>
<td>Credit 4.4</td>
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<tr>
<td>Reduced Site Disturbance, Protect or Restore Open Space</td>
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<tr>
<td>Stormwater Management</td>
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<tr>
<td>Heat Island Reduction, Non-Roof</td>
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<tr>
<td>Heat Island Reduction, Roof</td>
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<td>Light Pollution Reduction</td>
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Source: Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.
**Source:** Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.

**LEED for Existing Buildings: Operations & Maintenance Registered Project Checklist**

<table>
<thead>
<tr>
<th>Yes</th>
<th>?</th>
<th>No</th>
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<tbody>
<tr>
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**Water Efficiency**

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**Credit 1, 1, 2, 4**

- **Minimum Indoor Plumbing Fixture & Fitting Efficiency**
- **Water Performance Measurement, Whole Building Metering**
- **Water Performance Measurement, Submetering**
- **Additional Indoor Plumbing Fixture and Fitting Efficiency**
- **Credit 2.1 10% Reduction**
- **Credit 2.2 20% Reduction**
- **Credit 2.3 30% Reduction**
- **Credit 2.4 40% Reduction**
- **Credit 2.5 50% Reduction**
- **Credit 2.6 Non-Potable Water Source Use**
- **Credit 2.7 Water Efficient Landscaping**
- **Credit 3.1 50% Reduction**
- **Credit 3.2 75% Reduction**
- **Credit 3.3 100% Reduction**

**Credit 4, 5**

- **Cooling Tower Water Mgmt, Chemical Management**
- **Cooling Tower Water Mgmt, Non-Potable Water Source Use**
LEED for Existing Buildings: Operations & Maintenance
Registered Project Checklist

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<th>Energy &amp; Atmosphere</th>
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<td>Prereq 1</td>
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<td>Prereq 1</td>
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<tr>
<td>Refrigerant Management, Ozone Protection</td>
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*NOTE for EA:1: All LEED for Existing Building projects registered after June 25th, 2007 are required to achieve at least two (2) points under EA:1.

<table>
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<th>Optimize Energy Efficiency Performance</th>
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<td>Yes</td>
<td>ENERGY STAR 67 / Alternative Score: 17% Above Average</td>
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<td>Yes</td>
<td>ENERGY STAR 69 / Alternative Score: 19% Above Average</td>
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<td>Yes</td>
<td>ENERGY STAR 71 / Alternative Score: 21% Above Average</td>
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<td>ENERGY STAR 73 / Alternative Score: 23% Above Average</td>
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<td>Yes</td>
<td>ENERGY STAR 75 / Alternative Score: 25% Above Average</td>
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<tr>
<td>Yes</td>
<td>ENERGY STAR 95+ / Alternative Score: 45%+ Above Average</td>
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</tbody>
</table>

Source: Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.
Source: Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.
Source: Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.
Source: Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.
### LEED for Existing Buildings: Operations & Maintenance

#### Registered Project Checklist

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<td>Credit 3 <em>Documenting Sustainable Building Cost Impacts</em></td>
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</table>

*Source: Lisa Mitchell, Property Manager for 355 Alhambra, Taylor & Mathis.*
Appendix C

LEED Certification Growth

LEED-NC Certified Building Stock

Source: Guma, Pyke, and Miller (2010).

LEED-EB Certified Building Stock

Source: Guma, Pyke, and Miller (2010).
Endnotes

1 For the purposes of this paper, sustainability is defined as “using methods, systems and materials that won’t deplete resources or harm natural cycles” (Rosenbaum, 1993).

2 In Bernstein (2009), a green building is defined as “one built to LEED standards, an equivalent green building program, or one that incorporates numerous elements across five category areas: energy, water and resource efficiency, responsible site management, and indoor air quality.”

References


LEED in the U.S. Commercial Office Market


Sincere thanks to my advisor and mentor, Lynn Fisher. I also thank the members of the Kenan Flagler Business School faculty who assisted me in various capacities: Patricia Harms, Audun Runde, Carol Seagle, and Claudia Kubowicz-Malhotra. There are others too, who provided research and background information on LEED-EB: Lisa Mitchell, Brian Gale, Walker Burchfield, and Bill Bailey. Thanks also to Lina Blumberg, Philip Blumberg, Victoria Rosa, Steve Zwang, Russ Grayson, and Jessica Mathews.

David Blumberg, Blumberg Capital Partners, or dblumberg@blumbergcapitalpartners.com.
The Key Drivers and Barriers to the Sustainable Development of Commercial Property in New Zealand

Authors
Sandy Bond and Guy Perrett

Abstract
In 2011 research was conducted to identify the key drivers and barriers to the sustainable development of commercial property in New Zealand (NZ) by surveying a cross-section of these market participants. The overall aim of the research was to identify any barriers that need to be overcome so that progress can be made towards advancing the sustainable building agenda in NZ’s commercial property sector that will help improve building energy performance and reduce greenhouse gas emissions. The results indicate there remain key issues for the property industry to resolve, the most significant of which is the commercial property sectors’ view of the cost premium for green buildings versus conventional buildings.

Worldwide initiatives, such as the Kyoto Protocol (Ministry for the Environment, 2010), which seeks to address global warming by setting targets for participating countries to reduce their greenhouse gas emissions, are underway in an effort to manage natural resources and the environment in a sustainable manner. It has been estimated that buildings contribute around 30% of greenhouse gas emissions globally (Arnel, 2010).

According to Klein, Drucker, and Vizzier (2009, p. 3), “The built environment thrives on the use of vast amounts of resources, including land, materials, energy and water... Yet opportunities for reducing damage to the environment present themselves throughout the entire process.”

It has been estimated that buildings contribute around 30% of greenhouse gas emissions globally.1 In 2002, eight countries responded to concerns about the impact of the property sector on the environment by establishing the World Green Building Council (WorldGBC). A number of other countries have subsequently joined the WorldGBC, including New Zealand (NZ). The stated mission of the WorldGBC is to “accelerate the transformation of the built environment towards sustainability” (World Green Building Council, 2010). One of the most advanced Green Building Councils is the United States Green Building Council (USGBC). The mission of the USGBC is to: “transform the way buildings and communities are designed, built and operated, enabling an environmentally and socially responsible, healthy, and prosperous environment that improves the quality of life” (USGBC, 2011).
While the NZ Green Building Council (NZGBC) was only established relatively recently in July 2005, and is lagging behind the major markets of Australia, United Kingdom, Canada, and the U.S. in terms of the number of Green Star rated buildings, research indicates that sustainable buildings will play an important role in NZ property portfolios in the future (Myers, Reed, and Robinson, 2008).

In NZ, key stakeholders in a position to influence sustainable property development in the market place include: the NZGBC, the NZ government, corporate tenants, major developers, institutional property investors and, to some extent, financiers. For the purposes of this research, a sustainable commercial property, or green building, is one that fits the social, environmental, and economic balance stated in the Brundtland definition of sustainability, evidenced by the property being certified by an independent third party. In NZ’s case, this independent third party is the NZGBC, which administers the Green Star building rating system.

**Literature Review**

**New Zealand Green Building Council**

The establishment of the NZGBC in July 2005 and the progressive development of the Green Star NZ rating tools have provided participants within the NZ property industry an initial framework to progress the investment in, and the financing and construction of, sustainable buildings. The NZGBC became a member of the World Green Building Council in 2006, bringing NZ into the international green building framework, yet maintaining its own identity.

The purpose of the NZGBC is to accelerate the development and adoption of market-based green building practices. The NZGBC achieves these aims through: (1) setting standards of best practice through the adaptation of the Green Star rating tool; (2) education and training for all areas of the building industry value chain; and (3) providing access to networks, information and resources for its members to actively lead the market (NZGBC, 2011a).

Green Star NZ is a comprehensive, national, voluntary environmental rating scheme that evaluates the environmental attributes and performance of NZ’s buildings using a suite of rating tool kits developed to be applicable to each building type and function. Currently, for non-residential property, rating tools are available for the following property types/categories: office, interiors, industrial, and education.

Green Star works by evaluating a building against a number of categories that assess the environmental impact that is a direct consequence of a building’s site selection, design, construction, and maintenance. The nine categories included within all Green Star rating tools (NZGBC, 2011a) are (1) management, (2) indoor environment quality, (3) energy, (4) transport, (5) water, (6) materials, (7) land use and ecology, (8) emissions, and (9) innovation.

While the NZGBC continues to work on rating tool design and development and to promote the sustainable development of NZ’s property sector, to date rating
tools are only available for the design and built stages of a building’s lifecycle within the above categories. Tools have yet to be developed for other property categories including retail and tourism properties.

An example of the NZGBC’s current efforts to promote sustainable development more widely is an initiative that the NZGBC has worked on with the Christchurch City Council, subsequent to and as a result of the devastation from the Canterbury earthquakes. This initiative includes the development of a new building rating tool specifically for the Christchurch recovery efforts called Building a Sustainable Environment (BASE). BASE is a simple, introductory-level green building assessment for the Christchurch Central City rebuild. The Central City Plan for Christchurch proposes that new office, retail, apartments, and mixed-use buildings within the Central City must achieve a ‘pass’ score under BASE. The tool has been developed as a separate, but complementary building assessment offering to the NZGBC’s existing Green Star tools (NZGBC, 2011b).

**Government Policies & Incentives to Improve the Energy Efficiency of Buildings**

In 2001, the NZ government introduced the New Zealand Energy Efficiency and Conservation Strategy (NZEECS). The NZEECS is prepared in accordance with the Energy Efficiency and Conservation Act 2000 and outlines government policies, objectives, and targets, and as required by the Act, will be in force for a period of five years. It is a detailed action plan for increasing the uptake of energy efficiency, conservation, and renewable energy programs across the economy. A second version of the NZEEC Strategy was published in 2007 that looked at the lessons learned under the previous Strategy. A third edition of the NZEECS (2011–2016) was released in 2011 that sets the government’s policies, objectives, and targets for the next five years and outlines the means by which these will be achieved.

The sections of the NZEECS of most relevance to commercial property is “Business” and “Public Sector,” two of the six sectors identified that will contribute to the overall NZ Energy Strategy 2011–2021 goal. The other four sectors are: Transport, Homes, Products, and the Electricity System. According to the NZEECS, “The greatest areas of potential improvement (in energy efficiency, ed.) are the transport and business sectors, followed by the residential sector,” (Energy Efficiency and Conservation Authority, 2011, p. 17).

According to the NZEECS 2011, “Energy efficient commercial building design and the use of building materials that enhance energy efficiency offer major opportunities to lock in substantial energy savings through a building’s life,” (EECA, 2011, p. 21). To assist the raising of building performance, the government pledges to invest in further research into how energy is used in buildings that will inform a review of the building code. Further, the government supports the adoption of market-based solutions that set aspirational goals above minimum standards that include the use of building performance rating tools, such as those developed by the NZGBC. The government recognizes that more energy-
efficient buildings require greater building management and technical expertise and is committed to further investing in building the capability and capacity of the building and construction sector.

Additionally, under NZEECS 2011–2016, the government’s procurement reform provides an important lever to support public sector agencies in making energy-efficient choices in the purchase and lease of energy-efficient buildings. As such, “local government has a significant role in providing community leadership, long-term investment planning and implementing building, resource management, and transport legislation,” (EECA, 2011, p. 27).

A 2009 Ministry for the Environment (MFE) report entitled New Zealand’s Fifth National Communication under the United Nations Framework Convention on Climate Change identifies policies and measures applicable to the commercial property sector. These include programs run by the EECA to support businesses to become more energy efficient: financial assistance through the Electricity Commission to improve electricity efficiency, and initiatives developed by MPI to increase the use of wood as a construction material as MAF-sponsored research shows that wood-based building products have a lower greenhouse gas footprint than other construction materials (Ministry for the Environment, 2011).

The EECA provides information on new technologies and energy management and one-on-one support for energy-intensive businesses. Grant funding is available for energy and design audits and also for new or under-utilized technology improvements. Up to 40% of the total project cost is available (up to $100,000), or up to 75% of the cost of a feasibility study (up to $10,000) for new technologies. Examples of technologies funded include fans and boiler controls, bio-digesters, and heat recovery systems (Ministry for the Environment, 2011).

The EECA is also the principal sponsor for the introduction and use of the National Australian Built Environment Rating System (NABERS) in NZ and has negotiated a license from the Australian government for an initial term of five years with an option to extend for a further five years. NABERS measures an existing building’s environmental performance during operation. It rates a building on the basis of its measured operational impacts in categories such as energy, water, waste and indoor environment (NABERS, 2010). The EECA is seeking to partner with the NZ property industry to administer the NABERS scheme in NZ. The EECA expects to formally launch NABERS (for office energy only, initially) in NZ by January 2013.

The Electricity Commission offers financial assistance to businesses in the commercial sector to improve their electricity efficiency. Businesses can apply for part-funding from the Electricity Commission for electricity efficiency projects where there is a current barrier preventing such projects from proceeding. These projects target efficiency measures such as upgrades of building management systems, lighting replacements, replacement of inefficient chiller systems, or installation of monitoring and targeting systems (Ministry for the Environment, 2011).

In addition to the specific government policies and measures outlined above, the general controls of building and environmental legislation, such as the Building
Act 2004 and Resource Management Act 1991, provide a broad framework to encourage sustainable development of the commercial property sector.

**Drivers and Barriers to Green Building**

A study of the NZ property sector by Myers, Reed, and Robinson (2008, p. 318) found that “the perception of the investor and developer markets in NZ was that sustainable buildings will play an important role in property portfolios in the future. Although there is uncertainty about the value and market for sustainable buildings at the present, investor optimism was clearly identified. However, the level of uptake and investment in sustainable buildings would be accelerated if evidence for the financial case for sustainable buildings was proven.”

There is a lack of research in NZ about the financial performance of green buildings compared to conventional buildings. However, in Australia, a study by Newell, MacFarlane, and Kok (2011) to assess the value premium of both NABERS energy and Green Star ratings in the office market found that a 5 star NABERS energy rated building delivered a value premium of 9% compared to a non-rated building, with a 5 star Green Star rating showing a premium in value of 12% compared to a non-rated building. A 3–4.5 star NABERS energy rated building achieved a 2%–3% value premium compared to a conventional building.

There are a number of quantitative studies of financial performance of green buildings in the U.S., where sales data are more readily available and sustainable ratings for buildings have been in existence longer [Leadership in Energy and Environmental Design (LEED) was developed in 1998 in the U.S.] than is the case for Australia or NZ (2003 and 2005, respectively). For example, a study by Fuerst and McAllister (2009) of the effect of eco-labeling (LEED and ENERGY STAR) on the occupancy rates of commercial offices in the U.S. found a significant positive relationship between occupancy rate and the eco-label. Controlling for differences in age, height, building class, and quality, the results suggest that occupancy rates are approximately 8% higher in LEED-labeled offices and 3% higher in ENERGY STAR-labeled offices. Miller, Spivey, and Florance (2008), using the CoStar database, found that LEED buildings command rent premiums of $11.33 per square foot over their non-LEED peers and rental rates in ENERGY STAR buildings represent a $2.40 per square foot premium over comparable non-ENERGY STAR buildings. ENERGY STAR buildings are selling for an average of 5.76% more, while LEED buildings command a 9.94% premium.

Drivers for green building, other than financial performance, are outlined, for example, by Yudelson (2010), and include:

- Utility cost savings for energy and water.
- Maintenance cost reductions.
- Increased value from higher net operating income (NOI), due to higher rents and greater occupancy in certified buildings.
- Increased occupier productivity, due to improved health of tenants, and reduced absenteeism.
The Key Drivers and Barriers

- Marketing benefits, especially for developers and building owners.
- Public relation benefits, especially for developers, building owners, and managers.
- Recruitment and retention of key employees.
- Demonstration of commitment to sustainability and environmental stewardship.

According to Ang and Wilkinson (2008), regulation is the tool government uses to drive the market toward more energy-efficient buildings. In addition, according to Bond (2010), in Australia the government and other public-sector bodies are leading by their examples in their briefs for sustainable buildings. Large progressive corporations in the private sector are also a leading driver for green buildings (Bond, 2010, p. 5). Many companies today have a strong environmental focus and sustainability policy at the core of their business, which leads them to occupy a green building.

Smith and Baird (2007) found that ‘rising energy costs’ is one of the primary drivers for sustainable buildings in NZ. Although according to the Green Building Council of Australia (2008), tenants have become less focused on savings in operating costs, and are placing a higher value on the intangible benefits, such as productivity, staff attraction and retention, and reduced sick leave and absenteeism. Miller, Spivey, and Florance (2008) estimate the productivity benefits from environmentally sustainable building designs to be as much as 10 times the energy savings from green efforts.

Despite the advantages of sustainable buildings, there are many barriers to investing in greening buildings (Urban Land Institute, 2009; Bond, 2010; Yudelson, 2010):

- **Financial Considerations:** One of the biggest barriers to investing in green buildings is the perception that they cost more compared to conventional buildings. However, according to Davis Langdon (2007), there is no significant difference in average costs for green buildings as compared to non-green buildings.
- **Split Incentives:** Another barrier is split incentives between landlord’s and tenant’s where the landlords are investing in green buildings but the tenants are benefiting through reduced energy and water costs, greater productivity, etc.
- **Lack of Knowledge and Experienced Workforce:** A lack of practical understanding among building owners about energy efficiency and green building, including overestimates of the initial cost premium, hinders the implementation of sustainability measures.
- **Lack of Incentives:** Incentives are not strong enough to change behavior. Energy prices are still low and tax and other political incentives are not significant enough to change behavior.

According to Choi (2009), the benefits of green buildings are only evident over the longer period and recommends documenting and communicating the cost,
benefits, and performance of green buildings as part of the strategy to increase adoption of green building practices.

The next section will briefly describe the research methodology and data set. The results are then discussed. The final section provides a summary and conclusion.

**Research**

Due to the limited number of sales of green buildings in NZ, a quantitative study to determine any expected value premium from such buildings was not possible. Instead, this study investigates the barriers and drivers to sustainable development, not to prove the “business case” for such development, but to learn what the industry perceives the drivers and barriers are to the uptake of sustainable building practices.

**Methodology**

The drivers and successes as well as the barriers and impediments to the uptake of sustainable practices were investigated. This involved a combination of an in person structured interview with a representative of the NZGBC and an online survey of participants in the commercial property sector.

**Survey Samples**

An interview was arranged with the NZGBC’s Director of Business and Technical, Rohan Bush, as the CEO’s nominee for the interview. The sample for the online survey of commercial property sector professionals and executives was compiled from various professional registers and websites, including the NZGBC’s website, the Property Institute of NZ membership directory, the Property Council of NZ membership directory, and the NZ Institute of Architects directory. This sample of 300 people consisted of property investors, property developers, property managers, architects, building contractors, financiers, project managers, and property consultants.

**Data Collection Methods**

The interview with Rohan Bush was conducted using a semi-structured questionnaire pre-approved by the NZGBC. The online survey of the commercial property sector was conducted utilizing Qualtrics online survey software. Due to the length of the overall survey and to encourage respondents to answer all applicable questions, the survey was structured in two parts. Section one targeted developers, investors, and managers and section two targeted the balance of the sample. With the exception of just a few questions that reflected the particular sample segment, the questions in section two mirrored those in section one.

The online survey had five sections. The first section was designed to capture information about the respondents, their companies, and whether or not they have experience in green building. The second section focused on respondents who
indicated they have experience in green building and sought to capture their views on a range of issues around their involvement in green building including key drivers and barriers to green building. The third section focused on the respondents who do not have any experience with green buildings, but expressed an interest in becoming involved in this sector of the industry. The fourth section focused on the respondents who indicated no interest in green building and sought to understand their reasons. The fifth section sought to capture all respondents’ views on the capacity of the NZ property sector to drive forward the sustainability agenda and what changes and improvements they view as being required to increase green building investment and development in NZ’s commercial property sector.

A survey link along with an explanation of the purpose of the survey was emailed to each person in the sample, inviting them to participate. A follow-up reminder email was sent one week after the initial email. The level of response to the online survey is discussed below. Responses from the survey were downloaded and analyzed using Excel. Numerical results are expressed as either an average of the scores for each category for a particular question (the lower the score, the more significant) or as a percentage of the total responses received for a particular question.

Results

NZ Green Building Council Interview Results
The interview was conducted with the NZGBC’s Rohan Bush. Questions were structured in two sections and were designed to obtain input from the NZGBC in seven key areas including:

1. Where the NZGBC is in its development as an organization.
2. The current view of green building within the public and private sectors.
3. The overall level of interest in green building.
4. Drivers and barriers to green building.
5. The status of the GreenStar certification system.
6. Education of property practitioners on green building.
7. The Christchurch rebuild.

The NZGBC Organization. The NZGBC has been in existence for over six years and has grown considerably. There are 13 full-time staff equivalents employed by the NZGBC and the organization’s work program addresses both residential and commercial buildings.

The NZGBC continues to attract a large number of organizations as members and enjoys a high level of industry support. Approximately one-third of the NZGBC’s income comes from membership subscriptions, a further third from running education and training programs, and the final third from running events and
managing special projects. While the NZGBC has progressed in its organizational development and in gaining industry support, until such time as it is fully resourced (including financing and staffing levels) to allow for further tools development, the industry as a whole will be somewhat hampered in its uptake of green building.

**Current State of NZ’s Green Building Industry.** The NZGBC considers that the current state of the green building industry in NZ is “developing” since the existing buildings performance tool, other building type tools, and NABERS are not yet in place. The NZGBC considers that the public are “moderately interested” in green building and observed that the media often picks up on events such as a new Green Star rated building being completed or a green building event being held. Notwithstanding this, the NZGBC believes that further education of the public is required concerning green building.

The NZGBC also considers that the government is only moderately interested in green building and that while there is some ministerial support, green building is not a top priority for the present government. It was noted that there is, however, some project-based government funding available. In comparison to its views on the government and public’s interest in green building, the NZGBC considers that the commercial property sector is very interested in green building given it has a registered membership of 450 businesses and organizations, generally good attendances at events, and a good uptake of Green Star ratings.

**Drivers and Barriers to Green Building.** When asked to rank various options (from 1 to 10, 1 being the most significant) as to what prevents the incorporation of sustainable features in developments, low client demand was ranked as the most significant, followed by high costs versus low perceived benefits. This response suggests that a lack of government incentives is a significant barrier to green building development, implying that increased government incentives would help to overcome the issue of cost. The full rankings are shown in Exhibit 1.

In terms of the drivers to green building development, an industry rating system was ranked as the most important driver, followed by competitive advantage, and thirdly tenant satisfaction and productivity. Exhibit 2 shows the full rankings.

Perhaps not surprisingly, the NZGBC identified the most significant driver as the Green Star rating system that it promotes. Beyond this, the rankings given by the NZGBC imply that market-related factors such as ‘competitive advantage’ are more significant drivers of green building than ‘government policy’ and regulatory controls such as the building code.

**Green Star Ratings.** The NZGBC licenses Green Star from the Green Building Council of Australia (GBCA) and has to obtain approval from the GBCA for changes to Green Star in NZ. While there are significant cost savings to the NZGBC by effectively ‘piggy backing’ on the GBCA, the NZGBC does not have the freedom to change Green Star in NZ as it so chooses.

The numbers of buildings that have been certified either with a Green Star design or built rating are shown in Exhibit 3. These figures indicate that two-thirds of
Exhibit 1 | Barriers to the Incorporation of Sustainable Features in Developments

(1 = most important, and 10 = least important)

- Other (nil response) 10
- Unwillingness to pay additional costs 4
- Low client demand 1
- High Costs vs low perceived benefits 2
- Limited availability of new technology 9
- Lack of government incentives 3
- Unreliable/improved technology 5
- Poor access to information 6
- Lack of owner/occupier awareness 7
- Lack of developer awareness 8

Exhibit 2 | Drivers of Green Building Development

(1 = most important, and 10 = least important)

- Greater availability of green products 9
- Increased education 10
- Industry rating system (Green Star) 1
- Building code 8
- Government policy 6
- Rising energy costs 7
- Superior building performance 5
- Lower Lifecycle costs 4
- Competitive advantage 2
- Tenant satisfaction & productivity 3
Green Star certifications have been awarded for newly constructed office buildings and around 78% of all Green Star certifications awarded to date have been for new buildings.

Over half (55%) of the ratings are for 5 Green Stars, compared to 36% for 4 Green Star and only 8% are 6 Green Star. This indicates that the market has an appetite for a 5 Green Star office product notwithstanding that a cost premium may apply in comparison to a conventional building or a 4 Green Star product. However, a 5-star rating is still more readily obtainable compared to a 6-star rating, where the cost premium can be significant. The “As Built” rating, which is based on performance data collected over a year and used to indicate whether the building is performing as designed, is less common, with only 17% of office ratings being “As Built.” This may be due to the use of ratings primarily for marketing purposes (to sell or lease space), as well as the additional cost of obtaining the “As Built” rating.

When asked to give an indication of any cost premium for building a green versus a non-green building of 4, 5, and 6 Green Stars, the NZGBC advised that no comprehensive research had yet been undertaken to test this in NZ, but that international research indicates that if a project is managed correctly, there is the potential for no cost premium to achieve a 4 or 5 Green Star certification. However, when not managed correctly, a 4 Green Star building can cost up to 5% more than a non-green building and a 5 Green Star building can cost up to 10% more than a non-green building. A 6 Green Star building, if managed correctly, has the potential to only cost around 5% more, but if not managed correctly, it could cost up to 10% or more than the cost of a non-green building. The NZGBC considers that one of the main barriers to the commercial property sector’s uptake of the Green Star certification system is the cost of obtaining certification. To address this issue, the NZGBC is planning a tool review with the objective of reducing the cost of obtaining certification by 20% to 30%.
Exhibit 4 summarizes the response by the NZGBC to the question around what can be done to improve the uptake and incorporation of energy/water saving (or generating) features into the design of new buildings and the retrofitting of existing buildings.

It is interesting to note that the NZGBC regards the introduction of a performance-based rating system, such as NABERS, as the most important thing that can be done to improve the uptake and incorporation of energy/water-saving features into new or existing buildings. There is presently a lack of tools available in the NZ market to properly rate the performance of commercial buildings with regard to energy and water consumption, although NABERS NZ is to be introduced in early 2013.

The next highest ranked action was mandatory reporting of energy performance. This is not employed as a tool to drive uptake of energy efficiency in NZ but it has been introduced with some success in Australia. Gunawansa and Kua (2011), who compared the mitigation and adaptation strategies of three coastal cities in two countries: Singapore, San Francisco, and Miami-Dade, also found that mandating green building design and construction has a direct impact on the diffusion of green buildings and recommend this as a successful strategy.

Further, the NZGBC does not believe that buildings need to recertify their Design and/or Built rating at periodic intervals. That is, once certification is achieved, unless refurbishment/redevelopment occurs, the certification continues indefinitely. Rather it is more appropriate that the operational performance of these buildings is measured and certified through a performance tool, such as NABERS.
To this end, the NZGBC has been working with the EECA to bring NABERS into NZ as a joint industry/government initiative. While the NZGBC would like to have developed its own Green Star building performance tool (close to a NABERS equivalent), due to funding restrictions and the EECA being keen on introducing NABERS into the NZ property market, it is likely that NABERS will become the property industry benchmark in NZ for measuring the environmental performance of commercial buildings.

The NZGBC considers that the introduction of NABERS into the NZ market will provide the following opportunities: (1) benchmarking of individual buildings and portfolios; (2) increased ability to improve the environmental performance of a building on a measured basis; and (3) better level of information available for existing and/or prospective tenants of a building.

In commenting on the strengths and weaknesses of NABERS, the NZGBC noted that NABERS is relatively simple and cost effective to manage. It is also highly flexible in that it can be applied to a ‘base building,’ an individual tenancy, or an entire building. The main weakness of NABERS that the NZGBC identified is that it is not a holistic approach to the assessment of a building’s environmental performance. Ideally, the NZGBC would like to see a Green Star design, built and performance-based system in place for the design and ongoing management of green-rated commercial buildings in NZ.

**Education of Property Practitioners.** While the NZGBC runs training programs for those who wish to become qualified practitioners and/or accredited professionals in the application of Green Star, it considers there is also a need for increased education of asset and property managers in the management of Green Star certified commercial property. The NZGBC is working with universities, technical institutes, and the Property Institute of NZ to ensure all relevant professions have access to quality education on green buildings.

**Christchurch Rebuild.** The final question to the NZGBC was in relation to the opportunities that the rebuild of the Christchurch CBD presents for the NZGBC to promote green building in NZ. The NZGBC recognizes that the Christchurch rebuild provides an opportunity for it to demonstrate leadership and to facilitate property industry and community discussion around the sustainability of the built environment. The NZGBC sees the Christchurch rebuild as an opportunity to make greater progress in advancing the sustainability of NZ’s built environment.

**Results from the Survey of the Commercial Property Sector**

The online industry survey of 300 NZ-based property professionals was undertaken in 2011. The survey was divided into two sections: section one asks questions about the respondent and their company’s background; section two asks questions about the respondent’s involvement with “green” buildings. The overall response rate was 18.67% \( (n = 56) \) after one follow-up reminder. Of the 56 people who participated, 34 (60.7% of those that responded, or 11.3% of the total sample) were involved in green buildings.

The sample of property professionals, many of whom are key players in NZ’s commercial property sector, included investors, developers, asset and property
managers, building contractors, architects, financiers, project managers, and property consultants. Exhibit 5 provides a breakdown of the professional backgrounds of the 300 people invited to take part in the survey.

For reasons not disclosed, financiers and project managers chose not to participate. Exhibit 6 provides a breakdown by profession of the 56 respondents. The largest respondent group was architects, followed equally by developers, investors, and managers. The ‘Other’ category was made up of corporate real estate managers, quantity surveyors, engineers, an energy management provider, and occupiers.

**Section One: Company Information.** Over three-fourths (77%, \(n = 43\)) of respondents hold senior management positions: managing directors or senior managers. The ‘Other’ category was represented by mid-tier property managers and property specialists. The majority of respondents were men (89%, \(n = 50\)) with 70% (\(n = 39\)) of the respondent’s company’s operational location being in Auckland, NZ’s largest commercial property market, 16% (\(n = 9\)) in Wellington, the capital city of NZ, 5.4% (\(n = 3\)) in Christchurch, and 7% (\(n = 4\)) located throughout NZ. The companies had been involved in the NZ property industry for a wide range of time periods from 3 years to 100 years (mean = 24.6 years). Exhibit 7 indicates that the spread of categories within which the respondents operate is strongly weighted towards commercial office, industrial, and retail property, with close to one-third being involved with a combination of these property types. The ‘Other’ category represents primarily residential, hotel, motel, and retirement village property types.
**Exhibit 6 | Respondent Categories**

- Developers: 8%
- Investors: 8%
- Managers: 8%
- Architects: 15%
- Project Manager: 0%
- Property Consultants: 3%
- Contractors: 4%
- Financiers: 0%
- Other: 10%

**Exhibit 7 | Property Categories**

- Commercial: 51%
- Industrial: 39%
- Retail: 45%
- Health: 22%
- Education: 23%
- Other: 21%
- Comm. Ind. & Retail: 11%
- Combination: 17%
Respondents were asked to indicate how their company addresses the issues of sustainability, in house. The sustainability focus of the respondents’ companies is shown in Exhibit 8. While it is perhaps not surprising that reducing energy consumption has a far greater focus amongst the respondents (66%) than the other categories, it is interesting to note that location also ranks highly, implying that ease of access to public transportation and other services is of high importance to many respondents. It is also worth noting that nearly one-third of respondents are yet to focus on sustainable practices within their organization. The ‘Other’ category includes items such as “we encourage cycling to work” and “Green Star certification for operators,” “staff programs, stakeholder engagement, community engagement,” and “we design to Green Star principles.”

**Section Two: Green Building Involvement.** When asked to indicate whether they had participated in green building, 34 respondents (60.7% of responding sample) indicated that they have, either as an investor, manager, developer, building contractor or consultant in the delivery of a green building project. Of the remaining 22 respondents (39.2%), 13 indicated that they intended to become involved in green building in the future, seven indicated they did not have such intentions, and two did not respond to this question. Overall, the respondents indicated a high level of interest in green building.

Feedback from the respondents who indicated that they either have had no involvement in green building to date or have no interest in green building at all is covered later. The responses to questions about building sustainably from the
34 respondents (11.3% of the total sample) who are involved in green building are considered next.

**Respondents Who Are Involved in Green Buildings**

The respondents involved in green building were asked how long they have been involved. From the 21 responses received (37.6% of the total respondent group of 56), the experience ranged from one to six years, with an average of four years. The number of buildings, new or retrofitted, that respondents have been involved with either to develop, manage or own varies between one and ten, with only one respondent indicating the higher level of involvement, and the mode is three. While these statistics indicate that the respondents are relatively light on green building experience, it is put more in perspective when one considers that the NZGBC was only established in July 2005.

Exhibit 9 indicates that the primary categories for new green buildings that the 21 respondents have involvement with have been the office and industrial sectors, with “other” represented by schools/education, hospital laboratories, and community buildings. Only ten respondents have involvement with green retrofitted buildings, and this has again focused on the office sector, but these respondents are also involved in the other sectors to a lesser extent.

**Drivers and Barriers to Green Building.** When asked to indicate their reasons for being involved in green building, 16 (80%) of the 20 respondents indicated that “benefit to the environment” is the primary driver, closely followed by “tenant demand” (75%, n = 15) and corporate social responsibility (60%, n = 12). Exhibit 10 outlines these responses. These results suggest that the commercial
property sector sees green building as offering a balance between the commercial and environmental aspects of property investment and development.

Only half (17) of the respondents involved in green buildings answered the question about where the demand for green buildings is coming from. The majority (94%) of those respondents consider that the demand comes from the client, less than half believe it comes from their recommendations to clients, and 23.5% said it was due to government requirements to procure or occupy green buildings. Only 17.6% said it was due to the NZ Building Code requirements and another 17.6% said it was for “Other” reasons such as a global response or tenant expectations.

Exhibit 11 indicates that the most preferred sustainable features being incorporated into new buildings are, in order of preference, air conditioning, light zoning/sensors, and thermal zoning. Similarly ranked for retrofitted buildings, most preferred were light zoning/sensors, followed by air-conditioning, and thermal zoning. The least preferred sustainable features indicated for both new and retrofitted buildings were waterless urinals and renewable energy sources. The ‘Other’ category includes features such as rain water harvesting, smart metering, and building management systems. There were 18 responses to the question on new building features representing 53% of the sample that is involved in green buildings, i.e., 34 (or 32% of all 56 respondents to the survey), and 13 responses
Next, respondents were asked to identify the most energy efficient sustainable building design features that they have used to achieve positive sustainability outcomes and to indicate payback periods where available. Answers were quite varied and included: “Good internal light composition, cross ventilation along with good thermal properties in construction materials.” “Upgrade to high frequency (HF) ballasts and eco fluorescent lighting: payback of approximately 2.1 years.” “Solar orientation to maximize natural light to floor plate.” “Daylight harvesting/daylight improvement: payback less than six months.” “Reduce open plan lighting levels to 400 lux.” “Separate metering of energy.” “Passive design coupled with solar shading and mixed mode natural ventilation.” “The use of VRV air-conditioning, light zoning, and sensors.” “Minimizing internal applied finishes, lighting and air-conditioning zoning, external sun shade devices.” “Passive ventilation, water reducing elements, solar: payback around five years.”

Respondents were also asked to identify the most effective building materials they have used to achieve energy-efficient, sustainable building outcomes and to indicate payback periods where available. Again, answers were quite varied and included: “Fly ash concrete, even though the cement is considered problematic.” “Recycled materials (green rated).” “Low E glazing.” “Exposed concrete for durability and thermal storage.” “Timber.” “Recyclable polyester insulation.”

These responses indicate that to a certain extent the industry is aware of and has implemented a range of energy-efficient design features, technologies, and materials in buildings to achieve positive sustainability outcomes. Although there appears to be somewhat limited knowledge amongst the respondents of the payback periods of incorporating these design features, technologies, and building materials.
When asked whether buildings that are designed to be more energy efficient are actually being used in a way that maximizes their energy/resource use performance, 29% of the 21 respondents to this question answered yes, 33% answered no, and the remainder were unsure. Those that answered ‘no’ indicated that better education of owners, managers, and occupiers of green buildings is needed. One respondent also noted that there are no measures to ensure that green buildings are operated as designed. Another noted that there is inadequate handover information/user guides provided to occupiers.

Respondents were asked if they know what the average energy/water saving is for a green building compared to a conventional building. The majority (86%) of respondents answered ‘no,’ indicating that there is a real need to educate and get information into the market around the performance of green buildings compared to conventional buildings. The introduction of a system such as NABERS will give more certainty to those involved in the property industry around the actual environmental performance of green buildings and will assist in the management of these buildings.

Exhibit 12 shows that according to respondents the primary barriers to the incorporation of sustainable features in developments are the markets unwillingness to pay for the additional costs of sustainable features and that the market is yet to be fully convinced that the extra cost of building green is supported by the benefits. There is also an indication that the market would respond more favorably to green building if there were government subsidies and incentives for doing so. The ‘Other’ category includes statements such as “our buildings are relatively new” and “not enough incentives.”

Exhibit 13 shows that the primary driver of green building is tenant satisfaction and productivity. Today, many corporations have sustainability policies integral to their business operations. The requirement to occupy a green building is often
mandated by a company’s sustainability policy. Therefore, it is not surprising that the industry rated tenant satisfaction and productivity as the key driver of green building development. Other key drivers include superior building performance and rising energy costs, followed by competitive advantage and lower lifecycle costs. Over the medium to longer term, it is these factors that set green buildings apart from traditional buildings.

**Cost of Green Buildings.** When asked to indicate what clients would consider an acceptable level of additional cost for incorporating sustainable features into a building, more than half of the respondents (52.9%) indicated that clients would accept a premium of up to 5%. The balance of the respondents was evenly split between no additional cost and a 5% to 10% additional cost. Exhibit 14 indicates respondents’ views of what they believe clients would consider the important financial and non-financial benefits for additional costs that may be incurred for
Exhibit 15 shows respondents views on the question of what the cost premium is (if any) for a green building versus a non-green building for a 4, 5, and 6 Green Star rating. The responses indicate that of the 17 respondents who answered this question over three quarters (76%) felt that there is a cost premium to achieve a 4 Green Star rated building of 3% to 10%. This is a wide variance for what can be described as an “entry level” Green Star rating and is markedly different to the NZGBC’s response to this question, which was zero increased cost if managed correctly, up to 5% otherwise.

The same issue appears to exist for 5 Green Star rated buildings. The industry response indicates a cost premium of 6% to 20%: 35% thought there would be a 6% to 10% premium and 41% felt the premium would be 11% to 20% premium. The NZGBC has indicated zero cost premium if done properly and up to 10% premium otherwise. Likewise, 82.4% of respondents indicated an 11% to 20% or more premium for a 6 Green Star rated building; 47% responded that they felt the premium would be 11% to 20% and 35% responded that they felt there would be a 20% or higher premium. Whereas the NZGBC advised a premium of 5 to 10% depending on how well a project is managed. This issue of the cost premium for green buildings versus non-green buildings is clearly something that the industry is weary of and appears to be a major barrier to the progress of green building in NZ.
Interestingly, when asked if a project’s profitability was projected to be lower due to green building practices being implemented would they still proceed, over half (53%, n = 9) of respondents answered ‘yes’ and 47% (n = 8) answered ‘unsure.’ Significantly, none of the respondents answered ‘no,’ indicating a degree of interest in green building, despite the sensitivity to a ‘cost premium’ for green buildings.

**Energy and Water Savings.** Respondents were asked to indicate what more they think can be done to improve the uptake and incorporation of energy/water savings (or generating) features into the design of new buildings and the retrofitting of existing buildings. Responses were similar for new and retrofitted buildings. Exhibit 16 shows that the industry considers that changes to the building code, legislation, and increased financial incentives are required to improve the uptake of energy/water saving features, indicating that the industry is not likely to implement energy/water saving measures voluntarily. Other suggestions included increasing water charges.

**Sustainability Agenda.** When asked to give their opinion of how important the sustainability agenda is to the NZ commercial property sector, the majority of respondents think that the sustainability agenda is important. Over half (54%, n = 20) think that it is fairly important, 27% (n = 10) very important, and 16% (n = 6) indicated it was extremely important to the NZ commercial property sector.

**Industry Capability.** Respondents were asked whether they consider that the NZ property industry has the knowledge/skills, technology, and resources to drive the sustainability agenda. Exhibit 17 shows that over half of the respondents answered ‘yes’ for each category, highlighting that they consider that the industry is generally well placed to advance green building in NZ.

Those respondents who answered ‘no’ to any category were asked to give a brief explanation of what knowledge/skills, technology or resources are required. Some constructive suggestions were received. The answers given are summarized as follows:

### Exhibit 16 | Actions to Improve Energy/Water Savings

<table>
<thead>
<tr>
<th>Actions</th>
<th>New Build Rank</th>
<th>Retrofitted Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building code</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Change in legislation</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>More rebates/subsidies</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Building certification</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Mandatory energy efficiency</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Availability of products</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Better advertising</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td>Other, please specify</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>
Knowledge/Skills: Need for simpler tools for rating of sustainability and information of the financial benefits and costs for achieving ESD properties; lack of experience and knowledge of green building technologies and products; industry needs to consider more than individual buildings and look instead at systems: ecology and natural systems, urban design, integration of buildings and landscape.

Technology/Resources: Lack of information on energy consumption of different classes and grades of property; need for a mandatory building energy rating system to reward green buildings or at least those that are energy efficient.

Changes and Improvements. The final general question asked respondents to identify the changes and improvements that are required to increase green building development and investment in NZ’s commercial property sector. A range of suggestions were put forward by 32 respondents (57%). These suggestions have been categorized under four headings: central and local government policy, cost/benefit, education, and building rating systems.

Central and Local Government Policy
1. Mandatory disclosure of a building’s environmental performance.
2. Regulation requiring sustainable features in buildings.
3. Introduction of central and local government subsidies, including tax breaks for certified buildings.

Cost/Benefit
1. More empirical evidence to demonstrate the benefits of green building to tenants and investors.

Education
1. Begin with education within schools and other learning institutions.
2. More training and education of all involved in the sustainable development and retrofitting of commercial property.

Rating Systems
1. Reduce the NZGBC cost of certifying a building by 50%.
2. Introduce a compulsory rating system for energy and water use. The planned introduction of NABERS will generate a new level of interest.
**Future Participation in Green Building.** Of the 22 respondents that have not been involved in green building, two-thirds \((n = 14)\) indicated that they intend to become involved in the future; 79% of their involvement will be in office properties. This focus on offices is similar to that Exhibit 9. There is an increase in expectations for both new and retrofitted retail property even though the NZGBC has yet to release a set of Green Star tools for retail property. While the retrofitting of industrial property is seen as important for those with an intention to get involved in green building, there is less focus on interiors, compared to those already involved in green building (Exhibit 18).

When asked to indicate their reasons for planning to become involved in green building, over nearly two-thirds \((64\%, n = 9)\) of the 14 respondents that answered this question advised that benefit to the environment and corporate social responsibility are the primary drivers. For this group, tenant demand was far less a factor \((36\%)\) than for those who have already had involvement in green building \((75\%, \text{see Exhibit 10})\). These results are shown in Exhibit 19.

The respondents who indicated no intention to become involved in green building gave a number of explanations for this. In their view, green building was just a fad, and although nice to have they did not see it as essential. Others indicated that it was for economic reasons or that their clients are not interested in green building options and are solely focused on immediate financial returns.

**Statistical Analysis**

A number of tests were run to determine if there were significant differences in responses between the varying professional groups. Cross tabulations and chi-
square tests were performed, and Cramer’s V and Phi obtained. However, there were no significant differences in responses between the varying professional groups for any of the questions. A limitation of the study was the small sample size. However, as more buildings become rated Green Star and with growing tenant and investor demand for green rated space and buildings, we expect an increase in involvement from many of the professional groups, particularly with the introduction of the NABERS NZ rating tool and if this were to be made mandatory, as it has been in Australia.

**Conclusions and Recommendations**

Green building is relatively new to the NZ commercial property sector, yet there are indications that as economic conditions improve, green building activity is poised to grow. In particular, the rebuild of the Christchurch CBD will provide a significant opportunity for the promotion and advancement of green building in NZ. The NZGBC expects to play a key role in the promotion of green building in the rebuild of Christchurch in terms of the training of professionals and facilitating property industry and community discussion around sustainability of the built environment.

It is anticipated that the NZGBC’s review and expected reduction in charges for Green Star will encourage a greater number of property developers and investors
to seek a Green Star rating for their buildings. The timing for completion of this review will be particularly relevant to the Christchurch rebuild. The introduction of BASE as an introductory level green building assessment specifically for the Christchurch rebuild should encourage developers and investors to incorporate sustainable features in their commercial properties and is a positive step for Christchurch. The NZGBC should also look at developing rating tools specifically for smaller projects that can be applied universally across NZ’s commercial property sector. This will encourage developers and owners of smaller commercial properties to participate in sustainable development.

As the property sectors key promoter of green building, the NZGBC needs to better educate the public and users around the benefits of green building. One of the significant barriers to the uptake of green building is the markets view of the cost premium for green building versus conventional building. There appears to be a difference of opinion between the NZGBC and that of industry on this issue. Given that cost premium was a common barrier to green building identified from the literature review, it would tend to support the findings from the industry survey. The solution to overcome this barrier appears to lie with the NZGBC and its training function. The NZGBC needs to clearly demonstrate to the commercial property sector the business case for green building. Otherwise, in the absence of government intervention, the growth of this sector will be very much determined by growth in tenant or end-user demand, which was identified by both the NZGBC and industry survey as a key factor in the uptake of green building at present.

It is also evident that the NZGBC needs to resolve its funding issues in order that staffing levels can be increased sufficiently to develop a full suite of Green Star rating tools, which will in turn provide a comprehensive green building ‘design’ and ‘built’ certification system to the NZ commercial property sector. There is also an opportunity for educational providers and professional bodies to incorporate green building education within their established qualifications for the medium to longer term supply of qualified professionals to the property sector.

Clearly, in achieving a green building solution there are design features and materials that are preferred by the industry. However, the actual use and management of green buildings needs attention, as the results from the survey indicate. This is also a matter that can be addressed by the universities and professional bodies in the training of asset, facilities, and property managers.

While central government could play a more direct role in encouraging the commercial property sector towards green building, by reinstating the green leasing policy and through regulation, tax breaks, and other incentives, the present government is more inclined to allow market forces to determine the level of green building that occurs. However, the government is somewhat supportive of sustainable development, as evidenced by the funding available through EECA, MAF, and the Electricity Commission. In particular, it is the EECA that is a key sponsor for the introduction of NABERS to the NZ property sector.
The introduction of NABERS NZ was identified by both the NZGBC and industry as providing a significant opportunity to promote and grow the level of market participation in green building in NZ. This is particularly relevant for the existing commercial building stock. Although the NZGBC would like to provide a comprehensive design, built, and performance-based assessment system, Green Star does not assess the ongoing environmental performance of green buildings.

The key industry drivers for being involved in green building are a balance between environmental/social conscience and the commercial/financial imperatives of commercial property investment and development including the opportunity to secure good quality tenants. As noted above, this industry enthusiasm for green building is somewhat tempered by the perception that green buildings are significantly more expensive to develop than conventional buildings. Looking forward, this is a matter that needs to be resolved within the property industry for green building to become the benchmark for the design and development of buildings within NZ’s commercial property sector.

Endnotes


2 The report Our Common Future (1987), put forward by the World Commission on Environment and Development (subsequently renamed the Brundtland Commission), popularized the notion of “sustainable development” and is defined in the report as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

3 BRE Environmental Assessment Method (BREEAM) was one of the earliest rating tools to measure the sustainability of new non-domestic buildings, developed in the U.K. in 1990.

References


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The participation of the NZGBC and its Director—Business Development and Technical, Rohan Bush, in the structured interview is appreciated. The participation of the respondents to the industry survey is also greatly appreciated.

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Sustainability and Income-Producing Property Valuation: North American Status and Recommended Procedures

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Abstract  The valuation of property with “sustainability” aspects is not a new property type nor does it call for a deviation from the traditional valuation methods for the appraisal of income-producing properties. However, there can be numerous and significant differences between sustainable and traditional properties that appraisers must consider, research, and address. This paper provides the first systematic procedure for evaluating sustainable property with practical guidance and advice for the integration of this procedure into the valuation process for appraisers, developers, building owners, real estate investors, lawyers, and other consumers of appraisal services. The proposed procedure is consistent with the “valuation process” promulgated by the Appraisal Institute while being consistent with the Uniform Standards of Professional Appraisal Practice, as well as the methodological and conceptual valuation literature.

The theoretical basis for the integration of sustainability considerations into the property valuation process began in 1996 [see Harrison and Seiler (2011) and Lorenz and Lützkendorf (2011) for a history of this topic]. However, the North American history of guidance for the appraiser, excluding specialized or academic journals that are not typically utilized by practitioners, is much less extensive, and includes the following:

- 2007 the Vancouver Valuation Accord meeting of valuation organizations, standards owners and implementers from 131 countries agreed to work towards embedding sustainability with valuation practices;
- 2009 Valuation Insights and Perspectives article “Finding Green in Sustainability: How to get in on the ground floor of this fast-moving trend;”
- 2009 Valuation Insights and Perspectives article “Valuing Sustainable Leases;”
prepared by a government, non-profit and private industry collaborative in the United States and Canada;

- 2008 Appraisal Institute offered one-day seminars on “Introduction to Valuation of Green Commercial Buildings” and “Valuation of Green Residential Properties;”
- 2008 Appraisal Institute book entitled *An Introduction to Green Homes*;
- 2010 The Green MLS Tool Kit, a collaborative effort among industry experts, including the Appraisal Institute, was developed to help Realtors® and appraisers more effectively consider the characteristics of high-performing homes;
- 2010 *Appraisal Journal* paper entitled “Valuing High Performance Houses;”
- 2010 *Journal of Sustainable Real Estate* paper entitled “Integrating Sustainability and Green Building in the Appraisal Process;”
- 2011 Appraisal Institute launched its Valuation of Sustainable Buildings Professional Development Program consisting of three one- and two-day courses on the valuation of high-performance residential and commercial buildings;
- 2011 *Valuation Insights and Perspectives* article entitled “Seeing Green: The Six Elements of Green Building and Tips for Supporting Appraisals;” and

Aside from these introductory materials/courses, there is currently a lack of comprehensive educational material and practical guidance on the integration of sustainability aspects into the educational programs for North American appraisers.

Lorenz and Lützkendorf (2011) identify four main arguments for the need to integrate sustainability aspects into the appraisal process. First, it is required by the transactions observed in the market place (sale prices, rents, marketing time-frames, marketing costs, etc.) and already foreseeable market developments (such as rising energy costs, changing and differentiated user requirements, environmental legislation, and sustainability reporting liabilities). Second, the professional ethics of the valuation profession and the resulting responsibility towards society dictate that valuation professionals take action to further advance sustainable development within the property and construction sector. Third, poor property valuation (i.e., a continuation of valuation business as usual) can lead to a misallocation of capital and the degradation of financial, natural, and social resources. For this reason, Muldavin (2010) argues that in the past, the failure of property investors and their professional advisors to appropriately incorporate revenue and risk considerations into sustainable investment decisions has led to an under-investment in sustainability. Today, with ever more stringent
governmental regulations and growing market participants’ interest in sustainability, this failure will increasingly result in suboptimal financial results for investors and, as a consequence, in society’s inability to achieve goals related to carbon reduction and other sustainability issues. Fourth, the lack of awareness of certain market participants regarding the relationships between the sustainability performance of buildings on the one hand and property risks and financial performance on the other leads to a situation where individual property assets are mispriced (hypothesis: conventional properties can be sold “overpriced” while sustainable buildings are “underpriced”), which in turn results in arbitrage investment opportunities for “enlightened” investors.

In fact, Lorenz and Lützkendorf (2011, p. 654) state: “Sustainability issues play a role in any valuation assignment, including the valuation of conventional buildings, because such buildings are already associated with higher risks (e.g., faster obsolescence and shorter remaining economic lifespan), which must be considered and priced today; this is particularly true whenever an income-producing property is valued by discounting and/or capitalizing the property’s net income. The nature of underlying logic of this valuation method simply requires that future risks (which are already foreseeable today) be considered when selecting appropriate discount or capitalization rates.”

This paper provides the North American appraiser, developers, building owners, real estate investors, lawyers, and other consumers of appraisal services with a roadmap to the appraisal of income-producing properties with sustainability considerations that is consistent with the “valuation process” of the Appraisal Institute, the Uniform Standards of Professional Appraisal Practice (USPAP), and the methodological and conceptual valuation literature.1

**Definition of Sustainability: Development and Buildings**

Although sustainability has many definitions and interpretations, a widely-accepted definition of sustainable development is from the 1987 (p. A/42/427) report of the Bruntland Commission: “development that meets the needs of the present without compromising the ability of future generations to meet their own needs.” The original intent of sustainable development included concerns of social equity between generations, basic global living standards, non-exploitation of others, and reducing the rate of consumption of non-renewable resources.

The adaptation of the global perspective of sustainable development to the real estate industry has resulted in a reference to “sustainable design,” “sustainable construction,” “high performance building,” “green architecture,” “green construction,” and “green building.”2 Properties that lack sustainability characteristics are often referred to as “traditional,” “conventional,” “unsustainable,” or “brown.” Whatever the descriptor for a building that has sustainability aspects, there is general agreement that when sustainable buildings are planned, constructed, and operated, the expectation is that they will offer high
quality in terms of urban integration, architectural design, functionality and technical infrastructure while simultaneously responding, with equal priority, to economic environmental and social requirements (Lützkendorf and Lorenz, 2007).

Within the built environment in North America, the National Association of Home Builders has described “green construction” as paying attention to energy efficiency, water and resource conservation, the use of sustainable or recyclable products, and measures to protect indoor air quality. The Appraisal Institute’s definition in The Dictionary of Real Estate Appraisal (2008, p. 192) is more globally-inclusive, as “the practice of developing new structures and renovating existing structures using equipment, materials, and techniques that help achieve long-term balance between extraction and renewal and between environmental inputs and outputs, causing no overall net environmental burden or deficit.”

Definitions aside, and recognizing that there are varying levels of a building’s sustainability or greenness, there is general agreement (e.g., Lorenz, Trück, and Lützkendorf, 2006; Warren-Myers and Reed, 2010) that the ideal sustainable buildings strive to achieve a reduction of the overall impact of the built environment on human health and the natural environment by: (1) reducing land use or environmental impact by not building in sprawl or a location that results in the spreading of development outwards from a city or suburbs to low-density and auto-dependent locations; (2) minimization of lifecycle costs by considering a cradle-to-grave analysis of all impacts associated with the building from extraction of the raw materials through manufacture, use, repair, maintenance, disposal, and recycling (Royal Institution of Chartered Surveyors (2009); (3) siting and structure design efficiency; (4) conservation of resources (energy efficiency, water efficiency, materials efficiency); (5) indoor air quality (IAQ), thermal quality, lighting quality, and safety to provide enhanced occupant comfort, well-being, and productivity; (6) operations and maintenance optimization; (7) waste and toxics reduction in the construction process and operation/use; and (8) optimization of one or more of the above to produce a greater cumulative effect.

Most North American appraisers will recognize the “valuation process” from The Appraisal of Real Estate (2008, p. 129) defined as “a systematic set of procedures an appraiser follows to provide answers to a client’s questions about property value.” The eight steps in the valuation process are depicted in Exhibit 1.
such as extraordinary assumptions, hypothetical conditions, and jurisdictional exceptions.

Most of the issues in this step of the valuation process are likely to have been addressed with the client prior to accepting the assignment. It is during this process and the Scope of Work Determination that the appraiser must address whether or not the appraisal of a property with “sustainability” aspects can be completed competently.
Step 2: Scope of Work Determination

Appraiser Competence

The Competency Rule of the USPAP (2012–2013, p. U-11) states: “The appraiser must determine, prior to accepting an assignment, that he or she can perform the assignment competently. Competency requires: (1) the ability to properly identify the problem to be addressed; (2) the knowledge and experience to complete the assignment competently; and (3) recognition of, and competence with, laws and regulations that apply to the appraiser or to the assignment.”

In addition to the standard issues of an appraiser’s familiarity with the market area, property type, geographic area, intended use, specific laws and regulations, or analytical method, a property with sustainability aspects may require competence in a wide variety of additional areas.4 For example, in 2008 the Institute of Green Professionals, an international credentialing and education organization for sustainable-development professionals (ceased operations in 2010), developed Literacy Elements for Sustainable-Development Professionals (see the Appendix). These literacy elements were derived from a consensus opinion of over 500 individuals working and teaching sustainability in disciplines of architecture, land-use planning, landscape architecture, engineering, real property valuation, accounting, and law. Many of these literacy elements could be considered basic elements of an appraiser’s competency for the valuation of a property with sustainability aspects.5

Looking at the future education of professionals that work with sustainable property, it is suggested that sustainability will soon be “systematically embedded within the curriculum to the benefit of professionals, professional bodies and educators” (Murray and Cotgrave, 2007, p. 7).

Reliance on Reports of Others

Few appraisers are familiar with the detailed aspects of green building design, construction, operation, and maintenance. Therefore, in the assessment of a property’s sustainability characteristics, most appraisers will utilize scientific and other technical evaluators or reports prepared by others such as architects, engineers, and rating systems. In these situations, USPAP instructs the appraiser to utilize an extraordinary assumption regarding the information obtained from other experts that is used in the appraisal.

With reliance on the reports of others, appraisers are reminded of USPAP’s (2012–2013, p. U-30) SR 2-3, which states, in part: “When a signing appraiser(s) has relied on work done by appraisers and others who do not sign the certification, the signing appraiser is responsible for the decision to rely on their work. The signing appraiser(s) is required to have a reasonable basis for believing that those individuals performing the work are competent. The signing appraiser(s) also must have no reason to doubt that the work of those individuals is credible.”
Additionally, where the appraiser relies upon another expert to provide an opinion on a factor that directly impacts value (e.g., energy savings), the appraiser should consider having the other professional “hold harmless, defend and indemnify” the appraiser for any disputes over the sustainability value input(s).

**LEEDigation and Green Building Litigation**

The last two decades have seen the increasingly rapid development of a variety of green rating systems designed and marketed to measure the environmental impact of particular products and building design elements. Most green building programs share much in common with the two most well-known national green rating systems: the Leadership in Energy and Environmental Design (LEED) systems and the Green Globes program. Like rating systems for other products and processes, these building programs include some that are self-certifying and others that rely on a system of third-party verification.

LEEDigation was first coined and defined by Cheatham (2009) as follows: “LEEDigation is green building litigation. LEEDigation could involve disputes arising from green building certification. LEEDigation could arise if a project fails to obtain government incentives or satisfy mandates for green building construction. LEEDigation could simply result from improperly designed or constructed green building strategies.”

LEEDigation is a special case of green building litigation and generally falls into three types of legal issues: (1) regulatory non-compliance; (2) green building certification; and (3) means, methods, and materials. These disputes can arise from improperly designed or constructed sustainability aspects, project costs increasing, construction delays, new technologies not working as planned, an owner’s or tenant’s unsatisfied expectations, failure to obtain government incentives, completed buildings not achieving the expected rating (e.g., LEED), buildings not achieving the expected energy savings, and similar issues.

Any party in the green building project (e.g., developers, contractors, subcontractors, construction professionals) faces potential liability for the performance of the building and other issues. The appraiser is not immune to liability and is cautioned to utilize extraordinary assumptions and reliance on the scientific and other technical reports prepared by other professionals with regard to the following non-exhaustive list of issues, many of which impact value opinions: (1) status of the property with respect to regulatory compliance; (2) status of the property with respect to rating system (e.g., LEED); (3) energy expense projections/savings (e.g., the technology in some micro-generation systems may be insufficiently developed so that there may be no savings over its life cycle), although some occupiers may demand these components and their presence may have an impact on marketability, demand, and value; (4) income projections higher than indicated by current market comparables; (5) expense projections lower than indicated by current market comparables; (6) replacement costs of specialized building materials and equipment; (7) continuity of the source of energy with renewable technologies such as wind generators and solar panels (e.g., in the event that the supply of energy to the building cannot be secured due
to inadequate grid capacity); and (8) other risk factors that may be relevant to a property with sustainability aspects.

Prum (2012, p. 2) suggests that for high performance buildings where special skills or knowledge is required of a professional, the courts will likely “impose an elevated standard of care to act reasonably based on their superior learning and experience.” Prum recommends, that while no case law has definitively resolved the appropriate standard of care for professionals on green building projects, it is wise to avoid this “untested corner of common law” by “taking a proactive approach with language of their choosing that stipulates the level they want applied in their agreement.” Therefore, appraisers, like other parties entering an agreement concerning a green building, are cautioned to make modifications to their client contract to address specific issues underlying the valuation of a sustainable property (e.g., reliance on reports of other professionals, extraordinary assumptions).

**Other Considerations for Scope of Work Determination**

In addition to the standard elements of the appraiser’s scope of work for an income-producing property, in order to fully integrate sustainability aspects into the valuation process and to appropriately consider the additional work required (and quote an appropriate fee), the scope should consider: (1) an expanded description of the property’s sustainability-related building characteristics, possibly supported by other expert reports; (2) a significantly more detailed analysis of the sustainability-related characteristics of the comparables, which may include a comparison of the energy modeling against comparable operational data; (3) capturing market participants’ awareness of the property’s sustainability attributes, property-related benefits, and risks; (4) a transparent and descriptive sub-analysis to support qualitative and quantitative adjustments; and (5) an expanded sensitivity analysis and/or Monte Carlo simulations and/or survey research.

### Step 3: Data Collection and Property Description

Step 3 consists of the collection of market area data, subject property data, and comparable property data.

**Market Area Data**

Of particular relevance for a subject property with sustainability aspects is capturing the general characteristics of the region, city, and neighborhood as they may impact trends, overall supply, demand and marketability.

**Subject Property Data**

The following sustainability characteristics should be considered by the appraiser. This is not an exhaustive list because assessing a property’s sustainability characteristics is a complex activity wherein stakeholders may have different
interpretations of the concept of sustainability and the physical structures can be complex.

**Building Certification.** Describe the subject and comparables building certification type, if any. For example, LEED, Green Globes, NAHB Green Home, ENERGY STAR, and Canada Green Building Council (CGBC) are recognized programs in North America. Sustainability assessment tools use prescriptive standards as opposed to valuation standards but they do provide valuable information to be able to make building comparisons. A green building certification or rating does not provide actionable information about the cost or market value of a building. There are different methods to acquire certification points or credits, many of which have little to do with the construction of the building (e.g., site selection or green building materials). Therefore, appraisers need to assess the actual building components and valuation-input parameters extracted through an analysis of comparable properties and of supply-demand relationships.

**Land Use/Site.** The appraiser’s analysis of the subject site will consider the natural site conditions, the climate, the rock bed and soil conditions, noise, and potential impacts of contamination for brownfield locations, as follows:

1. A site for the construction of a new building with sustainability aspects may utilize the site’s inherent features including trees for shade and water as a visual amenity.

2. For the construction of a new building with sustainability aspects or for the renovation of an existing building for sustainability aspects, the climate and natural energy sources may be considered. For example, the analysis of wind-flow patterns to maximize the use of natural ventilation and consideration of the seasonal and daily path of the sun across the site to minimize or maximize the impact of this natural energy source. Appraisers are cautioned to consider solar access laws and the potential for solar access conflicts on the site.10

3. A site for the construction of a new building with sustainability aspects will avoid sites with site-sensitive elements and restrictive land types (e.g., high-functioning wetlands, floodplains, other natural areas, igneous and metamorphic rock that could release radon, sites with soil conditions that are subject to subsidence, creep, and landslides, sites that have the potential for significant degradation of the natural environment).

4. Developers of buildings with sustainability aspects will typically avoid sites with high noise levels such as those near airports, major highways, or railways. Where noise is unavoidable, several different noise mitigation methods can be utilized such as green roofs, higher-quality window and building materials, natural site features (e.g., landscaping, berm), and/or manmade sound barriers (e.g., absorptive or reflective acoustical fences).

5. While the construction of a building on a brownfield may result in a higher score for a sustainability development rating system, the appraiser must consider the potential negative impacts of contamination, such as the cost of monitoring, insurance, indemnification, future liabilities, risk of offsite migration, increasing impact of climate change through soil
erosion (tidal, fluvial, and surface water), wind, and other climactic actions with potential cost and value impacts.\textsuperscript{11} The consideration of environmental contamination is addressed in the USPAP (2012–2013) AO-9 including the Competency Rule, relevant property characteristics, specialized terms and definitions, and issues involved in valuing potentially impacted properties as if unimpaired and as impaired.

6. In the valuation of a proposed development on a brownfield or other sites with contamination, the appraiser should consider government financial incentives together with the potential for increased operating costs and risks of contamination.

\textbf{Building Design.} The design characteristics of sustainable properties typically include components designed to achieve longer lifecycles. They will have different resource utilization or ecological footprints and/or design features that can impact a property’s investment characteristics.

Corps (2008) and Pivo (2010) argue that it is more important to make improvements to existing property performance than developing better new facilities because existing properties comprise the bulk of the income-producing market. This means that the vast majority of appraisal assignments involving sustainability aspects will be for existing properties that did not begin as sustainable properties.

The appraiser should consider the following building components:

1. The appraiser should consider the quality of the building, its use (including end-of-life use and adaptation), its characteristics, and location, as it relates to market expectations. A building constructed of durable, reusable or recyclable materials may be less likely to suffer premature obsolescence and may have decreased costs of updating or modifications. A sustainability design characteristic will typically consider climate change and its potential impacts on the property and environmental hazards such as floods and storms. For buildings nearing the end of their economic life, the appraiser may consider the value of recycled or reusable materials upon deconstruction (e.g., a positive cash flow input in the reversionary year of a discounted cash flow analysis).

2. Design efficiency should be considered in terms of gross building area, finished building area, and leasable building area. Energy costs, as impacted by design efficiency, can have an impact on tenant costs, occupancy percentage, operating expenses, marketability, and market value.

3. Good resource efficiency and operating cost savings can be achieved through sustainable technology (e.g., solar, wind, water reuse, low-flow fixtures, occupancy sensors). Each type of technology should be assessed with regard to its initial cost, cost of maintenance, whether it has a long history of use and reliability or is relatively new and untested.

4. Flexibility in use potential, particularly for offices, allows for tenant changes in the future at less refit cost with less functional obsolescence.
Recently, office workspaces have changed, with a more collaborative workspace or a more flexible area for employees, and an open floor plan that costs less to build and decorate.

5. The highest and best use of the land or building will likely change over time. A building with a structural design that allows for change of use and/or user is inherently more sustainable. A building that can be adapted for an alternate or higher and better use rather than demolition is less of a burden on resource depletion and is likely to suffer less obsolescence.

6. Companies located in buildings with superior indoor environmental quality including improved indoor surroundings (lighting, ventilation, acoustics, and ergonomic design) have been found to have less absenteeism (for asthma, allergies, depression, and stress-related conditions) and higher productivity (e.g., Syal, Grady, and Korkmaz, 2009; Heerwagen, 2010). The appraiser needs to investigate whether the market participants (owners and users) understand these benefits, and the market impacts, if any, on factors such as tenant lease-up, rental rate, lease term, roll-over probability, marketability, and market value.

7. The appraiser should consider other sustainability design qualities of the subject property and comparable properties that the market demands, such as convenient and secure facilities for bicycles, sustainable vehicle parking, showers, lockers, and a green roof for an occupant park.

**Building Materials.** Where a building or its components are approaching the end of their economic life, any hazardous materials will have an impact on the ability of the materials to be recycled or reused. This has a quantifiable impact on the cost of rehabilitation or demolition, and land value. The appraiser should seek expert opinions on potential hazards of building materials and cure, remediation and/or removal costs. The most common building material hazards are: (1) respirable silica in sand, concrete, brick, Portland Cement, ceramic tile, stone, and other materials made of stone or earth; (2) lead in paint, plumbing, solder, connectors, roof flashings, and in fasteners; (3) asbestos in insulation, boilers, pipe covering, plaster, vinyl floor tile, glazing compound, caulking compound, roofing materials, drywall board and taping compound, linoleum, flooring, and other adhesives, acoustical materials, fireproofing insulation, and exterior siding materials; (4) polychlorinated biphenyls (PCBs) in electrical transformers, light fixture ballasts, and in other electrical equipment; (5) glass fiber in insulation and as reinforcement in plastics; (6) mineral wool in insulation and as reinforcement in vinyl composition floor tiles; (7) cadmium as a rust inhibitor on hardware and in paints; (8) asphalt as a sealant in adhesives and in many roofing materials; and (9) radioactive isotopes in ionization-type smoke detectors and compact fluorescent lamps.

Sustainable building materials and products may have a significant impact on the building characteristics and demand for the sustainability-focused owner and tenant because they can help reduce the environmental impacts associated with the extraction, transport, processing, fabrication, installation, reuse, recycling,
and disposal of these building source materials. According to the California Department of Resource Recycling and Recovery (2012), the use of sustainable building materials can provide reduced maintenance/replacement costs over the life of the building, energy conservation, improved occupant health and productivity, lower costs associated with changing space configurations, and greater design flexibility. Their material/product selection criteria are as follows:

1. **Resource Efficiency**: Accomplished by utilizing materials that meet the following criteria:
   a. **Recycled Content**: Products with identifiable recycled content, including postindustrial content with a preference for postconsumer content.
   b. **Natural, Plentiful or Renewable**: Materials harvested from sustainably managed sources and preferably have an independent certification (e.g., certified wood).
   c. **Resource-efficient Manufacturing Process**: Products manufactured with resource-efficient processes including reducing energy consumption, minimizing waste (recycled, recyclable, and/or source-reduced product packaging), and reducing greenhouse gases.
   d. **Locally Available**: Building materials, components, and systems found locally or regionally saving energy and resources in transportation to the project site.
   e. **Salvaged, Refurbished, or Remanufactured**: Includes saving a material from disposal and renovating, repairing, restoring, or generally improving the appearance, performance, quality, functionality, or value of a product.
   f. **Reusable or Recyclable**: Select materials that can be easily dismantled and reused or recycled at the end of their useful life.
   g. **Recycled or Recyclable Product Packaging**: Products enclosed in recycled content or recyclable packaging.
   h. **Durable**: Materials that are longer lasting or are comparable to conventional products with long life expectancies.

2. **Indoor Air Quality**: Enhanced by utilizing materials that meet the following criteria:
   a. **Low or Non-toxic**: Materials that emit few or no carcinogens, reproductive toxicants, or irritants, as demonstrated by the manufacturer.
   b. **Minimal Chemical Emissions**: Products that have minimal emissions of Volatile Organic compounds (VOCs). Products that also maximize resource and energy efficiency while reducing chemical emissions.
   c. **Low-VOC Assembly**: Materials installed with minimal VOC-producing compounds, or no-VOC mechanical attachment methods and minimal hazards.
   d. **Moisture Resistant**: Products and systems that resist moisture or inhibit the growth of biological contaminants.
e. **Healthfully Maintained:** Materials, components, and systems that require only simple, non-toxic, or low-VOC methods of cleaning.

f. **Systems or Equipment:** Products that promote healthy IAQ by identifying indoor air pollutants or enhancing air quality. Rating systems also consider natural light and designs that allow it to impact interior areas, such as transom lights and use of outdoor air, such as operational windows.

3. **Energy Efficiency:** Maximized by utilizing materials, components, and systems that help reduce energy consumption.

   a. **Water Conservation:** Utilize materials and systems that help reduce water consumption in buildings and conserve water in landscaped areas.

   b. **Affordability:** Consider when building product lifecycle costs are comparable to conventional materials, or as a whole, are within a project-defined percentage of the overall budget.

The selection of sustainable building materials can impact the cost of servicing and replacing the materials. The ability to reuse, repair, and replace materials will typically improve their lifecycle value (defined as the cost or value of the material divided by its useful life, adjusted for any value as a recyclable asset, and adjusted for its waste value and carbon footprint). The use of sustainable building materials may impact the appraiser’s estimate of maintenance and repair cost, especially when compared with buildings that lack these sustainability aspects.

The Intergovernmental Panel on Climate Change (2007) report projects that the global temperature of the planet’s atmosphere will likely increase 1.1°C–6.4°C by the end of this century, relative to 1980–1999 baseline data. At the same time, temperature rises are linked to changes in precipitation patterns and an increase in the incidence and severity of extreme events (e.g., hurricanes, tornadoes, severe droughts, and floods). There has been a significant amount of research on city and community planning for climate change (e.g., Blakely, 2007; International Union for Conservation of Nature and Natural Resources, 2010).

The ability of a building to withstand changes in temperature and severe weather conditions while maintaining the safety and comfort of the occupants is an important sustainability aspect for many building owners and tenants. Buildings without the ability to withstand these conditions may be vulnerable to obsolescence, are inherently a higher risk, and may require retrofitting or demolition. Buildings that have taken climate change into consideration may lead to a value premium.

Low energy costs in many countries have been an impediment to the adoption of buildings with alternative energy systems. However, as high energy costs (especially fossil fuels) are likely for the foreseeable future, energy efficiency is of paramount consideration to investors and owners because it has the potential to provide the most economic return of any sustainability aspect.

Another important energy efficiency factor, and currently only applicable for major corporations, investors, and governments, is the scoring of companies for their
sustained commitment to controlling greenhouse gas emissions, disclosing data and strategies, supporting regulatory actions, and taking practical, near-term steps to finding lasting solutions. Ceres, a coalition of 130 major investors, companies, and public interest groups, is one of the leading climate change and corporate governance rating systems. The rating of climate risk management practices is also available from government initiatives, such as the U.S. EPA’s Climate Leaders and ENERGY STAR programs. Many major public corporations have recently added paragraphs to their annual Form 10-K securities filing that address their programs for energy costs conservation. Energy conservation has grown from being the exclusive issue of corporate profitability, to embracing global climate change, climate risk, and sound corporate governance. For an increasing number of major corporations, a corporate presence in a green building is mandatory for consistency with corporate governance policies and energy commitments.

Energy costs have risen significantly and this will impact tenants with a division of expenses between the landlord and the tenant, landlords with leases on a gross basis, and eventually base rents where energy costs are the responsibility of the landlord. It follows that a sustainability rating or energy labeling for buildings will increasingly be a consideration for tenants and may hasten the renovation of buildings that are less energy efficient. The appraiser is cautioned to compare buildings with similar energy efficiency systems/ratings in the selection of comparable sales, rentals, and financial characteristics.

As important as energy efficiency is in the description of a building’s sustainability characteristics, the appraiser should also consider the source of energy used within a building. The relevant energy issues are whether it is from a carbon-free source (e.g., wind, solar, ground source heat pumps) or not, and whether the energy source is secure in terms of continuity.

For buildings with a whole or partial carbon-free energy source, the appraiser should consider whether the technology of the building’s generation system is or is not sufficiently developed to result in a benefit from installation over the typical life of the building. If not, a capital cost for its updating or replacement may be applicable.

Even in North America where water has been both plentiful and cheap, society is increasingly coming to see it as a scarce and depleting resource. At least 36 states are expected to face water shortages within the next five years with results that include rising temperatures causing increased evaporation; loss of high-altitude snowpack that supplies a significant amount of water in the West; rising sea levels causing saltwater infiltration of freshwater aquifers in coastal states; shrinking water levels in the Great Lakes; and population increases and increasing water consumption.

Water is rapidly becoming a target for conservation due to projected shortages, increasing cost, and corporate social responsibility (CSR) policies. In commercial buildings where the majority of water consumption is not for drinking purposes, the relevant building characteristics may include a variety of equipment designed to reduce water consumption, such as the use of “gray water” for
landscaped areas and flush toilets, waterless urinals, and rainwater collection and redistribution systems.

Landscaping for sustainability will utilize drought resistant and perennial groundcovers that require minimal water, chemicals, and fertilizers to survive. Effective use of trees has the potential to significantly reduce air-conditioning costs by reducing light penetration and reducing heating costs when used as windbreaks while shrubs and ground cover reduce temperature due to absorption, evaporation, and radiation control.

With rising landfill costs, escalating diesel fuel prices, and increasing regulatory pressure, waste management is becoming a significant cost issue for income-producing properties. There are many potential waste streams in our income-producing properties that can be valuable resources for energy and reduced operating costs. These include food processing waste, waste plastic, and municipal wastes destined for landfills. A centrally-controlled recycling system of a building with convenient access and storage is increasingly an important sustainability metric in determining its sustainability performance.

**Location Analysis.** The location analysis can consider its accessibility, contextual fit, and the impact of the site improvements on the subject site. In order to be consistent with sustainability issues, the building may be accessible via a range of public and mass transportation for people and materials or more fuel-efficient or convenient transportation alternatives.

The contextual fit, referring to the sustainability-appropriateness of a building within its location, can be described as having (1) a catalyst or “halo” effect with a positive impact on values on its locality; (2) an “echo” effect where “the existence of the building itself leads to an increase in values in the area which rebounds on the subject property;” and (3) a negative effect where the subject building deters social and business activity in the area with a negative impact on values (Ellison and Sayce, 2006, p. 301).

The location of the building and its site development can positively or negatively impact the ecosystem. Relevant to the appraiser are ecosystem characteristics that might have an impact on the economic performance of a property. Examples of ecosystem impacts on the value of the property might include atypical site development costs, issues that have regulatory or remediation impacts/costs, setbacks from water courses, flooding, and rising sea levels.

**Regulation, Tax, and Financial Incentives.** The federal government and many state and local governments have decided to require or encourage more environmentally-friendly building policies. A wide variety of different approaches are utilized to accomplish these policy objectives including statutes, ordinances, and regulations that compel and/or incentivize green building initiatives. In some cases the government will develop its own building or development standards and others may select standards that have been developed by an independent third-party organization (e.g., LEED, Green Globes).

Many of these factors can impact value and should be considered in the comparable analysis. The appraiser should be aware of incentives such as grants,
loans and taxes, planning incentives (e.g., expedited review, permit fee waivers, density bonuses, reductions in parking space requirements), and credits from validated and registered carbon emissions reductions. \(^{14}\)

Similarly, the appraiser should consider whether state and local governments utilize negative incentives (e.g., construction waste disposal fees, taxes levied on unsustainable aspects of buildings, greenhouse gas emission fees\(^{15}\)) to discourage low performance projects and practices.

In this complex and constantly changing arena, appraisers are cautioned to rely on other experts with specialized knowledge.\(^{16}\)

When an appraiser is providing a value-in-use estimate, investment analysis, or in a consulting assignment, the individual should consider the developing field of “green mortgaging,” which may provide a lower lending rate for green development.

**Green Leases.** For an income-producing property, the lease is an appraiser’s key element in the projected performance of a building. The lease defines the contractual relationship between the landlord and tenants (e.g., who does/pays what, when, how). For appraisers’ familiar with the typical commercial lease, they will find a number of new issues to consider in an analysis of a green lease.

For the appraiser who typically reads the lease, presumes typical property management, and inputs the lease terms into Argus Valuation–DCF or similar software, the analysis of an income-producing property with sustainability characteristics requires a deeper level of analysis. A green lease, although there is no widely-accepted definition, is a lease that requires both the landlord and tenant to act responsibly in terms of the conservation of resources and efficient use of materials and resources while maintaining a healthy and productive interior environment. Model green leases have been developed by BOMA International (http://www.boma.org), the Corporate Realty Design & Management Institute (http://www.squarefootage.net), the Open Standards Consortium for Real Estate (http://www.oscre.org), and the Real Property Association of Canada (http://www.realpac.ca). Appraisers are advised to view these green leases so as to be able to compare these models with the green lease at a subject property.

A green lease may have an impact on cash flow in the case of reserves for replacement, tenant improvements, maintenance and refurbishing to sustainability standards. Absence of a green lease and/or failure to adequately maintain the attributes designed to improve sustainability performance may harm the building performance, increase capital costs and/or operating costs, and may impact insurance. Its absence may also cause sustainable certification to be lost, thereby losing the attributes that attracted the tenants, causing increased vacancy, tenant turnover, marketing, tenant concessions, and reduced rent.

Whitson (2010) offers the five building operating issues below and explains how a green lease differs from a non-green lease:

1. **Energy:** A typical non-green lease for a multi-tenant office building is likely a net lease where there is a pro-rata share allocation of the operating
costs. This type of lease provides no method for the tenant to see any economic benefit from reducing energy consumption. In one type of an effective green lease, the landlord is responsible for all energy costs up to a stated allowance and, with the use of sub-meters for tracking each tenant’s energy use, any energy usage over the allowance is billed to the tenant as additional rent. With shared incentives, the owner can lower operating costs and improve return through continued high efficiency. Tenants are encouraged to manage their energy consumption (e.g., through controlling after-hours energy use).

2. Operating Performance: Mendell et al. (2006) found that the most important health complaints in office buildings were excessive building moisture, inadequate outdoor air, excessive dust, pollutant gases and odors, inadequate thermal control, and inadequate attention by management to indoor environments. These issues may be addressed in a non-green lease and refer to general terms such as “reasonable” or “comparable” to other buildings of the same class in the area. A green lease should state that the building’s indoor air quality will comply with ANSI/ASHRAE Standard 55-2004, Thermal Environmental Conditions for Human Occupancy and ANSI/ASHRAE Standard 62.1-2010, Ventilation for Acceptable Indoor Air Quality. The purpose of these standards is to specify minimum temperature and ventilation rates and other measures that are “acceptable to human occupants and that minimize adverse health effects” (Standard 62.1-2010, p. 1). It is also suggested that the lease should state the operational limits (e.g., temperature, humidity) of the IAQ systems.

3. Recycling, Daytime and Green Cleaning, Green Pest Management: Most often not addressed in a non-green lease but a requirement for one, these clauses will address operating performance standards as they relate to cleaning and maintenance activities (including green cleaning procedures, sustainable cleaning products, hardscape and landscape maintenance, integrated pest management, and waste management). The USGBC framework maximizes operational efficiency while minimizing environmental impacts of buildings in LEED for Existing Buildings Operations and Maintenance. Appraisers should be generally familiar with its contents in order to assess the subject’s operating standards (http://www.usgbc.org/DisplayPage.aspx?CMSPageID=221).

4. Annual Environmental Performance Report: A green lease will include an annual environmental performance report by and for tenants and owners on such issues as operating hours, energy use, renewable energy, water use, and recycling. This is indicative of a performance-based property management approach to guide their planning, maintenance, operations, and contracting practice to maximize property sustainability. Many corporations now require their supply chain to provide annual environmental performance reports.

In March 2010 the Open Standards Consortium for Real Estate (http://www.oscre.org), a consortium to facilitate collaboration on standardized data exchange, developed core lease abstract data for green leases to
enhance environmental and sustainability reporting. This document is available for public use and will make the collection, analysis, and reporting of information for the landlord and tenants more transparent and cost effective.

5. **Interior Construction:** The use of sustainable building materials can provide reduced maintenance/replacement costs over the life of the building, energy conservation, improved occupant health and productivity, lower costs associated with changing space configurations, and greater design flexibility. Therefore, the material/product selection for the initial fit-out of tenant space and subsequent tenant improvements must also be consistent with resource efficiency (e.g., recycled or renewable content, durable, locally available), indoor air quality (e.g., minimal VOCs, moisture resistant), energy efficiency, water conservation, and affordability. Both the Tenant Work Letter Agreement and the Contractor Regulations should address the sustainable product requirements and the construction practices.

The appraiser should consider the elements of the LEED for Commercial Interiors certification, which provides a checklist of sustainability elements that can be utilized for the analysis of the subject property and comparables (http://www.usgbc.org/DisplayPage.aspx?CMSPageID=145).

**Comparable Property Data**

Paralleling the description of the subject property to the greatest degree possible, the comparable property data will address the sustainability characteristics of the comparable properties (e.g., improved sales, rentals) including building certification, analysis of the land use/site, building design characteristics, the building materials, a location analysis, impacts of any regulatory, taxation or financial incentives, and relevant elements of the green leases.

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**Step 4: Data Analysis**

**Market Analysis**

Of particular relevance for a subject property with sustainability aspects is capturing the characteristics of the market area that impact supply (e.g., availability of similar properties, government initiatives/incentives), demand (e.g., movement of corporations into the area with strong CSR goals, market sensitivity to sustainability), and marketability.

**Highest and Best Use Analysis**

The most significant difference between the highest and best use analysis for a property with sustainability aspects and one without is the test of financial feasibility. The appraiser may find that the market area does not support a building with a high level of sustainability attributes (i.e., a higher cost) and only recognizes
energy efficiency (a marginally higher cost than one with a lower level of energy efficiency). The appraiser’s market analysis, sales comparables, rent comparables, and DCF input variables will all be factors to consider in the financial feasibility analysis, the final opinion of maximal productivity, and the conclusion of highest and best use.

**Step 5: Site Value Opinion**

The most significant differences between the data, analysis, and final site value opinion for property that will have, or has been developed with sustainability aspects, and one without, may include site characteristics (inherent features such as water, shade, natural view amenity, wind-flow patterns) and atypical site development costs (e.g., soil subsidence, contamination).

**Step 6: Application of the Approaches to Value**

There is general agreement among the sustainability and valuation literature (e.g., Guidry, 2004; Corps, 2008; Royal Institution of Chartered Surveyors, 2009; Warren-Myers and Reed, 2010; Lorenz and Lützkendorf, 2011) that appraisers should consider a number of sustainability issues. The technical and functional characteristics of the sustainable subject property must be described, evaluated, and quantified. These characteristics have a positive impact on market value within many markets (Robinson, 2005; Bowman and Wills, 2008; Miller, Spivey and Florance, 2008; Eichholtz, Kok, and Quigley, 2009, 2010; Miller, 2010).

A rental and sale price premium for buildings with a green label or certification has been indicated (e.g., Miller, Spivey and Florance, 2008; Miller, 2010). Therefore, market data should be considered to determine whether there is market support for a value premium for these buildings or a value discount for buildings without these aspects.

User comfort, occupant performance, and positive health aspects of sustainable building materials and designs may have an impact on marketing time and costs, absorption period, market rent, the selection of what constitutes a competitive property, tenant renewal, cost of tenant refit, and marketability (e.g., Abbaszadeh, Zagreus, Lehrer, and Huizenga, 2006). A Royal Institution of Chartered Surveyors (2005, p. 5) case study states that “perhaps the largest single area of value from green buildings lies in the ‘soft’ gains that can be difficult to value with conventional accounting methods.”

Sustainability issues such as biodiversity preservation, environmental impact and cultural quality may enhance the reputation of the building, building owner or occupants (e.g., Green Building Council Australia, 2008). Although the impacts on property prices have yet to be isolated, they may also have an impact on marketing time and costs, absorption period, market rent, the selection of what constitutes a competitive property, tenant renewal, cost of tenant refit, and marketability.
The extent to which sustainability aspects are reflected in value estimates appears to be highly dependent on local and regional market conditions and the preferences of market participants. The view of Lorenz and Lützkendorf (2011, p. 654) (and supported by this paper) is that “sustainability issues play a role in any valuation assignment, including the valuation of conventional buildings, because such buildings are already associated with higher risks (e.g., faster obsolescence and shorter remaining economic lifespan) which must be considered and priced today.”

There is also general agreement among the sustainability literature and guidance to appraisers (e.g., Green Building Council Australia, 2008; Lorenz and Lützkendorf, 2011) that the preferred method for integrating sustainability aspects into the appraisal process is by adjusting single valuation parameters (e.g., market rent, occupancy, expenses, capitalization rate). This method is preferred because it requires a cause-and-effect relationship between the building’s sustainability characteristic and the valuation-input parameter.

It is generally recommended (e.g., Lorenz and Lützkendorf, 2011, p. 653) that the appraiser include an analysis of the “sustainability-related risks and opportunities of the subject property (including the risk of changes in estimated property values) as well as to enhance the understanding of the overall valuation result and to improve the informational content that serves as a basis for decision-makers.” The appraiser can place this analysis within each of the valuation approaches where risk (market risk, financial, capital market, inflation, liquidity/marketability, environmental, legislative, and management) adjustments are derived/applied.

**Sales Comparison**

The availability of comparable properties will vary significantly with the property type and market area. This approach is reliable when there are a sufficient number of comparable sales and when the sustainability characteristics of these properties are similar to the subject property. Comparable sales may be very difficult to find in some markets. However, in “some markets, especially with municipally sponsored programs, it will be relatively easy to find comparable properties and the sales comparison approach can be applied with a great deal of reliability” (Guidry, 2004, p. 64).

Even in markets where there are comparable sales, the difficulty remains in identifying the physical characteristics, sustainability attributes, and sustainability performance of the comparable sales. For this information, the appraiser must go well beyond the typical factors (e.g., arm’s length transaction) within the sale verification process. The appraiser must research energy certificates, interview the property manager or owner (and possibly tenants), building architect and/or general contractor, and review building files. If the appraiser determines that there is sufficient data to apply the sales comparison approach, for a property with sustainability aspects, the appraiser should consider, at a minimum, the following adjustments to the comparable sales: (1) higher comparable sale prices for sustainable buildings; (2) lower comparable sale prices for conventional buildings; (3) building certification; (4) lower/higher operating costs; (5) lower/higher replacement costs; (6) market participants’ preferences/image/reputation/
competitiveness/marketability; and (7) longer/shorter remaining economic life. Many of the DCF variables discussed above also applicable in the sales comparison analysis.

In the absence of sufficient comparable sales to provide market-derived support for an adjustment that the appraiser considers necessary in order to reflect the typical actions of market participants, it is suggested that the appraiser explains the lack of data to support the estimated adjustment. The appraiser should also provide a sub-analysis support (e.g., similar property type beyond the subject’s market area, market area conditions, interviews of market participants) for the adjustment. The appraiser should provide sufficient information to establish a cause-and-effect relationship between sustainability-related building characteristics and the valuation adjustment factor.

**Cost**

If the appraiser determines that the cost approach is applicable to the valuation of the subject property, for a property with sustainability aspects, the appraiser might consider the following adjustments or modifications to the analysis: (1) tax incentives, grants and loans, and other incentive programs; (2) slightly higher replacement costs (e.g., Ellison and Sayce, 2006) and in some jurisdictions may require renovations to meet green standards; (3) special technical building equipment; (4) depreciation (physical deterioration and functional obsolescence may be lower for green construction due to superior construction and energy efficiency (Guidry, 2004); and (5) remaining economic life (as regulatory building sustainability standards increase, the future economic life of the building may be compromised as upgrading expenditure becomes more expensive). Alternately, green buildings may have longer economic lives because they are built with more durable, low-maintenance materials (Guidry, 2004).

It is relevant to note that the Marshall & Swift® building cost estimation service now provides cost estimates for sustainable buildings and their components.

As in the sales comparison approach, when adjustments are applied, the appraiser should provide sufficient information to establish a cause-and-effect relationship between sustainability-related building characteristics and the cost adjustment factor.

**Income Capitalization**

**Sustainability Valuation Inputs for DCF**. Consideration of sustainability aspects can be applied within the income approach. The discounted cash flow (DCF) method is addressed in this paper as the valuation-input parameters are explicit in this approach, whereas in direct capitalization, where they are largely implicit, the analysis fails to capture the detailed sustainability-related income, expenses, and risks. In the DCF analysis, the main valuation-input variables are the risk premium in the capitalization and/or discount rates, and the variables in the cash flow. Lorenz and Lützkendorf (2011) provide “a simplified overview of the composition of these two main valuation-input variables for the valuation of both conventional and sustainable buildings” (see Exhibit 2).
The two main valuation-input variables of risk premium and cash flow depend upon numerous sub-analyses including the sustainable building features, the risk avoidance characteristics of the property that may exist because of its sustainability characteristics, and the risks due to location, the subject’s features, and the market. Exhibit 3 indicates some of the factors that link to the appraiser’s cash flow and risk projections.

The DCF input variables for a property with sustainability aspects include many of the same inputs as a conventional building. However, the data, analysis, and final inputs must be based upon a market-derived analysis of comparable sales and rentals of sustainable buildings with similar highest and best use, income-expense ratios, future expectations of value changes over the projected holding period, risk characteristics, and other factors as determined by the appraiser. This list of must-haves for the ideal comparable and market-derived input variables is most appropriate for the classroom, although seldom within the reality of the appraisal office. “It is likely that for the foreseeable future, quantitative analyses of data and information on comparable properties will indicate a numerical range for each valuation-input variable, and that the practitioner’s qualitative judgment will ultimately determine the final value of key input parameters” (Lorenz and Lützkendorf, 2011, p. 659).

For a property with sustainability aspects, the appraiser should consider the following input variables in the DCF: potential gross income, vacancy and collection loss, operating expenses, terminal capitalization rate, and discount rate.
Exhibit 3 | Factors Linking Cash Flow with Risk Projections

Potential gross income may be impacted by: (1) Rental growth (factors to consider include projected changes in supply/demand and changes in occupant costs such as energy cost savings which may increase the amount available for rent); (2) positive accessibility factors such as convenience to walk to work, bicycles, and/or public transportation access and/or negative factors such as accessibility that restricts access to the more efficient transportation modes that may undermine productivity and compromise employee recruitment and retention (e.g., Ellison and Sayce, 2006); (3) tax incentives, grants, and loans, as well as other incentive programs; (4) image of the building; (5) building occupants with either a strong CSR reputation that may positively impact the marketability and value of the property, or a tenant with poor CSR credentials could have the opposite affect (see Ellison and Sayce, 2006); (6) building certification; (7) building design and materials (e.g., thermal, acoustic, and visual comfort as well as IAQ for a healthy building, worker productivity, worker sickness, and absenteeism) as they relate to rental rate (e.g., Boyd, 2005); (8) supply and demand for the property with sustainability aspects; (9) share of tenant expenses or other green lease elements; (10) tenant improvement costs that require sustainability characteristics; (11) space flexibility/adaptability; (12) level of functionality/fitness for the desired purpose; (13) minimization of mobility/travel costs; (14) resilience against extreme events (e.g., flooding, earthquakes, heat waves); and (15) tenants attracted by energy efficiency and/or renewable energy sources.

Vacancy and collection loss may be impacted by any of the elements that impact PGI in addition to the quality of tenants that will be attracted to the property due to these sustainability characteristics. Additionally, this may reduce vacancy risk due to higher attractiveness of the building for the tenants for numerous reasons, including CSR objectives.

Operating expenses (OE) may be impacted by: (1) structural condition (may impact deferred maintenance and ongoing maintenance); (2) type of construction (deferred maintenance and ongoing maintenance); (3) building materials (longevity and cost of updating/replacement); (4) technical quality (longevity and capital costs and maintenance); (5) energy efficiency (cost of energy); (6) systematic and appropriate maintenance; (7) green lease (allocation of operating expenses/tenant reimbursement); (8) space flexibility (tenant improvement costs); (9) contamination (remediation or ongoing monitoring costs); and (10) locational risks (resilience against extreme events such as flooding).

Terminal capitalization rate may be impacted by: (1) market’s perceived future risk for sustainable buildings with the subject’s characteristics; (2) market expectations of future supply/demand for sustainable buildings; (3) expectations of income and value changes over a typical holding period; and (4) market expectations regarding economic life and obsolescence.

The discount rate may be impacted by locational, property-specific, and market risks, including, but not limited to: (1) locational risks due to soil stability/contamination, changes in market area quality/desirability, and changing climactic conditions; (2) property-specific risks due to structural condition, type of construction, building materials (lower risk of losing a tenant and environmental
litigation), durability and resilience of building, changes in market preferences (quality, attractiveness), image and potential changes to image/marketability, ability to meet market rental expectations, and ability to meet market yield expectations; and (3) market risks due to real estate conditions and projections for the subject property type; economic conditions and projections (e.g., competing asset classes are likely affected by sustainability and may have an indirect impact on the cost of capital); political, legal, and private sector policy, conditions, and projections (possibly as a response to issues such as energy costs, resource depletion, and climate change); certainty of future cash flows; and probability of acts/events beyond control. Exhibit 3 captures many of the elements of cash flow and risk for a property with sustainability aspects.

**Sensitivity Analysis.** As an additional section, typically within the income approach, a sensitivity analysis/Monte Carlo simulations are recommended to show the impacts of changing factors such as market conditions and uncertainties (e.g., French and Gabrielli, 2004, 2005; Lorenz, 2006; Bowman and Wills, 2008; Green Building Council Australia, 2008; Lorenz and Lützkendorf, 2011). Appraisers are typically familiar with applying a sensitivity analysis in a DCF analysis. This might involve minor variations in various inputs such as rental income, operating expenses, tenant roll-over percentage, terminal capitalization rate, and discount rate.

However, buildings with sustainability aspects have the potential for different and more complex changing future conditions, such as political, technical, and economic risks that are not well accounted for in standard valuation methods. A Monte Carlo simulation method can address these risks, and any other future uncertainty or risk. This section of the appraisal report should clearly explain the cause(s) of the sustainability-related risks or uncertainty, any abnormal uncertainty, and the degree of uncertainty, including the risk of changes in the value estimate(s). However, Monte Carlo simulations are not currently part of the typical educational programs for appraisers in North America. Acquiring this skill set may be well-advised for the appraiser valuing larger or more complex sustainability projects. Appraisers new to Monte Carlo simulations are referred to Hoesli, Jani, and Bender (2006), Barreto and Howland (2010), and Rode, Fischbeck, and Dean (2001). There are a number of Monte Carlo software packages, including @Risk software by Palisade Corporation and GoldSim from GoldSim Technology Group.

**Hedonic Pricing.** In an attempt to integrate aspects of energy efficiency into income-property valuation methods, numerous researchers have applied multiple regression analysis in the framework of hedonic pricing models to empirically establish the effects of energy-efficiency characteristics on property values. Robinson (2005), Bowman and Wills (2008), Miller, Spivey, and Florance (2008), Eichholtz, Kok, and Quigley (2009), and Miller (2010) suggest that sustainability aspects have a positive impact on market value. In contrast, Leopoldsberger, Bienert, Brunauer, Bobsin, and Schützenhofer (2011) suggest that the market does recognize energy efficiency as a value-influencing factor of buildings with sustainability aspects.
The above studies, however, all use hedonic modeling to integrate aspects of energy efficiency into income-property valuation approaches. Leopoldsberger, Bienert, Brunauer, Bobsin, and Schützenhofer (2011, p. 124) suggest: “One should note when examining the analysis illustrated and explained that such advanced interpretation methods to derive valuation input parameters fall well beyond the scope of standard valuation practices as (1) they require a huge sample of comparable property information not usually available to valuers, and (2) they can only be performed with advanced statistical knowledge. Therefore, it is unlikely that valuers could extract statistically significant results even if they could carry out such analysis in practice.”

Survey Research. As previously stated, while the ideal would be “revealed preference” data (sales or executed leases) to support the adjustments in the sales comparison approach and the valuation-input variables in the DCF, it is likely the practitioner’s qualitative judgment will ultimately determine the final value of key inputs (Lorenz and Lützkendorf, 2011). However, it is incumbent upon the appraiser to go beyond an exclusive reliance on a “practitioner’s qualitative judgment” in order to comply with the USPAP’s Competence Rule and to excel in real property litigation settings.

Gordon (1988, p. 259) states that “Most appraisers now come to realize that all value estimates are economic forecasts that attempt to simulate the thinking of knowledgeable market participants.” And, according to Allen and Austin (2001, p. 395), Appraisers have only two ways to predict the choices or transactional values of buyers and sellers. The first way is estimates that are inferred from observed actions such as the sale of comparable properties. This approach, derived from early valuation theory economists, has a strong bias in favor of transactional data. The second way is preferences, anticipations, beliefs and attitudes of knowledgeable market participants. These are measured by market survey techniques.

There is a debate in the literature on an appraiser’s use of formal survey research in determining a value estimate. The debate typically surrounds the use of a quantitative diminution in value, such as the damage due to contamination, as measured by the contingent valuation method [see the literature review by Throupe (2011)]. However, there is agreement that surveys can be used as a secondary or support role for valuation (e.g., McLean and Mundy, 1998; Roddewig, 1999; Bell, 2008). For example, Flynn, MacGregor, Hunsperger, Mertz, and Johnson (2004) utilized a survey to show a causal link between an environmental disamenity and the loss in market value, not to measure market value itself. This type of survey design and use would be consistent with showing a causal link between a property’s sustainability aspect(s) and positive perceptions of the market participants, upward adjustment(s) applied by the appraiser, and increase in market value. This causal link would go a long way towards supporting the appraiser’s estimates of adjustments and value-influencing variables. Further, this “causal link is critical in litigation where the valuation measurement is not enough, and appraisers are asked to support the causality link for their opinions” (Throupe, 2011, p. 303).
Step 7: Reconciliation of Value Indications and Final Opinion of Value

The purpose of the reconciliation section of the appraisal report for a property with sustainability aspects is no different than any other property. According to *The Appraisal of Real Estate* (2008), the purpose of the final reconciliation process is to resolve the differences among various value indications, to reveal conflicts or unresolved questions, to provide a quality control assessment of the valuation process, and to identify key factors that should be cited and explained, or elaborated upon, within the appraisal report. However, for the property with sustainability aspects, the questions asked in reconciling value indications may be slightly different than for a conventional or traditional subject property. For the convenience of the reader, the reconciliation questions in *The Appraisal of Real Estate* (2008, p. 560) are repeated below, with additional questions for a sustainable subject property, if applicable, in italic font.

**The Sales Comparison Approach**

1. Are there an adequate number of sales?
2. Are the sales comparable?
   a. Does the market differentiate in terms of tenant or investor demand between a property with sustainability aspects and one without?
   b. Does the market differentiate in terms of tenant or investor cost savings, or the life cycle or market value between a property with sustainability aspects and one without?
   c. To what extent do the building’s sustainability features compare with the comparables?
   d. Is there green certification, and is it valued by buyers and/or tenants in the market?
   e. Are there trends in tenant occupant needs/requirements that will impact marketability?
   f. Are the characteristics of the subject and comparables connected with their position on sustainability issues or their CSR criteria?
   g. Are the subject and comparables impacted by sustainability regulations, tax incentives or other issues that impact rent and/or value?
3. Are there prior sales of the subject property that need to be analyzed?
4. Is there market support for the adjustments that were made?
5. Were those factors that could not be supported by quantitative adjustment dealt with adequately using qualitative analysis in the reconciliation?
6. Is the range of adjusted sale or unit prices within the range exhibited in the market?
7. Are the conclusions of the approach consistent with the conclusions in the other approaches?
Land Valuation

1. Are there an adequate number of sales?
2. Are the sales comparable?
   a. Do the comparables reflect similar sustainability characteristics such as accessibility, contextual fit, and site-specific ecosystem?
3. Is there market support for the adjustments that were made?
4. Were those factors that could not be supported by quantitative adjustment dealt with adequately using qualitative analysis in the reconciliation?
5. Is the range of adjusted sale or unit prices within the range exhibited in the market?

The Cost Approach

1. Is the land value well supported?
2. Are the cost estimates reliable and market-based?
3. Do the cost estimates account for all of the costs?
4. Are renovations required to meet some green standard?
5. Are the sales used to extract depreciation from the market reliable?
6. Were physical, functional, and external depreciation estimated accurately?
   a. Can any sustainability deficiencies be rectified by retrofitting or are there barriers due to building characteristics or financial feasibility?
   b. Is the building made more or less susceptible to depreciation and obsolescence by reason of its sustainability aspects?
7. Are the conclusions of the approach consistent with the conclusions reached in the other approaches?

The Income Capitalization Approach

1. Is there an adequate number of rental comparables?
2. Are the rental properties comparable?
   a. Does the market differentiate in terms of tenant or investor demand between a property with sustainability aspects and one without? If so, do they add realizable value and is this a temporary or longer-term benefit?
   b. Does the market differentiate in terms of tenant or investor cost savings, or the life cycle or market value between a property with sustainability aspects and one without?
   c. To what extent are the building’s sustainability features reflected in the comparables?
   d. Is there green certification, and is it valued by tenants in the market?
   e. Are the subject and comparables impacted by sustainability regulations, tax incentives or other issues that impact rent and/or value?
3. Is there market support for the adjustments that were made?
4. Were those factors that could not be supported by quantitative adjustment dealt with adequately using qualitative analysis in the reconciliation?
   a. Was the appropriate level of explanation provided for adjustments and/or were alternate valuation methods utilized to support the adjustments?
5. Is the historical expense information available? If so, how reliable is it?
6. Do the owner’s income and expense statements include all income?
7. Do the owner’s income and expense statements include all expenses?
   a. Is the building made more or less susceptible to depreciation and obsolescence by reason of its sustainability aspects?
   b. Will the building require a greater allowance for operating expenses or capital costs due to its sustainability aspects?
8. Do the owner’s income and expense statements include any expenses that are not typical?
9. Are the expense projections in line with market estimates?
   a. Are the market’s projections for energy costs reflected in the appraiser’s projections for income reimbursements and expenses?
   b. Can any sustainability deficiencies be rectified by retrofitting or are there barriers due to building characteristics or financial feasibility?
   c. Do the sustainability aspects and internal flexibility and adaptability reduce the cost of tenant improvements and increase the probability of tenant renewal?
10. Is there market support for the capitalization method?
11. What is the impact, if any, of “green mortgaging” which may provide a lower lending rate for green development?
12. Is there market support for the capitalization or discount rate?
   a. Does the market recognize less risk for buildings with good sustainability characteristics due to greater demand and therefore a lower investment risk?
   b. Does the increasing awareness of sustainability issues and the movement for carbon reduction have an impact on purchase decisions and investment yield?
   c. Have all the sustainability aspects that could potentially impact PGI, VCL, OE, risks, capitalization and discount rates (stated within this paper) been considered?
13. Does the method of capitalizing income reflect market patterns?
14. Are the conclusions of the approach consistent with the conclusions in the other approaches?
   a. Does the valuation consider, explain and reflect all material factors that may influence value?

_The Appraisal of Real Estate_ (2008, p. 560) states that the final “reconciliation relies on the proper application of appraisal techniques and the appraiser’s
judgment.” This statement is highly applicable to the current status of appraising income-producing properties with sustainability aspects. Lorenz and Lützkendorf (2011, p. 659) state: “In valuation practice [...] it is rare for an individual practitioner to possess significant data on comparable properties that would enable quantitative analyses to directly and precisely determine appropriate valuation-input parameters for the valuation of a particular property. It is likely that for the foreseeable future, quantitative analyses of data and information on comparable properties will indicate a numerical range for each valuation-input variable, and that the practitioner’s qualitative judgment will ultimately determine the final value of key input parameters.” Consistent with the reconciliation criteria in The Appraisal of Real Estate (2008), the appraiser will consider the appropriateness, accuracy, and quantity of evidence in the development of a final opinion of value that is meaningful and defensible.

**Step 8: Report of Defined Value**

The reporting of the final opinion of value is unchanged for a property with sustainability aspects and one that lacks these characteristics.

**Conclusion**

In this paper, by following the “valuation process” promulgated by the Appraisal Institute, appraisers and consumers of appraisal services are provided with a roadmap to the appraisal of income-producing properties with sustainability considerations. While it is clear that a sustainable property is not an entirely new property type and does not yet possess criteria that call for a deviation from the traditional valuation methods, it creates many new factors to be researched and addressed by appraisers, and considered by consumers of appraisal valuation and appraisal consulting services.

Over time, appraisers will encounter an increasing number of sustainable buildings, sufficient data to derive value-input variables, and an increasing number of appraisal assignments for sustainable properties. Through this evolution, the appraiser’s sustainability education will grow in depth and complexity. However, until that time, appraisers and consumers of appraisal services are cautioned to:

1. Consider, with a limited number of opportunities to have worked on appraisals of buildings with sustainable aspects and the limited number of course offerings that address the unique property characteristics and valuation issues, whether the report is prepared in compliance with USPAP’s Competency Rule.

2. Consider modifying the client contract to parallel the intended scope of work, reliance on the opinions of other professionals, extraordinary assumptions, and other relevant factors that may impact the appraisal report and its credibility.

3. Rely on other professional reports for areas impacted by sustainability characteristics that are outside the appraiser’s expertise.
4. Expand the scope of work to fully integrate sustainability aspects into the valuation process.

5. Go beyond the typical scope of research for comparable sustainable rentals and/or sales in order to understand all of the property characteristics and preferences of market participants.

6. Conduct a sub-analysis to be able to provide the client with a cause-and-effect relationship between sustainability-related building characteristics and the valuation adjustment factor.

7. Avoid generalizing the results of sustainability study results (e.g., assertions that certified buildings command a value premium over those that are not certified), across property types, market areas, and market conditions.

**Appendix**

**Towards an Interdisciplinary Language for Sustainable-Development Professionals**

**Literacy Elements for Sustainable-Development Professionals**

Literacy Elements for Sustainable-Development Professionals is a consensus opinion on the basic multidisciplinary, sustainable-development knowledge needed for individuals working and teaching in professional specialties of architecture, land-use planning, landscape architecture, engineering, real property valuation, accounting, and law.

These Literacy Elements provide a vision for the future to help such professionals and others gain a better understanding of sustainable development, around which the following questions and answers have been compiled.

**Q1: Why do we need Literacy Elements for Sustainable-Development Professionals?**

A: Literacy Elements for Sustainable-Development Professionals provides focus, direction, and coherence to the highly complex disciplines of sustainable development. Literacy Elements are needed because:

- Professional specialization hinders the ability to think broadly and across boundaries. Sustainability issues are too broad and complex to be dealt with in a compartmentalized professional or academic fashion. They require a holistic approach, as well as interdisciplinary knowledge and skills in order to solve complex, interrelated, and multi-dimensional problems.

- A professional population sharing a “common understanding” or “common language” of sustainable development will enhance individual and interdisciplinary professional communication, competence, and hasten global sustainability.
Q2: Why do we need Literacy Elements for professionals when many existing education programs address sustainability?

A: University-based and professionally targeted programs provide some opportunities for the acquisition of expert sustainable-development insights (e.g., daylighting for architects, protecting bio-regions for land-use planners, inter alia). However, Literacy Elements address an extensive body of knowledge of the origins of sustainable development, its interdisciplinary and complex features, innovative strategies, as well as the integration of science, humanities, and social sciences for each project in which the professional/academic is involved.

Q3: Who is developing the Literacy Elements and why?

A: The Institute of Green Professionals (IGP) with the help of academics, professionals, NGOs, governments, and professional societies in every discipline are currently involved in developing the Literacy Elements. These Literacy Elements and Knowledge Components may be used or modified to develop academic and professional courses and to underpin professional standards. IGP will use the Literacy Elements and Knowledge Components to develop its free open-access course entitled: “General Comprehensive Course: Sustainable-Development Literacy for Professionals.”

Q4: What are the Literacy Elements?

A: There are two broadly-based Literacy Elements:

1. Understanding interdisciplinary and complex conceptual frameworks, models, theories, terms, and methods for sustainable development.

2. Thinking in a holistic way about sustainable development problems and having the knowledge and vision to recognize that interdisciplinary approaches are necessary to solve problems dictated by the innate complexity and interconnectedness of social, economic, and ecological systems.

Q5: How are the Literacy Elements operationalized?

A: The two broadly stated Literacy Elements are operationalized by a list of Knowledge Components. These Components will provide individuals with the “common language” or communication tools and general knowledge to facilitate interdisciplinary communication. They are the specific theories, concepts, issues, and terms that form the “common language” basis of understanding sustainable development. (See Appendix A for the Knowledge Components.)

Q6: Is this an attempt to delineate knowledge boundaries into a reductive agenda inconsistent with the complexity and interdisciplinary characteristics of sustainable development?

A: No. The professionals and academics for these Literacy Elements have a dominant role to play in creating more sustainable forms of economic development, environmental protection, and social equity. These
Elements are a first step towards improving sustainable-development outcomes by providing such individuals with a “common language of sustainability.” They are neither designed to abandon specialized technical knowledge, nor to place limits on knowledge. Rather, they provide a common language for sustainability professionals and academics to identify potential linkages, strategic collaborations, and understand the interrelationships between different sustainable strategies to create effective sustainable development and sustainable-development education.

Q7: **Are these Literacy Elements and the Knowledge Components intended to be more than a generalist’s introduction to sustainable development?**

A: No. Short of a PhD in sustainable development, there are few academic programs that would produce an “expert” or graduate in the subject. These Elements and Components are intended to introduce the knowledge that forms the basis for the sustainable-development professional and educator.

Q8: **Why are the proposed standards referred to as “Literacy Elements” rather than “standards”?**

A: Literacy Elements and their Knowledge Components are not formal “standards” with auditable requirements as in the International Organization for Standardization (ISO) 14000 family for environmental management. They are referred to as Elements/Knowledge because they are a model or example of what forms the basis of a “common language” for sustainable development professionals and academics as established by consensus.

Q9: **Do the Literacy Elements and their Knowledge Components comprise a curriculum?**

A: No. It is anticipated that educators and professional organizations would use the Literacy Elements and the Knowledge Components to develop their own curriculums and assessment techniques, as well as the other components of an overall curriculum plan. However, at the postgraduate level in a profession where learning is based on professional practice, individuals would construct their own version of the curriculum according to the dictates of specific projects or enterprises.

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**Appendix A**

**Knowledge Components**

The most common conceptual framework for sustainable development (SD) is the Three E model of Economic, Environment, and Social. This is also referred to as the Triple Bottom Line (or people, planet, profit).
We recognize that the Three E model will become dated. A more complete model than those previously existing has already been developed by Jabareen (2003) in: “A new conceptual framework for sustainable development.” However, for the time being, this model remains consistent with the predominant Three E conceptual framework, the existing language in most organizations, and our focus in this consensus document on built-environment professionals and educators.

The Knowledge Components are organized by first stating the conceptual framework (economic, environment, social), describing the heading(s) within the framework, followed by the relevant theories, concepts, issues, and terms.

Special Notes to Reviewers: This list can expand à la Malthus; however, the focus is on what is most applicable for sustainability professionals. If you make a suggestion for a new topic, please provide a web link or full citation to a relevant paper that is available online, a web-based lecture/presentation, or book.

1. **Economic:** This concept is organized under the headings of (a) integrative management and (b) eco-form.

   (a) **Integrative Management:** This concept represents SD’s view that social development, economic growth, and environmental protection are to be holistically integrated in order to achieve SD. The integrative approach argues that the responsibility for bringing about changes lies with governments in partnership with the private sector, educational institutions, in collaboration with national, regional and international organizations. In addition, national plans, goals and objectives, national rules, regulations and law, and the specific situations whereby different countries are placed are the overall framework in which such integration takes place.

   **Theories/Concepts/Issues/Terms**
   
   Holistic approach
   
   UN Commission on Sustainable Development and sustainable consumption
   
   World Business Council for Sustainable Development
   
   Agenda 21
German Best Available Technology legislation
Waves of innovation and the next industrial revolution; closed-loop manufacturing
Precautionary principle, definition, measures and legislation
Organization for Economic Cooperation and Development policy instruments
  Polluter pays principle
  Definition of pollution and polluter
  Recent court cases
  Extended producer responsibility
Khazzoom-Brooks postulate and the rebound effect
Role of education in SD
Role of professional education in SD
Principles to guide sustainability (e.g., do no harm)
Barriers to achieving sustainability (e.g., short-terminism)
How to measure growth
Abandoning the three “canonical principles” of micro-economic theory
Patterns of consumption
Integrative SD methods for business
  Equator Principles
Integrative SD methods for consumers
Integrative SD methods for government
SD and consumer motivation
Global Reporting Initiative
Competitive advantage via innovation
Integration of environmental concerns and development in planning and management
Integrating sustainability into corporate strategy
Economic instruments as incentives
Quotas, trades, offsets and banks
Reasons economic growth is consistent with sustainable development
Emerging business opportunities
Describing the sustainable organization
Examples of industry responses to climate change
Life cycle costing and performance
Environmental accounting systems
Systems of integrated environmental and economic accounting
Social Responsibility
Example of Interface Ltd as the first sustainable corporation
Cluster development
ISO 14000 and 14001
Independent certifying of products
Multi-stakeholder engagement
Integration of Building Information Modeling and ISIS method for SD projects

(b) **Eco-Form:** This concept represents the ecologically desired form and design of the human habitat such as urban spaces, buildings, and houses so as to enhance/achieve SD.

**Theories/Concepts/Issues/Terms**

- Land use
  - “RUrbanism” and Goa 2100 project
  - Mixed use development
  - Smart growth
  - Neotraditional development
  - Urban containment
  - Form-based codes
- Competing geometries
  - Fractal “geometry of nature”
  - Euclidean “marks of humanity”
- Water property rights and conservation
- Ecology
- Cultural heritage
- Buildings
  - Reasons/benefits for change
  - Barriers to change
  - Information, market and institutional failures affecting SD
  - Rating schemes
  - Retrofitting existing buildings
  - Net positive development
- Design
  - Whole system design
  - Elements of eco-development practice
  - Sustainable habitats/compact housing designs
  - Climate neutral buildings
  - Alternative building materials
  - Cradle-to-cradle/closed-loop system v. eco-efficiency
Biomimicry
User comfort and satisfaction
Form and space
Building Information Modeling (BIM)
Recycling and downcycling
Energy efficiency
Conservation
Eco-villages
Transportation
  Sustainable transport systems
  Integration of pedestrians and cyclists
  Implications of behavior and cultural practices
Access
  Air quality and micro-climate
_user comfort and satisfaction

2. **Environment:** This concept is organized under the headings of (a) natural capital stock and (b) ethical paradox.

(a) **Natural Capital Stock:** This concept represents the natural material assets of nature including the ecosystems that support life. Natural capital includes all natural assets: humans can modify it, and humans can enhance its reproduction, but it cannot be created by humans. Natural capital stock is usually divided into three categories: (1) non-renewable resources such as mineral resources; (2) the finite capacity of the natural system to produce “renewable resources” such as food crops and water supplies; and (3) ecosystems services, the capacity of natural systems to produce the essentials for life, including photosynthetic reactions, production of oxygen, cleansing of air and water, as well as nature’s ability to absorb and eliminate the emissions and pollutants that arise from human actions without suffering from side effects. This implies heavy costs will be passed on to future generations. A constant natural capital is frequently referred to as a criterion for sustainability where resource stock should be held constant over time to avoid threatening future generations’ opportunity to create wealth and well-being.

**Theories/Concepts/Issues/Terms**
Global environmental issues/declining ecosystems
Economic methods of environmental valuation
  GDP, cost-benefit analysis
  Revealed preference, stated preference and other methods (e.g., benefits transfer)
Human capital, cultivated capital, total capital
Environmental services
Natural limits
Ecological economics v. environmental economics
Strong/weak sustainability
Current geological epoch of Anthropocene (Crutzen)
Resource productivity improvements (e.g., Bioheap in mining)
Water
   World Commission on Dams Report (2000)
   Improving water efficiencies
Energy
   Hidden costs of externalities
   Methods to reduce greenhouse emissions
   Sustainable energy methods in urban development
Land utilization
Waste
   Physical methods and economic instruments for pollution control
GEO4 Report
UN Millennium Ecosystem Reports
IPCC Reports on Climate Change

(b) **Ethical Paradox:** This concept represents the perceived ethical paradox with the combining of the words “sustainable” and “development.” At one extreme, “sustainability” is defined as an ecological process or state than can be maintained indefinitely and is ethically based upon the “intrinsic right of nature.” At the other ethical extreme, “development” modifies the land and exhausts natural resources and is ethically supported by our right to “dominate nature.” Virtually all definitions of SD recognize a tension between the goals of environmental protection and economic development.

**Theories/Concepts/Issues/Terms**

Early Environmentalism: in the words of Henry David Thoreau, John Muir, and Aldo Leopold

Modern Environmentalism 1960s and 1970s: in the words of Rachel Carson, Kenneth E. Boulding, and Garrett Hardin

Sustainability in the words of Wendell Berry, David Brower, Amory Lovins, Wes Jackson, William Cronon, E.O. Wilson, Alan Durning, Paul Hawken, and Rebecca Solnit

Concepts of sustainability and SD

1. Carrying capacity
2. Cultural carrying capacity
3. Biological diversity
4. Ecological footprint
5. Fair share, overshoot
6. Decoupling economic growth from negative environmental pressure

7. Net positive development
   Bruntland Report (1987) and sustainable development
   Sustainable prosperity
   Common principles to achieve sustainable development

3. **Social:** This concept is organized under the two headings of (a) equity and (b) political global agenda.

   (a) **Equity:** This concept represents the social aspects of SD and the required balancing of social aspects with environmental and economic objectives in order to attain SD. It is believed that this social dimension is critical for SD since the unjust society is unlikely to be sustainable in the long term. A truly sustainable society is one in which wider social needs, equity, and economic opportunity are integrally related to environmental limits imposed by supporting ecosystems.

   **Theories/Concepts/Issues/Terms**
   The equity principle/Brundtland Commission
   Millennium Development Goals
   Intragenerational equity
   Intergenerational equity
   Weak sustainability and strong sustainability
   Environmental justice
   Societal–poverty, population growth, productivity gap, health and welfare, gender issues, indigenous peoples’ rights, social benefits and costs, employment and skills, competition effects, viability, social equity, quality of life, democracy, empowerment, public participation

   (b) **Political Global Agenda:** This concept represents the new global discourse that conceives the earth as one unified community with unique cultural subregions worthy of respect and preservation. It aims to address global environmental and development problems at their root causes. It also aims to provide the people of the developing world with the tools and resources needed to equalize opportunities and enable them to address pressing problems of deforestation, climate change and loss of biodiversity; this is in addition to issues basic to survival such as population growth, disease, poverty eradication, and changing consumption and production patterns.

   **Theories/Concepts/Issues/Terms**
   The International Bill of Human Rights (1993)
World Summit on Sustainable Development Plan of Implementation (2002)
Millennium Development Goals
Global commons
Johannesburg Declaration on Sustainable Development
Base of the pyramid (Prahalad and Hart)
Kyoto Protocol (2008)
OECD (1999) project of national systems of innovation
Agenda 21 whole society approach to sustainable development
Human rights principles
Participation principle
International law and environmental agreements
Government economic measures, actions and legislation
Key factors of SD (e.g., poverty, population, pollution)
Role of governments and new global agenda
Tragedy of the commons
Roles of self-regulation, private regulation and civil regulation
Principles of ecological economics
Ecological footprint
Economic growth vs. physical growth
Race to the bottom v. race to the top practices
North-south divide
Social Accountability Standard 8000
Microfinance institutions
Non-governmental organizations (NGOs)

Endnotes

1 The subject of this paper is being considered in Congress. On October 19, 2011, Senators Bennet (D-Colo.) and Isakson (R-Ga.) introduced the Sensible Accounting to Value Energy (“SAVE”) Act [S. 1737] to improve the accuracy of mortgage underwriting used by federal agencies by ensuring that energy costs are included in the underwriting and appraisal process. Although not likely to be adopted this election year, it indicates the growing need to include sustainability in appraisals.

2 Prum (2010) is an excellent source of the terms and definitions used to describe green buildings.

3 The Problem Identification section USPAP’s Scope of Work Rule is the source authority for these elements. See USPAP 2012–2013, p. U-13.

4 See the relevance of the Competency Rule for Fannie Mae appraisals in McCuen and Gransberg (2007).
For additional sources on a wide variety of green real estate topics (including financing), consult the outstanding Research Library and Links at the Green Building Finance Consortium at http://www.GreenBuildingFC.com.

A comprehensive explanation of the rating systems can be found in the chapter entitled “An Overview of Green Construction Rating Programs” in Feichtner et al. (2011). This book is intended for construction firms, however, is highly recommended for appraisers and other professionals involved in green construction.

Britell (2010) details terminology, real property law, liability, due process, government mandates and incentives, green building codes, zoning laws, tax credits.

Appraisers and other professionals involved in green buildings should consider the types of limitation of liability provisions to be included in their contracts (Prum and Del Percio, 2010–2011).

Substantive sections of this list have been modified from the 2009 RICS Valuation Information Paper by Ellison and Sayce (2006).

Significant growth in solar energy development has led to liability claims for shading a neighbor’s solar panels and damages for the panels reduced productivity. See Rule (2010).

For the valuation of properties with detrimental conditions, see Bell (2008).

Refer to http://en.wikipedia.org/wiki/Corporate_social_responsibility for an overview of CSR.

Recommended reading for appraisers is a comprehensive recent addition to the literature on green building regulatory structures, government requirements and incentives by Prum, Aalberts, and Del Percio (2012).

For example, Bay Area Air Quality Management District Reg. 3-334 (2009, p. 12) (adopted May 21, 2008) greenhouse gas emission fee and fees for “indirect sources” such as “development projects that generate or attract motor vehicle trips, and may also include other sources of emissions, such as fireplaces, home heating and cooling and landscape maintenance equipment, that indirectly cause air pollutant emissions and that can adversely affect local and regional air quality.”

For a basic introduction to this topic, see Circo (2009) and Kirokawa (2009).

Harrison and Seiler (2011, p. 63) found that the “political ideology of the local market area, may materially influence the market value of environmental amenities within industrial property markets.” They caution generalizing the results of green certification study results to new property types, market areas or time periods.

References


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A Market Evaluation of Colorado’s High-performance Commercial Buildings

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Abstract
Colorado’s real estate industry leaders remain skeptical about the financial benefits of high-performance commercial buildings. A survey and index were developed to understand the industry’s perspectives on public policies, programs, and market mechanisms. Additionally, a secondary data analysis was conducted to determine if these buildings command financial benefits for the industry. While national studies reveal financial benefits, the results from Colorado are parallel with the market perception: the financial benefits for high-performance commercial buildings in Colorado are unverifiable at this time, primarily due to limited data sets from existing programs and industry databases. Policy recommendations to improve data availability are included.

Human-induced climate change is largely accepted in the scientific community and is becoming more widely accepted throughout society (Ray and Pugliese, 2011). Trillions of dollars are expected to be spent mitigating the effects of climate change over the next several decades (Drummer, 2011). Because the built environment accounts for approximately 40% of greenhouse gases and energy consumption in the United States, retrofitting existing buildings to high-performance standards is increasingly accepted as one of the most effective and efficient financial solutions for mitigating climate change (Eichholtz, Kok, and Quigley, 2009).

At the national level and in major markets, the financial benefits for constructing and retrofitting commercial buildings to high-performance standards are realized. Several studies indicate a rental (3%–17%) and sales price (13%–26%) premium for Leadership in Energy and Environmental Design (LEED) and ENERGY STAR buildings (Eichholtz, Kok, and Quigley, 2009; Miller and Pogue, 2009; Wiley, Benefield, and Johnson, 2010; Fuerst and McAllister, 2011; Fuerst and McAllister, 2011). The combination of the market premiums and potential threat of national regulation has prompted the conventional real estate industry to respond by investing in sustainability within their organizations. For example, industry leaders, such as CBRE, Jones Lang LaSalle, ProLogis, and Cushman and Wakefield, are hiring sustainability experts, implementing sustainability programs, and joining organizations such as the Greenprint Foundation. However, many conventional real estate industry experts at the state and local levels remain skeptical and unconvinced that there are financial benefits for constructing and retrofitting commercial buildings to high-performance standards, often rejecting case studies from major markets or research conducted at a national scale.
Colorado is a national leader in high-performance commercial buildings. Colorado led all states with the most LEED-certified space per capita in 2011 (U.S. Green Building Council, 2012). The state ranks ninth in the nation for the number of LEED buildings per state and tenth for the number of LEED buildings as a percentage of total buildings (CoStar Group, 2011). While Colorado ranks highly in national green building statistics, how do prices, rents, and occupancy rates of high-performance commercial buildings compare to conventional buildings in Colorado? What are the perceptions of Colorado’s commercial real estate industry experts on the financial benefits of high-performance buildings? What additional data and/or policies would be needed for a state such as Colorado to prove the business case for high-performance buildings to its skeptical industry?

This paper is a first attempt to evaluate Colorado’s high-performance commercial building business case. We define high-performance commercial buildings as LEED certified and ENERGY STAR rated buildings. We present the results from a data analysis using CoStar, LEED, and ENERGY STAR data for Colorado. We also present results from a survey of Colorado’s commercial real estate industry experts about their perceptions of high-performance commercial buildings. Additionally, we describe the development and initiation of the first year of the Colorado High-Performance Commercial Building Index (Index). The Index is intended to track perceptions of supply and demand for Colorado’s high-performance commercial buildings over time.

Methodology

Colorado’s CoStar, LEED, and ENERGY STAR Data

We analyzed Colorado’s commercial buildings using data from the CoStar database. We developed hedonic OLS regression models, the common real estate research methodology for estimating determinants for rent and sales price, and evaluated occupancy (Fuerst, 2009). CoStar has the largest commercial real estate database, totaling approximately 3 million buildings nationally and including information on sales, leasing, tenants, and operating expenses (Florance, Miller, Spivey, and Peng, 2010. CoStar identifies 68,007 Colorado commercial buildings as of the summer of 2011. However, because of missing data in several fields, we reduced the sample size for these analyses. The sample size varied for each regression model. For example, 6,518 buildings were in the rent price regression model that included all building types, but only 1,305 office buildings were in the sales price regression model. Even though office buildings constitute the smallest percentage of the total commercial building stock, the majority of LEED and ENERGY STAR buildings are office buildings (Exhibits 1 and 2). Regression diagnostics are in the Appendix.

Definitions of Variables Used in Analysis

The regression models estimate the relationships certain attributes have with the response variable: Rent per square foot—The average weighted rent per square foot in a building.
Exhibit 1  |  Quantity and Type of LEED and ENERGY STAR and Non-LEED and ENERGY STAR Commercial Buildings in Colorado

Exhibit 2  |  Regression Data Sample Size

<table>
<thead>
<tr>
<th>Total Commercial Buildings</th>
<th>LEED</th>
<th>ENERGY STAR</th>
<th>Both</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>68,007</td>
<td>309</td>
<td>167</td>
</tr>
<tr>
<td>Rent Price: All Building Types</td>
<td>6,518</td>
<td>81</td>
<td>167</td>
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<td>Sale Price: All Building Types</td>
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<td>128</td>
</tr>
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<td>Rent Price: Office</td>
<td>2,574</td>
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<td>163</td>
</tr>
<tr>
<td>Sale Price: Office</td>
<td>1,304</td>
<td>45</td>
<td>125</td>
</tr>
<tr>
<td>Rent Price: Industrial</td>
<td>1,801</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Rent Price: Retail</td>
<td>2,144</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

The explanatory variables used in the various models were selected because they were available, logical, statistically significant, and exhibited little collinearity. These explanatory variables include three continuous variables. Percent Leased is the percentage of the building that is leased; Rentable Building Area (thousand square feet) is the square footage of rentable space in the building, in thousands; and Year Built is the year in which the building was built.

The explanatory variables used in the models also include several categorical attributes. Binary (or dummy) variables indicate the absence or presence of the attribute. When an attribute has more than two categories, a base case is represented by the other binary variables each having a value of zero. LEED equals 1 if the property is a LEED-certified building. Developed by the U.S. Green Building Council (USGBC), LEED verifies that a building has met certain high-
performance criteria. ENERGY STAR equals 1 if the property is an ENERGY STAR-rated building. Developed by the U.S. Environmental Protection Agency (EPA), an ENERGY STAR rating means that a building has met certain high-performance criteria. Industrial is a category of building type; this variable equals 1 if the property is an industrial building. Retail is a category of building type; this variable equals 1 if the property is a retail building. Office is a category of building type; this variable equals 1 if the property is an office building. Mountain Resort is a category of geographic location; this variable equals 1 if the building is located in one of the following counties: Clear Creek, Eagle, Grand, Gunnison, Lake, Pitkin, San Miguel, or Summit. Colorado Springs is a category of geographic location; this variable equals 1 if the building is located in one of the following counties: El Paso, Pueblo, or Teller. Northern Colorado is a category of geographic location; this variable equals 1 if the building is located in either Larimer County or Weld County. Non-metro/Rural is a category of geographic location; this variable equals 1 if the building is located in one of the following counties: Alamosa, Archuleta, Chaffee, Cheyenne, Custer, Delta, Elbert, Fremont, Garfield, Huerfano, Kit Carson, La Plata, Las Animas, Lincoln, Logan, Moffat, Montezuma, Montrose, Morgan, Otero, Ouray, Park, Prowers, Rio Blanco, Rio Grande, or Routt. Mesa County is a category of geographic location; this variable equals 1 if the building is located in Mesa County. Denver MSA is a category of geographic location; this variable equals 1 if the building is located in one of the following counties: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, or Jefferson. Building Class A is a category of building class classified by the Building Owners and Managers Association (BOMA) International; Class A office buildings are “Most prestigious buildings competing for premier office users with rents above average for the area. Buildings have high quality standard finishes, state of the art systems, exceptional accessibility and a definite market presence.” Building Class B is a category of building class classified by BOMA International; Class B office buildings are “Buildings competing for a wide range of users with rents in the average range for the area. Building finishes are fair to good for the area. Building finishes are fair to good for the area and systems are adequate, but the building does not compete with Class A at the same price.” Building Class C is a category of building class classified BOMA; Class C office buildings are “Buildings competing for tenants requiring functional space at rents below the average for the area.”

**Survey and Colorado High-performance Commercial Building Index**

We developed a survey to capture the opinions of commercial real estate industry experts, including developers, financiers, investors, designers, and government staff, to understand their perceptions of Colorado’s high-performance commercial building industry (Exhibit 3). We identified these experts through key organizations such as the Urban Land Institute, the University of Colorado Real Estate Center, the Colorado Governor’s Energy Office, the U.S. Green Building
Exhibit 3 | Survey Participant Occupations

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Provider</td>
<td>22.9%</td>
</tr>
<tr>
<td>Architect/Designer</td>
<td>10.5%</td>
</tr>
<tr>
<td>Financier/Lender/Banker</td>
<td>6.5%</td>
</tr>
<tr>
<td>Consultant</td>
<td>17.0%</td>
</tr>
<tr>
<td>Government</td>
<td>6.5%</td>
</tr>
<tr>
<td>Developer</td>
<td>9.2%</td>
</tr>
<tr>
<td>Investor</td>
<td>5.2%</td>
</tr>
<tr>
<td>Lobbyist/Activist</td>
<td>0.0%</td>
</tr>
<tr>
<td>Investor/Owner/Owner’s Representative</td>
<td>18.3%</td>
</tr>
<tr>
<td>Other</td>
<td>3.9%</td>
</tr>
<tr>
<td>Total</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Council’s Colorado Commercial Real Estate Initiative, the Appraisal Institute, the Southwest Energy Efficiency Project, and the Commercial Real Estate Development Association (NAIOP) that agreed to take the survey. Survey questions explored factors that influence and inhibit the construction and retrofits of commercial buildings to high-performance standards. Additionally, we developed the Colorado High-performance Commercial Building Index (Index), which is intended to be an annual survey to quantify expectations for supply and demand for high-performance commercial building space each year. The survey asked owners/managers six qualitative questions about their perception of the high-performance property market for the current quarter (e.g., sales potential, likelihood of tax credits, tenant demand, public perception, etc.). Results were presented in values between 0 and 100 (0, pessimistic; 50, neutral; and 100, optimistic).

The target audience was identified from mailing lists provided by the Colorado Governor’s Energy Office, University of Colorado Real Estate Center, Colorado Commercial Real Estate Development Association, appraisers, as well as social media sources, such as a web survey, Facebook, Twitter, and LinkedIn. A total of 378 experts in high-performance buildings in Colorado were identified who agreed to participate in the Colorado High-performance Commercial Building Market Survey, which would then be used to develop an index. Of the 378 experts who agreed to take the survey, 202 completed the survey (a 53.4% response rate).

Market survey questions were developed by the research team, and eight experts tested the survey instrument, including the Colorado Governor’s Energy Office staff. The length of the survey was intentionally short to generate a high response rate and be replicable over time.
Results and Discussion

CoStar, LEED, and ENERGY STAR Data Analysis

We analyzed sales price, rent, and occupancy for all building types in Colorado. A hedonic OLS regression model was developed that explains 33.8% of rent variability (Exhibit 4). While the model is significant, it explains relatively less variation than similar studies at a national scale (Eichholtz, Kok, and Quigley, 2009; Miller and Pogue, 2009). The model suggests LEED-certified buildings attract $3.54 higher rent per square foot than conventional buildings. Likewise, ENERGY STAR-rated buildings tend to have $2.87 per square foot higher rents than conventional buildings. The regression model developed for sales prices for all building types explained only 10% of the variance. There were no significant
### Exhibit 5 | Rent per Square Foot for Office Buildings

<table>
<thead>
<tr>
<th>Coeff.</th>
<th>Std. Err.</th>
<th>t-Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>43.773</td>
<td>7.071</td>
<td>6.190</td>
<td>0.000</td>
<td>29.907</td>
</tr>
<tr>
<td>LEED</td>
<td>1.182</td>
<td>0.566</td>
<td>2.088</td>
<td>0.037</td>
<td>0.072</td>
</tr>
<tr>
<td>ENERGY STAR</td>
<td>0.951</td>
<td>0.423</td>
<td>2.248</td>
<td>0.025</td>
<td>0.121</td>
</tr>
<tr>
<td>Building Class A&lt;sup&gt;a&lt;/sup&gt;</td>
<td>5.318</td>
<td>0.418</td>
<td>12.724</td>
<td>0.000</td>
<td>4.498</td>
</tr>
<tr>
<td>Building Class B&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2.148</td>
<td>0.209</td>
<td>10.270</td>
<td>0.000</td>
<td>1.737</td>
</tr>
<tr>
<td>Percentage Leased</td>
<td>0.016</td>
<td>0.003</td>
<td>5.734</td>
<td>0.000</td>
<td>0.011</td>
</tr>
<tr>
<td>Rentable Building Area&lt;sup&gt;b&lt;/sup&gt;</td>
<td>0.006</td>
<td>0.001</td>
<td>4.648</td>
<td>0.000</td>
<td>0.004</td>
</tr>
<tr>
<td>Year Built</td>
<td>-0.016</td>
<td>0.004</td>
<td>-4.457</td>
<td>0.000</td>
<td>-0.023</td>
</tr>
<tr>
<td>Mountain Resort</td>
<td>4.687</td>
<td>0.928</td>
<td>5.048</td>
<td>0.000</td>
<td>2.866</td>
</tr>
<tr>
<td>Colorado Springs</td>
<td>-3.406</td>
<td>0.219</td>
<td>-15.519</td>
<td>0.000</td>
<td>-3.836</td>
</tr>
<tr>
<td>Northern Colorado</td>
<td>-2.510</td>
<td>0.259</td>
<td>-9.680</td>
<td>0.000</td>
<td>-3.018</td>
</tr>
<tr>
<td>Non-metro/Rural</td>
<td>-2.257</td>
<td>0.726</td>
<td>-3.110</td>
<td>0.02</td>
<td>-3.681</td>
</tr>
<tr>
<td>Mesa County&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-2.261</td>
<td>0.713</td>
<td>-3.170</td>
<td>0.002</td>
<td>-3.660</td>
</tr>
<tr>
<td>Multiple R</td>
<td>0.541</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R²</td>
<td>0.293</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adj. R²</td>
<td>0.290</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Std. Err.</td>
<td>4.111</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: The number of observations is 2,574. For the regression, df = 12, SS = 17,924, MS = 1,494, F = 88, Significant F = 0.000. For residential, df = 2,561, SS = 43,278, MS = 17. For the total, df = 2,573, SS = 61,203.

<sup>a</sup>Base case Office
<sup>b</sup>Thousand square feet
<sup>c</sup>Base case Denver MSA

Differences of occupancy rates among LEED (87.09%), ENERGY STAR (88.50%), and conventional buildings (87.63%).

**Office.** Even though office buildings constitute the smallest percentage of the total commercial building stock (Exhibit 2), the majority of LEED and ENERGY STAR buildings are office buildings, which is similar to national trends (Fuerst and McAllister, 2009). The sample size for rent prices was 2,574 total buildings, 234 of which are LEED and ENERGY STAR (Exhibit 5). The sample size for sales prices was 1,305, of which 170 are LEED and ENERGY STAR buildings. Results from the CoStar analysis indicate that 74% of LEED and ENERGY STAR buildings are office buildings; 40% of LEED and ENERGY STAR buildings are Class A office buildings.

A regression model was developed that explains 29.3% of the variance of office rent prices per square foot (Exhibit 5). Building class was a strong predictor of
rent prices. Class A buildings had $5.32 higher rents per square foot than Class C buildings. LEED buildings had $1.18 higher rents per square foot, while ENERGY STAR buildings had $0.95 higher rents per square foot.

**Retail.** Most LEED and ENERGY STAR buildings in Colorado are offices, not retail or industrial. We were not able to develop a regression model for retail that explained more than 11% of the variation in rent price. The sample size for rent prices was 2,144 total buildings, 12 of which are LEED and ENERGY STAR (Exhibit 2).

**Industrial.** While there are almost 20,000 industrial buildings in Colorado, the sample size for rent prices was only 1,802 total buildings, two of which are ENERGY STAR. No LEED industrial buildings were identified. A regression model was developed that explained more than 35% of the variation in rent price and a $4.81 per square foot premium for ENERGY STAR buildings (Exhibit 6).

**Discussion.** All of the regression models for high-performance commercial buildings had low samples sizes, which is one possible explanation for the weak models. Even though Colorado has approximately 70,000 commercial buildings, we had a complete dataset of only 10% for sales price and 4% for rent of the building stock. Additionally, less than 1% of Colorado’s commercial building stock is LEED certified or ENERGY STAR rated. Hence, evaluating Colorado’s high-performance commercial building business case is difficult at this time because of the small number of LEED and ENERGY STAR buildings; lack of available sales, rent, and performance data for the entire building stock; and the inability to identify high-performance commercial buildings that are not LEED or ENERGY STAR certified. The decision to construct or retrofit to high-performance standards without seeking certification or a rating is becoming more popular. Instead, many of these building owners are choosing to participate in voluntary local energy- and water-reduction programs like Watts-to-Water, ResourceSmart, or Boulder’s Ten for Change (NAIOP Colorado Chapter, 2010; Watts to Water, 2012; 10 for Change, 2012).

Trends for office buildings at a state level are similar to those at a national level. Building type and class were highly correlated to the certification or rating of a building. CoStar defines Class A office buildings as “an extremely desirable investment-grade property...with above average rental rates and in an excellent location with exceptional accessibility” (CoStar Group, 1997–2010). Therefore, it is not surprising that most of the LEED and ENERGY STAR buildings are located along major metropolitan corridors, particularly along Interstate 25 that runs north to south in Colorado (Exhibit 6).

Retail trends in Colorado also followed national trends. The fact that the retail sector includes approximately 25% of the total LEED and ENERGY STAR buildings in Colorado is not surprising. As is the case nationally, consumer-driven demand for high-performance commercial buildings in the retail sector is not a great as tenant-driven demand in office buildings. Yedelson (2007) presents cost as the foremost challenge to greening the retail sector. Even though the retail sector is typically a late adopter, Colorado does have a few hallmark green retail
### Exhibit 6 | Rent per Square Foot for Industrial and All Buildings

<table>
<thead>
<tr>
<th>Coeff.</th>
<th>Std. Err.</th>
<th>t-Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A: Industrial buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>$-47.788$</td>
<td>$8.311$</td>
<td>$-5.750$</td>
<td>$0.000$</td>
<td>$-64.088$</td>
</tr>
<tr>
<td>ENERGY STAR</td>
<td>$4.815$</td>
<td>$1.936$</td>
<td>$2.487$</td>
<td>$0.013$</td>
<td>$1.018$</td>
</tr>
<tr>
<td>Building Class A or B&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$0.322$</td>
<td>$0.144$</td>
<td>$2.243$</td>
<td>$0.025$</td>
<td>$0.040$</td>
</tr>
<tr>
<td>Percentage Leased</td>
<td>$0.007$</td>
<td>$0.002$</td>
<td>$3.649$</td>
<td>$0.000$</td>
<td>$0.003$</td>
</tr>
<tr>
<td>Rentable Building Area&lt;sup&gt;b&lt;/sup&gt;</td>
<td>$-0.014$</td>
<td>$0.001$</td>
<td>$-11.064$</td>
<td>$0.000$</td>
<td>$-0.017$</td>
</tr>
<tr>
<td>Year Built</td>
<td>$0.028$</td>
<td>$0.004$</td>
<td>$6.593$</td>
<td>$0.000$</td>
<td>$0.019$</td>
</tr>
<tr>
<td>Mountain Resort</td>
<td>$4.000$</td>
<td>$0.829$</td>
<td>$4.826$</td>
<td>$0.000$</td>
<td>$2.374$</td>
</tr>
<tr>
<td>Colorado Springs</td>
<td>$-0.863$</td>
<td>$0.183$</td>
<td>$-4.716$</td>
<td>$0.000$</td>
<td>$-1.221$</td>
</tr>
<tr>
<td>Northern Colorado</td>
<td>$-0.676$</td>
<td>$0.201$</td>
<td>$-3.360$</td>
<td>$0.001$</td>
<td>$-1.070$</td>
</tr>
<tr>
<td>Non-metro / Rural</td>
<td>$-1.445$</td>
<td>$0.544$</td>
<td>$-2.657$</td>
<td>$0.008$</td>
<td>$-2.512$</td>
</tr>
<tr>
<td>Multiple R</td>
<td>$0.355$</td>
<td>$-0.126$</td>
<td>$0.122$</td>
<td>$2.733$</td>
<td></td>
</tr>
</tbody>
</table>
**Exhibit 6**  (continued)

Rent per Square Foot for Industrial and All Buildings

<table>
<thead>
<tr>
<th>Coeff.</th>
<th>Std. Err.</th>
<th>t-Stat</th>
<th>P-value</th>
<th>Lower 95%</th>
<th>Upper 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Panel B: All buildings</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-21,988,272</td>
<td>4,828,363</td>
<td>-4.554</td>
<td>0.000</td>
<td>-31,455,735</td>
</tr>
<tr>
<td>LEED</td>
<td>-116,232,937</td>
<td>38,251,606</td>
<td>-3.039</td>
<td>0.002</td>
<td>-191,236,761</td>
</tr>
<tr>
<td>ENERGY STAR</td>
<td>123,844,601</td>
<td>24,677,581</td>
<td>5.019</td>
<td>0.000</td>
<td>75,456,753</td>
</tr>
<tr>
<td>Rentable Building Area</td>
<td>831,377</td>
<td>63,642</td>
<td>13.063</td>
<td>0.000</td>
<td>706,588</td>
</tr>
</tbody>
</table>

| Multiple R     | 0.326 |        |         |           |           |
| R²             | 0.106 |        |         |           |           |
| Adj. R²        | 0.105 |        |         |           |           |
| Std. Err.      | 216,390,134 |     |        |           |           |

Notes: For Panel A, the number of observations is 1,801. For the regression, df = 9, SS = 1,929, MS = 214, F = 29, Significant F = 0.000. For residential, df = 1,791, SS = 13,382, MS = 7. For the total, df = 1,800, SS = 15,311. For Panel B, the number of observations is 2,836. For the regression, df = 3, SS = 1.6E+19, MS = 5.2E+18, F = 112, Significant F = 0.000. For residential, df = 2,832, SS = 1.3E+20, MS = 4.7E+16. For the total, df = 2,835, SS = 1.5E+20.

a Base case Building Class C
b Thousand square feet
c Base case Denver MSA or Mesa County
establishments, such as Northfield in Stapleton, a suburb of east Denver that was formerly the site of Denver’s Stapleton Airport (Forest City, n.d).

With the exception of companies such as ProLogis that embrace third-party certification systems and pursue tenants with strong brands such as BMW, most industrial building owners do not see value for these certifications. Because consumer demand for high-performance commercial buildings is also low in the industrial sector, less than 1% of the industrial buildings in Colorado are Class A and only 12 are ENERGY STAR rated; therefore, with a few exceptions, industrial owners are not electing to endorse these programs at this time because of low demand and additional costs. However, this sector may be more likely to participate in programs that address operations than building construction programs since building construction is a minor part of the total energy consumption (Kolwey, 2012). Currently, the Colorado Industrial Energy Challenge (CIEC), a voluntary program designed to help industrial facilities reduce their energy consumption through improved efficiency, has a higher number of industrial building owner participants than there are third-party certified industrial buildings. There are 24 participants in CIEC and only 12 LEED and ENERGY STAR industrial buildings (Southwest Energy Efficiency Project, 2011).

**Colorado Commercial High-Performance Building Survey and Index**

In the survey results, we focus on the two most and least important factors that the Colorado commercial real estate industry experts identified for each question.

**Rent and Sales Price**

Respondents believe that the strongest factors influencing whether to construct or retrofit buildings to high-performance standards are price and rents (Exhibit 7). Evidence supports the idea that Colorado’s LEED buildings attract a premium. However, whether the Colorado commercial real estate community believes that high-performance commercial buildings attract a premium is still in question. For example in 2011, a 500,000-square foot office tower was built and sold in Denver for a record price estimated at $430 per square foot or $213 million (Jackson, 2011). However, there is debate as to why the building attracted a premium price. “Invesco is buying a solid income stream,” said Mary Sullivan, one the most influential investment brokers in Denver. “It’s nice to have the bells and whistles of the LEED certification, but the driving force was the income stream.” Hence, even though a LEED Platinum building attracted a premium, one of the leading industry experts was not convinced that the premium was attributed to the LEED certification.

**Operating Costs**

Respondents indicate that operating costs are the second-most important factor influencing the decision to construct or retrofit commercial buildings to high-performance standards. Additionally, in 2011, the University of Colorado conducted a Market Research Pilot Survey to identify key topics for the Index
When the respondents were asked how they distinguished between high-performance and conventional commercial buildings, they identified the operating costs of the building first and third-party certification second.

Nationally, the little available research on operating costs is conflicting. While some research studies show significant savings, others indicate minimal, if any, savings. For example, a study that evaluated the post-occupancy data of 22 high-performance General Service Administration buildings reveals that average aggregate operating costs for water utilities, energy utilities, general maintenance, grounds maintenance, waste, recycling, and janitorial costs were 19% lower than comparable buildings (Fowler, Rauch, Henderson, and Kora, 2011). In contrast, Miller and Pogue (2009) reported that in some cases, the savings from green buildings are counterbalanced by increased costs. For instance, in this study, green buildings had lower energy costs, yet higher operating costs in areas such as maintenance and recycling. Additionally, factors such as climate, building orientation, installation methods, and building management greatly influence the overall energy costs. Nevertheless, all things being equal, we would expect high-performance commercial buildings to better compete with conventional
commercial buildings in the future if energy costs rise and the price of carbon is internalized into the operational costs.

The commercial real estate industry in Colorado appears convinced that operation costs are a pivotal factor influencing whether or not they will decide to construct or retrofit to high-performance standards. We do not have enough detailed operations data at this time from key buildings in Colorado to develop transparent in-depth pro forma level case studies to evaluate how high-performance commercial buildings compare to conventional commercial buildings. Even if the high-performance commercial buildings in Colorado did have lower overall operating costs compared to conventional commercial buildings, it would be difficult to convince the commercial real estate industry until we developed several transparent in-depth case studies through voluntary efforts and/or required mandatory disclosure through regulation.

**Regulation**

Respondents ranked regulation sixth out of seven factors that influence high-performance commercial building construction and retrofits (Exhibit 7). Commercial green building regulation in Colorado includes LEED and/or high-performance building requirements for state buildings and any buildings that receive 25% or more in public funds (U.S. Green Building Council, 2011; State of Colorado, 2012). Aside from public buildings, most local requirements are for residential instead of commercial buildings. Cities and counties that have residential programs include Boulder, Telluride, Summit County, and Aspen. The lack of widespread regulation for high-performance commercial buildings could be a reason that respondents ranked regulation as less important. However, numerous jurisdictions within Colorado are considering adopting the International Green Construction Code (IGCC). Fort Collins recently adopted a mandatory commercial green building code, based in part on the IGCC (City of Fort Collins, 2012). Denver is reviewing the IGCC for adoption as a voluntary code (Bosco, 2011). Longmont is reviewing the IGCC for adoption (City of Longmont, 2011).

After this new commercial green building code is more widely adopted, we would expect Colorado’s real estate industry experts to revise their response for regulation to be a key factor that influences high-performance building construction. However, this may not be the case since regulation by definition targets minimum standards for building construction and therefore might not be thought of as high performance. On the other hand, minimum standards over time are increasingly reaching higher standards. For example, energy codes gained 30% more efficiency from 2006 to 2012. Now the launch of the first IGCC in 2012 is driving high-performance commercial buildings as the minimum standard for any state or jurisdiction that adopts the new green building code. If Colorado’s real estate community does not recognize regulation as a driving factor for green building after the IGCC or other similar codes are widely adopted, this could indicate that philosophically a minimum building code does not translate into high-performance commercial buildings, regardless of its level of efficiency.
**Productivity**

Respondents ranked productivity as the least influential factor regarding whether or not a building is constructed or retrofitted to high-performance standards. Price and rent premiums, operating costs, vacancy rates, tax incentives, regulation, and absorption were all ranked higher (Exhibit 7). As most of the research points out, productivity, especially in an office environment, is a difficult variable to measure. Miller and Pogue (2009, p. 7) outline the commonly-measured variables in current research on productivity studies as “absenteeism, hours worked, tardiness, safety rule violations, number of grievances filed, and employee turnover,” but comment that “there are many examples where workers are not efficient and hours worked [do] not equate to productivity.” Regardless, they used similar variables, sick days and self-reported productivity percentage change after moving offices, to show that: (1) 54.5% of respondents agree or strongly agree that they are more productive; (2) respondents’ productivity increased on average 4.88%; (3) 45% of respondents agree that they are taking few sick days; and (4) sick days decreased on average to 2.88 days/year. Their results agree with similar research conducted in Australia (Dunckley, 2007) and by others (e.g., Wyon, 2004).

While overall respondents ranked productivity last as a factor to construct or retrofit to high-performance standards, they do acknowledge that evidence that supports increased productivity would be compelling in that a 1% increase in annual productivity over several hundred employees within a building would generate substantial savings. The challenge is similar to operating costs. Until we develop several transparent in-depth case studies through voluntary efforts and/or required mandatory disclosure through regulation that evaluates the productivity locally, the Colorado commercial real estate industry is likely to remain skeptical.

**Tax Incentives**

Tax incentives have been offered by the federal government since 2006 in the amount of $0.30–$1.80 per square foot for new commercial and existing construction, depending on technology and the amount of energy reduction (DSIRE, 2012a). Still, respondents ranked tax credits four out of seven as a factor that influences whether a building is constructed or retrofitted to high-performance standards (Exhibit 7). Another question asked what incentives would most encourage constructing or retrofitting to high-performance standards. Respondents chose tax credits and abatements as the primary mechanism (Exhibit 8). This disparity between factors that influence current and past construction and retrofits, and factors that could influence future construction and retrofits of commercial building to high-performance standards begs the question, is there a problem with the existing tax incentive program? Is it too restrictive by requiring a 50% energy reduction from baseline buildings? Is it an appropriate incentive amount? The Department of Energy is currently working with Congress to redesign the tax incentive program (Department of Energy, 2012). Further research could provide insight to these questions.

In comparison to the federal tax incentive that offers $0.30–$1.80 per square foot, New Mexico’s legislature passed the Sustainable Building Tax Credit in 2009,
offering $3.50 per square foot for buildings that achieve LEED Silver certification to $6.25 per square foot for buildings that achieve LEED Platinum certification (DSIRE, 2012b). The federal tax incentives might not be enough to entice Colorado’s commercial real estate industry to construct or retrofit to high-performance standards, and Colorado does not offer an additional state tax credit similar to that offered by New Mexico.

**Technical and Marketing Assistance**

In addition to the stormwater utility fee, respondents also ranked marketing and technical assistance as the least likely factors that would encourage them to construct or build to high-performance standards. A gap may exist between the marketing and technical assistance that is currently provided by the Colorado state government and largest utility and the assistance that would be welcomed by the Colorado commercial real estate industry.

Both the Colorado Governor’s Energy Office (GEO) and Colorado’s major utility, Xcel Energy, offer technical assistance programs. Moreover, Xcel also offers a marketing assistance program. The utility offers a specialized technical assistance program called the Commercial Real Estate Program for owners of commercial buildings that are 50,000-square feet or more (Xcel Energy, 2012a). Clients are provided with cost and energy savings estimates from upgrades and details on how to best run the building’s mechanical systems. Xcel also offers new construction and retrofit design assistance programs, a marketing program for builders, and a builder’s hotline (Xcel Energy, 2012b). As an example, the historic Oxford Hotel in downtown Denver benefited from $34,000 in rebates and decreased its energy usage by 47% (Xcel Energy, 2012c). The GEO also offers technical assistance, including energy savings calculators and new construction and retrofit resources. Why the survey does not reflect these successes is unknown. Additional research would be required to better understand this response.

**Cost and Complexity**

The respondents ranked cost as the leading reason commercial buildings are not built or retrofitted to high-performance standards (Exhibit 9). Evidence is available
Exhibit 9 | Effective Factors to Influence Growth of High-performance Buildings

<table>
<thead>
<tr>
<th>Important Incentives</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tax Credits and Abatements</td>
<td>1</td>
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<tr>
<td>Grants</td>
<td>2</td>
</tr>
<tr>
<td>Density and Height Bonuses</td>
<td>3</td>
</tr>
<tr>
<td>Permit Fee Reduction / Waiver</td>
<td>4</td>
</tr>
<tr>
<td>Expedited Review / Permitting Processes</td>
<td>5</td>
</tr>
<tr>
<td>Impact Fees</td>
<td>6</td>
</tr>
<tr>
<td>Revolving Loan Programs</td>
<td>7</td>
</tr>
<tr>
<td>Occupancy Taxes</td>
<td>8</td>
</tr>
<tr>
<td>Technical Assistance</td>
<td>9</td>
</tr>
<tr>
<td>Marketing Assistance</td>
<td>10</td>
</tr>
<tr>
<td>Stormwater Utility Fee</td>
<td>11</td>
</tr>
</tbody>
</table>

at a state level that has evaluated construction costs of LEED buildings compared to conventional buildings. Mapp, Nobe, and Dunbar (2011) analyzed the building costs, square footage costs, soft costs, and hard costs of LEED certified and non-LEED certified banks in western Colorado. They determined that the costs of construction were similar to one another and that the actual cost of LEED certification was estimated to be between 1.5% and 2% of total building costs.

Respondents self-interpreted and ranked complexity as the second leading factor inhibiting building and retrofits, which could include navigating regulation and incentives for each state and jurisdiction, evaluating emerging technologies, or projecting price premiums and costs. Two leading inhibitors, cost and complexity, suggest that education and information dissemination efforts should focus on the comparable cost and simplicity of high-performance commercial building standards compared to buildings with minimum standards.

**Expertise and Certification**

Expertise and certification were ranked as the lowest factors inhibiting the construction and retrofit of buildings to high-performance standards. With approximately 830 USGBC Colorado Chapter members as of 2011, the state is well-equipped with green building expertise (U.S. Green Building Council Colorado Chapter, 2012).

Evaluating the business case for high-performance commercial buildings depends on being able to distinguish between high-performance and conventional buildings. However distinguishing between high-performance and conventional buildings is becoming more challenging. For this evaluation, we could only distinguish between LEED and ENERGY STAR buildings and noncertified
buildings. Distinguishing between buildings that have low water and energy usage and those that have high water and energy usage would be ideal and is not possible at this time. Furthermore, using LEED and ENERGY STAR as a proxy for high-performance commercial buildings is problematic, since buildings are being constructed and retrofitted to “All But Certified” (ABC) standards and are not seeking certification. The term ABC is used to describe a high-performance building that may have been built to LEED, ENERGY STAR, or other high-performance standards but ultimately were not certified or rated. It is uncertain how many buildings are ABC since there is no national performance data-tracking system aside from those within established programs. While Colorado has a significant level of expertise, we must do a better job classifying high-performance commercial buildings by factors such as energy and water usage versus just their certification or rating.

**High-performance Commercial Building Index**

The survey asked Colorado’s commercial real estate industry about its expectations of the changes in demand and supply to lease, purchase, and construct high-performance commercial buildings from 2011 to 2012. Results show that the supply of leasable high-performance commercial building space because of new construction had an Index value of 54.6, meaning that the real estate industry expects very little change in the supply of these buildings from 2011 to 2012 (Exhibit 10). Comparatively, the demand for leasable high-performance commercial building space had an Index value of 68.3 (Exhibit 11). This indicates that the community expects that the availability and new construction of high-performance buildings is unlikely to change but the demand for leasable space is expected to increase moderately. Higher demand for leasable high-performance commercial building space could spur growth in the retrofit market for existing leasable space.

Similarly, the availability of purchasable high-performance commercial buildings space had an Index value of 51.8, meaning that the real estate community expects very little change from 2011 to 2012. However, the Index value is 65.4 for the demand of purchasable high-performance commercial buildings. Again, the
Exhibit 11 | Perception of Supply of High-performance Buildings

<table>
<thead>
<tr>
<th>Metric</th>
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<tbody>
<tr>
<td>Availability of High-performance Commercial Buildings to Lease because of new construction.</td>
</tr>
<tr>
<td>Availability of High-performance Commercial Buildings to Lease because of increased vacancy.</td>
</tr>
<tr>
<td>Availability of High-performance Commercial Buildings to Purchase because of new construction.</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index Value</th>
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<tr>
<td>54.6</td>
</tr>
<tr>
<td>51.8</td>
</tr>
<tr>
<td>51.8</td>
</tr>
<tr>
<td><strong>52.7</strong></td>
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</table>

Exhibit 12 | Perception of Demand for High-performance Buildings

<table>
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<td>Demand for High-performance Commercial Buildings to Purchase</td>
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<tr>
<td>Demand for High-performance Commercial Buildings to Build</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Index Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>68.3</td>
</tr>
<tr>
<td>65.4</td>
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<tr>
<td>57.7</td>
</tr>
<tr>
<td><strong>63.8</strong></td>
</tr>
</tbody>
</table>

demand for high-performance buildings is expected to outweigh the availability of such buildings, potentially leading to an increase in high-performance commercial building construction.

Policy Recommendations

Remove Regulatory Barriers to Allow Performance Data Disclosure

We had very little performance data available to evaluate the business case for high-performance commercial buildings. The lack of transparency pertaining to operating costs, productivity, and actual building performance makes evaluating the business case difficult, which results in significant skepticism among conventional building owners about whether or not high-performance buildings result in a financial benefit. Improving transparency is possible. The Northeast Energy Efficiency Partnership developed a roadmap for a disclosure policy in the northeastern United States (Northeast Energy Efficiency Partnership, 2009). This type of regional document could lay a framework for Colorado. It could also enhance the state’s reputation as a leader in disclosure, similar to its role in greening the residential Multiple Listing Services (U.S. Green Building Council, 2012). Additionally, voluntary programs, such as the Environmental Protection Agency’s Portfolio Manager could work to make their data publically available. Until data becomes available through either mandatory disclosure laws or
voluntary mechanisms, developing a financial case for high-performance buildings will be limited to case studies, which will be minimally effective in convincing Colorado’s commercial real estate industry of the value of high-performance commercial buildings.

**Adopt the Most Recent Codes and Standards**

Adoption of the most recent building codes would raise the minimum standards of building performance and possibly, availability of performance data. Both the new International Green Construction Code Public Version 2.0 (IGCC PV2) (International Code Council, 2012a) and the 2012 International Energy Conservation Code (International Code Council (2012b) will require the commissioning of mechanical systems and lighting. The IGCC PV2 requires a comparison of energy usage and demand patterns for 12 months before and after alterations (International Code Council, 2012a). Also, the new outcome-based compliance method is dependent on post-occupancy data. In addition, the IGCC requires that tenants have access to their utility data unlike in the past (International Code Council, 2012b). All of these new additions to codes and standards will make performance data more transparent, at least to the building owners and code officials. Therefore, new code adoption would both raise standards of commercial buildings and could provide a source of critical data.

**Support a National Labeling Program for Buildings**

The transparency and availability of performance data could be improved as national labeling programs (e.g., miles per gallons type rating program) for buildings are supported. In addition to the LEED and ENERGY STAR programs, several additional programs, such as ASHRAE’S Building Energy Quotient have been developed and just needs to be implemented (ASHRAE, 2012). Such programs provide both private and public sectors with the necessary information to make efficient and effective long-term investments in the built environment.

**Conclusion**

State and local conventional real estate industry experts remain skeptical about the high-performance commercial building business case despite the growing body of national research and major market case studies that demonstrate a premium for LEED and ENERGY STAR buildings. We developed a quantitative evaluation of Colorado’s high-performance commercial building business case. Even though Colorado is a market leader for LEED and ENERGY STAR buildings, the percentage of the entire stock of 70,000 commercial buildings is less than 1%. Furthermore, of the 70,000, adequate data were available for less than 1% of the commercial attributes (sales price, rent, size, year built, year renovated, etc.) needed to analyze whether or not these buildings attract a premium. The data that were available to analyze has significant errors. While the regression models for rent and sales prices were significant, they only accounted for small variation in price and rent in the models.
The industry expert survey revealed that the financial case is the most important decision-making factor; however, statistical analysis was unable to verify the business case. The Colorado High-Performance Commercial Building Index indicated that the demand for leasing and purchasing high-performance commercial buildings in 2012 is expected to be greater than the supply according to the Index. The industry’s anticipation of an increase in demand could be attributed to the national market demand trend toward high-performance buildings. Moving forward, we recommend that the Colorado commercial building industry (1) improve the quality of the data available for evaluation for the entire building stock; (2) develop transparent case studies with detailed financial analyses; and (3) work with utilities and building owners voluntarily and/or through regulation to obtain critical performance data related to energy consumption, water consumption, and productivity. Additionally, a method to identify non-LEED or non-ENERGY STAR high-performance commercial buildings, a.k.a “All But Certified,” will be critical steps to evaluating the future business case. Until the business case is evaluated at a state level in which the results clearly show financial benefits for high-performance commercial buildings, it will be difficult to persuade the conventional real estate industry to voluntarily construct or retrofit commercial buildings to high-performance standards on a large scale. Furthermore, the lack of a convincing business case will make justifying major public expenditures to retrofit the commercial buildings in an effort to mitigate climate change also difficult.
### Appendix

**Exhibit A1** | Regression Diagnostics: Rent per Square Foot for All Building Types
Correlation Matrix and Variance Inflation Factors

<table>
<thead>
<tr>
<th></th>
<th>LEED</th>
<th>ENERGY STAR</th>
<th>Industrial</th>
<th>Retail</th>
<th>Percentage Leased</th>
<th>Rentable Building Area</th>
<th>Year Built</th>
<th>Mountain Resort</th>
<th>Colorado Springs</th>
<th>Northern Colorado</th>
<th>Non-Metro/Rural</th>
<th>Mesa County</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED</td>
<td></td>
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<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td>-0.069</td>
<td></td>
<td></td>
<td>-0.096</td>
<td>1</td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Retail</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>-0.109</td>
<td>-0.432</td>
<td>1</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Percentage Leased</td>
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<td>0.068</td>
<td></td>
<td></td>
<td></td>
<td>-0.028</td>
<td>-0.007</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Rentable Building Area</td>
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<td>0.331</td>
<td>0.453</td>
<td>0.006</td>
<td>-0.096</td>
<td>0.140</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Year Built</td>
<td>0.083</td>
<td>0.042</td>
<td>0.050</td>
<td>0.003</td>
<td>0.068</td>
<td>0.048</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mountain Resort</td>
<td>-0.011</td>
<td>-0.016</td>
<td>-0.022</td>
<td>0.038</td>
<td>0.029</td>
<td>-0.023</td>
<td>0.044</td>
<td>1</td>
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<td>Colorado Springs</td>
<td>-0.035</td>
<td>-0.062</td>
<td>-0.048</td>
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<td>-0.024</td>
<td>-0.085</td>
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<td>-0.047</td>
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<tr>
<td>Northern Colorado</td>
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<td>-0.059</td>
<td>-0.006</td>
<td>0.024</td>
<td>-0.059</td>
<td>-0.103</td>
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<td>-0.038</td>
<td>-0.180</td>
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<tr>
<td>Non-metro/Rural</td>
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<td>-0.022</td>
<td>-0.014</td>
<td>0.044</td>
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<td>-0.033</td>
<td>-0.024</td>
<td>-0.013</td>
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<tr>
<td>Mesa County</td>
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<td>-0.023</td>
<td>0.051</td>
<td>-0.007</td>
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<td>1.011</td>
<td>1.070</td>
<td>1.068</td>
<td>1.018</td>
<td>1.016</td>
</tr>
</tbody>
</table>

VIF = Variance Inflation Factor
### Exhibit A2 | Regression Diagnostics Rent Per Square Feet for Office Buildings

**Correlation Matrix and Variance Inflation Factors**

<table>
<thead>
<tr>
<th></th>
<th>LEED</th>
<th>ENERGY STAR</th>
<th>Building Class A</th>
<th>Building Class B</th>
<th>Percentage Leased</th>
<th>Rentable Building Area</th>
<th>Year Built</th>
<th>Mountain Resort</th>
<th>Colorado Springs</th>
<th>Northern Colorado</th>
<th>Non-metro/Rural</th>
<th>Mesa County</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED</td>
<td>1</td>
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<tr>
<td>Building Class B</td>
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</tr>
<tr>
<td>Percentage Leased</td>
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<td>0.024</td>
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<tr>
<td>Year Built</td>
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</table>
### Exhibit A3 | Regression Analysis: Rent per Square Foot for Industrial Buildings

Correlation Matrix and Variance Inflation Factors

<table>
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<th>Correlation Matrix</th>
<th>VIF</th>
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<td>Building Class A or B</td>
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<td>Percentage Leased</td>
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<td>Year Built</td>
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<td>-0.003 0.015 -0.015 -0.029 0.021 1</td>
</tr>
<tr>
<td>Colorado Springs</td>
<td>-0.014 0.013 -0.019 -0.085 0.040 -0.033 1</td>
</tr>
<tr>
<td>Northern Colorado</td>
<td>-0.012 -0.007 -0.041 -0.081 0.069 -0.029 -0.159 1</td>
</tr>
<tr>
<td>Non-metro/Rural</td>
<td>-0.004 -0.029 -0.071 -0.049 -0.036 -0.009 -0.051 -0.045 1</td>
</tr>
<tr>
<td>VIF</td>
<td>1.002 1.236 1.025 1.089 1.197 1.005 1.046 1.049 1.015</td>
</tr>
</tbody>
</table>
Exhibit A4 | Regression Analysis: Last Sales Price for All Building Types
Correlation Matrix and Variance Inflation Factors

<table>
<thead>
<tr>
<th></th>
<th>LEED</th>
<th>ENERGY STAR</th>
<th>Rentable Building Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEED</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENERGY STAR</td>
<td>0.491 1</td>
<td>0.528 1</td>
<td></td>
</tr>
<tr>
<td>Rentable Building Area</td>
<td>0.421 0.528</td>
<td>1 1</td>
<td></td>
</tr>
<tr>
<td>VIF</td>
<td>1.384 1.578</td>
<td>1.455</td>
<td></td>
</tr>
</tbody>
</table>

Endnotes

1 Greenprint Foundation’s mission “is to lead the global real estate community toward value-enhancing carbon reduction strategies that support the Intergovernmental Panel on Climate Change (IPCC) goals for global greenhouse gas stabilization by 2030.”

2 Data were queried in January 2011.

References


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J.C. Martel, University of Colorado, Denver, CO 80208 or jc.martel@ucdenver.edu.
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Comparative Analysis of Housing in Conservation Developments: Colorado Case Studies

Authors
Christopher Hannum, Steven Laposa, Sarah E. Reed, Liba Pejchar, and Lindsay Ex

Abstract
Conservation development (CD) is an approach to the site design of a development property that combines residential development and land conservation. CD has been heralded as an environmentally-friendly development alternative and a means to finance land conservation. We employ a Box-Cox hedonic methodology using transaction data for all CD subdivisions in five Colorado counties, as well as a unique sample of homes in comparable nearby rural non-CD subdivisions to assess the value of the CD amenity to homeowners. Our research demonstrates significant sales price premiums for homes located in regulated and unregulated CDs relative to comparable non-CDs.

Conventional residential development poses several challenges to sustaining healthy ecosystems and human communities in the United States. Residential development is a leading driver of changes to biodiversity (McKinney, 2002) and ecosystem services that are critical for human well-being (Kroeger and Casey, 2007). Moreover, conventional residential designs have been linked to declines in the health of human communities (Frumkin, 2002). Land use and residential design also affect human well-being through public health, social equity, climate impacts, and community integrity (Dannenberg, 2003; Alberti 2005; Ewing, Bartholomew, Winkelman, Walters, and Anderson, 2008).

Although efforts to conserve natural resources on private lands have grown rapidly in recent years (Chang, 2010), land continues to be converted to residential and urban development at twice the rate that it is being protected (Aldrich and Wyerman 2005; USDA, 2009). Current funding for land conservation is inadequate to assemble an inclusive and ecologically viable network of conservation areas (Lerner, Mackey, and Casey, 2007). A recent National Association of REALTORS® (NAR) study demonstrated that environmental features are important to 90% of home buyers in the U.S. (NAR, 2008). The high rates of land development, conservation finance gap, and changing preferences among homeowners make this a critical time to examine new approaches for incorporating conservation objectives into development practices, financing land conservation, and providing a model for sustainable homeownership rates.
Standard economic theory suggests that as income rises, so too will demand for most goods, services, and amenities. Since economic growth inevitably leads to increases in income and living standards in the long run, this presents a conundrum for advocates of sustainable building practices and many environmentally-friendly housing attributes and amenities. Bloom, Nobe, and Nobe (2011) find a positive price premium associated with ENERGY STAR homes, while Aroul and Hansz (2011) find a similar premium for dual-pane windows. Goodwin (2011), examining survey data, finds that the importance placed on ENERGY STAR ratings and heating and cooling costs are negatively correlated with the subject’s income. Many green amenities provide external benefits to society, but only cost savings to the individual directly affected. These costs matter less to high-income individuals, and if the green attribute provides an effective disamenity, as with compact fluorescent bulbs (Wall and Crosbie, 2009), that fact could inhibit adoption. Even where the green attribute does not create a disamenity, as with dual-pane windows, we would expect future income growth to slow the pace of adoption. However, some characteristics of a sustainable housing development might provide tangible aesthetic benefits to the individual homeowner and in such a case would expect greater possibilities for private supply of green housing amenities with limited need for government involvement.

Conservation development (CD) is an approach to the site design of a development property that combines residential development and land conservation with a goal of providing functional protection for natural resources (Milder, 2007; Pejchar, Morgan, Caldwell, Palmer, and Daily, 2007). CD includes a wide range of project types, ranging from just a few houses on large tracts of rural land, to suburban conservation subdivisions, to large master-planned communities in urban areas. CD has been heralded as an environmentally-friendly alternative to residential sprawl, as well as a means to finance land conservation. Exhibit 1 (Arendt, 1996) illustrates a CD (c) in contrast to a conventional dispersed development (a). In a CD, the natural resources of the property (b) are initially mapped and protected and home sites are then clustered on a smaller portion of the site.

Although CD has been in use for more than four decades in the U.S. and accounts for up to one-fourth of private land conservation (Milder and Clark, 2011) and a growing proportion of residential development activity, little is known about home sales, valuation trends, absorption patterns, and marketing strategies in CD
projects relative to conventional subdivisions. Potential benefits of CD to developers and homeowners include reduced infrastructure and capital costs, higher perceived housing value and quality, faster absorption rates, market differentiation, and access to open space and opportunities for a healthy lifestyle (McMahon, 2010).

This study uses an extensive and unique dataset of home sales and tests for positive externalities in terms of residential home sale prices in CDs vis-à-vis sale prices for homes in non-CD projects. Although more information regarding our filtering process is discussed in the Methods and Data section, the authors grouped residential developments into four main categories: regulated CDs, unregulated CDs, 35-acre subdivisions, and large lot subdivisions.

Based on the diverse characteristics of the five Colorado counties and four types of residential developments, and given the limitations of the data, we investigated three research questions: (1) Are there significant differences in prices for homes in CD projects versus 35-acre, large lot, and unregulated CD projects? (2) Are there significant differences in prices for homes in CD projects across the five Colorado counties? (3) Are there significant differences in the total number of sales and transactions between CD projects and non-CD projects?

This research has broad applications to real estate developers, residential brokers and agents, real estate capital market participants, homeowners, decision makers, and land use planners at the local, state, national, and international levels. Investigating the outcomes of residential homes in CDs is of both academic interest and practical importance to the industry. The real estate industry benefits from an enhanced understanding of home values and sales trends in sustainable residential development projects. Additionally, our research will produce practical recommendations for land use planners and policymakers to adopt and revise CD ordinances that enable and encourage this emerging approach to sustainable residential development among local jurisdictions. The results of this project will help communities achieve cumulative, positive impacts for natural resource conservation and envision more sustainable models for residential development.

**Literature**

The introduction discussed several relevant articles from the conservation biology and ecology literature. The general gap between the conservation biology literature and real estate literature addressed in this article focuses on the financial aspects, impacts, and consequences of projects such as CDs. There is limited research addressing issues on the financial viability, risk and returns, subsequent home price appreciation rates, or lot absorption rates of CD projects.

The body of research on the influence of protected open spaces and home values is rich in case studies and public policy implications. Open spaces have been shown to influence the value of adjacent properties (Bolitzer and Netusil, 2000; Geoghegan, 2002), and nearby residents are more willing to pay for urban parks than more distant residents (del Saz Salazar and Menéndez, 2007). Other research indicates differences between the home pricing impacts of, and demand for, private
subdivision open space and public open space (Bates and Santerre, 2001; Bowman, Thompson, and Colletti, 2009; Abbott and Klaiber, 2010). Towe (2009) finds a greater impact for privately-held farmland than for open space owned collectively by neighborhood associations. Irwin and Bockstael (2001) find evidence of a substantial premium associated with open space using an instrumental variables regression, and that similar estimates using OLS may be biased downward by endogeneity in land use.

While studies consistently find a positive value associated with proximity to open space, these results may have little applicability to the question of CD site planning and CD in unincorporated areas of Colorado specifically. In these areas, proximity to open space, be it publicly-owned wilderness or private rangeland, is the rule rather than an exception. At issue is whether protected open space as part of the site design has an observable price impact even in those areas where natural amenities are not scarce. Within the framework of evaluating the value of proximity to open space rather than location within a development of a given design, Irwin (2002) finds that permanently preserved open space (as in a CD) in Maryland provides a greater price impact than does similar but potentially developable open space.

Recent studies have also examined the valuation impact on housing, appreciation rates, and consumers’ preferences for CD. Bowman, Thompson, and Colletti (2009) applied three methods to determine homeowners’ value of conservation features in conservation-oriented subdivisions in Cedar Rapids, Iowa. The authors found higher five-year appreciation rates for homes in CD projects versus conventional subdivisions and that consumers’ willingness to pay for conservation features was influenced by income, gender, and concerns about urban development (Bowman and Thompson, 2009). Reichert and Liang (2007) examining the housing market in Geauga, Ohio found no statistically significant difference in appreciation rates between CD and non-CD projects. The authors suggest that this finding may be due to a buyer preference for privately-held open space, rather than that owned collectively or in trust. As with all housing amenities, it may simply be the case that the full value of an open space amenity is immediately capitalized into the purchase price if neither that amenity nor its subjective valuation is changing over time.

Kopits, McConnell, and Walls (2009) find a positive price impact of shared open space, but conclude that this is inadequate to compensate for the loss of valued lot size, with cluster site planning leading to lower home prices overall. Mohamed (2006) focused on residential developments in Kingston, Rhode Island analyzing 184 lot sales, as well as absorption and development costs for CD compared with non-CD projects. The author found lower development costs per lot on average and fewer days on market (DOM) for lots in CD projects versus lots in conventional subdivisions.

**Setting and Data**

Colorado is a particularly appropriate setting for investigating the distribution and financial dimensions of CD projects, due to its rapidly growing human population,
Comparative Analysis of Housing

Exhibit 2 | Sample Colorado County Statistics

<table>
<thead>
<tr>
<th></th>
<th>Chaffee</th>
<th>Douglas</th>
<th>Larimer</th>
<th>Mesa</th>
<th>Routt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Population</td>
<td>17,809</td>
<td>285,465</td>
<td>299,630</td>
<td>146,723</td>
<td>23,509</td>
</tr>
<tr>
<td>Housing units</td>
<td>10,020</td>
<td>106,859</td>
<td>132,722</td>
<td>62,644</td>
<td>16,303</td>
</tr>
<tr>
<td>Median home value</td>
<td>$248,100</td>
<td>$338,700</td>
<td>$246,000</td>
<td>$221,000</td>
<td>$422,300</td>
</tr>
<tr>
<td>Median household income</td>
<td>$42,941</td>
<td>$99,198</td>
<td>$56,447</td>
<td>$52,067</td>
<td>$60,876</td>
</tr>
<tr>
<td>Land area (sq. mi.)</td>
<td>1,013.40</td>
<td>840.25</td>
<td>2,596.00</td>
<td>3,328.97</td>
<td>2,362.03</td>
</tr>
<tr>
<td>Persons per sq. mi.</td>
<td>17.6</td>
<td>339.7</td>
<td>115.4</td>
<td>44.1</td>
<td>10.0</td>
</tr>
</tbody>
</table>

Note: The source is the U.S. Bureau of Census; all data from 2010 Census.

widespread adoption of local land use regulations to guide CD design, and the availability of project documentation and financial information for existing CD projects. We focused our research on five counties that represent a broad range of economic, demographic, geographic, and housing characteristics and have at least 16 unique CD projects (Exhibit 2). For example, according to the U.S. Census Bureau, 2010 population ranges from a low of 17,809 in Chaffee County to a high of 299,530 in Larimer County, land area from 840 square miles (sq. mi.) in Douglas County to 3,328.97 sq. mi. in Mesa County, and median home values (2006–2010) range from $221,000 in Mesa County to a high of $422,300 in Routt County. Together these counties account for approximately 41% of all Colorado CD projects.

Exhibit 3 illustrates the geographic location of the five Colorado counties. Larimer County is home to the Fort Collins-Loveland metropolitan statistical (MSA) area and Estes Park, a gateway community to Rocky Mountain National Park; Douglas County is located to the south and is included in the highly urbanized area of the Denver-Aurora MSA; Routt County includes extensive public lands, ranching communities, and the ski resort and vacation city of Steamboat Springs; Mesa County includes Grand Junction, the largest city on the western slope of the Rocky Mountains; and Chaffee County contains both rural mountain and agricultural regions in central Colorado.

We combined two unique datasets to address the gap in applied research on CD projects. The first is a spatial database of CD project locations and parcel and subdivision boundaries, which our working group previously compiled for CD projects in 19 Colorado counties. We first identified counties that have adopted a land use regulation or ordinance that establishes guidelines or provides incentives to encourage development of CD projects. As of 2010, 33 counties in Colorado had adopted a CD ordinance. We then contacted each county’s land use planning department to obtain a list of subdivisions that had been completed through the CD regulatory process. We identified the corresponding parcel and subdivision boundaries in the GIS database. Of the counties with CD ordinances, 29 had an
available geographic information system (GIS) database of parcel and subdivision boundaries and 19 had completed at least one CD project. To date, we have mapped a diverse sample of nearly 400 CD projects in unincorporated areas of 19 counties. CD projects range in area from 2 to 900 ha, with 1 to 435 residential lots, and a mean of 62% of each property is set aside as protected open space.

In the five counties, we also identified conventional residential development projects for comparison to the CD projects. We selected the five counties to represent a range of characteristics—urban and rural; agricultural, natural resource, and service-based economies; and a variety of ecosystem types—and to be distributed across different geographic regions of the state (Exhibit 3). Within each county, we selected comparable conventional development projects to be located near the CD projects and to be as similar as possible in total area and development yield. We visually inspected parcel and subdivision boundaries, and legal descriptions from the tax assessor’s data associated with the parcel database, to identify candidate developments for comparison. All comparable developments are located within 10 km, and most are located within 5 km, of the nearest CD project in each county.

Two types of comparable developments that we selected represent the primary land use planning alternatives for development of a conventional, dispersed
Exhibit 4  |  Number of Developments by County and Category

<table>
<thead>
<tr>
<th></th>
<th>Larimer</th>
<th>Douglas</th>
<th>Mesa</th>
<th>Routt</th>
<th>Chaffee</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regulated CD</td>
<td>49</td>
<td>5</td>
<td>9</td>
<td>10</td>
<td>7</td>
<td>80</td>
</tr>
<tr>
<td>Unregulated CD</td>
<td>10</td>
<td>3</td>
<td>8</td>
<td>2</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Large Lot</td>
<td>20</td>
<td>16</td>
<td>19</td>
<td>9</td>
<td>9</td>
<td>73</td>
</tr>
<tr>
<td>35-Acre</td>
<td>4</td>
<td>9</td>
<td>2</td>
<td>8</td>
<td>3</td>
<td>26</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td>33</td>
<td>38</td>
<td>29</td>
<td>22</td>
<td>205</td>
</tr>
</tbody>
</table>

residential property in unincorporated areas of the counties: (1) projects developed through Colorado’s 35-acre subdivision exemption, or (2) projects developed through the county’s subdivision or zoning regulations for large lot development. The third type of comparable development represents an alternative option for development of a CD project: projects with significant inclusion of conservation design elements (e.g., clustering of housing), but which were not developed through the CD regulatory process. Often these ‘unregulated’ CD projects were also developed through the 35-acre subdivision exemption.

We merged the spatial database of CD and comparable development projects with the CoreLogic database, a unique database comprised of approximately 1.7 million residential sale transaction records for the period 2000 to 2011:Q1 in Colorado. We used the parcel and subdivision boundaries, and associated attribute data, to identify residential sales transaction records within each type of development. Inaccurate or missing spatial locations associated with the residential sales transactions prevented a spatial join of the two datasets. Instead, we used a combination of parcel numbers and other unique identifying characteristics in the assessor’s data (e.g., subdivision name) associated with the parcel database to join the attribute tables of the two datasets. We verified matching records in the joined database through visual inspection of residential and subdivision locations and comparison of data in additional attribute fields. Exhibit 4 shows the breakdown of developments by county and development category. In all, 205 developments met all criteria for inclusion in the final dataset. Exhibit 5 displays the average characteristics of the developments themselves and of the properties in the various development categories organized by county.

As shown in Exhibit 5, homes in regulated and unregulated CDs tend to be sold for more and be both newer and larger than homes in traditional large lot subdivisions. The developments themselves tend to be larger in traditional 35-acre subdivisions and comparable in large lot subdivisions, and regulated and unregulated CDs. The average number of lots, however, is comparable between regulated CDs and 35-acre developments (in which the average lot size is much larger) and higher in large lot and unregulated CDs. While some conventional developments are designed with open space, the percentage of open space in regulated and unregulated CDs is far higher. Accordingly, yield in regulated CDs is low relative to large lot and even unregulated CDs. Home sales per lot are
### Exhibit 5 | Descriptive Statistics (All Developments)

<table>
<thead>
<tr>
<th></th>
<th>County</th>
<th>35-Acre</th>
<th>CD</th>
<th>Large Lot</th>
<th>Unregulated CD</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Acreage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>31.0</td>
<td>10.3</td>
<td>9.2</td>
<td>1.9</td>
<td></td>
</tr>
<tr>
<td>Douglas</td>
<td>36.1</td>
<td>9.4</td>
<td>7.5</td>
<td>15.6</td>
<td></td>
</tr>
<tr>
<td>Larimer</td>
<td>11.2</td>
<td>5.9</td>
<td>2.0</td>
<td>2.4</td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>22.9</td>
<td>2.0</td>
<td>1.8</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Routt</td>
<td>35.9</td>
<td>14.6</td>
<td>6.4</td>
<td>29.3</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>30.6</td>
<td>7.1</td>
<td>4.6</td>
<td>5.9</td>
<td></td>
</tr>
<tr>
<td><strong>Average Building Square Footage</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>2,531.0</td>
<td>2,421.1</td>
<td>2,573.4</td>
<td>2,352.0</td>
<td></td>
</tr>
<tr>
<td>Douglas</td>
<td>4,967.8</td>
<td>5,594.4</td>
<td>3,240.7</td>
<td>6,270.0</td>
<td></td>
</tr>
<tr>
<td>Larimer</td>
<td>1,791.0</td>
<td>3,679.1</td>
<td>2,412.1</td>
<td>3,670.1</td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>2,113.0</td>
<td>3,128.3</td>
<td>2,432.2</td>
<td>2,867.2</td>
<td></td>
</tr>
<tr>
<td>Routt</td>
<td>3,436.7</td>
<td>5,844.7</td>
<td>2,892.7</td>
<td>5,185.0</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>3,507.2</td>
<td>3,897.5</td>
<td>2,678.1</td>
<td>3,687.5</td>
<td></td>
</tr>
<tr>
<td><strong>Average Sale Amount ($)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>$563,000</td>
<td>$334,493</td>
<td>$387,130</td>
<td>$263,187</td>
<td></td>
</tr>
<tr>
<td>Douglas</td>
<td>$925,442</td>
<td>$897,180</td>
<td>$434,770</td>
<td>$1,576,483</td>
<td></td>
</tr>
<tr>
<td>Larimer</td>
<td>$320,400</td>
<td>$433,675</td>
<td>$292,027</td>
<td>$483,016</td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>$535,000</td>
<td>$193,034</td>
<td>$233,827</td>
<td>$297,707</td>
<td></td>
</tr>
<tr>
<td>Routt</td>
<td>$1,759,630</td>
<td>$1,857,924</td>
<td>$697,146</td>
<td>$1,641,504</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$1,017,178</td>
<td>$604,925</td>
<td>$369,836</td>
<td>$615,917</td>
<td></td>
</tr>
<tr>
<td><strong>Average Year Built</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>1980.3</td>
<td>2000.4</td>
<td>2000.7</td>
<td>1993.9</td>
<td></td>
</tr>
<tr>
<td>Larimer</td>
<td>1964.8</td>
<td>1999.3</td>
<td>1986.3</td>
<td>1995.9</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1985.6</td>
<td>2000.2</td>
<td>1989.1</td>
<td>1998.0</td>
<td></td>
</tr>
<tr>
<td><strong>Average Year of Sale</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>2007.3</td>
<td>2007.5</td>
<td>2007.0</td>
<td>2006.9</td>
<td></td>
</tr>
<tr>
<td>Douglas</td>
<td>2004.0</td>
<td>2006.9</td>
<td>2003.6</td>
<td>2007.8</td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>2008.1</td>
<td>2003.9</td>
<td>2003.7</td>
<td>2005.4</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2005.0</td>
<td>2005.5</td>
<td>2004.2</td>
<td>2005.1</td>
<td></td>
</tr>
<tr>
<td><strong>Total Area (hectares)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>144.6</td>
<td>31.4</td>
<td>75.6</td>
<td>38.1</td>
<td></td>
</tr>
<tr>
<td>Douglas</td>
<td>342.5</td>
<td>375.6</td>
<td>255.9</td>
<td>367.9</td>
<td></td>
</tr>
<tr>
<td>Larimer</td>
<td>40.1</td>
<td>76.1</td>
<td>41.8</td>
<td>69.5</td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>88.0</td>
<td>33.7</td>
<td>26.7</td>
<td>56.3</td>
<td></td>
</tr>
<tr>
<td>Routt</td>
<td>266.8</td>
<td>218.0</td>
<td>156.0</td>
<td>535.9</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>230.3</td>
<td>103.9</td>
<td>103.1</td>
<td>132.1</td>
<td></td>
</tr>
<tr>
<td><strong>Open Space (hectares)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>41.4</td>
<td>21.9</td>
<td>4.8</td>
<td>25.4</td>
<td></td>
</tr>
<tr>
<td>Douglas</td>
<td>158.9</td>
<td>217.6</td>
<td>24.6</td>
<td>160.7</td>
<td></td>
</tr>
<tr>
<td>Larimer</td>
<td>0.0</td>
<td>45.5</td>
<td>7.5</td>
<td>36.5</td>
<td></td>
</tr>
<tr>
<td>Mesa</td>
<td>0.0</td>
<td>18.6</td>
<td>1.6</td>
<td>35.2</td>
<td></td>
</tr>
<tr>
<td>Routt</td>
<td>15.1</td>
<td>164.1</td>
<td>3.0</td>
<td>51.2</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22.5</td>
<td>66.5</td>
<td>5.1</td>
<td>50.3</td>
<td></td>
</tr>
</tbody>
</table>
Exhibit 5 | (continued)
Descriptive Statistics (All Developments)

<table>
<thead>
<tr>
<th>County</th>
<th>35-Acre</th>
<th>CD</th>
<th>Large Lot</th>
<th>Unregulated CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Space (%)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>28.6%</td>
<td>69.7%</td>
<td>6.3%</td>
<td>66.8%</td>
</tr>
<tr>
<td>Douglas</td>
<td>46.4%</td>
<td>57.9%</td>
<td>9.6%</td>
<td>43.7%</td>
</tr>
<tr>
<td>Larimer</td>
<td>0.0%</td>
<td>59.8%</td>
<td>18.0%</td>
<td>52.4%</td>
</tr>
<tr>
<td>Mesa</td>
<td>0.0%</td>
<td>55.1%</td>
<td>6.0%</td>
<td>62.5%</td>
</tr>
<tr>
<td>Routt</td>
<td>5.7%</td>
<td>75.3%</td>
<td>2.0%</td>
<td>9.5%</td>
</tr>
<tr>
<td>Total</td>
<td>9.8%</td>
<td>64.0%</td>
<td>4.9%</td>
<td>38.0%</td>
</tr>
<tr>
<td>Number of Lots</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>7.3</td>
<td>9.6</td>
<td>23.1</td>
<td>50.3</td>
</tr>
<tr>
<td>Douglas</td>
<td>24.9</td>
<td>32.8</td>
<td>92.6</td>
<td>71.7</td>
</tr>
<tr>
<td>Larimer</td>
<td>3.0</td>
<td>14.6</td>
<td>49.8</td>
<td>52.8</td>
</tr>
<tr>
<td>Mesa</td>
<td>5.5</td>
<td>13.9</td>
<td>24.9</td>
<td>19.1</td>
</tr>
<tr>
<td>Routt</td>
<td>16.8</td>
<td>16.4</td>
<td>54.4</td>
<td>23.0</td>
</tr>
<tr>
<td>Total</td>
<td>15.5</td>
<td>15.5</td>
<td>50.0</td>
<td>42.0</td>
</tr>
<tr>
<td>Yield (Lots per hectare)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>0.050</td>
<td>0.254</td>
<td>0.356</td>
<td>0.812</td>
</tr>
<tr>
<td>Douglas</td>
<td>0.075</td>
<td>0.102</td>
<td>0.343</td>
<td>0.201</td>
</tr>
<tr>
<td>Larimer</td>
<td>0.075</td>
<td>0.212</td>
<td>2.166</td>
<td>1.006</td>
</tr>
<tr>
<td>Mesa</td>
<td>0.065</td>
<td>0.446</td>
<td>1.266</td>
<td>0.353</td>
</tr>
<tr>
<td>Routt</td>
<td>0.064</td>
<td>0.080</td>
<td>0.479</td>
<td>0.041</td>
</tr>
<tr>
<td>Total</td>
<td>0.068</td>
<td>0.219</td>
<td>1.101</td>
<td>0.616</td>
</tr>
<tr>
<td>Transactions per Lot</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>0.137</td>
<td>0.299</td>
<td>0.288</td>
<td>0.079</td>
</tr>
<tr>
<td>Douglas</td>
<td>0.679</td>
<td>1.787</td>
<td>0.963</td>
<td>0.205</td>
</tr>
<tr>
<td>Larimer</td>
<td>1.583</td>
<td>1.265</td>
<td>1.230</td>
<td>1.883</td>
</tr>
<tr>
<td>Mesa</td>
<td>1.182</td>
<td>2.568</td>
<td>1.527</td>
<td>1.386</td>
</tr>
<tr>
<td>Routt</td>
<td>1.194</td>
<td>1.159</td>
<td>0.855</td>
<td>2.065</td>
</tr>
<tr>
<td>Total</td>
<td>0.861</td>
<td>1.398</td>
<td>1.056</td>
<td>1.242</td>
</tr>
<tr>
<td>Sales per Lot</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chaffee</td>
<td>0.136</td>
<td>0.119</td>
<td>0.120</td>
<td>0.040</td>
</tr>
<tr>
<td>Douglas</td>
<td>0.170</td>
<td>0.329</td>
<td>0.383</td>
<td>0.033</td>
</tr>
<tr>
<td>Larimer</td>
<td>0.583</td>
<td>0.414</td>
<td>0.542</td>
<td>0.710</td>
</tr>
<tr>
<td>Mesa</td>
<td>0.545</td>
<td>0.912</td>
<td>0.656</td>
<td>0.542</td>
</tr>
<tr>
<td>Routt</td>
<td>0.403</td>
<td>0.244</td>
<td>0.380</td>
<td>0.543</td>
</tr>
<tr>
<td>Total</td>
<td>0.268</td>
<td>0.414</td>
<td>0.446</td>
<td>0.454</td>
</tr>
</tbody>
</table>

comparable between regulated CDs, unregulated CDs, and large lot developments, yet lower for conventional 35-acre subdivisions. However, transactions per lot (which include sales of undeveloped land) are somewhat higher in regulated and unregulated CDs, perhaps due to the lower average age of the developments.

We began this endeavor with data from Core-Logic on 7,638 individual property transactions between 1998 and 2011: 3,285 from Larimer County, 1,928 from Douglas County, 1,360 from Mesa County, 906 from Routt County, and 159 from Chaffee County. Included were a wide variety of characteristics of the sale and of the property itself, linked to subdivision characteristics and locations through a subdivision identifier. While the data set did contain geocoding data for each property such as estimated latitudes and longitudes, these data were
determined to give often implausible locations; therefore latitude-longitude data for the subdivision as a whole were used for each property within that subdivision.

For the purposes of a hedonic price analysis, many of these transactions would be invalid. Our two primary concerns were to filter out those transactions that were not sales and those transactions that were sales of developable land as opposed to finished homes. While the impact of location in a CD on the value of developable land is not without interest, the dataset was formed by a database, which links information taken at time of sale to current information about the property. As a result, a property sold may now include a 4,000 sq. ft. home built in 2008 and not reflected in the sale price of $40,000 in 2004; since there is little difference in the data, such an observation cannot be included. To address the first concern, we have restricted our sample to those transactions involving warranty deeds, joint warranty deeds, or special warranty deeds and have excluded all transactions with a sale price of zero. To address the second concern, we excluded all transactions with a year built listed after the year of sale, as well as those observations with no recorded year built or year of sale. After a trial run showed that properties listed with the same year built and year of sale sold for 93% less on average than properties with year built at least one year before the year of sale, we excluded those as well. In order to include distance variables, a further 65 observations were cut that lacked even subdivision level data. As a result of these cuts, our final five-county sample includes 2,222 observations corresponding to property sales. Exhibit 6 shows the breakdown of home sales in the final dataset by county and development category.

**Methodology**

Our methodology follows a standard hedonic model where the market price of a product is taken to be a reduced form function of demand and/or supply side characteristics (Rosen, 1974). Hedonic price models have been used extensively throughout the real estate and housing literature (Sirmans, Macpherson, and Zietz, 2005) using such characteristics as the square footage of a home, the presence of a finished basement or the presence and age of dual-pane windows (Aroul and
**Exhibit 7 | Full Dataset Results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta_0(r)$</td>
<td>$\beta_0(r)$</td>
</tr>
<tr>
<td><strong>INTERCEPT</strong></td>
<td>43.6696*** $(0.9097)$</td>
<td>43.6916*** $(0.8838)$</td>
</tr>
<tr>
<td><strong>LIVING AREA</strong></td>
<td>0.0245*** $(0.0012)$</td>
<td>0.0236*** $(0.0012)$</td>
</tr>
<tr>
<td></td>
<td>$77.27$</td>
<td>$74.43$</td>
</tr>
<tr>
<td><strong>LOT AREA (IN SQ. FT.)</strong></td>
<td>0.0001 $(0.0000)$</td>
<td>0.0001 $(0.0000)$</td>
</tr>
<tr>
<td><strong>AGE</strong></td>
<td>-0.0758*** $(0.0350)$</td>
<td>-0.0464 $(0.0352)$</td>
</tr>
<tr>
<td></td>
<td>-$828.36$</td>
<td>-$506.68$</td>
</tr>
<tr>
<td><strong>NUMBER OF BATHROOMS</strong></td>
<td>1.1958 $(0.2812)$</td>
<td>1.0464*** $(0.2822)$</td>
</tr>
<tr>
<td></td>
<td>$17,858.63$</td>
<td>$15,628.36$</td>
</tr>
<tr>
<td><strong>DISTANCE TO LARGEST TOWN</strong></td>
<td>-0.0001 $(0.0001)$</td>
<td>-0.0001 $(0.0001)$</td>
</tr>
<tr>
<td><strong>GARAGE</strong></td>
<td>2.6546*** $(0.4500)$</td>
<td>2.1296*** $(0.4408)$</td>
</tr>
<tr>
<td></td>
<td>$55,197.00$</td>
<td>$42,553.31$</td>
</tr>
<tr>
<td><strong>DOUGLAS CTY</strong></td>
<td>1.5506*** $(0.5417)$</td>
<td>2.6772*** $(0.5087)$</td>
</tr>
<tr>
<td></td>
<td>$32,242.76$</td>
<td>$53,496.26$</td>
</tr>
<tr>
<td><strong>CHAFFEE CTY</strong></td>
<td>-0.1089 $(1.0721)$</td>
<td>0.3622 $(1.1053)$</td>
</tr>
<tr>
<td></td>
<td>-$2,264.85$</td>
<td>$7,237.33$</td>
</tr>
<tr>
<td><strong>MESA CTY</strong></td>
<td>-1.0417*** $(0.3726)$</td>
<td>-0.5281 $(0.3726)$</td>
</tr>
<tr>
<td></td>
<td>-$21,659.89$</td>
<td>-$10,552.24</td>
</tr>
<tr>
<td><strong>ROUTT CTY</strong></td>
<td>10.7905*** $(0.7778)$</td>
<td>11.7352*** $(0.7992)$</td>
</tr>
<tr>
<td></td>
<td>$224,368.68$</td>
<td>$234,491.42$</td>
</tr>
<tr>
<td><strong>REGULATED C.D.</strong></td>
<td>2.7178*** $(0.4581)$</td>
<td>4.0120*** $(0.5092)$</td>
</tr>
<tr>
<td></td>
<td>$56,512.42$</td>
<td>$80,166.58$</td>
</tr>
<tr>
<td><strong>UNREGULATED C.D.</strong></td>
<td>—</td>
<td>3.5008*** $(0.5057)$</td>
</tr>
<tr>
<td></td>
<td>—</td>
<td>$69,952.03$</td>
</tr>
<tr>
<td><strong>y1998</strong></td>
<td>-5.0352*** $(1.3391)$</td>
<td>-4.5779*** $(1.4134)$</td>
</tr>
<tr>
<td></td>
<td>-$104,697.34$</td>
<td>-$91,475.22</td>
</tr>
<tr>
<td><strong>y1999</strong></td>
<td>-2.8544*** $(0.6017)$</td>
<td>-2.8124*** $(0.5788)$</td>
</tr>
<tr>
<td></td>
<td>-$59,353.14$</td>
<td>-$56,197.59</td>
</tr>
<tr>
<td><strong>y2000</strong></td>
<td>-1.8272*** $(0.6991)$</td>
<td>-1.7995*** $(0.6777)$</td>
</tr>
<tr>
<td></td>
<td>-$37,993.40$</td>
<td>-$35,957.39</td>
</tr>
<tr>
<td><strong>y2002</strong></td>
<td>0.6706 $(0.6872)$</td>
<td>0.5066 $(0.6694)$</td>
</tr>
<tr>
<td></td>
<td>$13,944.65$</td>
<td>$10,123.09$</td>
</tr>
<tr>
<td><strong>y2003</strong></td>
<td>0.4371 $(0.6079)$</td>
<td>0.4227 $(0.5825)$</td>
</tr>
<tr>
<td></td>
<td>$9,089.07$</td>
<td>$8,445.67$</td>
</tr>
<tr>
<td><strong>y2004</strong></td>
<td>1.5632*** $(0.6190)$</td>
<td>1.5362*** $(0.5940)$</td>
</tr>
<tr>
<td></td>
<td>$32,503.71$</td>
<td>$30,696.41$</td>
</tr>
</tbody>
</table>
**Exhibit 7** | (continued)

**Full Dataset Results**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th>Model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\hat{\beta}(r)$</td>
<td>Marginal Effect [%]</td>
</tr>
<tr>
<td>$y_{2005}$</td>
<td>3.1218***</td>
<td>$64,911.80$</td>
</tr>
<tr>
<td></td>
<td>(0.5587)</td>
<td>[22%]</td>
</tr>
<tr>
<td>$y_{2006}$</td>
<td>4.1347***</td>
<td>$85,974.05$</td>
</tr>
<tr>
<td></td>
<td>(0.6193)</td>
<td>[30%]</td>
</tr>
<tr>
<td>$y_{2007}$</td>
<td>4.7277***</td>
<td>$98,303.74$</td>
</tr>
<tr>
<td></td>
<td>(0.6934)</td>
<td>[34%]</td>
</tr>
<tr>
<td>$y_{2008}$</td>
<td>3.4543***</td>
<td>$71,826.13$</td>
</tr>
<tr>
<td></td>
<td>(0.7335)</td>
<td>[25%]</td>
</tr>
<tr>
<td>$y_{2009}$</td>
<td>1.4168***</td>
<td>$29,459.20$</td>
</tr>
<tr>
<td></td>
<td>(0.7154)</td>
<td>[10%]</td>
</tr>
<tr>
<td>$y_{2010}$</td>
<td>0.2464</td>
<td>$5,123.81$</td>
</tr>
<tr>
<td></td>
<td>(0.7715)</td>
<td>[2%]</td>
</tr>
<tr>
<td>$y_{2011}$</td>
<td>1.2120</td>
<td>$25,201.53$</td>
</tr>
<tr>
<td></td>
<td>(1.0948)</td>
<td>[9%]</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.7069</td>
<td>—</td>
</tr>
</tbody>
</table>

*Note: The number of observations is 2,222. Brackets indicate percentage change for Box-Cox marginal effects whereas $\$ figures indicate the dollar marginal effect. Parentheses indicate t-stats.

***Significant at the 5% level.*

Our dependent variable is the transformed sales price of the property, while the independent variables include binary year dummies and a vector of housing characteristics. Each resulting coefficient means little on its own, but the transformation can be reversed to derive a dollar marginal effect.

A likelihood-ratio test indicates that a Box-Cox power transformation of the continuous variables (Box and Cox, 1964) is likely to provide a better fit for the sample data than does a standard log-log hedonic model (equivalent to a Box-Cox transformation with $\theta = \lambda = 0$) and to limit, if not eliminate, potential problems of heteroscedasticity. Using such a transformation, the dependent variable ($Sales Price$) is raised to the power of $\lambda$ while continuous independent variables are raised to the power of $\theta$, with binary independent variables left untransformed. To complete the transformation, we then subtract one from the transformed variable and divide by its respective transformation parameter. The parameters $\theta$ and $\lambda$ are then derived using maximum likelihood estimation. Our best fit estimate for $\lambda$ is 0.2093, with a standard error of 0.0106 and for $\theta$ 0.7656 with a standard error of 0.0639.
$t\text{Price} = \alpha + \beta_1 t\text{Living Area} + \beta_2 t\text{Lot Area} + \beta_3 t\text{Age} + \beta_4 t\text{LMean} + \beta_5 t\text{Total Bath} + \beta_6 t\text{Basement SqFt} + \beta_{10} t\text{Bedrooms} + \beta_{11} CD + \sum_{t=1998}^{t=2011} \beta_t y_t + \sum_j \beta_j X_j + \sum_i \beta_i X_i + \varepsilon,$  \hfill (1)

where:

- $t\text{Price} = \frac{(Sales \ Price^\lambda - 1)}{\lambda};$
- $t\text{Living Area} = \frac{(Living \ Area^{\theta} - 1)}{\theta};$
- $t\text{Lot Area} = \frac{(Lot \ Area^{\theta} - 1)}{\theta};$
- $t\text{Age} = \frac{(Age \ of \ Home^{\theta} - 1)}{\theta};$
- $t\text{Total Bath} = \frac{(# \ of \ Bathrooms^{\theta} - 1)}{\theta};$
- $t\text{Basement SqFt} = \frac{(Basement \ Area^{\theta} - 1)}{\theta};$
- $t\text{LMean} = \frac{(Travel \ Distance \ to \ Largest \ Town^{\theta} - 1)}{\theta};$

$y_t (1998...2011) =$ dummy year variable ($1 =$ year sold, $0 =$ all others);

- $X_j =$ A vector of binary housing characteristics, including: Garage, Central Air, Pool, Waterfront, No Quality, Good Quality, Excellent Quality, Fair/Low Quality;
- $X_i =$ A vector of binary county variables including: Routt, Chaffee, Douglas, and Mesa; and
- $CD =$ A dummy variable for location within a regulated conservation development.

The baseline or null, a property for which all categorical variables take on a value of zero, would be located in Larimer County in a non-CD, sold in 2001 with average quality and no garage, pool or basement. Our methodology for selecting comparable subdivision, along with the Colorado Public Schools of Choice legislation and the large size of school districts in rural Colorado, lessens the importance of school district location in comparing properties.

**Results**

Our findings are broadly supportive of the idea that the location of a property within a CD constitutes an environmental amenity with a positive impact on the value of that property. Results from our five-county combined data set suggest a statistically significant increase in sales price of approximately 20% from location within a CD rather than an otherwise similar subdivision, which might be a rural large lot, 35-acre subdivision or unregulated CD. When the impacts of both location within a regulated or an unregulated CD are tested against a baseline of large lots and 35-acre developments they provide a positive marginal effect of
roughly 25% and 29% of the purchase price of a home, respectively. In model 1, we include “unregulated CDs” (subdivisions that employ certain conservation practices, but skirt the regulatory process) in the baseline non-CD group; in model 1, unregulated CD is included as a separate subdivision category. It should be noted that while the difference between CD and the null is statistically significant at the 5% level in both model 1 and model 2, as is the difference between unregulated CD and the null in model 2, the difference between regulated and unregulated CDs in model 2 is not statistically significant.

Coefficients on our control variables are, for the most part, consistent with both theory and common sense. A larger home sells for more, as does a home with more bathrooms. Adding a square foot to the typical home adds $74.43 to the sales price of that home while adding a bathroom adds $15,628.36. Doubling both would roughly double the total market value of the home. Relative to the baseline location within Larimer County, homes in Douglas County and Routt County sell for more while homes in Mesa and Chaffee Counties sell for less. Coefficients for binary year variables tell the story of the Colorado housing market as a whole over the past 14 years: rapid price increases to 2001 (the baseline year) followed by two years of stagnation, an upswing from 2004 to 2007 then three years of price declines prior to a slight rebound in 2011. By 2010, housing prices in our sample had returned to approximately 2001 levels.

As expected, sales prices decreased with age and distance from the nearest major town. Age does not have a tremendous impact. The sales price of a home decreases by only $516 with an additional year of age and the effect is not statistically significant when dummy variables for both regulated and unregulated CDs are included, although it is when only the regulated CD variable is included. Our distance variables were calculated using coordinates for subdivisions rather than individual properties within those subdivisions due to problems with the reliability of individual property GPS coordinates within our data set. We tested four different distance variables, all or which use travel distance as opposed to linear distance: mean distance to the largest town in the county (LMEAN), minimum distance to the largest town in the county (LMIN), mean distance to the nearest town (NMEAN), and minimum distance to the nearest town in the county (NMIN). LMEAN was selected due to a marginally better fit. The impact of LMEAN in the full sample regressions is relatively small and insignificant; in part (as shown below) because it appears that the impact of LMEAN is quite different in different counties and for different development types.

One surprise is that for our full sample, which is primarily higher-end homes in rural areas or on the outskirts of towns, the size of lot did not have a statistically significant impact at the 5% level. An additional square foot of land raises the market price by only six cents, one additional acre by approximately $2,500. When we break down the sample by category, increasing lot size increases sale price by a small but statistically significant amount (9¢ per square foot or $4,062 per acre) for homes in non-CDs and by a large and significant amount (38¢ per square foot or $16,662 per acre) for homes in unregulated CDs. The low value associated with additional lot size in a non-CD in our sample leads to an implied
value of land that is greater when held in common and perpetually preserved than when allocated to increase the size of individual private lots, in contrast to the findings of Kopits, McConnell, and Walls (2007), Reichert and Liang (2007), and Towe (2009).

For homes in regulated CDs, the impact of an extra square foot of land was both negative and statistically significant. The difference between non-CDs and unregulated CDs (in which ownership of land is subdivided fully during development) could be explained by amenity values, since unregulated CDs are designed with environmental amenities in mind. When comparing regulated and unregulated CDs, it might potentially be the case that larger individual lots within a CD diminish the amenity values to all from commonly-held open lands.

A glance at the binary year coefficients for the four subdivision categories suggest that while prices in categories were hit hard by the recent recession (with an approximate 30% drop peak-to-trough) and have begun to rebound in all four, they did not follow similar paths following the 2001 recession. In many parts of the country, the 2001 recession was a mere blip, but the Colorado tech industry had experienced rapid growth in the 1990s and the recession meant the loss of a significant number of high paying jobs. House prices in lower-amenity non-CD subdivisions increased somewhat less rapidly in the late 1990s but continued to increase throughout the 2000s. For high-amenity regulated and unregulated CDs, price growth in the late 1990s was more rapid and both experienced price drops following that recession, although both seem to have been affected more equally in the most recent downturn. When the dataset is subdivided by development category, as displayed in Exhibit 8, we find no evidence of a higher appreciation rate for CD or non-CD properties between 1999 and 2011. While this contradicts the findings of Bowman, Thompson, and Colletti (2009), it is not inconsistent with the idea of open space as a valued amenity, provided the value of that amenity is capitalized in the initial purchase price.

We ran two sets of regressions using single county subsamples: one using only those property characteristics that were available for all counties and another using all property characteristics available for that particular county. Chaffee County was excluded due to the limited number of sales. For the first, limited, set of regressions we see similar impacts for location within a CD in each county. Despite that fact, the regulated CD coefficients are statistically significant at the 5% level in Larimer, Douglas, and Mesa Counties and significant at the 10% level in Routt County. The unregulated CD coefficients are significant at the 5% level only in Larimer and Routt Counties and at the 10% level in Mesa County. Though the impact in Douglas County is large, there is too much statistical noise to indicate anything definite. The marginal impact of regulated CDs is quite similar to the full sample result in Larimer, Douglas, and Routt Counties (30%, 26%, and 31%, respectively) but a notably smaller 19% in Mesa County. While this could be partially the result of randomness due to reduced sample size, it might also be the case that counties in the urban and suburban Front Range or resort areas have a greater demand for environmental amenities than do blue-collar mountain
### Exhibit 8 | Results by Development Category

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regulated C.D.</th>
<th>Unregulated C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\beta(\gamma)$</td>
<td>Marginal Effect [%]</td>
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<td><strong>INTERCEPT</strong></td>
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</tr>
<tr>
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<tr>
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<td></td>
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</tr>
<tr>
<td><strong>y1998</strong></td>
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</tr>
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</tr>
<tr>
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<td>(4.2025)</td>
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### Exhibit 8 | (continued)

**Results by Development Category**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regulated C.D.</th>
<th>Unregulated C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td>R²</td>
<td>0.7697</td>
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<table>
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<tr>
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<th>All C.D.</th>
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<td>(0.4444)</td>
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<tr>
<td>MESA COUNTY</td>
<td>−0.9698***</td>
<td>$−18,242.39</td>
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<tr>
<td></td>
<td>(0.4477)</td>
<td>[−7%]</td>
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</table>
### Exhibit 8 (continued)

Results by Development Category

<table>
<thead>
<tr>
<th>Variable</th>
<th>Non-C.D.</th>
<th>All C.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\hat{\beta}$ ($t$)</td>
<td>Marginal Effect [%]</td>
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<tr>
<td><strong>ROUTT COUNTY</strong></td>
<td>9.5479*** $\pm$ 0.7466</td>
<td>71%</td>
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<td><strong>y1998</strong></td>
<td>−</td>
<td>−</td>
</tr>
<tr>
<td><strong>y1999</strong></td>
<td>−6.5531*** $\pm$ 1.7167</td>
<td>−44%</td>
</tr>
<tr>
<td><strong>y2000</strong></td>
<td>−5.1448*** $\pm$ 1.9685</td>
<td>−34%</td>
</tr>
<tr>
<td><strong>y2002</strong></td>
<td>−1.3274 $\pm$ 1.2694</td>
<td>−9%</td>
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<tr>
<td><strong>y2003</strong></td>
<td>−2.7130 $\pm$ 1.5993</td>
<td>−18%</td>
</tr>
<tr>
<td><strong>y2004</strong></td>
<td>−0.2877 $\pm$ 1.2748</td>
<td>−2%</td>
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<tr>
<td><strong>y2005</strong></td>
<td>−0.0018 $\pm$ 1.2666</td>
<td>0%</td>
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<tr>
<td><strong>y2006</strong></td>
<td>1.9550 $\pm$ 1.4060</td>
<td>13%</td>
</tr>
<tr>
<td><strong>y2007</strong></td>
<td>1.9500 $\pm$ 1.2866</td>
<td>13%</td>
</tr>
<tr>
<td><strong>y2008</strong></td>
<td>0.3782 $\pm$ 1.2935</td>
<td>3%</td>
</tr>
<tr>
<td><strong>y2009</strong></td>
<td>−2.4133 $\pm$ 1.4356</td>
<td>−16%</td>
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<tr>
<td><strong>y2010</strong></td>
<td>−2.7880*** $\pm$ 1.3549</td>
<td>−19%</td>
</tr>
<tr>
<td><strong>y2011</strong></td>
<td>−0.8720 $\pm$ 1.6849</td>
<td>−6%</td>
</tr>
</tbody>
</table>

**R²**

|                | 0.691 | 0.7266 | 645 |

Notes: Brackets indicate percentage change for Box-Cox marginal effects. Parentheses indicate $t$-stats. ***Significant at the 5% level.
### Exhibit 9 | County Level Regression Results (Coefficients with Robust SE)

<table>
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<th>Variable</th>
<th>Larimer</th>
<th>Douglas</th>
<th>Mesa</th>
<th>Routt</th>
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<tr>
<td>INTERCEPT</td>
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<td>54.60516</td>
<td>40.20772</td>
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<td>(1.0394***)</td>
<td>(1.6795***)</td>
<td>(2.2347***)</td>
<td>(4.0536***)</td>
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<tr>
<td>LIVING AREA</td>
<td>0.02464</td>
<td>0.0173</td>
<td>0.0219</td>
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<tr>
<td></td>
<td>(0.0016***)</td>
<td>(0.0017***)</td>
<td>(0.0046***)</td>
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<td>0.0001</td>
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<td>(0.0000***)</td>
<td>(0.0000***)</td>
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<td>(0.0429***)</td>
<td>(0.0587)</td>
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<td>(0.4691)</td>
<td>(0.6178)</td>
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<td>(3.7439)</td>
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<td>(3.3291***)</td>
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<td>-</td>
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<td>(0.5111***)</td>
<td>(1.3153***)</td>
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<td>(0.8680)</td>
<td>(0.8672)</td>
<td>(1.7427***)</td>
<td>(3.0556)</td>
</tr>
</tbody>
</table>
Counties such as Mesa. Without more data, this may be impossible to determine conclusively.

Where additional property characteristic information is available on a county-by-county basis, most results show the expected sign and scale. Pools increase the value of a home as do garages and central air conditioning, although not significantly in all counties. Basements and waterfront location (likely due to the definition of waterfront in the sample) do not. While a larger number of bathrooms increase the sales price of a home, a larger number of bedrooms (assuming an equivalent square footage) decrease it. Compared to the baseline condition of ‘average quality,’ homes with good or excellent quality sell for more (as do homes with no quality listed) while homes with fair or low quality sell for less.

In regressions using additional variables for property characteristics, the two counties with the largest numbers of available characteristics—Larimer and Mesa—show large decreases in the size of the CD coefficient relative to county subsample regressions using limited characteristics. In Larimer County, the marginal effect of regulated CDs falls from 30% to only 14%, although the coefficient remains statistically significant.

In Mesa County, the marginal effect falls from 19% to 12.3% while in Routt and Douglas Counties (where fewer additional characteristics are available the size) the impact of location within a regulated or unregulated CD is largely unaffected. In Larimer County, the coefficients for both regulated and unregulated CDs remain statistically significant when additional property characteristics are included while in Mesa County both become insignificant, although this may be due in part to the small sample size from Mesa County. These results suggest that part of the increased value associated with presence within a CD overall may be capturing unrecorded improvements in the homes themselves if, for example, homes in CDs are relatively more likely to be in good condition compared to those in other types of subdivisions.
## Exhibit 10 | County Level Regression Results (Marginal Effects)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Larimer</th>
<th>Douglas</th>
<th>Mesa</th>
<th>Routt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIVING AREA</strong></td>
<td>$82.75</td>
<td>$66.49</td>
<td>$50.34</td>
<td>$225.55</td>
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<td>$-296.01</td>
<td>$-3,601.10</td>
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<td>$50,188.74</td>
<td>$91,775.94</td>
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Note: Brackets indicate percentage change for Box-Cox marginal effects.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Larimer</th>
<th>Douglas</th>
<th>Mesa</th>
<th>Routt</th>
</tr>
</thead>
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### Exhibit 11 | (continued)

Extended County Level Regression Results (Coefficients with Robust SE)

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<th>Douglas</th>
<th>Mesa</th>
<th>Routt</th>
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<td>0.5957</td>
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Notes: Parentheses indicate t-stats. For Larimer, N = 936; for Douglas, N = 632; for Mesa, N = 347; for Routt, N = 265.

***Significant at the 5% level.
### Exhibit 12 | Extended County Level Regression Results (Marginal Effects)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Larimer</th>
<th>Douglas</th>
<th>Mesa</th>
<th>Routt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LIVING AREA</strong></td>
<td>$62.17</td>
<td>$61.51</td>
<td>$56.22</td>
<td>$230.23</td>
</tr>
<tr>
<td><strong>LOT AREA (IN SQ. FT.)</strong></td>
<td>$0.07</td>
<td>$0.12</td>
<td>$0.11</td>
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Note: Brackets indicate percentage change for Box-Cox marginal effects.

### Conclusion

Housing markets at the national, regional, and city levels are recovering from the housing crash of 2007. Conservation development projects are not immune to the stigma and negative consequences of households deleveraging, increasing defaults,
decreasing second home markets, and lower homeownership rates (Burger and Carpenter, 2010). Numerous transactions were eliminated from our study due to deed types reflecting foreclosures and public sales. As the country eventually recovers from the Great Recession of 2007 and 2008 with improved economic conditions, interest in CDs and other housing transactions is likely to improve.

Our research focused on three questions. Based on our analysis, we conclude there are significant differences in prices for homes in CD projects versus 35-acre, large lot, and unregulated CD projects; there are significant differences in prices for homes in CD projects across the five Colorado counties; and there are significant differences in the total number of sales and transactions between CD projects and non-CD projects.

Despite low per hectare yields, CDs may not represent an unattractive alternative to developers of rural land or land on the urban/rural fringe. As other authors (Mohamed, 2006; Bowman, Thompson, and Colletti, 2009) have noted, there are reasons to expect cluster development plans like CDs to decrease developer costs rather than raise them—if we compare plans for the same site. While lot size does itself represent an amenity, the results suggest that the impact of additional privately-held land is only 9 cents per square foot or $4,062 per acre. Given the average lot size of a home in a large lot development (4.6 acres), allocating two-thirds of the land of the development site to conservation would provide roughly twice the price premium of allocating the same land to larger individual lots.

Our research demonstrates a significant sales price premium for homes located in CDs relative to comparable non-CD projects, while controlling for housing, time, and location factors. We find that while the price premium associated with regulated and unregulated CDs is similar, the impact of property characteristics on prices in the two categories may differ. Understanding such differences between CDs and non-CDs will help developers and residential brokers create appropriate development and marketing strategies. If CD projects are also ecologically beneficial, our results suggest that this approach to development is a viable tool for conservation finance.

This research is limited to sales transactions for the five counties and four development categories. We do not address initial lot sales, net absorption trends, time to construct a home after the initial closing, or the value of the initial home; we capture only sales subsequent to all of these events. It is therefore possible that further research into the initial development, marketing, and home construction factors may complicate or confirm our results. If a relationship exists between turnover and CD status within specific school districts only, our data set may not capture bias induced by school district. Additionally there is very limited research on the overall financial returns to the developer with sufficient data such as time-dependent development costs, expenses, and lot sales to calculate internal rates of returns. Although our extensive dataset included transactions indicating foreclosures, we did not address how CD projects compared to non-CD projects during the recent housing downturn.
Endnotes

1 This article is a product of the Global Challenges Research Team on Conservation Development, School of Global Environmental Sustainability, Colorado State University (http://cd.colostate.edu).

2 The primary residential dataset is a unique database of approximately 1.7 million residential sale transaction records for the period 2000 to 2011:Q1 in the State of Colorado collected by CoreLogic (http://www.corelogic.com/).

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Sustainable Management of Real Estate: Is It Really Sustainability?

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Abstract
This paper investigates from a management perspective exactly what building owners and managers of commercial real estate are actually doing in the guise of sustainability. This research investigates key owners of real estate portfolios in Australia and New Zealand, and examines what they perceive sustainability to mean to their commercial real estate portfolios and their level of implementation. The research uses a qualitative framework in order to gain an understanding of owners’ perceptions of sustainability. The findings reveal that owners perceive sustainability to be very important to the longevity of their portfolios. However, at present, sustainability factors are limited to resource efficiency measures in their real estate portfolios. Consequently, this research questions whether current interpretation and implementation of sustainability in commercial real estate is merely ‘changing the name’ of best practice management to ‘sustainability.’

Sustainability is no longer a new phenomenon in the real estate industry; it has become a common enough phrase. However, some wonder about the meaning of the word, as it is almost an oxymoron in the context of real estate (Lorenz, Trück, and Lutzkendorf, 2007). There has been a significant change in commercial real estate markets worldwide to move towards incorporating sustainability in real estate portfolios (DeFrancesco and Levy, 2008). Many real estate trusts and funds claim to have increasing levels of sustainability in their portfolios, corporate social responsibility reporting, certifications, and the list demonstrating their level of sustainability goes on (Newell, 2008). However, when examining sustainability in the context of the triple bottom line, are these trusts and funds actually achieving anything or is it more like green wash?

This paper examines real estate trust and funds’ management perspectives about incorporating sustainability into assets or portfolios. The paper has focused on three sectors of investigation: the perception of sustainability, its importance to real estate portfolios, and the implementation of sustainability in real estate portfolios. The research aims to highlight the disconnect between conceptual understanding of sustainability, and whether the level of implementation of sustainability is actually achieving sustainability objectives through the management of real estate. This paper considers the real estate markets of Australia and New Zealand, and the differences in their perceptions of sustainability, its implementation, and focus.
The paper is organized as follows. First there is a discussion of the background to the rationale and the methodology for the research, followed by an analysis of the results from the research. Finally, the discussion and conclusions, which highlight the implications for real estate trusts and funds and their endeavors to incorporate sustainability into real estate portfolios, completes the paper.

**Background**

The world needs a more sustainable built environment to reduce the impact of humans on the earth’s resources and on climate change. To understand sustainability in the real estate context, the holistic expectations of world sustainability need to be examined, along with how they can be manifested in real estate.

The possible definitions of sustainability vary widely and number more than 500, which leads to much confusion (Phillips, 2003) and constant redefinition (JLL, 2007a). However, the majority of definitions have developed or evolved from those such as Brundtland’s (1987), Pearce, Markandya, and Barbier’s (1989), and the World Business Council for Sustainable Development’s (WBCSD, 2006). Awareness of the need for sustainability has developed from the increasing global focus on the world’s finite resources, excessive carbon dioxide emission levels, and the threatening consequences of global warming and climate change. The need for solutions to preserve our way of life for future generations is urgent (Stern et al., 2006; Garnaut, 2008).

Sustainability is a broad, all-encompassing term, but the ability to assess the level of sustainability in a property is proving to be elusive, with more than 600 environmental, social, and economic assessment tools available (Dixon et al., 2008). This study acknowledges that there are many interpretations and many assessments of sustainability; however, for this study, the focus is on the elements of the triple bottom line, namely, environmental, social, and economic factors, and their applicability to commercial real estate. The working definition for this study is: Throughout the lifecycle of a property, being its design, construction, operation and disposal, the property consumes as few natural resources as possible, reduces the production of greenhouse gas emissions and waste, minimizes the impact on the earth while providing an enhanced environment for occupants and the greater community, and achieves life-long economic satisfaction.

The sustainability aspects in the built environment are concentrated on reducing the environmental footprint of the building, and have been identified, primarily, through: (1) reduced production of greenhouse gas emissions (particularly carbon dioxide); (2) reduced use of natural resources, in particular, water, gas and electricity; (3) reduced waste production and increased recycling; (4) enhanced building occupant health, comfort, and safety; (5) production of renewable resources; (6) collection of water for potable and non-potable uses; and (7) recycling and treatment of sewage and waste water (Kats, 2003; von Paumgartten, 2003; Lucuik, 2005; JLL, 2006, 2007a, 2007b; GBCAUS, 2007, 2008a; NZMFE, 2007).
It is commonly observed that the terms ‘green’ and ‘sustainable’ in relation to buildings are treated synonymously, and refer to the concept that such buildings use resources like energy, water, materials, and land more efficiently than buildings that are just built to code (Kats, 2003). Therefore, for the purposes of this study, green and sustainable are taken to be synonymous (Keeping, 2000). However, in commercial real estate, it is not so much that a building is sustainable or green that matters, it is more the level of sustainability claimed (Warren-Myers, 2011).

A concerning perception in the Australasian market is that sustainability is mainly focused on energy efficiency; however, the conceptual understanding of sustainability goes well beyond energy efficiency. Likewise, there are often attributes, which infer a level of sustainability but are not necessarily sustainable. Real estate could, in fact, be made to have uniform building design; however, due to location and the locational characteristics of the building, the level of sustainability will alter, as will the effects on the surrounding development and community. The focus of competitive edge or advantage has been a current theme in commercial real estate investment since the 1980s, and in recent times has changed towards increasing awareness of economic consideration and managerial attention to resource use and building capabilities (Krumm, Dewulf, and de Jonge, 1998). Since 2000 this has changed to incorporate sustainability as a way of achieving a competitive edge in commercial real estate. Initially this played a key role in new development. More recently, however, there is an increasing focus on existing stock and operational performance of buildings.

Commercial entities, like Jones Lang LaSalle and others, have presented sustainability management in the existing building stock to concentrate on resource efficiency, mainly energy, water, and waste (JLL, 2006). The economic connection and discussion on value is a key focus of many articles and papers encouraging real estate investors and owners to implement or invest in sustainability. Consequently, the information provided has identified tangible components of the building, namely through the operational aspects of the building [see Warren-Myers (2012) for further discussion on literature discussing sustainability and value]. Sustainability management in commercial real estate is still cost dominated and the competition affected by practices that are perceived to detrimentally affect value (or add cost) (Heywood and Kenley, 2008). The realm of sustainable asset management in achieving sustainability and triple bottom line objectives is still a developing field. This paper highlights the commercial real estate asset management investment perspectives and actions towards sustainability in the Australasian market.

Real estate is considered unique in that no two assets are identical. Assessing and comparing the level of sustainability in a building is impossible if there is no common ability to identify and quantify the level of sustainability (Kwong, 2004). There are a vast number of rating tools worldwide, all with differing methods of assessing sustainability in real estate (Dixon et al., 2008). The rating tools are often complicated to use and the levels of understanding are limited, making it difficult to ascertain and compare the levels of sustainability in commercial real estate (Dixon et al., 2008). However, sustainability is perceived as measurable by these ratings tools, particularly in real estate markets. The rating tools are not
necessarily the ultimate method of identifying sustainability in real estate, although they are at present acting as a driver for discussion and measurement of sustainability in the market. These tools are likely guiding owners, trusts and funds, and other market stakeholders towards a certain definition of sustainability. Whether it is appropriate or not, the real estate industry needs to be aware that simple resource management is not necessarily achieving the objectives and criteria of sustainability nor assisting the triple bottom line even if they achieve a higher NABERS rating for example (operational energy efficiency assessment tool in Australia). Consequently, defining the actions via rating tools to enable real estate to be called sustainable is not acceptable and can mislead the market.

Primarily, sustainability has been focused on the new building market, as the major sustainability assessment tools (e.g., LEED, GREEN STAR, and BREAM) are primarily focused on the design and construction of new buildings. Had these tools involved ‘embodied energy’ in their assessments, the focus may not have alighted on the new buildings, but on the adaption of the existing building stock instead, which makes up a considerable proportion of the real estate stock. However, the assessment schemes are tools used to create a common language, promote concepts of sustainability, and improve the way in which we design and construct buildings. Primarily, they are used as part of the marketing campaign to entice buyers and tenants to the building. There is still, however, relatively little focus on the existing stock.

The recent Commercial Building Mandatory Energy Disclosure Program (CBD, 2011) includes the existing building stock; however, only on an energy-related basis at this point. The NABERS tool in Australia does have attributes with which to measure other factors such as water and waste; however, the industry’s perceptions and focus are still either on new buildings and the achievement of a GREEN STAR rating, or developing energy efficiency in both new and existing buildings (NABERS, 2011; GBCA, 2012). The sustainability issue for the existing building stock, as well as the general market, is of concern, and investment in sustainability remains uncertain.

Another factor in relation to the existing stock, which many choose to ignore, is that some of the principles on which these existing buildings were designed are actually built using good design principles, which these days would be classified as sustainability (Lopez and Browning, 2007). So, in some cases, existing buildings may comply with certain sustainability principles but are unrecognized because of the requirements of the rating systems and the lack of industry interest in the existing stock. In commercial real estate, there appears to be a strong focus on certain elements of sustainable asset management that achieves components of the triple bottom line; however, overarching achievement of the environmental, social, and economic within the asset’s management still seems to be a high reaching target. This study investigates investors’ perceptions of what sustainability means in real estate and its level of importance in the portfolio, and how they are endeavoring to incorporate sustainability principles within the asset through upgrades and management. Whether their perceptions and actions can truly be identified as achieving the triple bottom line and sustainability is questioned in this paper.
Sustainability is an important focus for property owners; however, there is limited indication of how they are achieving sustainability in real estate portfolios. The ability of owners to achieve the economic considerations for optimal sustainability allocation seems to be a key barrier in preventing broad-scale investment in sustainability in real estate (Daly, 1990). However, over time, there have been multiple reports identifying that the costs of building sustainably are the same or only marginally higher than producing a building to code (Matthiessen and Morris, 2007). In addition to other market factors that have popularized sustainable development, such as market obsolescence, prior to the beginning of the global financial crisis in 2008 a new office building in Sydney would require a GREEN STAR rating, as, if it did not have such a rating it would be considered obsolete by the market.

A key concern is the connection between sustainability and economic return, and the need for owners to justify their investment in sustainability, and whether it affects the type of sustainability in which owners are investing. There are certainly enough drivers for sustainability, from cost-benefit analyses, the limitation of risk and obsolescence, and capitalizing on tenant demand and requirements. However, considering these drivers for sustainability in buildings, is the way sustainability is being implemented and managed in buildings actually achieving the objectives of sustainability?

**Methodology and Results**

This research investigates the major real estate owners, namely, real estate trusts and funds, their perception of sustainability, and the investment or implementation of sustainability within real estate portfolios. The research investigated four questions: (1) What are owners’ perceptions of the importance of sustainability in the commercial real estate industry? (2) What do owners perceive as the most important aspect of sustainability in commercial real estate? (3) To what level do owners believe they are implementing sustainability in their portfolios? (4) Where do owners perceive the value in sustainability implementation?

The research questions were investigated using a combination of qualitative data collection and analytical methods. This approach was used in order to achieve an understanding of the knowledge levels, perception, and implementation of sustainability in the commercial real estate market. The study examines the behavioral attitudes of owners; consequently, this necessitated qualitative data collection using surveys (Neuman, 2007). The analysis of the qualitative data took two forms: first, content analysis and then, in order to gain greater understanding of the frequency and strength of responses and attitudes, the data were coded and quantified to allow statistical analysis.

The study examined the Australian and New Zealand commercial real estate markets. The purpose of examining two markets in the Australasian region was to allow for deeper understanding and explanation of the research, to investigate whether perceptions differed, and to produce findings that may be generalized for other markets (Miles and Huberman, 1994). The choice of the Australian and New...
Zealand markets was because of their similar market dynamics in the context of the product, the client base offering in terms of occupiers and governance, and the type of investment.

Sustainability integration into the markets has emerged hand-in-hand with the development and promotion of sustainability rating tools in these markets, and, as a result, there is a time difference in the level of market maturity between the Australian and New Zealand real estate markets (Warren-Myers, 2010). This was considered as a limitation in the research; however, it has demonstrated the different perspectives in the conceptual thinking of the stakeholders in each market. The reason for not comparing one of these markets with another international example, such as the United Kingdom or the United States, is that they are considerably larger in size than Australia and New Zealand, and, importantly, the dynamics in the markets, as well as the governance, product type, and investment are very different. This may produce some restriction in the implications and generalizability of this investigation for other markets such as the U.K. and the U.S. However, this study highlights the market evolution and development phases, which would be considered to be transferable to most markets, but would require individual investigation.

The focus of the survey sample was listed real estate trusts in Australia and New Zealand that specialize in commercial office investment. There were only 11 office-only REITs in Australia and 16 multi-sector AREITs out of 58 in 2008 (BDO, 2008). Ernst and Young (2008) identified 64 AREITs with only 8 in New Zealand. Consequently, AREITs were targeted in Australia, and comprised the Australian sample, whereas in New Zealand the listed trusts were approached; however, this number was supplemented by major commercial investment companies present in the New Zealand market at the time.

The data collection used a survey instrument comprised of a semi-structured standardized open-ended interview. This paper presents the results of four key questions asked during an extended survey originally of nine questions allowing open-ended responses. The objective was to gain an understanding of the market dynamics around sustainability through owners’ perceptions of sustainability in the market, and to investigate the investment and implementation levels of sustainability in commercial real estate portfolios. The preference for interviewing owners was to ensure that the most appropriate respondent in the company, trust or fund was interviewed [e.g., the chief executive officer (CEO), general manager (GM), senior fund manager, or portfolio manager], thus primarily concentrating on the decision-makers within the organizations. It was perceived that speaking to more senior representatives would provide a more knowledgeable and reliable source of information regarding the activities being undertaken, perceptions, and future directions. A smaller sample of preferred respondents was used in this data collection to increase the understanding of the behavior, actions, and characteristics of the investor market and avoid the limitation of deceptive responses, such as from junior employees who have no input into decisions concerning investments and acquisitions (Neuman, 2007).

The sample included 30 real estate trusts, funds, and companies whose primary focus was investment in commercial real estate; there were 16 from Australia and
14 from New Zealand, from the original sample of 64 (EY, 2008) or 66 (BDO, 2008). This represents 28% of the total number of AREITs in Australia; however on specialization (commercial office) this sample represents 59% of the AREITs.

**Perception of Sustainability**

Participants were asked about their perception of sustainability in the commercial real estate market. Their responses were analyzed using content analysis, which identified several layers of categorization. The layers were then narrowed down to three key themes and the affect extraction technique of relational analysis was used. This technique allowed the responses to be scaled and compared. The three key themes in the analysis process were: (1) time for when sustainability would be a critical issue; (2) awareness of sustainability in commercial real estate; and (3) importance of implementing sustainability in commercial real estate.

The data categorization and coding provided the basis of the themed responses to the questions and an understanding of the range of responses. However, the analysis required further breakdown and quantification. Further analysis was conducted using quantitative content analysis techniques, utilizing the relational analysis method and affect extraction approach allowing statistical analysis (Fellows and Liu, 2003; Busch et al., 2005). Relational analysis and affect extraction allows the data to be explored for relationships, which are then coded into a numerical form for statistical analysis (Busch et al., 2005). This was only applied if this level of analysis was useful in supporting the theory obtained through the thematic analysis of the surveys. The quantitative content analysis of the data allowed the data to be analyzed using statistical tests, identifying and quantifying the data, and also assessing the differences between the data sets of Australia and New Zealand.

After using content analysis, the investor enabled the use of both a qualitative and inference based analysis of the data. The qualitative responses were analyzed on a content basis and themes were categorized in response to the question.

Using the affect extraction technique, the responses were scaled to enable the average sentiments of the owners to be identified. The emotional level of the theme used a range of 1 to 5. In order to make comparisons between Australia and New Zealand, statistical analysis of the responses found an average, standard deviation, and the 95% confidence level for each country, as shown in Exhibit 1. Statistical analysis included the use of an independent sample t-test that assessed the differences between the themes, and whether significant differences between Australia and New Zealand were evident. The test was statistically significant.

The level of importance of sustainability perceived and rated by the individuals did not reach statistical significance. In examining the qualitative responses, it is suggested that sustainability is a conscious issue for the investors and has a level of importance in portfolio management already in both Australia and New Zealand. This coincided with the examination of the awareness differential between the countries, which was also found to be statistically significant (p-value <.0001), which demonstrates there is a significant difference between Australia.
and New Zealand in their awareness of sustainability. This is indicative of the relative differences in the maturity of the markets in terms of sustainability introduction and implementation, and rating tool adoption.

When examining the time theme, again it was also significantly different; however, interestingly, the respondents from the qualitative information from New Zealand indicate they have a sense that sustainability is an issue and the time is now. Yet, this finding does not match their awareness of the issue. The t-test indicates that the difference in awareness between Australia and New Zealand is statistically significant (p-value .011). Perhaps the global and local push for sustainability, as well as the global awareness of climate change and global warming leads to the requirement for immediate action, and has had an impact on this category.

Overall, owners in Australia and New Zealand are favorably disposed towards sustainability from a market perspective. Sustainability is an issue they are aware of and they know that action needs to be taken.

**Perceptions of Sustainability in the Investors’ Real Estate Portfolio**

This question investigated the perception of sustainability in real estate as a consideration for investors’ portfolios. The analysis used a frequency of response analysis, and identified that owners’ perceptions of sustainability were primarily focused on operating expenditure and energy consumption. There were other factors discussed including rating tool assessment, location, indoor environment quality, and quality of office space; however, lower emphasis was placed on these areas.

Several themes emerged as to why owners focused on certain initiatives and strategies including: (1) clear identification of the return on investment; (2) identification of the increase in net income; (3) anticipation of increasing energy and other resource costs; therefore, minimization would reduce this risk; (4) future-proofing against the possibility of carbon taxing; and (5) minimizing real estate risk and obsolescence, from a functional, technical, and market perspective.

The distribution of frequency overall is shown in Exhibit 2, which shows a number of areas respondents’ perceive as referring to sustainability in real estate. The

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**Exhibit 1 | Owner Perceptions of Sustainability in Commercial Real Estate Markets**

<table>
<thead>
<tr>
<th>Awareness</th>
<th>Time</th>
<th>Importance</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZ</td>
<td>AUS</td>
<td>NZ</td>
</tr>
<tr>
<td>Average</td>
<td>3.071</td>
<td>4.250</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>0.829</td>
<td>0.856</td>
</tr>
<tr>
<td>95% Con. Level</td>
<td>0.434</td>
<td>0.420</td>
</tr>
<tr>
<td>T-test</td>
<td>0.0001</td>
<td>0.011</td>
</tr>
</tbody>
</table>
results display a strong emphasis on operational expenditure, at 49%, with 18% for both indoor environment quality and energy consumption. It is interesting to note that within the sustainability literature, there is very little discussion of ‘operational expenditure’ being a primary pillar of sustainability. There was the potential that respondents were using this term as a generalized comment; however, there was expectation that sustainability on the whole would reduce more than just the resource elements in the operating expenditure (e.g., reduced management costs, reduced maintenance etc.). This response could be more aligned with resource efficiency rather than operating expenditure, which generally incorporates a whole range of items or costs to the owners relating to the running of the building. Such costs do not necessarily align directly with sustainability concepts. However, when examined on a country basis, a different picture is revealed.

Exhibit 3 shows that there were significant differences in perceptions in relation to respondents’ understanding of sustainability in real estate; those in Australia had a 65% response in favor of operating expenditure, compared to 23% for those in New Zealand, whereas respondents in New Zealand perceived sustainability to focus on indoor environment quality (38%), compared to Australia in which this did not even rank.

It would appear from these results that respondents’ perceptions of sustainability in commercial real estate in Australia are focused on the (possible) benefits relating to cost minimization, whereas New Zealand is using sustainability as a marketing edge to attract and retain tenants. It is evident from the previous question that Australian respondents have a strong focus on sustainability, yet their perception of sustainability is manifested in operating expenditure. It could be surmised that their focus is on the minimization of resource costs, namely, energy. This view was further supported by statistically testing the responses using a chi-
square test to identify the independence of the responses. This test identifies whether the responses are completely random or whether there is a focus on a particular answer, which would identify whether the respondents are indicating a specific preference for a particular perspective of sustainability.

The result of the chi-square test revealed that Australian respondents \((p\text{-value} < .0001)\) demonstrated a definite directional response to the question as to what their perception of sustainability manifested itself in real estate as, whereas the New Zealand owners had no definitive direction to their answers \((p\text{-value} .565)\). This test identified a significant difference between Australian and New Zealand respondents’ answers to this question. Thus New Zealand respondents’ approach to sustainability is more holistic. However, when the qualitative data are analyzed, it is apparent that these respondents are more broad-minded in accepting the generalized discussion and ideas about sustainability, but limited testing or implementation [see later questions and Warren-Myers (2010)]. Whereas the Australia respondents were or had tested some of these initiatives and analyzed them from a monetary perspective, which indicates and leads to the identified differences in the maturity of the markets. The New Zealand commercial real estate market is identified as being more immature as a result of there being no clear preference for particular sustainable attributes in commercial real estate. This finding is not surprising, as the introduction of sustainability to the market has only recently occurred in New Zealand. However, if this study were undertaken in the future it would be interesting to see whether their views follow the Australian perception and opinion, or whether it remains relatively holistic.

Overall the respondents indicated that operating expenditure was important, which was elaborated on to include energy consumption, and, to a lesser extent, water
consumption. There is the potential for duplication in the responses here, which would mean the equating that 77% of Australian and 46% of New Zealand respondents focus and perception about sustainability in commercial real estate portfolios is around the operating expenditure minimization option. The initiatives focused on cost minimization, particularly energy costs. Respondents were also very concerned about the concept of future-proofing properties against vacancy, taxes, and obsolescence, and expressed the desire to attract tenants to the building. They believed sustainability upgrades, investment, and implementation may serve to reduce the issues relating to vacancy and obsolescence, consequently ensuring future income and reducing the risk profile of the portfolio and the individual assets.

**Sustainability Implementation Levels in Real Estate Portfolios**

To ascertain respondents’ levels of sustainability implementation, questions were asked about the level of implementation and what type of initiatives and strategies they were implementing in their portfolios. The qualitative data were analyzed using content analysis, then using the relational analysis and affect extraction techniques. The data were further analyzed using cluster analysis. Cluster analysis identified three key groups of owners and their levels of implementation: (1) none/low levels of implementation; (2) medium levels of implementation; and (3) high to very high levels of implementation. The stratification of owners and their investment levels is shown in Exhibit 4.

The level of implementation ranged widely, from planning to undertake sustainability, to mass implementation across the portfolios. Because the spectrum was quite broad and categorization using a number of sub-themes helped to identify patterns between the investors and between the countries. The data was grouped into five categories of implementation: (1) no/limited implementation; (2) low level implementation; (3) medium level of implementation; (4) high level of implementation; and (5) very high level of implementation. This categorization has helped to ascertain the differences between the two countries’ respondents’ answers and gain an understanding as to the level of implementation happening within the industry itself.

**No/Limited Implementation**

Respondents made a range of comments from no action, having intention to implement, and minimal consideration with limited implementation of sustainability that might be a future possibility for commercial portfolios. There were comments that “sustainability will be a key focus in the future” but no indication of how they were going to implement sustainability in their property portfolios. Some respondents indicated that “an initial review of selected (appropriately) profiled assets will be undertaken in the future to ascertain existing sustainability level.” However, there was no indication of how or when the person was going to examine the sustainability levels of the property. There were no Australian responses in this category, only New Zealand respondents who were obviously not implementing sustainability initiatives in their portfolios. These
investors rationalized their inaction by the “market isn’t ready,” “there is no demand,” and “it (sustainability) is just a fad.”

**Low Level Implementation: Restricted to Planning and Selective Assets**

The majority of responses were from New Zealanders where their current focus was to examine existing assets for potential sustainability upgrades. However, it was noted “this will be timed with conversions or upgrades at the occurrence of a catalyst, such as lease expiry or upgrade requirement, that suggests it will be beneficial to the investment return of the asset” and “when assessing our strategic plans we are driven by the mutual wants and needs of the market and their opportunities and potential for upgrading particular properties where appropriate.” The current lack of market demand was their justification for limited implementation of sustainability. Consequently, they saw sustainability as an option only at lease expiry or if other significant requirements occurred, before they would consider adopting or implementing any sustainability strategies. The strategies are property and tenant specific. There was no indication of portfolio-wide initiatives to be implemented.
Medium Level of Implementation: Reviewing of Assets’ Operational Performance and Developing Improvement Plans to Implement Initiatives and Improve Sustainability

Responses categorized in this theme were mostly Australian with some New Zealand responses. There is a commitment to review the performance of properties and to develop and implement initiatives to improve their. The focus of this category was on operational sustainability and the efficiencies that can be obtained through low-cost initiatives and active monitoring of the properties. Respondents indicated restriction, in actions relating to the metering of energy, water, and waste information, as most of the properties did not have advanced systems in place to accurately measure these resources. The respondents required sustainability action plans for all assets, with short-term initiatives and longer-term upgrades that would align with lease expires. Respondents indicated their rationale for concentrating on resources, in particular energy efficiency, was to reduce costs and engage tenants in the sustainability initiatives to ensure cost minimization across the portfolio. Respondents from both Australia and New Zealand are really focused on cost minimization strategies, which they believe sustainability can provide, in terms of the efficiencies obtained under the umbrella statement of sustainability. This category had the most comments pertaining to their intent to “produce asset strategies in terms of operating properties, designing, and also buying or developing properties” that focused on the minimization of resource costs.

High Level of Implementation: Investors Auditing, Developing and Implementing Sustainability Initiatives across Property Portfolios

Respondents were implementing sustainability at a broader level, with active auditing and development of strategic short- and long-term sustainability improvement plans, which were in excess of operating expenditure or resource costs minimization plans, incorporating more holistic aspects of sustainability. Respondents demonstrated a single-mindedness on sustainability, in particular on measurable attributes, and were focused on portfolio-wide certification through measurement tools like NABERS and where possible GREEN STAR. They had strong sustainability strategies implemented portfolio-wide, with objectives like “our whole portfolio will be 3 stars NABERS by the end of 2008” and commitments to “4.5 stars across the portfolio by 2012.” They indicated that certification tools, in particular NABERS, provided baseline assessment criteria for the portfolios. They then identified commitment objectives to improve and achieve higher certifications across the portfolio in the future. This provided an active focus and the implementation of many strategies that could be transferred from property to property. To achieve further improvement, more strategic and cost intensive approaches are required, as the ‘low-hanging fruit’ has been picked to achieve current parameters. Long-term commitments of respondents demonstrates that active “metering and monitoring happening throughout the portfolio with continual improvements being made to ratings and identification of improvement potential” and the need for “coordinated approaches to integrate further improvements throughout the portfolio.”
Very High Level of Implementation: Portfolio-wide Commitments to Development and Investment of Only Rated Properties

The final category identified only a few respondents who really focused on being market leaders in the industry. Their approach involved whole portfolios achieving very high levels of both design and operational industry certification and significant measures to upgrade portfolios to achieve high levels of sustainability certifications. Respondents used similar strategies to the previous category, to examine “the current position of the property and create a roadmap (energy, water and waste) on how to improve the sustainability over time, the aim is to have the whole portfolio achieving a 4.5 NABERS rating by 2012.” However, the focus on sustainability is not limited to energy, water, and waste as the growing importance of indoor environment quality requires “6 monthly assessments throughout the portfolio of the indoor environment quality of our properties” to ensure that they are providing a superior level of quality to the occupiers of the property. These strategies are going beyond just cost saving strategies for the portfolio and are beginning to address a broader concept of sustainability.

There are clear differences in the clustered groups that also reflect the countries the owners’ portfolios are in. There is a cluster of New Zealand respondents in the zero to low level of sustainability implementation who are not implementing sustainability at all, in addition to a proportion who are contemplating but are yet to act. At the other end of the spectrum, there is a cluster of Australian respondents in the high to very high levels of implementation category. The dominant group, however, is the larger middle group made up of respondents in both Australia and New Zealand. This is the group that has medium levels of implementation of sustainability strategies in their portfolios and properties.

Type of Implementation Adopted

The study investigated respondents’ implementation types and strategies in regard to sustainability. Content analysis was used to analyze the responses. The frequency of responses identified different attributes they believed to have the most financial benefit, and there were recognizable differences between Australia and New Zealand. This finding was further tested using a chi-square test to identify whether a directional focus in the responses was evident. Exhibit 5 shows a considerable difference between sustainability implementation practices in real estate in Australia and New Zealand. New Zealanders demonstrated a more varied approach to sustainability implementation, whereas Australian owners were primarily focused on energy conservation.

Sustainability initiatives and strategies implemented by the majority of respondents from Australia were focused primarily on energy efficiency and, in particular, initiatives that focused on conservation and consumption (65%). The second highest rating initiatives were focused on the operational expenditure section (incorporating management, water and energy resource efficiency, and use minimization) at 18%. Then, at 6% were marketability and rating tool certification, and 5% sustainable attributes (like solar panels, fuel cells, water recycling, tanks
etc.) brought up the sum total of the focus of Australian respondents’ sustainability implementation strategies and initiatives. It is clear Australians were focused on energy conservation and consumption as the main sustainability attribute, which was rationalized in their responses as providing the strongest demonstrated financial return. New Zealanders, on the other hand, had a relatively even distribution of operating expenditure and marketability, at 23% each, followed closely by energy conservation, sustainable attributes, and indoor environmental quality. In order to identify whether the respondents had a directional focus to their responses, chi-square tests were conducted. These tests found Australian respondents to have a statistically favored choice for energy efficiency ($p$-value < .0001), unlike New Zealand respondents who did not have statistical significance ($p$-value of .718), indicating no clear favorite choice or directional focus. The level of market evolution and the knowledge of the benefits of sustainability and its impact on the market values of properties evidenced by the strong focus of Australian owners have on those strategies. New Zealand respondents, meanwhile, do not have a clear favorite, indicating the market has not yet developed to a point where it values sustainability.

The sustainability strategy or initiative being implemented most by respondents is energy conservation. A distinct differential between Australia and New Zealand is evident, with Australian respondents favoring the direct benefits of energy efficiency and conservation, whereas New Zealand respondents demonstrated no clear direction. The respondents are clearly focused on cost reduction and tenant demand, and only implementing sustainability initiatives that would appeal to tenants. However, cost minimization is a clear favorite of Australian respondents. This finding concurs with some views on the ‘value’ question, as discussed by Bowman and Wills (2007), where value will likely be identified through savings
achieved in resource use or operational expenditure, as well as through minimization of tenant vacancy, and having the draw card to ensure tenant turnover is minimal.

**Conclusion**

The findings reveal that survey respondents’ ideas of sustainability are focused on cost minimization strategies. Can this truly be said to be contributing to ensuring we increase the level of sustainability in the built environment? It would appear that although it is laudable that the study participants are implementing sustainability initiatives, it is not really achieving sustainability. Management practices to identify and implement cost minimization strategies have been around for a long time in property management. So, what is really happening? Best practice property or real estate management techniques are simply being re-packaged as ‘sustainability’ initiatives and implementation schemes.

Survey respondents are aware of the increasing importance of sustainability in the built environment, and are at varying levels of implementation. However, the implementation of sustainability is limited to cost minimization strategies, focusing mostly on energy efficiency. They have identified the value in sustainability as resource cost minimization, and, consequently, are investing in initiatives focused on that aspect. However, they are not as yet able to realize the market value of these sustainability initiatives through the appraisal process of these assets, so are limited in their justification of implementing sustainable strategies. The logical correlation between building performance and value is that properties that are better maintained have, historically, achieved better market rents, values, and sale prices as the result of good management. Cost minimization concepts are not new to property management; the term ‘sustainability’ has merely been highlighted and captured in building design, construction, and management. Thus, it can be said that many of the aspects currently touted as sustainability, and implemented under the guise of sustainability, are just a part of best practice real estate management. Best practice management is expected for commercial funds and real estate investment trusts, as it is the drive for increased investment and performance. Attitudes towards management practice do vary on country basis but is also dependent on the timing of the property cycle.

Sustainability, and awareness of sustainability, has brought to attention the importance of life cycle costing (LCC) in capital budgeting processes. The elevated consciousness of LCC in asset strategies, in particular operational costs and mitigation against future risks relating to sustainability, has meant LCC and sustainability are considered to be synonymous. Sustainability has raised its profile in the industry, but this does not necessarily lead to economic sustainability, nor does it necessarily achieve the other components of sustainability. However, LCC is not a new concept. It rose to the forefront in the 1970s and 1980s when the oil crises occurred, which led to the considerable prominence of this theory in property management (Harris, 2008). LCC has, essentially, been redeveloped as a concept under a new name, sustainability, which provides increased marketing and profile for owners as a result of market perceptions towards climate change and
global warming. Respondents’ interpretation of sustainability is focused on resource cost minimization strategies, particularly energy. However, this does draw a link between the concepts of triple bottom line theory, whereby environmental factors are incorporated at the same time as economic viability is justified. Consequently, two sectors of the ‘sustainability’ definition are achieved. The extent of these environmental provisions may be viewed as elementary and inadequate in the larger scheme of the requirements for sustainability in commercial real estate, and they do not necessarily advocate increased sustainability in the commercial real estate sector.

Historical observations between ‘well run’ properties and market value may provide guidance as to the relationship between sustainability and market value. The real objectives of sustainability are to address environmental, social, and economic elements. This study, however, suggests that economic elements remain the priority for owners. Consequently, where environmental elements can be addressed in relation to economic elements, such as the minimization of energy costs, owners seem to consider these actions as addressing sustainability in their real estate portfolios. This research has found that environmental and social factors alone are relatively ignored by otherwise, unless there is some connection to economic viability. As a result, this paper questions whether owners are actually seeking sustainability or being green within their real estate portfolios, or are they just ensuring a marketing edge and economic longevity in regard to cost savings, which are linked to best practice management.

The concept of sustainability is, in essence, to develop an overall improvement in commercial real estate through environmental, social, and economic elements. However, this study demonstrates that implementation of sustainability is being limited by property owners to energy and resource efficiency measures, which are strongly focused on economic elements with limited application of the overarching objectives of sustainability. Therefore, this narrow focus on cost minimization is not a new phenomenon in the real estate market; it has just been dressed up as sustainability to gain the rewards of minimizing costs, and consequently, to enable the marketing of the properties to be seen as more socially responsible. In reality, the owners seem hesitant to step beyond the cost-saving initiatives where they cannot identify direct paybacks or quantify the marketing advantages. This means current efforts at sustainability are just best practice management, which has been and should be occurring anyway. An examination of the more holistic characteristics of the incorporation of sustainability into commercial real estate portfolios needs to be undertaken to fully implement sustainability.

Clearly, if owners are not implementing more holistic attributes and are limiting their ‘sustainability’ to cost minimization management, the ability to identify a relationship between sustainability and value is limited. Consequently, this will lead to limited investment in sustainability in the commercial real estate sector that is not directly linked to cost minimization. Even then, cost minimization has its limits, as many leases are on a net basis, and the benefits flow more directly to the tenants. Little acceptance within the appraisal professions, in Australia or New Zealand, have incorporated the benefits this style of sustainability is making to the performance and value of the asset. Although energy efficiency and its
consequential impacts, such as reduced carbon emissions, are to be commended, the overarching principles of sustainability are not being achieved. In the long term, social, environmental, and economic impacts for many connected in the management, ownership, occupation or interaction with real estate will result, and the costs in the future may be significant across the triple bottom line as a result of the lack of adequate sustainability incorporation into real estate now.

**Endnotes**

1. In 2012 a new group included the REITs and many other real estate investors in a sustainability-oriented self-reporting scorecard administered by a new industry led organization started by Nils Kok. It is found at www.gresb.com and stands for the Global Real Estate Sustainability Benchmark. The overall GRESB score is split into two categories: “management & policy” and “implementation & measurement.” Management and policy represents 30% of the GRESB score, whereas implementation and measurement has a weight of 70%. Thus, the overall GRESB score rewards actions more than words.

2. Respondent Q (NZ): “Sustainability will be a key focus in the future.”

3. Respondent Z (NZ): “An initial review of selected (appropriately) profiled assets will be undertaken in the future to ascertain existing sustainability level.”

4. Respondent Z (NZ): “…market isn’t ready.”

5. Respondent Q (NZ): “…there is no demand.”

6. Respondent W (NZ): “…it’s just a fad.”

7. Respondent Y (NZ): “Existing assets strategic plans for each asset will incorporate sustainability focus however this will be timed with conversions or upgrades at the occurrence of a catalyst such as lease expiry or upgrade requirement that suggests it will be beneficial to the investment return of the asset.”

8. Respondent X (NZ): “When assessing our strategic plans we are driven by the mutual wants and needs of the market and their opportunities and potential for upgrading particular buildings where appropriate.”

9. Respondent G (AUS): “Our internal committee produce asset strategies in terms of operating buildings, designing and also buying or developing buildings.”

10. Respondent J (AUS): “Our whole portfolio will be 3 stars NABERS by the end of 2008. Next year the target goes up and so on and so forth, we’ve got metering and monitoring happening throughout the portfolio with continual improvements being made to ratings and identification of improvement potential.”

11. Respondent I (AUS): “We are using NABERS/ABGR since 2002 across our portfolio and we have committed to having 4.5 stars across the portfolio by 2012, currently we are at 3.8 stars. We have implemented all the obvious low hanging fruit initiatives and now we have a coordinated approach to integrate further improvements throughout the portfolio.”

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15 Respondent F (AUS): “All our existing portfolio have sustainability road maps, where we identify the current position of the building and create a roadmap (energy, water and waste) on how to improve the sustainability over time, the aim is to have the whole portfolio achieving a 4.5 NABERS rating by 2012. Also we are conducting six monthly assessments throughout the portfolio of the indoor environment quality of our buildings.”

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Landscape Restoration and Stewardship Funded in Perpetuity through Home-site and Golf Course Development

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Abstract: A challenge for sustainable development on restored landscapes is to secure funding in perpetuity for restoration. We report on a project that has provided a stable source of long-term funding for restoration in conjunction with development of housing, a golf course, and other amenities. At the restored site, historic grazing and a dam system had degraded hydrology and vegetation. Post-restoration ecological metrics now indicate a five-fold increase in spawning trout, and doubling of bird species. Private funding supports prairie and wetlands restoration efforts through a contractual sales-transfer fee and homeowners’ dues. A naturalist coordinates restoration and land stewardship. The project provides a model for restorative-development projects supported in perpetuity.

The restoration of degraded landscapes in recent years has been motivated by economic incentives and legal regulations, as well as by burgeoning recognition of land-stewardship responsibilities (Reeve, Lichatowich, Towey, and Duncan, 2006). In the American West, funding for restoration projects has derived from both public and private sectors. An ongoing challenge for land restoration efforts has been to secure a stable source of funds to maintain restored landscapes (Ehrenfeld, 2000; Holl and Howarth, 2000).

During the twentieth century, conservation efforts in the United States were dominated by large-scale federal projects. The past century brought the development of the National Park and National Forest Systems, the National Wildlife Refuge System, Wilderness Areas, and the Bureau of Land Management. These large-scale conservation efforts have been supported through federal budgetary consent.

In recent decades, private land conservation efforts have increased dramatically (Land Trust Alliance, 2010). For example, by 2010 in the U.S., land trusts had conserved more than 19 million ha, up from ~9.6 million ha (Land Trust Alliance, 2010) in 2000. This dramatic expansion of conserved lands reflects the burgeoning use of conservation easements. It also reflects the extent to which private landowners are increasingly interested in supporting and engaging in conservation efforts.
Here we describe how the challenge of securing long-term funding for conservation projects was addressed in efforts to acquire and restore prairie and wetland habitat on a then-working 710-acre ranch near Jackson, Wyoming. This ranch was purchased by a group that subsequently developed an 18-hole golf course and residential community on the property. Degradation of this landscape had occurred during a century of intense grazing by horses (*Equus caballus*) and cattle (*Bos* spp.). These historical impacts were exacerbated by construction of a major dam and dike system offsite, with negative consequences for local hydrology and for the ecology of an onsite narrow-leaf cottonwood (*Populus angustifolia*) forest.

Restoration efforts on this property, now known as 3 Creek Ranch, are supported through development of luxury residential housing and a golf course, and have led to reestablishment of prairies, spring creeks, and wetlands (“3 Creek Ranch, Jackson Hole”). The project is sustained through a contractual sales-transfer fee and monthly homeowners’ association (HOA) dues that currently support and will endow the property’s Nature Center. An onsite naturalist, supported by the HOA, coordinates efforts to monitor and promote restoration, and runs education programs that foster land stewardship and community involvement in landscape restoration and preservation. We describe several successful features of this restorative development project, and propose that they can be adapted and implemented on many scales to foster and sustain restoration of other human-inhabited landscapes.

**History of the Restoration and Development Project**

**Identification of the Property**

Two of the authors (TH and MB) first visited the property in the winter of 2000. The former 4 Lazy F Ranch in Jackson, Wyoming consisted of 710 acres of pasture, hayfields, wetlands, cottonwood (*Populus* spp.) forest and three spring creeks that flowed year-round and contained native cutthroat trout (*Oncorhynchus clarki bouvieri*). The property had been used for many decades as a cattle ranch, but had potential to be restored as a habitat for birds, small and large mammals, native grasses, and shrubs. There was also substantial opportunity for restoration of wetlands and spring creeks. Hay fields on the upper bench of the former ranch were noted for their potential as sites for development of a residential community and golf course.

**Entitlement Process**

After a period of investigation and due-diligence inspection of the property, developers obtained an option to purchase, and initiated the legal entitlement process to secure approval to develop the property. Prior to groundbreaking, the developers collaborated with environmental consultants to write a mission statement emphasizing the landscape restoration goals of the project. After a series
of public hearings, developers obtained entitlements from relevant governmental agencies. Public hearings had a real impact on the entitlement and design process, and set the foundation for a collaborative and solution-oriented approach among all interested parties. Discussions were held with the Jackson Hole Conservation Alliance, the main conservation group in Jackson, WY. The Conservation Alliance was consulted for input on the proposed project; its support was a key factor in obtaining approvals during the entitlement process. Through cooperation with the Alliance and local city and county commissions, approvals for development and restoration were obtained in a timely fashion.

Identifying Expert Consultants

County regulations require that large-scale developments have a Natural Resource Management Plan (NRMP) that includes guidelines and regulations for a water quality monitoring network, chemical application standards, and overall landscape planning to ensure that the development does not result in negative impacts to these resources. Local consultants were selected to develop an NMRP, and to guide various aspects of the development process to ensure compliance. Development and ecological restoration experts included a landscape architect, a land surveyor, an engineering group, hydrologists, wetlands- and stream-restoration experts, architects, and a golf-course design group.

Two naturalists were recruited to develop and implement a plan for the onsite Nature Center. They coordinated the vision and efforts of other consulting professionals, and developed a stewardship program to restore and create new habitat. Drawing on their prior experience with local raptors, the naturalists established an onsite education, conservation, and wildlife-rehabilitation program, with emphasis on raptors.

Funding the Initial Efforts, and Long-term Stewardship, through a Sales-transfer Fee

Initial costs of restoration are usually considered as a component of development costs in many land development projects in the U.S., and were so considered in this project; long-term stewardship typically requires a separate funding mechanism. A key and initial goal of this development/restoration project was to provide a sustainable source of funding, and to ensure that each homeowner had a direct investment in, and connection with, the restoration aspect of the project. To this end, a sales-transfer fee was established as part of the deed for each property. The fee requires that the seller contribute 0.2% of the sales fee to the stewardship fund each time a property is sold. In the event that sales transfer fees accrued in a given year are insufficient to support costs for continuing restoration efforts and for the Nature Center, the HOA is obligated to cover any shortfall through homeowner fees.

Eighteen months into the project, near the end of the entitlement process, funding for the entire project was obtained from a development fund. Investors in this development fund recognized ecological restoration as integral to the economic
outcome of the project, and thus shared the values of restorative development. We estimate that more than 5% of land procurement and development costs were directed towards restoration efforts. It is likely that amenities of restoration and the Nature Center together substantially increased property values and more than offset the developers’ initial investment in restoration. Available data, however, do not provide information on the extent of these likely increases.

Restoration and Development Activities

Restoring Creek Beds and Creek Banks

A key goal of the 3 Creek Ranch restorative development project was to remedy the degradation of riparian areas. Over the past half century, the ecological function of most small, spring-fed side channels of the Snake River in Jackson, Wyoming had been negatively impacted by a dam and over 30 miles of levees constructed for flood control (Anthony, 1998). The cessation of the periodic flooding of these tributaries had led to degradation of riparian ecosystems through sedimentation and loss of habitat suitable for fish-spawning and for the regeneration of native cottonwood trees. Only a few side channels and spring creeks remained active as fish-spawning habitat. Diversion of water from the Snake River and Gros Ventre River for irrigation of ranch lands adjacent to 3 Creek Ranch had created numerous hydrologic impacts within 3 Creek, including altered timing and intensity of peak flows, channel width-to-depth ratios, substrate size, and excessive sediment loading.

Portions of two of the creeks that remained active, Blue Crane Creek and Spring Creek, exist partially on 3 Creek Ranch. The naturalist provided oversight of a major effort to restore and rehabilitate 3.5 miles of spring creeks to improve habitat for native cutthroat trout. Oversight was also provided for the construction of three ponds designed and built specifically to provide winter habitat for trumpeter swans (Cygnus buccinator). Wetland restoration spanned a substantial portion of the property. The restoration created additional wetlands, including large ponds surrounding the ~200-acre golf course. Sod from native wetlands was placed along the perimeters of these new ponds, permitting establishment of five plant species native to western wetlands, including hardstem bulrushes (Scirpus acutus), Beaked Sedge (Carex utriculata), and Nebraska Sedge (Carex nebrascensis). These new plantings also provided substantial bird habitat on the perimeters of the ponds.

Restoring Riparian Areas and Grasslands

Riparian areas near Jackson, Wyoming are typically dominated by populations of Colorado blue spruce (Picea pungens) and narrow-leaf cottonwood. Prior to restoration, the extent and apparent health of native river bottom cottonwood forests on the ranch had been compromised by many years of livestock and horse activity. The dam and levees that had existed on the property for several decades disturbed the periodic floods that facilitate reproduction of cottonwood trees
In contrast, spruce, which are not dependent on flooding for reproduction, had come to dominate areas where historical flooding regimes were disturbed, a phenomenon that has been described elsewhere (Anthony, 1998). To redress these problems, efforts to restore trees at 3 Creek Ranch focused on restoring conditions favorable to the reproduction and persistence of cottonwood.

Grasses that had become established in the absence of flooding regimes posed a particular challenge to cottonwood reproduction. These grasses had dense root structures, enabling them to outcompete other plants for access to space for germination. The sexual reproduction of cottonwoods, in particular, was severely limited because few seeds were able to germinate amid dense grass roots. The vegetative reproduction of cottonwoods was also limited by a herd of approximately 800 elk (*Cervus elaphus*) that ate new suckers that emerged on existing trees. The elk herd continues to roam the ten miles of the Snake River riparian area adjacent to 3 Creek Ranch, and typically visits the property each summer and fall. Efforts are underway to use fencing to protect from elk the emerging cottonwood suckers and new plantings.

The cottonwood-spruce riparian ecotone on 3 Creek Ranch abuts approximately 300 acres of open meadows. Prior to restoration, these meadows consisted of both native and non-native wetland, and upland grasses, forbs, and shrubs. These meadows had been heavily impacted by decades of horse grazing. Initial efforts to restore prairie habitat consisted of removing horses and fences, aggressive management of noxious weeds, installation of native willow and sod along creek banks, and planting mixtures of native seed.

Approximately two years of year-round time and effort went into this initial phase of landscape restoration. Considerable time was given to ecological restoration of the three spring creeks. Shallow ponds were designed specifically for trumpeter swan feeding and loafing habitat, and were constructed in parallel with restoration of spring creek and wetland habitats. The development team also established protocols for periodic maintenance of all restoration programs in perpetuity. For example, all three spring creeks on the property continue to receive varying levels of additional water from upstream irrigation practices. This irrigation water comes from the Snake and Gros Ventre Rivers, and bring with it sediment and silt into spring creeks during seasonal high-flow periods. Every four years the naturalist leads efforts mechanically to remove sediment and to clean or replace fish-spawning gravels.

The upland grass meadows adjacent to the riparian areas also had been impacted by over 80 years of livestock grazing, resulting in establishment of non-native grasses and noxious weeds. Immediately after acquisition of the property, an aggressive weed-management program was begun in cooperation with the County Extension Office. Livestock were removed, plant species of concern were identified, and an appropriate long-term management plan was developed. Within two years of these interventions, native grasses and shrubs started to return.

Effective, ongoing management of the restored native prairie habitats is facilitated by communication and collaboration between the naturalist and golf course...
personnel. A key goal of this collaboration is to allow operation of the golf course and other recreational amenities, as well as the residential properties, without compromising the quality of the restored native areas on the property. Golf course maintenance includes application of biodegradable herbicides and pesticides that were selected to surpass the requirements noted in the county-required NRMP.

The quality of surface and ground water is monitored to ensure maintenance of a healthy aquatic ecosystem. Water quality in wells, ponds, and streams of the development was monitored eight times per year during the initial five years of the project, and since then has occurred four times per year in summer months. Tests of water turbidity, pH, dissolved O₂, and temperature, and the levels of chemical herbicides and pesticides, have consistently revealed that water quality meets or surpasses the standards mandated by federal and state agencies. The town of Jackson, Wyoming provides domestic water and sewage treatment for the development.

**Development of Residential and Recreational Facilities**

The 3 Creek Ranch development now includes 136 residential lots, an 18-hole championship golf course, fitness center, tennis courts, swimming pool, clubhouse, bike paths connecting to the existing community bike-path system, and groomed cross-country ski trails. Spruce, aspen (*Populus tremuloides*), and shrubs were planted around residential sites and common areas in strict compliance with established guidelines set forth in the Covenants, Conditions, and Restrictions (CC&Rs) of the development with the complementary goals of increasing habitat for birds, and providing visual screening. Most of the other landscaping at home sites is restricted to native species, and is maintained without chemical herbicides and pesticides. Watering of native species occurs primarily during an initial two-year establishment phase.

**Establishing Housing Opportunities for Employees and the Broader Community**

The 3 Creek Ranch development includes subsidized onsite rental housing for employees. Offsite affordable housing was provided as mitigation by 3 Creek Ranch, and is conveniently located near schools and public transportation.

**Ongoing Operations**

**Nature Center**

The 3 Creek Ranch development team sought to engage property owners as stewards of the restored landscape. To this end, the Nature Center was established to educate and involve residents of the development in landscape health and monitoring, and to provide a model of land stewardship that other developments might follow. To be successful, the Nature Center and its Naturalist Program needed to be embraced by development leaders, sales and marketing teams, and
future and current 3 Creek residents, and to be supported financially through the governance documents of the HOA. In particular, the Nature Center had to be a part of the project ethos from the outset, and in perpetuity.

The Nature Center supports a year-round Naturalist and Outdoor Pursuits Program, and is located in a restored, 1,000-square-foot homestead cabin in the center of the development. The Nature Center is the focal point for residents and potential owners to participate in outdoor recreational and educational activities, both within the development and in the surrounding region. The Nature Center and its Naturalist and Outdoor Pursuits Program were key marketing elements that distinguished the development from others.

For 3 Creek residents and their guests, the Nature Center serves several functions. It is a meeting place for scheduled outdoor activities, and houses a library of field guides, natural history books, and maps of the region. It also maintains a collection of mammal skulls and skins for interpretive talks, and equipment such as spotting scopes, binoculars, and technical instruments to measure water quality and quantity. Each week, the naturalist provides a presentation at the Center on topics of natural and human history, and hosts guest speakers from the community.

**Land Stewardship, and Monitoring of Plants and Animals**

During the early entitlement phase of the project, the naturalist supervised compliance with the environmental stewardship requirements of the U.S. Fish and Wildlife Service and the Wyoming Game and Fish Department. These supervisory efforts included updating an atlas of native and exotic plants. Animal diversity and abundance records were collected for songbirds, raptors, trumpeter swans, stream macro-invertebrates, and amphibians. The naturalist operates a Monitoring Avian Productivity and Survivorship (MAPS) station on the property, records patterns of elk movement, and monitors stream pH, dissolved oxygen concentration, turbidity, water temperature, and seasonal-flow discharge.

The naturalist maintains a year-round schedule of guided outdoor events and activities to foster and sustain residents’ awareness of natural history and ongoing restoration efforts. Guided summer activities include weekly day hikes, a bicycling program, canoeing and flat-water kayak trips on local lakes, stargazing and astronomy evenings, wildlife viewing, and birding trips in the local area. In winter, the naturalist oversees management of an onsite Nordic ski track, and offers weekly ski clinics, snowshoe trips, and winter outings throughout the local area.

**Fishing Program**

The naturalist designed and created a weekly calendar of angling opportunities to regulate and monitor angling activity at onsite spring creeks. This structure was implemented to ensure long-term ecological integrity of the creeks and the fishery, while providing significant angling opportunities for residents. A full-time fishing guide manages the angling program from the Nature Center. The fishing program is highly regulated, with an established ‘beat system,’ which prevents over-fishing in any one area. Fishing is catch-and-release only, and is highly restricted during spawning periods.
Raptor Rehabilitation Center

Initially, the naturalist managed a year-round raptor rehabilitation and education center from facilities located at the Nature Center. In the past three years, the raptor program grew and it soon became clear that the number of raptors in need of care far exceeded the space capacity and naturalist’s time required for their care. As described below in the Broader Impacts section, the Center was successfully moved, with assistance from the development, to become the Teton Raptor Center.

Mechanisms to Provide Funding in Perpetuity

The naturalist program is funded by the HOA out of a portion of the monthly HOA fees contributed by each household, and from a 0.2% tax on sales and resales at 3 Creek Ranch. Portions of these fees continue to build an endowment for the Nature Center, the naturalist activities, and continuing restoration efforts.

Methods for Surveying Birds and Fish

Bird counts for which data are reported here were conducted, beginning in 2002, by the same individual (RS) as part of weekly stewardship responsibilities, and are an on-going activity. Counts are conducted and recorded by walking the same areas on the property two to three times a week, for approximately two hours per observation period, and in representative vegetation types. Bird species are identified visually by using binoculars, and aurally through recognition of bird calls and song. A majority of bird counts were conducted between sunrise and late morning hours. Some birds were observed and recorded opportunistically, and not during scheduled stewardship events. Homeowners joined RS for many bird-count outings.

All cutthroat-trout redd surveys reported here were conducted by RS, with assistance from a local Game and Fisheries biologist, and are ongoing. Individuals conducting surveys walk slowly along each creek bank. Disturbed or cleaned gravel or cobble areas showing a pit and a tail spill are recorded as a trout redd. The location and estimated size of each redd is recorded and mapped on aerial photographs. Typically, surveys are conducted each year in late-April, mid-May, and mid-June along all spring creeks on the 3 Creek property. Because of high silt levels in Cody Creek during an April survey period, data reported here include late-June redd counts for this creek.

Results of Restoration as Assessed through Wildlife Surveys

Fostering the return of native cutthroat trout was an important goal of this restorative development project. To this end, restoration of stream beds with spawning gravel was carried out over the four-year period from 2004 to 2007 (Exhibit 1A). Prior to and during the first year of gravel restoration efforts, fewer
Cumulative numbers of (a) Linear Feet (LFT) Spawning Gravel Placed, (b) Homes Built, (c) Shrubs Planted, (d) Aspen Planted, and (e) Spruce Planted during restoration efforts from 2002 to 2010. With the exception of Homes Built, for which an upper limit was imposed by the 136 sites available on the property, quantitative goals were not established prior to restoration efforts.

than five spawning redds were observed in each of three years (Exhibit 2A). Within a year of the start of gravel addition, the number of spawning redds began to increase; at least 20 redds were observed in each of the three years following completion of this restoration in 2007 (Exhibit 2A).

The addition of gravel in potential spawning areas was thus correlated with the number of redds in the areas restored. The increase in redds began in 2005, one year after the start of gravel addition, and has not declined substantially following the onset of restoration. From these observations, we conclude that the potentially...
disruptive process of restoring gravel did not lead to substantial transient declines in habitat quality, and is consistent with a nearly immediate, and lasting, positive impact on the fish population.

Home construction began in 2005, and continued through 2010 (Exhibit 1B) to the present. New plants were established on and near home sites and the golf course during the same time period; cumulative numbers of shrubs (Exhibit 1C), aspen (Exhibit 1D), and spruce (Exhibit 1E) increased in concert with the construction of homes (Exhibit 1B). The number of bird species observed increased during these construction efforts, with a doubling of species from 60, as observed in 2005, to 120, as observed in 2010 (Exhibit 2B). The finding of a positive correlation between the amount of vegetation planted and avian species richness suggests that plant restoration was beneficial, even in the midst of construction activities and the ensuing greater density of homes.

In addition to an increase in the numbers of bird species observed during and following the restoration period, the number of individuals of at least one migratory species observed on the property—the trumpeter swan—showed substantial increases. Following completion of pond and wetlands restoration, the number of individual trumpeter swans observed per day increased from 15 to 40, with over 100 swans observed on many days in November through March. Data for future years will be required to assess whether these high counts for species and individuals indicate the establishment of stably increased diversity and population densities.
Broader Impacts on Habitat, Wildlife, and Stewardship

Establishment of the Teton Raptor Center

As mentioned above, a Raptor Rehabilitation Center established by the naturalist program grew quickly, and soon surpassed the space capacity and the naturalist’s time required for the raptors’ care. The Center was moved to a new location in the community, and became the Teton Raptor Center, under the direction of three full-time staff, and more than 40 volunteers.

The Center now hosts more than 20,000 guests per year, who visit to learn about raptors and local natural history. The Teton Raptor Center is now a self-sustaining, not-for-profit entity that houses injured and falconry birds, conducts outreach-education programs, and assists federal and state agencies in raptor conservation efforts. The Center is licensed at both federal and state levels. Individuals from 3 Creek Ranch continue to assist in these offsite conservation programs.

Reopening of Fish Corridors

Restoration of corridors for native fish is an essential priority in the construction of riparian ecosystems (Evans and Johnston, 1972; Gowan, Young, Fausch, and Riley, 1994). Restoration of fish habitats at 3 Creek Ranch would be of little value if offsite creeks were not also clear for passage of Wyoming’s only native trout, the cutthroat, and the non-native brook trout (*Salvelinus fontinalis*). An unobstructed passage way for spawning fish to travel from creek headwaters to meet larger populations at the confluence with the Snake River was a goal for both 3 Creek Ranch and upstream property owners. To assess for possible obstructions upstream, the 3 Creek naturalist approached neighboring property owners to inform them of the goals and progress of restoration on 3 Creek Ranch. In response, upstream neighbors elected to hire the biologists who had worked on 3 Creek Ranch to restore creeks on their own properties. The ensuing offsite restoration projects identified numerous problems, including culverts inappropriately elevated above stream level.

One successful project was funded privately and by a grant from the local Fish and Game Department. The project included removal of a weir dam built in the early 1900s, and its replacement with an effective cross-vane weir fish ladder (Exhibit 3). The removal of this water obstruction made available over nine miles of spring creek water, including over three miles of high-quality spawning habitat. A follow-up program has been established to monitor near- and long-term outcomes of this project.

Key Lessons and Concluding Remarks

The restorative development of 3 Creek Ranch provides a model for how land restoration projects can be initiated by developers and sustained in perpetuity by
Replacement of a weir (left), four feet in height, with a fish ladder (right) restored fish access to nine miles of creek water, including high-quality spawning habitat. Photos by Brian Remlinger, Alder Environmental.

contractual agreements with homeowners. Several key features of the project serve as lessons readily applicable to other restorative development projects:

**Cultivating Shared Values with the Local Government and Community**

Development of a mission statement early in the entitlement process helped property developers, local government, and local citizens to focus on the dual property development and restoration goals of the project. Gaining the support of a local conservation group was instrumental in establishing this dialogue. The moderate size of the adjacent residential community encouraged multiple in-person meetings. Such direct meetings with a majority of local residents may not be feasible in some larger communities. Internet-based communication systems, however, could be used to invite comment and contributions on emerging mission statements for similar development projects in both rural and urban settings.

**Long-term Monitoring of Habitat Quality**

The 3 Creek Ranch sales-transfer fee ensures funding for the naturalist position and for the Nature Center. This mechanism ensures the continuity of monitoring of restoration outcomes, and of opportunities for homeowners and their guests to learn about local ecology. Monitoring efforts require resources proportional to the size of the property under restoration. Restoration and monitoring on a larger scale are feasible when larger land areas have proportionally more homeowners. For sparsely populated developments, a large fraction of the total restoration costs fall on each individual homeowner. This may impose an upper limit on the magnitude of possible restoration efforts when property owners are few.

In our project, wildlife census data were collected before, during, and following the initiation of development and restoration efforts. Our recommendation for similar projects in the future is to begin onsite data collection efforts several years prior to the initiation of restoration, and also to include quantitative data on water
quality and use. Such data will provide information on baseline annual fluctuation in water and wildlife patterns. Data from unrestored neighboring properties and for small, unrestored areas set aside onsite will provide useful controls and information on the scale of the impact of restoration efforts. Interpretation of future measures of restoration outcomes will benefit when collection and analysis of such control data are planned from the outset of the project.

**Engaging Homeowners in Study of Local Ecology**

The 3 Creek naturalist is aided in wildlife monitoring by homeowners who volunteer as participants. Many of these property owners have gained an introduction to restoration ecology through the Nature Center. Here, scale clearly matters in that small property developments will find it more difficult to sustain the costs of a natural history center, and to support a resident naturalist. For larger developments, several naturalists may be hired without imposing unreasonable costs to individual homeowners. History indicates that volunteer efforts will likely be scalable. The Audubon Society’s Christmas Bird Count has engaged the wildlife-monitoring efforts of volunteers since 1900, and demonstrates the richness of data that can be collected through extremely large-scale citizen-scientist projects. Future restoration projects may also benefit from establishment of funded internships for researchers to study restorative development.

**Ensuring Economic Stability for Projects of Various Sizes**

The goal of funding restoration efforts in perpetuity was met in the 3 Creek Ranch project through establishment of a sales-transfer fee, in conjunction with contributions from a monthly HOA fee. Development initiatives on the smaller scale of tens rather than hundreds of acres can focus on pairing residential development with initiatives to foster sustainability and restoration goals. The Cohousing Association of the United States (2012), for example, notes the preservation of moderate-size tracts of open space as a frequent community goal. A sales transfer fee in some such instances may be appropriate to sustain conservation and restoration of these shared open spaces, and could also support employment of a naturalist if salary costs were shared among several cohousing communities.

An alternate approach, perhaps more suitable for large developments, is for the real estate developer to provide an initial lump-sum endowment for restoration and conservation efforts. This approach was used to establish and now supports the Santa Lucia Conservancy in Carmel, California, whose responsibilities include restoration and maintenance of natural areas in the nearby 20,000-acre Santa Lucia Preserve. The Preserve includes home sites and a golf course on 2,000 of these acres; the remaining land is maintained as a nature preserve. Both 3 Creek Ranch and The Preserve are innovative models for private ventures that secure funding for restorative development, and that complement ongoing, publicly-funded projects. 3 Creek Ranch provides the added benefit of ensuring that direct and sustained financial support is provided by the property owners themselves, thereby more directly engaging them in stewardship of the restored landscape.
We thank the following individuals for their contributions to the 3 Creek Ranch restorative development project: Bucky and Harry Oliver, previous owners of 4 Lazy F Ranch, Dusty Zaunbrecher, Certified Wetland Ecologist, Jeff Klausmann, Wetland Ecologist, Brannon Bleggi and Jim Verdone (Verdone Landscape Architects), Joe Urbani and Case Brown (Urbani Fisheries), Brian Remlinger, Wetland Ecologist (Alder Environmental), and Margaret Creel (3 Creek Ranch/The Raptor Center). The authors also acknowledge contributions of the late Andy Smith, Wetland Ecologist (Intermountain Aquatics). Additional input was provided by Carney Logan Burke Architects, Jackson, Wyoming; Jorgensen Engineering, Jackson, Wyoming; Wyoming Game and Fish Department; U.S. Fish and Wildlife Service; Jackson Hole Conservation Alliance, and the Teton County Housing Authority. Len Carlman, Michelle Connor, Gene Duvernoy, John Marzluff, Ken Shiovitz, Jeffrey Dunk, and Josh Tewksbury provided helpful feedback on this paper.
Sustainability for Suburbs

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Abstract
The purpose of this paper is to encourage dialogue resulting in action to address unsustainable suburban sprawl. This paper focuses upon suburbs out of recognition that regional and global sustainability is not approachable until the adverse impacts of suburban sprawl and decline are resolved.

A movement inspired by smart growth principles and new urbanism has emerged, intending to improve the sustainability of existing suburban communities in decline. It advocates the transformation of declining suburbs into mixed land use, pedestrian-friendly, and village-like communities with increased density. Planners and designers associated with the movement generate designs and form-based codes to re-constitute suburbs through what is called suburban retrofit and sprawl repair.

If suburbia is to be repaired or retrofitted, substantial funding and eminent domain powers of government may not be the primary project drivers. Starting in 2005, the capabilities of government redevelopment activities have been limited by anti-condemnation legislation and scant funding allocations from state and federal legislatures.

The study reported in this paper was undertaken to find ways to financially support the transformation of suburbia into sustainable communities. The first step was to identify the financial, governmental, and institutional obstacles facing sprawl repair and community revitalization in this era of eroding local redevelopment agency funding and eminent domain power. In the second step, an assessment was made of the feasibility of applying remaining governmental capabilities together with existing funding and land assembly vehicles to catalyze redevelopment activities. Emphasis was placed on determining if funding from the private sector could replace the need for public sector funds. A finding of the study was that some new public policy applications and private investment vehicle adaptations would be necessary to accommodate private investment and mortgage funding requirements. Changes and innovations in enabling statutes and codes were also proposed as part of the path to more sustainable suburbs.

The investigation reported in this paper concluded that suburban decline and sprawl should and can be addressed to promote metropolitan sustainability. A related finding was that emerging planning and design efforts intended to transform existing suburbs into sustainable communities can be advanced if successful model projects or phases are built with public or non-profit funding and existing institutional vehicles are adapted to reduce risk and engage the private sector. Even so, leveraged government funding and public policy innovations are
identified as key factors in pushing the suburban sprawl abatement agenda forward.

**Literature Review**

The negative impacts of suburban sprawl and calls for change have been identified and documented in the reference guide edited by Soule (2006), which sought to define sprawl and provide historical, legal, economic, social and political frameworks, define sprawl dynamics, highlight the problems, measure sprawl, and render policy prescriptions. Rome (2001) provided an early warning about suburban sprawl. The author explored the history of suburbs, the innovations of Levitt, the emergence of conservation-based anti-sprawl movement, and focused upon open space, wildlife, water, and soil conservation impacts. The author concluded with an argument for a land ethic. Duany, Plater-Zyberk, and Speck (2000) focused upon suburban architecture, home building and design, physical health, connectivity, and transit-oriented development. They argued for a robust proactive public sector made stronger to deal with sprawl and prescribed stronger powers for regional governments.

Lucy and Phillips (2006) argued that core cities are ascendant while older suburbs are in decline. They focused upon dispelling myths about the benefits and ills in living in cities compared to suburbs. Pastor, Dreier, Grisby, and Lopez-Garza (2000) focused upon the regional perspective in the Los Angeles metro area and argued that core cities and suburbs are becoming demographically similar and interdependent. They paid special attention to poverty issues.

Beatley (1999) suggested that planners and regulators in the United States can benefit from the traditions and modern methods applicable to suburbs in Europe. He was joined by Newton (2008) to argue that Australia has issues similar to those in the U.S. and Australians have developed approaches that could benefit American urban regions. Richardson, Chang-Hee, and Bae (2004) reported that France and the United Kingdom have developed sprawl symptoms similar to those in the U.S.

Specific design solutions for sprawl remediation that begin with redevelopment of suburban commercial land uses were suggested by smart growth advocate Sobel (2005) and Dunham-Jones and Williamson (2009), who suggested suburban retrofit and sprawl repair advocate Tachieva (2011).

Smith (2009) advanced the idea of asynchrony and recommended planned densification to retain otherwise lost value as the positive effects of development change highest and best use. He recommended planned densification as a technique to achieve this goal. Choi (2009) recommended that project design and financial planning be integrated. Lienberger (2008) argued that to redevelop suburbs there needed to be a uniform industry-wide set of design solutions for standardized suburban real estate products.

Several papers in the *Journal of Sustainable Real Estate* were found to have direct relevance to the subject matter of this article. Rauterkus and Miller (2011)
investigated residential land values and walkability. They found an enduring direct relationship. Bradshaw (2011) surveyed innovative real estate development firms and found that the conventional development process creates problems and innovative firms sought out investors more patient than is typical. They develop properties in various regions and formed durable relationships with designers of sustainable real estate products. Warren-Myers and Reed (2010) found that lack of transparency of financial drivers restricts substantial investment in sustainability because stakeholders have limited ability to measure sustainability and understand its impact upon value. Pivo (2010) argued that upgrading existing properties is more important than developing better new facilities. Examples from the U.S., Europe, and Australia were presented to illustrate that sustainable property investing will require technical skill and cooperation between owners and tenants.

Galuppo and Tu (2010) determined that real estate capital market players have concerns that project users will not recognize the value of green space and will not pay extra rent to receive the benefits. Players who were surveyed believed that lack of consumer awareness and lack of incentives is a major barrier to the growth of green development. Rauterkus, Thrall, and Hagen (2010) studied the relationship between location efficiency and mortgage default and reported that default probability decreases with higher walk scores except in low income areas. Addae-Dapaah, Hiang, and Shi (2009) reported that commercial building users in Singapore are unaware of green building financial benefits and are therefore somewhat resistant to paying higher rents to receive the benefits.

Rohde and Lutzkendorf suggested that there is untapped potential for real estate consultants to proposer by consulting about and developing sustainable property investment products and advocates the establishment of sustainable property funds.

Choi (2009) argued for a variety of principles and actions to promote adoption of green development practices. They included but were not limited to integration of design and financial teams, documentation of costs, benefits and market data for green developments, implementation of location-efficient mortgages, and sustainable use of redevelopment land.

Adding Suburban Sprawl Abatement to the Sustainable Real Estate Agenda

Sustainable real estate literature has recently been focused upon support for individual sustainable projects. Topics such as measuring the value of green buildings and projects, examining and managing risk, sustainability education, ratings systems, operating costs, and other important work have been meaningful contributions. Projects and communities benefitting from such work are not likely to be truly sustainable environments if their host regions are not sustainable. Eighty-four percent of Americans live in metropolitan regions and 51% of the metro region residents live in suburbs. The “elephant in the room” yet to be fully addressed is the unsustainable nature of existing American suburbs and their impact that inhibits local and metropolitan sustainability.

This paper examines financial, institutional and public policy barriers to the reconfiguration of suburbs. It does not seek to evaluate design specifications for
suburban repair. The fundamental purpose is to revitalize discussion about the need to address the negative impact of suburban sprawl on regional and global sustainability. An additional intent is to discover pathways that facilitate financial, institutional, and government action to resolve this serious threat to global well-being.

**The Case for Repairing Suburban Sprawl**

There are numerous reasons to stimulate revitalization of some existing suburban communities with sustainable planning and practices. The negative impacts and remediation prescriptions of suburban sprawl have been identified and documented in numerous works such as a reference guide edited by Soule (2006), which sought to define sprawl and provide historical, legal, economic, social, and political frameworks; define sprawl dynamics, highlight the problems, measure sprawl, and render policy prescriptions. The Urban Institute (2002) found a relationship between sprawl, poverty, inequality, politics, and incentives to mitigate sprawl and examples drawn from Portland and Maryland. Rome (2001) provided an early warning about suburban sprawl. The author focused on negative open space, wildlife, water, and soil conservation impacts. The author concluded with an argument for a land ethic. A list of the unsustainable aspects of suburbia they identified includes but is not limited to transportation network inefficiency and deficient public transit, loss of farmland, inequality, water and air pollution, and high energy consumption. Households are impacted by a missing sense of community. The Urban Institute (2002) reported increased living and transportation expenses, long personal time consumed in vehicular trips, and an unjust burden on poor households. Strum and Cohen (2004) reported that, “Sprawl significantly predicts chronic medical conditions and health-related quality of life.”

The detrimental impacts of sprawl listed above are sufficient reasons to not delay in prioritizing the implementation of sprawl abatement. Recent trends add more rationale and urgency to start correcting suburban conditions. They are listed below.

1. Short, Hanlon, and Vicino (2007) reported that many first-tier suburbs¹ and their retail centers are 40 to 60 years old. Some are considered distressed. Without public or private renewal initiatives, they become obsolete as they fall prey to physical, economic, environmental, and visual decline. This problem might also be an opportunity. In some cases, as retail centers, residences, and neighborhoods approach the end of their economic life and decline, so do their property values. All other factors held constant, declining values may increase the economic feasibility of renewing these communities.

2. Density is considered a desirable sustainable community attribute. Lucy and Phillips (2006) found that between 1990 and 2000, 26% of U.S. suburbs studied declined in population.
3. Some suburbs are suffering from distressed retail neighborhoods and shopping centers because of a sluggish economy, unemployment, population shifts, and deterioration.

4. During the past decade, major retailing trends tilting toward e-commerce have been adverse to “brick and mortar” big box and traditional shopping center anchor tenant revenues, resulting in increasing vacancies and failing suburban retail centers. A ripple effect of these changes has begun to impact sales tax revenues for local governments.

5. Some aging shopping neighborhoods have become obsolete due to changes in retail practices and consumer trends. They are in need of redevelopment and increased backup population density to revive flagging sales.

6. Municipal property and sales tax revenues have been falling, fomenting budgetary crisis for local governments due to the conditions noted above (Lucy and Phillips, 2006).

7. Regional sustainability is negatively impacted by the existence of majority populations located in low density suburbs.

8. The global supply of carbon-based energy has diminished while its cost has skyrocketed since the time that post-WWII suburbs were designed and built. These communities typically have segregated land uses that create inefficient gaps between housing, places of employment, shopping, and recreation, necessitating numerous protracted personal household auto trips per day. If these dynamics are improved, energy conservation would result and prices might drop.

9. Low density suburbs lack viable public transit and are not pedestrian friendly. Increasing density and mixing land uses sets the stage for the development and use of improved public transportation and increased pedestrian trips. Decreased auto trips resulting from density and transportation improvements may yield cleaner air for metro regions. Money in household budgets can be released for other essential or discretionary purposes, thereby adding stimulus to the struggling American economy.

10. Sustainable nations, continents, and regions are necessary to achieve global sustainability. The impact of low density suburbs like all other urban metro problems such as crime and pollution can be shared international problems. For example, air and water pollution resulting from sprawl do not stop at the international border between San Diego and Tijuana or El Paso and Juarez.

11. Issues associated with low density American suburbs are not particular to the U.S. Other developed and developing nations also have low density suburbs, along with their negative regional and global impacts. Richardson and Bae (2004) found that despite sustainable traditions and government intervention, France and Great Britain have been experiencing suburban sprawl and its affects similar to American conditions. Pucher et al. (2005) reported that India is experiencing rampant suburban sprawl. Should sprawl repair be attempted and proven
successful in the U.S., communities in other nations might be benefit from the experience of American efforts as they tackle similar issues. Remediation of international suburban sprawl impacts can assist sustainability on a global level.

12. In many regions, demand and pricing have been increasing for central city real estate. Although some first-tier suburbs are in decline, their proximity to center cities offers a marketing opportunity making redevelopment more feasible than in prior decades. If they are redeveloped, their proximity to central cities can become a competitive advantage.

13. The American economy has been struggling to overcome the employment effects of a troublesome recession that started in 2008. Previously normal levels of employment have prevented complete recovery since that time due, in part, to global outsourcing of jobs once performed in the U.S. Development and redevelopment creates local jobs in the construction and real estate related industries that cannot be outsourced. Secondary employment results in industries that supply construction and provide real estate related services and maintenance. Employment is created on a tertiary level when suburban renewal includes new industrial and commercial land uses.

**Repair and Retrofit: Designing to Reverse Sprawl and Decline**

Driven by declining tax revenues, physical deterioration, and environmental impacts, suburban governments have become interested in and proactive about redevelopment, adaptive re-use, in-fill, and densification for their communities. In response, some urban planners and designers have begun to recognize and minister to the need to make suburbs more sustainable. Suburban redevelopment projects are being formulated by designers and planners to rescue older suburbs and their retail centers from decline with plans based on sustainable principles.

A suburban redevelopment movement, inspired by *new urbanism* and *smart growth* principles has become known as *sprawl repair* or *suburban retrofit*. Its planning concepts and design standards have been articulated in a published “toolkit” and a book of redevelopment-driven case studies from previous years. To date, the emerging impetus to transform suburbia has focused on vacant or marginally performing commercial retail districts and properties.

Tachieva (2010) provided design and form-based code recommendations for transforming existing suburban sprawl into mixed-use, denser pedestrian, and transit-friendly, village-like “community units.” The author advocated revamping dead and obsolete retail centers into new downtowns with increased density improved by mixed use. She recognized the need for incremental approaches toward suburban repair starting with retail centers in decline. Spatial and site analysis/design, together with infrastructure/transportation change, incentives, and code changes on the block, neighborhood, community, and regional scales were
prescribed. Toolkit components include but are not limited to increased densities and conversion from Euclidian ordinances with segregated land uses to form-based codes that permit mixed land uses and improvement types. Emphasis in sprawl repair and retrofit is on the creation of mixed land use, pedestrian-friendly dense community units.

Dunham-Jones and Williamson (2010) documented the history of and the current imperative for suburban redevelopment, adding density and changing the land use mix for first-ring or tier suburbs. Their case studies noted suburban retrofit projects with adaptive re-use and mixed land uses that typically received subsidies by redevelopment agencies, arguing that more such projects and backing are needed. Sobel (2005) also included case studies of suburban mall transformations.

Sprawl repair and suburban retrofit planners and designers have not limited their talents to incubating redevelopment plans. They have been involved in creating form-based codes for local governments and plans for new suburban communities built on greenfields as well.

There are communities that are approaching sustainability such as Portland, Oregon and Miami, Florida. They offer satisfying visions of how some components of sustainable communities look and function. Even-so, their characteristics, location, and history may not be directly applicable to many suburban sprawl remediation situations, in part because they do not suggest a viable path for the funding of suburban sprawl remediation.

Portland is considered to be an outstanding model of an American sustainable community. It was recognized as one of three international cities doing the most to achieve sustainability. Central to its progress is regional growth boundary legislation to restrain additional suburbanization of existing farmland and open space. Portland’s sustainability was enhanced by installation of public transit and city-funded wetlands acquisition. The city also created public-private partnerships to restore native vegetation (Grewe, Anderson, and Butman, 2002). The model it presents is a useful one but the Portland experience does not provide instruction about how to finance the replacement of buildings and improve density in existing suburbs.

Miami is another example of progress toward sustainability. Even so, some may find it difficult to transpose the Miami experience and process to the task of rebuilding suburbs. Miami is a core city with urban infrastructure and amenities. It is centrally located inside a suburban metropolitan region. The focus of this paper is upon the type of suburbs that radiate out on three compass bearings from Miami.

There are recognized new urbanism models of sustainability that were built on greenfields. Seaside, Florida has been an inspiration for planners who would like to redevelop suburbs. Seaside is a small real estate development on the Florida Panhandle and was developed on vacant land. Kentlands, Maryland is not a municipality nor suburb but a real estate development on converted farmland inside a suburb. They were not existing suburbs that were developed. The
financing and development issues of such enclaves are not comparable with the conditions in declining suburbs.

A basic building block in the tool kit of sprawl repair and retrofit is the high density mixed use pedestrian-friendly community unit. An example has been recently developed in Parole, Maryland. The Parole Shopping Center was acquired, demolished, and replaced by a $400,000,000 development of shopping, residential units, hotel, and offices now known as the Annapolis Town Center development in the unincorporated portion of Anne Arundel County known as Parole, Maryland. Although internal financial developer outcomes are not public, the center seems to be successful. It has no vacant retail space and many tenants are nationally-recognized companies. As prescribed by sprawl repair writings, the town center has been an incremental development. The first phase of predominantly retail space opened in 2008 and subsequent phases have added and are continuing to add additional residential condominium and rental apartment units.

The redevelopment model that the Annapolis Town Center (Exhibit 1) represents is valuable but its applicability to other suburbs in need of revitalization and sustainable development may be limited. It is located in Anne Arundel County, which is a suburban area with a profile of exceptionally high income households. The median home cost in Parole in 2009 was $442,399. The same year, Parole had a median household income of $81,543, with an unemployment rate of 6.4% and a 13.5% increase in population during the nine years before 2009 (City-data.com, 2012). These statistics indicate that the financial risks of investing in and building the Town Center was lower than it would be in most suburbs that are suffering from physical and economic decline, demographic changes, as well as loss of population and viable retail activity.
Most sprawl repair and retrofit planners and designers would be pleased with the design model that the Annapolis Town Center project presents. Its apparent success in obtaining funding and market acceptance is probably achievable in other upper income stable suburban communities. Private sector investment in and development of mixed land uses and densification may be a normal progression in markets without much need of stimulus or subsidy in communities with high income demographics. Suburban downtowns such as Bellevue, Washington and Coral Gables, Florida appear to have experienced private investment and redevelopment resulting in densification, mixed use, and a more pedestrian-friendly environment.

There are examples of sustainable communities in countries other than the U.S. Marique and Reiter (2011) identified Malmo, Sweden and Kronsberg, Germany among a list of sustainable neighborhood models in Europe. These examples and the others listed by the authors are new developments, sponsored with up to 95% government funding. Beatley (1999) encouraged American planners to learn much about sustainability from old and new cities in Europe, including Amsterdam. Beatley and Newman (2008) also encouraged planners to draw lessons from cities in Australia. The information the authors provide leaves a reader inspired but left with the conclusion that government intervention is the path to sustainable reform. As true as this may be, the question of how to finance suburban redevelopment in the U.S. with declining government funding and tools remains unanswered.

The intended contribution of this paper is to catalyze dialogue, research, and actions to finance and build sustainable community design and undertake suburban redevelopment without all of the governmental tools and funding that once benefitted American communities and remains a mainstay in other countries to this day.

The investigation for this paper started with the assumption that sprawl repair and retrofit and their design standards are beneficial concepts that deserve to be refined and installed. Nevertheless, it is fair to mention that generic design standards for a project or community may be difficult to apply in the field. For example, there may be agreement among sprawl repair designers and planners that increased density and mixed use to support a five minute pedestrian trip radius (the “pedestrian shed”) is a desirable sprawl repair design standard. On the other hand, after physical, social, economic, and financial feasibility is considered for a specific site, this or any design standard may require modification or revision.

Density increase in sprawl repair is a good illustration of how a generic standard might not apply to a specific site without modification. Higher density levels than presently exist in most of suburbia are considered important in establishing sustainable communities but the question is, “How dense?” Despite the useful criteria of the pedestrian shed, there may be no “one-size-fits-all” answer. Even if a universal density standard or criteria is valid and preferable, the cost of improving substandard topography, groundwater, and soil conditions on some sites would set varying limits to appropriate density.

All social benefits and costs should be considered in establishing design standards for rebuilding suburbs into sustainable communities. The indications, the task, and
the results can be complex and confusing when evaluating appropriate density and other design specifications for a sprawl repair location. For example, Harries (2006) reported that increased density levels are associated with increasing incidence of crime but mentions that this finding is subject to modification according to the socio-economic profiles of the residents. Another example is that municipal financial capacity can affect feasible project density. Ladd (1992) determined that increasing population density will only decrease local government costs when density is less than 250 persons per square mile. Increased density over that figure increases the per capita government spending.

Pathways to Rebuilding Suburbia

This section reports on the identification and assessment of barriers to the implementation of plans for sustainable suburbs. The next step was to identify and analyze the capacity of existing programs, institutions, legal, and investment vehicles to support the public and private sector funding necessary to build redevelopment projects. The last step was to devise and propose new investment vehicles if needed to supplement the execution of suburban betterment programs. Findings were evaluated to determine the likelihood of successfully launching suburban sprawl remediation projects. In the summary, a conceptual roadmap toward better suburbs was outlined. Key findings of the investigation for this paper are reported and intended to stimulate dialogue about addressing suburban impacts on sustainability with suburban retrofit and sprawl repair.

Conditions that inhibit potential public or private investment in and redevelopment of existing suburbs are identified below.

Local Redevelopment Activities Have Been Drastically Curtailed

Tachieva (2011) and Dunham-Jones and Williamson (2012) prescribed the use of redevelopment funds, resources, and eminent domain powers in support of suburban redevelopment and reported on previous projects to redevelop retail centers. Prior to the current decade, most redevelopment projects were conceived of, financed, and managed by local redevelopment agencies, and funded by state and federal government funds and tax increment financing. Since then, legislative economic, governmental, legal, and public opinion factors have limited or curtailed the historical role and techniques of redevelopment. These changes have magnified the challenge of revitalizing any community including those in the suburbs.

In post WWII years, redevelopment projects were originally intended to foster full employment by targeting and revitalizing declining urban locations characterized by aged, deteriorated structures with terminal economic decline. Most central cities treated by redevelopment were originally built at higher density than found in suburbs, with grid pattern streets, abundant existing public transportation, and proximity to urban amenities. Redevelopment was managed by local governmental agencies with adequate federal and state funding for parcel acquisition, assemblage, infrastructure overhaul, parcel retention over protracted periods, and land price write-downs. These features were essentially subsidies that
enabled private real estate developers to access cleared land and funds and proceed
to rebuild communities. Local agencies possessed strong powers of eminent
domain. Redevelopment was enabled by a favorable political climate, relatively
unencumbered by NIMBYism, budgetary concerns, and political resistance.

Political reaction to real and perceived abuses of redevelopment powers arrested
aspects of redevelopment. Because of resistance to adequate taxation levels,
federal and local governments are presently in budgetary crisis. As Exhibit 2
demonstrates, federal community development block grant funding direct to
municipalities has been drastically reduced.

Concerns about takings and environmental issues can introduce uncertainty about
public support with prospects for delays and excessive developer exactions. Great
Recession market dynamics and tight money have also added a layer of
complication to the availability and use of eminent domain, public institutional,
and private funds for any project.

From 2005 until the present, the use of eminent domain in redevelopment has
been increasingly limited not only by economics and citizen resistance but also
by legislative, administrative, and legal decision making. According to Mihaly and
Smith (2011), 40 states have taken some action to limit the use of eminent domain.
During his second term in office, George W. Bush limited the grounds for federal
takings by Executive Order 13406 entitled “Protecting the Property Rights of the
American People.” On February 28, 2012, the U.S. Congress passed H.R. 1433,
which overturns a 2005 Supreme Court decision affirming the ability of state and local government to take control of private property under the doctrine of eminent domain and hand it to another private developer. Virginia has a bill on the November 2012 ballot that narrowly defines the use of eminent domain under a proposed amendment to Virginia’s Constitution. “The Virginia Eminent Domain Amendment, Question 1” is on the November 6, 2012 ballot in the State of Virginia as a legislatively-referred constitutional amendment. (Ballot-pedia.org, 2012). California exhibits the extreme of this trend. Under ABX 126, both redevelopment funding and local agencies were terminated by the state in 2012.

**Lack of Data Inhibits Private Sector Funding of Suburban Revitalization**

During the current decade, marketplace shifts have occurred that have witnessed increased demand for the advantages of central city locations. Properties benefiting from this trend enjoy increasing financial feasibility for redevelopment with less need for massive doses of public subsidy. Because of close proximity to central cities, first-tier suburbs may have the ability to take on the marketing patina of a center city neighborhood, if their decline is arrested and reversed by revitalization. Unfortunately, robust public sector redevelopment is not readily available to such communities at this time.

Sprawl repair and suburban retrofit authors, designers, and planners leave to developers the task of acquiring funds for suburban redevelopment projects. As noted above, federal and state funding has been reduced and condemnation powers that once subsidized developers and fueled redevelopment have been weakened.

In the absence of adequate public funding and eminent domain, use of governmental “sticks and carrots” to catalyze both urban and suburban change will likely prove inadequate to launch or sustain revitalization. Private sector engagement to fill the gap left by public sector withdrawal has become critical for suburban renewal envisioned by the suburban sustainability movement. It is not helpful that in time of such need, private sector investment and mortgage lending criteria has become very conservative and risk-adverse due to the real estate market meltdown of 2008 and its continuing ramifications.

Choi (2009) identified lack of financial precedent as an institutional barrier to green building. Before engagement with innovative projects, financial players require enough market data to become comfortable with risk levels of any project. This issue is even more critical for unprecedented or innovative forms of development such as green projects in suburban redevelopment. Even in times of relaxed investment and lending criteria, adequate information about outcomes on similar previously built projects is necessary to engage private investment capital and mortgage funding. Comparable sales data are required to fuel feasibility studies and real estate appraisals, which assists investors and lenders in determining risk and reward levels (Miles, Berens, Eppli, and Weiss, 2007). Absence of adequate and reliable data of this nature for innovative projects in a market area is a barrier to innovation in real estate development.
Although Dunham-Jones and Williamson (2012) presented detailed case studies of previous retrofit and repair projects that were enabled by redevelopment agencies, financial outcomes for project developers, investors, and lenders are not available in these studies. These data are considered proprietary and difficult for any researcher to obtain. This deficit makes it very difficult to obtain investment and mortgage financing for suburban redesign projects.

In view of the diminished capacity of government redevelopment, conservative funding policies of private capital and mortgage sources and lack of information on innovative projects, it is fair to say that the issue of how to fund sprawl repair and suburban retrofit is the major obstacle for advocates.

**Suburban Redevelopment Requires Missing Master Development Functions**

The real estate industry traditionally uses a five year investment, development, and ownership window within which to project return on and of investment funds to be received. Major redevelopment projects can take longer than five years. Protracted build and sell-out time frames increase the risk of reduced returns or loss of capital. More than moderate development risks are not usually acceptable to lenders and investors.

Investment risk is an important issue because real estate development is capital intensive and is typically financially leveraged by using institutional mortgage funding. Sources of capital for mortgage originators include bank depositors, secondary market funds, insurance policy holders, and retirement fund members. The legal fiduciary responsibility that mortgage originators have to these types of “public” funding sources obligates them to undertake stringent due diligence investigations, typically with the use of data and opinions from third-party appraisers and market feasibility consultants in the loan approval process. If adequate documentation is not available or if data and opinions indicate more than conservative project risk levels, mortgage originators will not make a loan to avoid future lawsuits of negligence from their capital sources. This is one reason that mortgage lenders and their borrower-clients are conservative about risk taking in development ventures. Another reason is that most development or construction loans are not only collateralized by real estate but also by personal or corporate guarantees. They do not accept unknown or highly speculative risks, pricing, absorption, and build-out time parameters without offsetting guarantees or subsidy.

In previous eras, the answer to issues associated with multiple years required for community was that local redevelopment agencies assumed the master developer role to fund high front-end costs, and absorb risk and holding costs associated with long-term investment in a project build-out. This enabled investors, the lenders and developers with shorter term time horizons to develop comparatively small phases of a large redevelopment project.

Local redevelopment agencies were able to purchase land at market prices, which were often too high to support private development, and then sell the acquired
land after writing-down the price, effectively subsidizing the project developer. Local agencies were able to perform these functions because they were recipients of receipt of federal and state grants, loans, and funding from municipal bond issues. Eminent domain provided by agencies absorbed and contained risk and expenses by assuring that all land required for a project could be acquired at market value, assembled and land-banked. Public redevelopment agencies also funded front end loaded expenses for infrastructure modifications and upgrades that could accommodate the progress of renewal for years and decades. If redevelopment is to be applied to suburbs, programs and investment vehicles must be adapted and/or invented to replace or compensate for the lost or fading master developer functions of local redevelopment agencies.

Value Added from Improving Suburbs Should Be Captured and Harnessed

The first phase of a redevelopment project in a community often occurs in a low sales volume, low value local real estate market environment. In the redevelopment of declining communities, initial consumer preference, market demand, and pricing constraints may not be conducive to implementing designs and codes mandating pricing and higher densities that enable sustainable community features. In such circumstances, low-density, low value structures result, establishing a community precedent and image that is likely to remain for the duration of the economic life of the structures erected.

When redevelopment occurs at low density and without other sustainable features, sunk building and infrastructure costs and their remaining life spanning decades preclude subsequent redevelopment to higher sustainability and density standards. This is unfortunate because demand trends several years subsequent to redevelopment launch may improve prospects for improved price points, along with demand that promotes density and other sustainable features. Once erected, buildings remain too valuable during most of their economic life to lose to demolition.

As the impact of revitalization catalyzes better market conditions over time, improvements constructed at the start of a project may no longer reflect highest and best use in later years. A mechanism is needed to capture a portion of the evolving future value increment due to the successful of redevelopment activities at the front end of a project. Alternatively, redevelopment projects might be designed to accommodate subsequent changes in highest and best use. Failure to do one or the other is a potential lost opportunity for the environment, economic development, and municipal revenue, as well as project cost minimization and return optimization.

Viewed from the standpoint of opportunity cost, for a government or developer to not recoup some of the future value added by redevelopment is to simply leave a pile of money sitting unclaimed on the table. Smith (2009) identified this timing issue and labeled it as asynchrony. He formulated a wedge-shaped diagram to express its dynamics (Exhibit 3).
The concept of asynchrony suggests that it is advisable to generate designs that encourage incremental projects with buildings and infrastructure that can be adapted to or accommodate increasing density and changes in highest and best use. There should also be mechanisms to capture some of the financial upside resulting from the success of the project rather than leave all of the windfall profits to property owners. To introduce and execute such a scenario would require innovations in title, legal instruments, zoning and building codes, as well as a method of monetizing future opportunity and harvesting it embedded in present value for use in funding the project at the front end.

**Barriers to Repairing Suburbs**

Lack of robust redevelopment agency capacity presents numerous issues when attempting to construct projects for sustainable suburban change. A list of the issues that may exist if projects lack redevelopment support includes:

- **Title Issues**: Parcels acquired for a project may be encumbered by leaseholds, easements, purchase options, covenants, conditions, and restrictions that prevent or impede effective sprawl repair. Without eminent domain, these less than fee interests may not be removable unless beneficiaries decide to voluntarily surrender or sell their interest.

- **Taxation Disincentives**: The specter of IRS capital gains taxation on a sale or lack of a suitable tax deferred exchange property may dampen
voluntary owner interest in selling all or parts of parcels necessary for a project. Without condemnation, sellers cannot take advantage of IRS Section 1033, which offers deferral on a condemnation influenced transaction for up to two years before a replacement property is acquired.

- **Adverse Encumbrances**: Most existing improved property is owned subject to mortgage financing, which has a due on sale clause. To implement sprawl repair, replacement financing adequate to fund acquisition and construction may be difficult to achieve in the present lending climate.

- **Mortgage Financing**: Lack of mortgage financing for mixed-use projects. Many sprawl repair plans include mixed-use specifications. As a result of unfavorable lending outcomes during recent years of recession, many mortgage lenders are not favorably disposed toward lending on mixed-use projects.

- **Build-out Time Lags**: Innovative retrofit or sprawl repair designs and codes may require development windows of 7 to 20 years or longer for full development and market absorption to occur. As previously mentioned, this is a mismatch with North American investment practice, which favors financial turnover every five years.

- **Expanding Entitlements**: Considerable lag time in market response can occur when project design catalyzes product and density changes. Project build-out and sell-out may take years or decades. This circumstance requires long-term project phasing, as well as unprecedented longer-term construction and take-out loan commitments. Risk aversion can be expected in the private sector for funding long-term project build-outs. There are several reasons for this, including the possibility of changes in applicable discretionary entitlements, land use ordinances, building codes, environmental impact obstacles, and the possibility of court injunctions.

- **Front-end loading of costs for acquisition, demolition, infrastructure modifications, and offsite upgrades. In former decades, redevelopment projects that required long-term phasing to reach build-out, supporting infrastructure and acquisition issues were typically resolved with the financial backing of redevelopment agencies. Where sprawl repair or retrofit plans increase density and require changes or upgrade of existing infrastructure, the resulting start-up costs must be borne by developers who operate with construction loans with terms of two to five years. The financial front end load of these costs may not be recoverable soon enough to provide a viable financial breakeven point soon enough to allow for acceptable investment rates of return for project investors and mortgage lenders.

- **Project Design Processes**: Sprawl repair planning and design professionals subscribe to the new urbanism movement’s confidence in using the public charrette as a vehicle to incubate, refine, and validate community planning and design proposals. The public, special interest groups, and agency officials attend these meetings. Affected property owners and a representative of a developer are invited to attend. Plans
and codes resulting from charrettes may produce an excellent design product that represents the best compromise amongst stakeholders, although it is not always certain that the product is buildable. Primarily because of budgetary constraints, investors, real estate appraisers, market/feasibility analysts, and mortgage lenders are typically not brought into the process during the charrette stage. Developers and land owners attending a charrette may not have the same perspective or objectivity of these missing players. For example, if a landowner may be motivated by receiving entitlements pursuant to a charrette-driven design, he or she can sell the property at a higher price than before. Developers never know if they can acquire capitalization until they have a plan to base a proforma financial feasibility analysis on and propose to financial sources. By that time, project codes and entitlements may have been approved or disapproved.

**Existing and Proposed Tools May Be Capable of Supporting Sprawl Repair**

In sprawl repair and retrofit writings, arguments for a return of the sizable role of redevelopment agencies that was witnessed in previous years are prominent. Given current budgetary lockups and anti- eminent domain political climate this wish is likely to remain unfulfilled. Replacing government-funded redevelopment funding, land banking, management, eminent domain, and subsidy with private sector initiatives appears to be a daunting task but one worth the effort to generate sustainable metro regions. Creative adaptations of existing institutional practice and new innovative approaches to support and encourage non-governmental funding for sustainable suburban redevelopment projects may be necessary.

The inspiration of an excellent sustainable suburban redevelopment design is not likely to motivate all necessary players to participate in building a project. Designers and planners typically rely upon developers to build their project designs. Developers are funded by investors and lenders to fund projects. Developers do not have the tools or the magic to build innovative projects without committed investment and mortgage funding to drive development. To make funding decisions, investors and lenders rely upon due diligence based on precedents and comparables that are lacking for most large scale innovative sustainable suburban projects.

Presented below is a “toolbox” of existing vehicles capable of adaptation to mitigate some developer, lender, and investor risks or capable of facilitating some level of funding for sustainable suburban redevelopment projects. Included in the list are proposed but untried mechanisms that could also be helpful in reducing developer risk and encouraging funding sources to invest by overcoming barriers recognized in this paper. These new proposals could appeal to lenders and investors by replacing some of the eroding master developer functions of local redevelopment agencies. It is noteworthy that even with reduced direct public redevelopment support, public programs and enabling legislation retain a central role in facilitating suburban betterment.
**Incremental Redevelopment**: Suburban repair and retrofit should be planned as incremental projects. This is because large scale projects take time to be absorbed by the market. In the absence of condemnation, project parcel acquisition is a waiting game. The principle of asynchrony predicts that market prospects can improve after initial phases of redevelopment have been built and improve the market environment. For some parcels required for a project, existing leases must expire, buildings must reach functional obsolescence, and potential user capacity and commitment to rent or purchase must evolve. Accordingly, project build-outs can take years or multiple decades. The time that it takes to launch and build-out redevelopment projects can be longer than the standard investment window of five years.

**Extended Master Plans and Permits**: Large scale incremental redevelopment may result in protracted project phases that range for longer than expiration of land use entitlements, building permits, and in some cases the lives of community general or master plans. Incremental development and the desire to capture value by capturing asynchronous value may necessitate that applicable community master plans have a lifespan that extends beyond projected redevelopment build-out dates.

**Long-term Density and Development Entitlements**: The point was made above that area-wide sprawl repair and retrofit will be incremental by necessity. Depending on market and project area characteristics, build-out can take several years or decades to accomplish. During this attenuated period, stakeholders will likely turnover, as will local politics and the composition and orientation of planning commissions and city councils.

The granting of durable development rights to developers or long-term development contracts between local governments and developers could be a method that encourages investment and developer participation. This is due in part to the fact that they mitigate risk levels by resolving the mismatch between project build-out timing, changing local politics, as well as the life of community general plans, decision-making bodies, and land use and building permit entitlements.

To assist communities in attracting developer interest and private funding for sprawl repair, local and state governments should consider legislation authorizing the use of uniform, durable transferable development rights or entitlements for sustainable suburban redevelopment. Some states, including Arizona, California, Colorado, Florida, Hawaii, Maryland, Minnesota, and Nevada permit the issuance of development agreements, commonly referred to as vested rights between developers and local governments (Miles, Berens, Eppli, and Weiss, 2007). Most other states would likely require enabling legislation to allow local governments to issue vested rights. The rights issued should not expire for the projected life of an incremental suburban redevelopment project. After issuance, they would not be subject to discretionary cancellation or modifications by regulators. To assist with capitalizing redevelopment projects, vested rights should be permitted to be transferable subject to provisions to assure entitled construction is bonded for completion according to criteria in the development agreement.
The ability and willingness of local governments to confer vested development rights that are permitted to be transferable with appropriate safeguards is necessary to support the following proposals.

- **Transferable Development Rights**: Long-term redevelopment projects typically have considerable front-end costs with payback periods that are not investor or lender-friendly. To address the need to capitalize high front-end costs, innovative investment vehicles could be helpful. To assist in meeting this need, we propose transferable rights to participate in future phases of a redevelopment projects. Future development rights (FDRs) would be similar to transferable development rights (TDRs), which are an existing procedure that permits transfer of density from one parcel to another. Ownership of TDRs can be sold by the recipient to another party. FDRs would be similar to TDRs in that development density rights or any project attribute would be transferable between parties. FDRs would be unlike TDRs in that the transfer of development rights would be transferable from one party to another but the location of the entitlement would remain the same. Documentation generated to memorialize the granting of a FDR could consist of contracts, certificates, options, deeds, or shares. FDRs could be sold or granted to holders to allow a degree of participation in aspects of redevelopment phases. Those interested in holding FDRs could include investors, lenders, developers, owners, buyers, sellers, tenants, non-profit sponsors, affordable housing sponsors, local governments, material or service vendors, sub-contractors, municipal infrastructure districts, home owner associations, and third party stakeholders.

The asset base supporting FDRs could consist of ownership, partial ownership or collateralization of vested development rights. They could be created and granted by local governments that confer vested development rights. FDRs could also be generated by development entities that receive grants of rights from local government.

FDRs could encompass all of the rights pertaining to developing an entire future phase or phases. They could also be divided into partial rights pertaining to a phase, building or location within projects. Selected examples of possible partial rights are rights to develop a specific land use in a future phase, rights to receive preferred returns or profits from a future development phase, and rights or options to purchase, lease or sublease the products of a future phase on a predetermined price schedule.

FDRs could be created as certificates of assignable air rights, ground leases, un-built but recorded condominium units, sub-rights to develop, contracts, shares in a holding company or preferred rights to receive payments, or scheduled net income or profit participation from the building a of phase. FDRs shares should be transferable. They could confer active rights to physically develop in a project phase or they could be passive with limited liability, conferring the rights to the holder to receive revenue or benefits from development activities on a specific parcel or set of parcels.
Another variant of FDRs could be guaranteed by assignment or hypothecation of vested rights to develop a project. They might or might not be conveyed as recordable instruments in the chain of title on subject properties. If FDRs were to be made part of the chain of title of subject parcels, they could be conveyed by special deed and recorded as ownerships of less than fee interests.

- **Advance Sales of Future Development Rights**: To capitalize initial project phases, FDRs or any other method of conveying future development rights could be created as liquid instruments designed to be bought, sold, and encumbered by loans.

- **Monetization of Marketable Future Development Rights**: FDRs or derivatives of FDRs could be offered for sale or resale to any third party through a securities market or offering or real estate brokerage house prior or subsequent to the first phase of a project. Revenue from initial share sales might become a significant source of initial project financing. Essentially, FDR shareholders would be investing in and holding speculative rights to revenue in a futures market. Revenue granting FDRs would be different from bonds in that there is no guarantee of any amount of future income or return of investment but only the right to receive specified amounts or portions of revenue if a project or project phase is successfully completed and sold or leased. Ownership of FDRs would also be different from ownership of shares in a development company. Ownership of FDRs could be anchored as a real property right and survive the bankruptcy of a development or land owning company. The right to harvest future profits from entitlements could be invested in, valued, traded, leveraged, and financed in a marketplace. Durability of underlying entitlements together with the transferability and liquidity of FDRs could mitigate some degree of risk for investors. Initial offerings could be priced or open to bidding. The discounted present value of harvesting possible benefits of later phase development is a speculative investment play and would yield low prices to issuers at the front end and profits to holders at the back end of a successful redevelopment project. Even so, FDR sales might contribute significant funding toward first-phase development expenses.

If FDRs prove to have a good track record and enjoy market success, they or their derivatives eventually might be bundled together and sold to REITs or stock market listed funds that trade in futures or financial paper.

FDRs for specific land uses in a revitalization zone could be offered for sale and purchased by prospective users of the type of real estate the land use represents. For example, a hotel chain or licensee might warehouse FDRs for multiple projects as long-term options to acquire and develop hotels. If a hotel company decided not to activate a FDR in its portfolio, it could be sold to a third party.

Government, title and security attorneys should participate in the development and evolution of FDRs. Title insurers should be also
involved in the development of this product. Insurance of FDRs may assist their market acceptance and open up a new line of business for the insurers.

- **Redevelopment and Density Benefits**: Distribution of redevelopment and density benefits to multiple stakeholders. Property owners and sellers, municipalities, transit, school and utility districts, property users and their associations, environmental and housing agencies are all examples of multiple stakeholders that could and perhaps should receive marketable FDRs or other types of development interests in lieu of direct funding to mitigate later phase impact issues.

Sellers of subject parcels for a redevelopment project could opt to take payment in part or in whole as FDR shares. The granting of FDR shares can act as a device to encourage stakeholder support, seller motivation, and provide for non-taxation revenue for government agencies by conferring benefits, mitigation revenue or funds to be derived from future redevelopment build-outs.

- **Integration of Project Design with Marketing and Financial Planning**: In the current public and private economic climate and without public subsidy for their projects, designers and planners are in need of implementation plans to navigate resistance from investors and lenders. Many community improvement plans are based on the ideal, leaving developers to attempt to make an ideal plan feasible.

With the exception of the early conceptual work of Smith (2009) and the contribution of Choi (2009), little attention has been given in print to the importance of making strong linkages between project design and investment at the earliest stages of incremental suburban redevelopment planning. In the absence of traditional government support for redevelopment, retrofit with sustainable elements and density in existing communities requires strategic planning and continuous feedback between the project design program and financial and marketing program planning requirements. It is better to anticipate and respond to perceived financial and marketing obstacles by optimizing integration of design with financial and marketing considerations in an effort to address them with an a priori rather than ad hoc treatment after specific designs and related codes have already been finalized by governmental fiat.

- **Location Efficient Mortgages**: One cause of suburban sprawl has been the ability of developers to develop greenfields on the ever expanding suburban fringe. Lower land acquisition and labor costs permit lower purchase prices for new homes than for comparable homes in more accessible and developed communities. Purchasers can more easily qualify for a loan with a home on the fringe that is priced lower. Central city and redeveloped suburban locations can be more competitive if mortgage lenders and borrower would have to consider the monthly costs of transportation in borrower qualification criteria.

- **Product Standardization**: Lienberger (2008) prescribed product standardization, mortgage industry accommodations, and non-profit entity
participation for suburban transformation. This remedy would be the result of the proven financial success of pioneering suburban retrofit projects. The building and sell-out of model projects that provide a documented history of marketing and financial outcomes is necessary for adoption of industry-wide standard products that Lienberger prescribed. Adequate traditional governmental redevelopment funding and support appears to almost be a political impossibility to sponsor one large incremental suburban sprawl repair and retrofit project. The magnitude of aggregate need for suburban revitalization across the nation could not be satisfied even with the availability of robust state and federal funding. Some of the limited state and local funds that are available could be used at-risk, to create model redevelopment projects and financial and market performance data for use by developers and their backers in raising capital and finance for subsequent projects. It is difficult to see how model projects and templates for future developments can evolve unless initially sponsored by some sort of public subsidy or non-profit foundation.

After adaptations of the existing techniques and formulations of new ones previously identified in this paper have been refined and proven and build model developments prove successful it is likely that suburban retrofit and sprawl repair can become a mainline industry model as foreseen by Lienberger.

- **Land Leases**: In cases where parcel acquisition and assembly is required for a project but owners will not sell and eminent domain cannot be employed (because of legal constraints or lack of funding), land leasing might be a solution. Pursuant to appropriately written land leases, several leased parcels may be merged for purposes of the leasee. Improvements may be modified or demolished and rebuilt. Advantages of land leasing include that there is no necessity for sellers to procure replacement properties to defer capital gains tax and the ability to retain assets and the ability to participate in the financial upside of a development project. The advantages to developers and sponsoring agencies include the ability to leverage funds by eliminating acquisition costs and an alternative to propose to land owners who refuse to sell.

- **Options and Land Contracts**: By definition, incremental suburban sprawl repair takes considerable time. Public non-profit foundations or private funds for a project can be conserved using leverage by paying for options or phasing payments by using a contract to purchase property using pre-determined pricing formulas during project build-out. The need for costs that are associated with the front-end loading of costs advance acquisition of parcels for a project is thereby drastically reduced.

- **Limited Partnerships and Cooperative Agreements**: Should individual property owners desiring to retain ownership of property required for redevelopment, or participate in future revenues they can contribute their property for a joint venture or for a limited liability private development partnership with private developers.

- **Government Agency Revenue Insurance or Guarantees**: Private capital and mortgage sources can be encouraged to fund revitalization
projects if speculative project risk is reduced. Risk for lenders and investors can be minimized if a financially sound local, state or federal government agency insurance pool guarantees occupancy of buildings, together with the income stream from resulting rents.

The advantage to guarantee or insurance programs is that they allow government agencies to leverage scarce funds. Unlike traditional redevelopment, the guarantee scenario requires little or no upfront agency funding to catalyze development by private developers. An insurance pool fund to pay-out for vacancies and defaults can be established in agency accounts. In addition to property and sales taxes and local employment increments that would benefit local governments by the guarantees, the insuring or guaranteeing agencies could receive a fee for participation in development profits at the back-end of projects. A portion of such financial returns could help fund the ongoing agency insurance pool.

A public relations obstacle may exist for insurance and guarantee programs. FHA, Fannie Mae, and Freddie Mac loan guarantees and insurance became a costly public expense during the mortgage meltdown of 2008. On the other hand, such loan programs are presently playing a very important role. These loans are available during the current credit crunch during which private mortgage originators have been constricting credit and abandoning other types of mortgage lending. If the prospect of the potential public relations obstacle can be addressed, revenue insurance and guarantees as proposed here show promise to yield good results in stimulating construction activity and assisting with economic progress in suburban, urban, and rural communities. Guaranteed or insured rental income makes a developer’s ability to secure available investment and mortgage money for the project more feasible. Lower interest and investor return rates may result because of resulting reduced risk levels.

- **Private Lease Guarantees or Insurance**: Private sector lenders or insurers can assume the same role and rewards as described above for governmental agencies. Another application is that private insurance or guarantees can underwrite or become underwritten by government agency guarantees.

- **Sandwich Leases**: In lieu of revenue insurance or guarantees, public or private funders can opt to reduce the risk associated with a project by committing to lease properties developed with the right of sublease. This vehicle has the upside of allowing the holder of the sandwich lease to be able to create a revenue margin or profit between the underlying rent to the property owner/investor if rents increase over time.

- **Special Districts**: Special improvement and taxation districts are a known vehicle that has been used for a variety of purposes, notably transportation and infrastructure improvements. Special taxation districts will likely have a broadened and significant role to play, if they are adapted to the needs of suburban revitalization.

- **Tax Increment Financing**: This source of capital for betterment projects is time tested and is a good candidate to be deployed for suburban
betterment projects. Future increments in tax revenue that accrues to a local government from a redeveloped district can be pledges to service interest and retire principle on municipal improvements bonds.

- **Public-Private Partnerships and Incentive Programs.** To lower private developer funding requirements, publicly owned land can be contributed in exchange for an interest in a development. Public land can also be leased or optioned to private developers for suburban renewal projects. Government agencies at the local, state or federal level can help jump start a project by contracting to purchase, lease or guarantee revenue from new space. They also can stimulate developments through application of the new tools proposed in this paper including but not limited to issuing irrevocable development permits and FDRs. In return for the action of a government that lowers private development risk or increases net revenue for a private developer, it can receive a limited partnership financial interest in a development.

- **Foreign Investors:** Offshore investors are emerging as a force in American real estate markets. Motivated by well-defined property laws and the reputation of a safe investment haven, foreign nationals purchase U.S. residences and commercial properties for income. Foreign sovereign and institutional investment funds have been taking investment positions in American commercial property, real estate companies, and REITs. As Exhibit 4 shows, foreign investment has become significant in U.S. metropolitan real estate markets. Bradshaw (2011) found that sustainable developers seek more patient investors. Some offshore investors are known to have investment time horizons beyond the five-year envelope preferred by domestic investors.

While it is less difficult to market real estate in internationally known

### Exhibit 4 | Foreign Investment in Commercial Property (2012.Q2)

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<th>Rank</th>
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*Note: The sources are Jones Lang LaSalle Capital Markets Research and Minnpost.com.*
cities, the new alliances between overseas investors and American real estate funds and companies may create new funding sources for suburban betterment projects and their developed real estate products.

- **The Federal Community Reinvestment Act** (12 U.S.C. 2901): This act, as amended, requires banks to reinvest a portion of their funds in the communities where branches are located. While there are many aspects as to how this requirement must be discharged, one historical use of funds was to assist distressed communities in recovery. Redevelopment that promotes mixed land uses including commercial or industrial uses, which can be characterized to provide new employment, have been and are projects that satisfy some CRA banking requirements.

- **Pre-sale and Pre-lease Commitments**: Since the mortgage meltdown of 2008, lenders have become increasingly adverse to lending for the construction or permanent financing of speculative space. In the current era, pre-construction commitments from users to buy or lease space have considerable persuasive power in the mortgage lending approval process.

- **Land Use and Density Changes**: Price feasibility points for redevelopment acquisition are not universal. As improvements reach the end of their economic life, they add no value to the underlying land. In theory, if or when the market value of the land increased by improvement demolition costs is at a level that allows a developer to build new improvements, charge his or her overhead, and make a profit appropriate to the project risk level, the land price represents a business opportunity and private redevelopment may be feasible. In many redevelopment scenarios, fully depreciated improvements may not write-down property values low enough to permit entrepreneurial development.

  In former years, the solution to overpriced land for redevelopment purposes was acquisition by a local redevelopment agency using public funds, followed by demolition of the devalued improvements and subsequent resale to a developer at a subsidized price. In instances where local agency acquisition and subsidy are not available and vacant land value does not support profitable development, redevelopment is not feasible. In some such cases, the need for subsidy to write-down land costs might be offset by increases in buildable site density and/or changes in land use. Either or both methods could increase the value of the subject site. These types of density and land use changes are advocated by suburban sprawl repair designers and planners.

  Increased density and mixing uses may or may not be successful in replacing redevelopment agency land price write-down subsidies. In practice, to qualify a priced site for purchase would require a discounted cash flow analysis, sometimes known as subdivision development analysis or financial feasibility study. A generic example of a subdivision development analysis to determine if a candidate parcel is priced right for development is shown below in Exhibit 5. The example assumes the development and sale of a 48-lot subdivision. In this highly simplified demonstration, the only project improvements are roads, sewers, and sidewalks with a five-year market absorption period.
Exhibit 5 | Subdivision Development Analysis

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<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginning inventory of lots</td>
<td>0</td>
<td>48</td>
<td>36</td>
<td>24</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Number of developed lots</td>
<td>48</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Number of lots sold</td>
<td>0</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>48</td>
</tr>
<tr>
<td>Ending inventory of lots</td>
<td>48</td>
<td>36</td>
<td>24</td>
<td>12</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cumulative no. of lots sold</td>
<td>0</td>
<td>12</td>
<td>24</td>
<td>36</td>
<td>48</td>
<td>48</td>
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<tr>
<td>Average price per lot</td>
<td>$40,000</td>
<td>$40,000</td>
<td>$42,000</td>
<td>$44,000</td>
<td>$46,000</td>
<td></td>
</tr>
<tr>
<td>Gross lot sales income</td>
<td>0</td>
<td>$480,000</td>
<td>$504,000</td>
<td>$528,000</td>
<td>$552,000</td>
<td>$2,064,000</td>
</tr>
<tr>
<td>On-site expenses</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Marketing costs</td>
<td>0</td>
<td>$33,600</td>
<td>$35,280</td>
<td>$36,960</td>
<td>$38,640</td>
<td>$144,480</td>
</tr>
<tr>
<td>Legal / closing</td>
<td>0</td>
<td>9,600</td>
<td>10,080</td>
<td>10,560</td>
<td>11,040</td>
<td>41,280</td>
</tr>
<tr>
<td>Real estate taxes</td>
<td>1,300</td>
<td>8,400</td>
<td>6,000</td>
<td>3,600</td>
<td>1,200</td>
<td>20,500</td>
</tr>
<tr>
<td>Overhead / maintenance</td>
<td>4,800</td>
<td>4,200</td>
<td>3,000</td>
<td>1,800</td>
<td>600</td>
<td>14,400</td>
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<td>Coordination / supervision</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td>20,000</td>
<td>100,000</td>
</tr>
<tr>
<td>Total</td>
<td>$26,100</td>
<td>$75,800</td>
<td>$74,360</td>
<td>$72,920</td>
<td>$71,480</td>
<td>$320,660</td>
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<tr>
<td>Entrepreneurial profit</td>
<td>0</td>
<td>72,000</td>
<td>75,600</td>
<td>79,200</td>
<td>82,800</td>
<td>309,600</td>
</tr>
<tr>
<td>Off-site development costs</td>
<td>240,000</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>240,000</td>
</tr>
<tr>
<td>On-site development costs</td>
<td>384,000</td>
<td>95,000</td>
<td>0</td>
<td>25,000</td>
<td>0</td>
<td>504,000</td>
</tr>
<tr>
<td>Net cash flow</td>
<td>($650,100)</td>
<td>$237,200</td>
<td>$354,040</td>
<td>$350,880</td>
<td>$397,720</td>
<td>$689,740</td>
</tr>
<tr>
<td>Present value</td>
<td>(613,302)</td>
<td>$211,107</td>
<td>$297,259</td>
<td>$277,930</td>
<td>$297,200</td>
<td>$470,194</td>
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<tr>
<td>Indication of land value</td>
<td>$470,194</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Source: American Institute of Real Estate Appraisers.

To determine if there is an economically feasible alternative of reusing a site at a given price by adding density, improvements, and different mixes of improvements, each reasonable redesign scenario would be analyzed by a discounted cash flow analysis. The formulation that shows the highest indication of land value is determined to be the highest and best use of the site. If the indicated value of a design specification alternative equal to or greater than the proposed purchase price, the proposed transaction is considered to be feasible. The alternative that shows the highest residual land value is determined to be the highest and best use of the site. Behind each number in the analysis is a sub-routine of supporting market data. For example, sales prices of developed lots or buildings are determined by analysis of comparable sales in the vicinity. By definition, many pioneering suburban redevelopment projects will not have close comparisons, which is one reason why investors, developer, and mortgage lenders are very cautious about funding innovative projects.

- **Pilot Communities.** Daluddrung (2011) suggested that government and non-profit funds be used to stimulate redevelopment activity in suburbs.
The benefit of this prescription is that if pilot projects prove to be successful, they provide precedents needed to provide due diligence data and case studies usable to solicit project support from developer, investors, appraisers, and mortgage lenders.

A variety of existing funding and acquisition vehicles supportive of suburban sprawl repair and retrofit, without heavy subsidy and eminent domain formerly provided by local redevelopment agencies have been identified in this paper. Some existing techniques require modification to be effective. New vehicles proposed in this paper should be refined and field tested. Techniques that might compensate for lack of eminent domain powers have been discussed as well.

As of now, there is no one proven method or set of funding and parcel acquisition techniques that will fit every suburban retrofit and sprawl repair situation. Because the replacement of functions formerly provided by a redevelopment agency is experimental, to pioneer the deployment of solutions discussed here, a team consisting of a real estate and land use attorney, a securities attorney, and a real estate feasibility consultant should perform additional research and development of the techniques discussed in this paper. On the operational level, a development feasibility specialist should be engaged to work as part of each project’s design team from the very start of the design process. As a result, project designs and planning should prove to be more practical in terms of funding possibilities. The purpose of this consulting position would be to identify candidate developers, lenders, and investor requirements, and to designate, mix, layer, and coordinate acquisition and funding vehicles to be employed for a given project. Part of his or her task would be to communicate, monitor, and enforce investment and mortgage-driven design and to provide financial and marketing evaluations of design alternatives.

**Conclusion**

For true sustainability, real estate projects must be part of a sustainable region and nation. Most metropolitan regions cannot be considered to be sustainable because they include large populations living in inefficient space-consuming suburbs. Some aging suburbs have not proven to be self-renewing and their decline compounds the impact of their unsustainable suburban design.

A design and form-based code movement has emerged to address the unsustainable characteristics of existing suburbs by planning revitalized, mixed-use, pedestrian-friendly, village-like community units. Decline of local redevelopment agency capabilities make the task of redeveloping with these solutions difficult and complicated. The funding of suburban transformation projects is also hampered by the requirements of lender and investor due diligence requirements, made even more stringent by reaction to the 2008 mortgage meltdown.

The ability of local government to address suburban decline and sprawl has been diluted by program defunding and substantial legislative, judicial, and executive
restrictions on the use of eminent domain for redevelopment purposes. A formidable set of constraints to private sector investment and mortgage capital backing for suburban revitalization and sprawl repair have been identified in the paper. An inventory and analysis of existing investment vehicles and practices indicates that they can be adapted and applied to compensate for the loss of strong support by redevelopment agencies. Existing vehicles must be supplemented by additional tools such as those proposed here to replace lost master developer functions formerly provided by local redevelopment agencies. Public policy and its implementation devices will continue to play a changed but critical role in getting sustainable suburban renewal products to market.

A conceptual roadmap to sustainable suburbs might start with taxpayer and bonding derived funds and non-profit foundation funds being invested in building pilot suburban sprawl repair projects or initial project phases. If pilot projects prove to be financially successful, private sector investments and mortgage funding are likely to follow. If positive market and financial information is documented and made available from an initial pilot project phase, private investment could follow in subsequent phases. Moreover, if several pilot projects in varying locations prove to be successful and are well documented, an industry standard set of sustainable suburban real estate products could evolve for national application by developers and due diligence use by financial sources. Widespread industry adoption could then make substantial inroads to resolving suburban sprawl and its regional and global implications.

The roadmap to suburban betterment offered in this paper requires the use of a toolkit of enabling devices to be mixed and matched to address sprawl repair. The analysis, articulation, conclusions, inventions, proposals, and interpretations should be considered and if found advisable, refinement and implementation of tools in the kit remains to be accomplished. Whether the information and approaches are found to be helpful, the purpose of this paper will have been served if it catalyzes dialogue and eventual action to address one of the most unsustainable aspects of real estate development—the local, regional, and global implications of existing suburban sprawl.

Endnote

1 The terms “first tier” or “first ring” suburbs refer to their seniority as original post-WWII suburbs to be developed in proximity to their urban cores. Their spatial location, size, and geographic configuration vary according to the region within which they are located. They are generally considered to be sandwiched between urban cores and suburban development of later vintage. Urban cores have recently acquired a favorable market appeal. Because of their proximity to the urban cores and the distances now associated with later suburban developments, suburbs have taken on the complexion and appeal of an urban core neighborhood.

References


Errol Cowan, University of San Diego and Planned Densification, Associates San Diego, CA 92110 or errolcowan013043@gmail.com.
2012 AMERICAN REAL ESTATE SOCIETY
JOURNAL MANUSCRIPT PRIZE WINNERS

Journal of Real Estate Research

Winner of the Homer Hoyt Advanced Studies Institute Manuscript Prize ($1,000) for the best research paper published in *JRER* in 2011.

**Credit Line Availability and Utilization in REITs**
William G. Hardin III and Matthew D. Hill
(33:4, 507–30)

Journal of Real Estate Portfolio Management

Winner of the PREA Manuscript Prize ($1,000) for the best research paper published in *JREPM* in 2011.

**REIT Performance and Lines of Credit**
David M. Harrison, Kimberly F. Luchtenberg, and Michael J. Seiler
(17:1, 1–14)

Congratulations to all the authors.
The American Real Estate Society proudly announces the following manuscript prize winners for research papers presented at the American Real Estate Society’s 28th Annual Meeting.


Real Estate Education, sponsored by Dearborn Real Estate Education: Kimberly Winson-Geideman and Nicholas Evangelopoulos for “Reading Lists for PhD Seminars in Real Estate.”

Housing, sponsored by the Lucas Institute for Real Estate Development and Finance at Florida Gulf Coast University: Eli Beracha and Babajide Wintoki for “Buyer Sentiment and Residential Home Prices: Evidence from Online Search Activity.”

Industrial Real Estate, sponsored by NAIOP Research Foundation: David M. Harrison for “Political Risk in Industrial Property Markets.”

Innovative Thinking, sponsored by the Maury Seldin Advanced Studies Institute (MSASI): Stephan Siegel, Henrik Cronqvist, and Florian Münkel for “Genetics, Homeownership, and Home Location Choice.”

Mixed Use Properties, sponsored by NAIOP Research Foundation: James R. DeLisle, Terry V. Grissom, and Christopher Bitte for “Mixed-Use Real Estate: An Options Pricing Model to Explain Behavioral Responses to Incentive Programs.”


Real Estate Brokerage/Agency, sponsored by the National Association of Realtors (NAR): Jia Xie for “Dual Agency Distortions in Real Estate Transactions.”

Real Estate Cycles, sponsored by the PYHRR/Born Trust for Real Estate Cycle Research: Deniz Igan for “A Closer Look at Co-Movements in Global Real Estate Cycles.”

Real Estate Finance, sponsored by Real Capital Analytics (RCA): Liu Bo, Tien-Foo Sing, and James D. Shilling for “Credit Expansion and Residential Mortgage Institutions.”


Retail Real Estate, sponsored by the Appraisal Institute (AI): Alain M. Chaney and Martin E. Hoesli for “Transaction-Based Versus Appraisal-Based Capitalization Rates: New Evidence on Cap Rate Determinants and Appraisal Smoothing.”


Seniors Housing, sponsored by the National Investment Center for the Seniors Housing and Care Industry (NIC): Kwame Addae-Dapaah and Quah Shu Juan for “Life Satisfaction among Elderly Households in Public Rental Housing in Singapore.”
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Real Estate Brokerage (Winter, 1995).

REITs (1995: Vol. 10(3/4)): Sponsored by the National Association of Real Estate Investment Trusts (NAREIT) and Equitable Real Estate Investment Management.


International Real Estate Investment (1996: Vol. 11(2)): Sponsored by Jones Lang Wootton USA.


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Chinese Real Estate Markets: (2012: Vol. 34(3)).
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1997: Seniors Housing (sponsored by the National Investment Center for the Seniors Housing and Care Industries: 248 pages).
2006/8: Indigenous Peoples and Real Estate Valuation Issues (co-sponsored by the Appraisal Institute Education Trust and the Appraisers Research Foundation).

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Director of Analytics  
CoStar Group, Inc.  
2 Bethesda Metro Center, 10th Floor  
Bethesda, MD 20814  
Phone: 888-576-9223  
Fax: 888-537-9358  
Email: jspivey@costar.com
The American Real Estate Society (ARES) Legacy Awards are for the three best papers published in the *Journal of Real Estate Research (JRER)* in selected years. The awards are $25,000, $10,000, and $5,000. The 2012 Awards below were determined by the votes of the JRER Editorial Board. The awards cover the period 2009–2011.

<table>
<thead>
<tr>
<th>YEAR PUBLISHED</th>
<th>AMOUNT</th>
<th>AUTHORS</th>
<th>TITLE</th>
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<tr>
<td>2011</td>
<td>$25,000</td>
<td>Nasser Daneshvary, Terrence M. Claretie, &amp; Ahmad Kader</td>
<td>Short-Term Own-Price and Spillover Effects of Distressed Residential Properties: The Case of a Housing Crash</td>
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<tr>
<td>2010</td>
<td>$10,000</td>
<td>Gary Pivo &amp; Jeffrey D. Fisher</td>
<td>Income, Value and Returns in Socially Responsible Office Properties</td>
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CALL FOR PAPERS
Journal of Real Estate Research
Special Issue on Asian Real Estate Markets

The American Real Estate Society announces a call for papers for a special issue of the Journal of Real Estate Research. Authors are encouraged to submit original research on topics related to the Asian Real Estate Markets. Areas of interest include, but are not limited to, the following:

- **Property Rights**: Their relationships with development strategies, property valuation, and market structure.
- **Pre-sale System**: The rationale for the system and its impact on property markets.
- **Foreclosure Laws**: Their protection to tenants and their impacts on mortgage lending practices and the capital market.
- **Tenant Eviction Protection**: Its effect on lease contract types, leasing strategies, and property values.
- **Planned Unit Development**: The value of design, planning, and amenities.
- **Units Provided by Employers and the Government**: The impact of their limited marketability on property prices and market structures.
- **Land Auction System**: Developers' strategies under supply constraints.
- **Land Lease**: The pricing of land leases and development options.
- **Brokerage System**: The system and its agency issues.
- **Development Process**: What can be learned from the development of real estate markets in Asia.
- **International Diversification**: The potential benefits of including the real estate of developing areas (or countries) in a diversified portfolio.
- **Real Estate Returns**: The risk-and-return characteristics of real estate investment in Asian real estate markets.
- **Performance Characteristics**: Its relationship with macroeconomic variables and policy changes.
- **Speculation vs. Fundamentals**: The behavioral aspects of Asian real estate markets.

All papers will be subject to double-blind anonymous review. Empirical and theoretical oriented manuscripts are welcome. Style and submission guidelines can be found at the back of JRER and on the ARES website. Electronic submissions are encouraged in Word or PDF formats. Authors should submit their manuscripts no later than October 1, 2013 to Ko Wang at ko.wang@baruch.cuny.edu.

The co-editors for this special issue are:

- **Vincent Mo**
  SouFun Holdings

- **Hongwei Wang**
  Shanghai University of Finance & Economics

- **Ko Wang**
  Baruch College
  City University of New York
CALL FOR PAPERS
Journal of Sustainable Real Estate

The American Real Estate Society, in cooperation with and funding by the CoStar Group, announces a call for papers for the fifth volume of the Journal of Sustainable Real Estate (JOSRE) in 2013. Authors are encouraged to submit original research that can help investors, developers, appraisers, lenders, asset managers, government officials, and land use regulators improve their strategies, decision making, and understanding of the impact of sustainable real estate practices. Topics and questions of interest include, but are not limited to, the following:

Work Space, Sales Space, and Productivity

- What is the impact of more sustainable real estate (more natural light, better ventilation, better temperature control, etc.) on worker productivity? Can we control for management and other factors affecting productivity?
- Have we improved how we measure productivity? (For example, new tools like www.mysammy.com are being used by employers to measure computer uses and time spent in various activities, but do they make sense?)
- Is traditional office space obsolete and what are the trends in more collaborative and innovative work space?
- What is the impact of green buildings on worker morale, retail sales, and benefits that go beyond energy savings? Can these be valued? Do they or will they eventually translate into rent?

Regulatory Issues

- How do local, state, and national government requirements compare and what have we learned about regulations versus incentives?
- Do we need mandatory disclosure of energy and water consumption? Are there examples of greater market transparency influencing property values?

Financing, PACE Programs, and Valuation Issues

- PACE programs are being promoted for commercial property. What are their benefits and costs? Will they impact investments in sustainable features that conserve energy or promote more efficient use of space?
- Have appraisers and lenders finally caught up with the impact on rents, operating expenses, and values from sustainable improvements? Are there successful competitive strategies for lenders and appraisers?

High-performance and Intelligent Building Systems

- Does solar pay off? Will real estate owners trade carbon credits some day?
- What is the state-of-the-art for water efficiency in terms of operation, rain water capture, and gray water use? What regulations impede or assist these efforts?
- What are examples of building practices that enhance flexible and productive use, extend economic life, and save retrofit costs?

Green and Sustainable Strategies and Policies

- Are there conflicts with state and local building codes and municipal subdivision and site conditions that make implementation difficult? Is land use and building code official education an issue?
- How many public and private companies have green policy statements? Has this affect real estate decisions?
- Portfolio approaches to energy consumption and sustainable benchmarks: For example, what will be the impact of GRESB? (See www.gresb.com.)
- What are the new technologies and strategies affecting water consumption? Are they cost-effective?
- Who is defending the status quo of the energy grid?

Case Studies of Net Zero Energy Buildings, Self-generated Power and Batteries

- What are the lessons learned from great new net zero buildings? Do we know how to store excess energy?

All papers are subject to anonymous double-blind review by practicing professionals and academicians. Articles must be written to be understandable by institutional real estate investors; lengthy formulas and mathematics should appear in an appendix. Applied empirical studies will be given preference. Style guidelines are at: www.josre.org. Submissions must be in MS Word or PDF format. Authors should submit their manuscripts to greenjournal@sandiego.edu.

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CALL FOR PAPERS

JOURNAL OF HOUSING RESEARCH

The American Real Estate Society announces a call for papers for the Journal of Housing Research (JHR). The objective of the JHR is to serve as an outlet for theoretical and empirical research on a broad range of housing related topics, including but not limited to, the economics of housing markets, residential brokerage, home mortgage finance and mortgage markets, and international housing issues.

All submitted manuscripts are subject to double-blind peer review by members of the journal’s Editorial Board and other real estate scholars and professionals. Electronic submissions are strongly encouraged, either as email attachments, CD-ROM or disk. Preferable word processing format is as a PDF or Microsoft Word file. Paper submissions require four copies of the manuscript. The JHR style is similar to the Journal of Real Estate Research (see www.aresnet.org or a copy of the journal for a style guide). Final revisions must be in Word, WordPerfect or other acceptable word-processing program.

Manuscripts should be original, unpublished works not under publication consideration anywhere else. Interested authors should contact or submit manuscripts to:

Ken H. Johnson
Florida International University
11200 SW 8 Street, MARC 234
Miami, FL 33199
Phone: 561-886-7099
jhr@fiu.edu
Call for Papers

Journal of Real Estate Practice and Education

The American Real Estate Society announces a Call for Papers for the Journal of Real Estate Practice and Education (JREPE). The purpose of the JREPE is to motivate research in real estate practice and education and encourage excellence in teaching. It provides a basis for the exchange of innovative opinions and research results among real estate practicing professionals, educators and researchers internationally.

The goal of the Journal is to make a significant advancement in the teaching and learning of real estate practice and education. The contributions from its content will provide an essential source of information on the teaching of real estate and become critical to the understanding of practice and education in the real estate area.

Manuscripts are solicited and encouraged in the following areas:

Practice: Innovations and experiments in all aspects of practice including training and teaching techniques (hardware, materials, technology and methods).

Education: Original empirical and theoretical papers on the evaluation of pedagogy methods, practice, attitudes, materials and learning methods in industry and academia.

Subject Matter: Substantive issues and/or research results that influence the body of knowledge and course content (practice and academia).

Special Features: Special topics such as significant events, curriculum developments, and special surveys.

Four hard copies of the manuscript should be submitted along with an electronic file in Microsoft Word or WordPerfect 6.0. Editorial guidelines printed in a current issue of the Journal of Real Estate Research should be followed. The JREPE is published biannually.

Interested authors should contact or submit manuscripts to:

William G. Hardin III  
Florida International University
Dept. of Finance  
11200 8th St., SW  
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Miami, FL 33199  
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EDITORIAL POLICY and SUBMISSION GUIDELINES

Journal Objectives
The Journal of Sustainable Real Estate (JOSRE) is an official publication of the American Real Estate Society (ARES). JOSRE is committed to publishing the highest quality analytical, empirical, and clinical research that is useful to business decision-makers in the fields of real estate development, economics, finance, investment, law, management, marketing, secondary markets, and valuation. Theoretical papers that fail to provide testable or policy implications are discouraged. Data used in empirical research must be thoroughly documented and sufficient details of computations and methodologies must be provided to allow duplication. Authors are encouraged to provide data (at a reasonable cost) for replication purpose should such a request arise.

The Editorial Board of JOSRE is interested in expanding the frontiers of scholarly real estate research and is willing to work with any potential author who is developing new and exciting ideas. Please visit http://www.josre.org for the most up-to-date information on the Journal.

Review and Publication Policies
The Editor reads each submitted manuscript to decide if its topic and content of the paper fit the objectives of JOSRE. Manuscripts that are appropriate are assigned anonymously by the Editor to one member of the Editorial Board and at least one other reviewer. The Editor makes the final decision regarding re-submissions. Upon receiving a re-submission, the Editor determines whether or not the manuscript should re-enter the reviewing process, be accepted or simply be returned.

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