The Value of Green Building
LEED Valuation
Phase I Report

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Contents

Summary

Because green building and certification are relatively new trends in efforts related to the built environment, the extent of opportunities and challenges have still not been fully realized. Initial research, summarized in this report demonstrates that there is room for significant advancements in gathering available data, research, and understanding of the value and valuation of green building. However, because green building certifications have so quickly taken hold, and in certain cities such as Seattle, there is essentially full market uptake of the principles behind the certification, exploration of this subject has revealed that the story may have "moved on." More specifically it seems that there are more important and pertinent facets regarding the valuation of commercial real estate.

Nevertheless this project's intent is to serve as a proof of concept. The aim is to develop a methodology for comprehensively comparing green, and green certified buildings, with those that are not. This report begins with explorations of academic literature and media reviews. The reviews are followed by a summary of interviews conducted with a select group of developers, building owners, investors, commercial tenants, brokers, architects, contractors, and experts from the financing side of development. These steps provide a theoretical framework and comprehensive picture of the conversation that surrounds green building and certification in the academic world, mainstream popular press, and the real estate community. This understanding informed the development of the methodology.

As found in Chapter 5, a methodology has been created for phase II of this research. This methodology attempts to remove any notion of certification and analyze buildings based solely on the presence of green components. A combination of building surveys and GIS analysis allows the researcher to compare buildings apples-to-apples, whether they have been certified or not. Once this is complete the research can then go back and identify whether or not the buildings that are certified are realizing better building economics (rent per square foot, occupancy, net operating income, etc.) than those that are not certified.

Further, this methodology allows the research to explore facets of building value other than just certification status. Ultimately the Runstad Center asserts that phase II of this research, the exploration of the value of green building certifications, is unnecessary. It is the Center's belief that an exploration of individual building amenities would likely provide a much more relevant topic and outcome. Fortunately, the methodology presented in this report can be slightly modified to achieve a process that would allow the researcher to conduct this alternative study. This alternative topic, should it be selected, would result in the identification of individual building amenities that add value to a building's economics as opposed to those amenities that do not. It would also allow for some quantification of how much more value those amenities add.

Introduction

Background

In recent years, due to the growing conversations regarding global climate change, public awareness of economic and social costs associated with finite resources and energy conservation has intensified dramatically. For over a half century the United States has been a disproportionate producer and consumer of global commodities, and many are beginning to move toward change. This past June, the Wall Street Journal published an article titled, "Sustainability Reports Gain Traction."[1] The article described that the percent of S&P 500 companies that produce reports on their sustainability efforts has risen from 20 percent in 2011 to just over 72 percent in 2013. Companies claim there is significant peer pressure to show efforts to curtail greenhouse gas emissions, reduce waste and improve efficiency in energy and water performance.

The industries associated with the built environment play a significant role in the environmental, social and economic aspects of modern society. Positively, the construction industry contributes substantially to the US economy, providing jobs both directly and indirectly, and accounted for just over 3.8 percent of the United States gross domestic product in 2012.[2] Negatively, building and construction activities produce noise, congestion, environmental impacts, and consume large amounts of material resources. In the United States, the building sector accounted for 41 percent of primary energy consumption in 2010.[3] (US Energy Information Administration, 2014) While current projections show this number declining over the coming decades, the 2040 estimates still put the building sector at just over one-third of primary energy consumption. The major implication of this is the production of greenhouse gases, and ultimately the exacerbation of global climate change.

The built environment offers a great potential for reduction in greenhouse gas emissions. Modest increases in the sustainability of buildings and operational energy efficiency can have considerable effects on their consumption.[4] This recognition has spurred a movement in recent years toward green building.

One way green building can be defined as building that: "...provides the specified building performance requirements while minimizing disturbance to and improving the functioning of local, regional, and global ecosystems both during and after its construction and specified service life," and another is, "...optimizes efficiencies in resource management and operational performance; and, minimizes risks to human health and the environment."[5] Within the Green building movement there have been a multitude of green building certification programs developed to assist in these efforts.

Internationally, green building certification programs include: Leadership in Energy and Environmental Design (LEED, United States), BRE Environmental Assessment Method (BREEAM, United Kingdom),

[1] Chasen, E. (2014, June 10). Sustainablity Reports Gain Traction. The Wall Street Journal. Retrieved June 2, 2015, from http://blogs.wsj.com

[2] Gross Domestic Product by Industry. (2013). U.S. Department of Commerce: Bureau of Economic Analysis, Retrieved June 2, 2015, from http://www.bea.gov/

[3] Annual Energy Outlook 2014. (2014, April 1). U.S. Energy Information Administration. Retrieved June 2, 2015, from http://www.eia.gov/

[4] Eichholtz, P., Kok, N., & Quigley, J. (2010, April 1). Sustainability and the Dynamics of Green Building. Retrieved June 2, 2015, from http://www.usgbc.org

[5] Standard Terminology for Sustainability Relative to the Performance of Buildings. (2008). American Society for Testing and Materials. Retrieved June 2, 2015, from http://enterprise1.astm.org

Green Building Council of Australia Green Star (GBCA, Australia), Green Mark Scheme (Singapore), DGNB (Germany), Comprehensive Assessment System for Built Environment Efficiency (CASBEE, Japan), Pearl Rating System for Estidama (Abu Dhabi Urban Planning Council), Hong Kong Building Environmental Assessment Method (HK BEAM), and Green Building Index (Malaysia).[6]

Each of these programs was developed by its respective green building council that also commissions the accredited professionals who assess each project.[7] The World Green Building Council has been established to coordinate the efforts of various green building councils around the world. The frameworks of these programs are similar to a large extent, each covering various aspects of sustainability through a variety of rating tools for different types of projects and a variety of different categories within each project type. Historically these programs have been voluntary rather than mandatory, while in recent years, municipalities have begun to use some of these certifications for incentives and even as mandates, especially for public buildings. In Seattle, for example, all new and major renovated government buildings are required to achieve a minimum of Silver Certification under the LEED standards (this will be better defined in the following section).

Earlier this year the U.S. Green Building Council released its list of the Top 10 LEED States of 2014.[8] To create the list, they divided the total number of square feet of space certified LEED in 2014 by the 2014 population. States are ranked by the square feet of space certified LEED in 2014 per person. Figure 1 shows the results.

State	Sq. Ft. Certified per Person	State Population	Sq. Ft. Certified	Projects Certified
Illinois	3.31	12,830,632	42.46M	174
Colorado	3.14	5,029,196	15.82M	102
Maryland	2.70	5,773,552	15.58M	132
Virgina	2.33	8,001,024	18.62M	150
Massachusetts	2.24	6,547,629	14.66M	99
Hawaii	1.95	1,360,301	2.66M	30
California	1.87	37,253,956	69.76M	517
Georgia	1.83	9,687,653	17.75M	87
Minnesota	1.79	5,303,925	9.51M	39
Arizona	1.74	6,392,017	11.15M	82
New York	1.74	19,378,102	33.69M	250

Figure 1: Top 10 States for LEED in 2014

In the United States, beyond the most renowned program, Leadership in Energy and Environmental Design (1993), there are other, generally newer efforts such as: Energy Star Building Certification (1992), The International Living Futures Institute (2006), Challenge 2030 (2002), Building Owners and Managers Association (BOMA) 360 (*year of inception unknown*), the Passive House Institute (1996 in Germany | 2003 in United States), Green Globes (2005), and the WELL Building Standard (2013). These programs operate differently with varying degrees of success. A comprehensive look at specifics of each program will be outlined in the following chapter.

[6] Zuo, J., & Zhao, Z. (2014). Green building researchâĂŞcurrent status and future agenda: A review. Renewable and Sustainable Energy Reviews, 30, 271-281.

[7] iBid.

[8] Long, M. (2015, February4). Infographic: Top 10 states for LEED in 2014. USGBC. Retrieved June 8, 2015, from http://www.usgbc.org/

U.S. Green Building Certification Programs

It is beneficial to understand the vast array of certification programs available in the green building world. While the following list is not entirely exhaustive, it explores many of the more prevalent and prominent programs.

Leadership in Energy and Environmental Design

In 1993, Natural Resources Defense Council (NRDC) senior scientist Robert K. Watson led a broad-based consensus process which included non-profit organizations, government agencies, architects, engineers, developers, builders, product manufacturers and other industry leaders.[1] Out of this process the U.S. Green Building Council created a green building rating system known as the Leadership in Energy and Environmental Design, or LEED. LEED was created to accomplish the following:[2]

- Define "green building" by establishing a common standard of measurement
- Promote integrated, whole-building design practices
- Recognize environmental leadership in the building industry
- Stimulate green competition
- Raise consumer awareness of green building benefits
- Transform the building market

During its first decade, LEED grew from one standard for new construction to a comprehensive system of six standards covering all aspects of the development and construction process. Green Building Council members, representing every sector of the building industry, developed and continue to refine LEED. The rating systems addresses eight major areas:

- Location and Planning
- Sustainable Sites
- Water Efficiency
- Energy and Atmosphere
- Materials and Resources
- Indoor Environmental Quality
- Innovation and Design Process

[1] The Leadership in Energy and Environmental Design (LEED). (n.d.) Environment. Retrieved June 2, 2015, from http://www.environment.gen.tr

[2] LEED. (2014). U.S. Green Building Council. Retrieved June 2, 2015, from http://www.usgbc.org

- Regional Priority

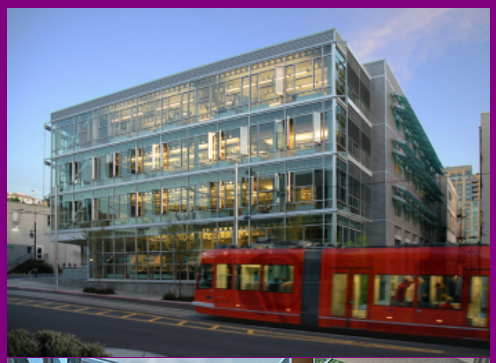
To receive LEED certification, building projects satisfy prerequisites and earn points toward achieving different levels of certification. Prerequisites and credits differ for each rating system, and teams choose the best fit for their project. Certification Levels include:

- Certified (40 points out of 110 possible)
- Silver (50 points out of 110 possible)
- Gold (60 points out of 110 possible)
- Platinum (80 points out of 110 possible)

Local Example: LEED Certification

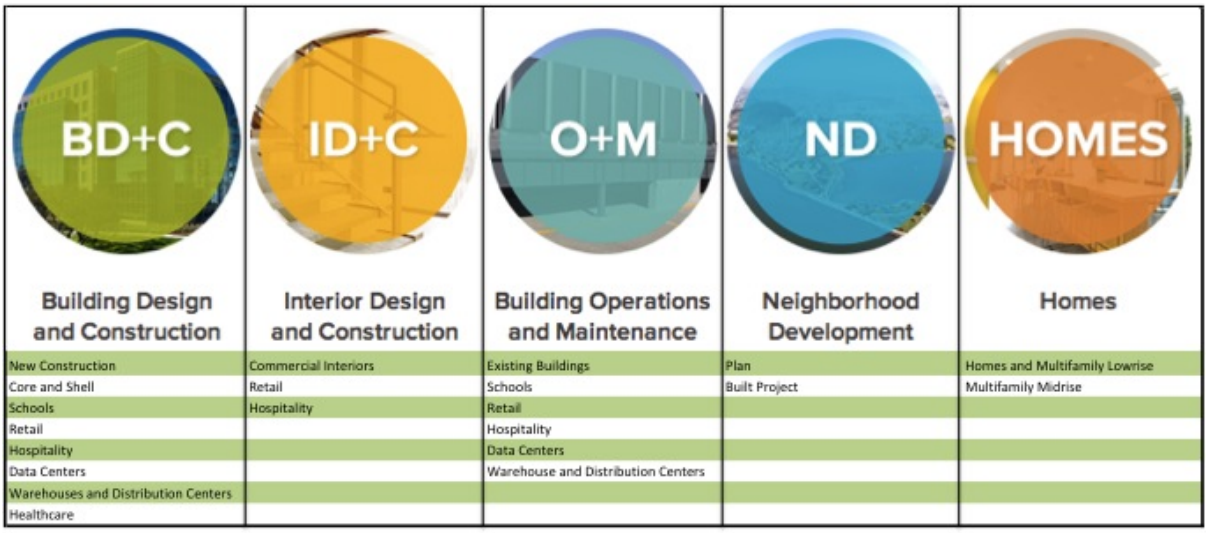
The Terry Thomas is a LEED Gold Core and Shell and LEED Platinum Commercial Interiors certified commercial office building in Seattle's South Lake Union. Designed by Weber Thompson and completed in 2008, this commercial office building is unique in the fact that it was developed without central air conditioning. Further the building boasts the following successes:

- Consumes 56% less energy than typical class A office space nationally
- Achieves 30% every savings through efficient hydronic heating, efficient equipment, electronically controlled lighting, high windows and ample daylighting, and white reflectant ceilings
- Through its storm water drainage system, efficient plumbing fixtures, and waterless urinals it saves 45-50% of water usage as compared to a typical building of its size
- Used only low Volatile Organic Compound (VOC) adhesives, sealants, paints, coatings and primers through the interior and exterior



As of late 2013, LEED is on its fourth version of certifications, which are now separated into five different rating systems. Within each rating system there are a number of subcategories. These rating systems and subcategories include:[3]

[3] iBid.



Building Design and Construction	Interior Design and Construction	Building Operations and Maintenance	Neighborhood Development	Homes
New Construction	Commercial Interiors	Existing Buildings	Plan	Homes and Multifamily Lowrise
Core and Shell	Retail	Schools	Built Project	Multifamily Midrise
Schools	Hospitality	Retail		
Retail		Hospitality		
Hospitality		Data Centers		
Data Centers		Warehouse and Distribution Centers		
Warehouses and Distribution Centers				
Healthcare				

To date, LEED standards have been applied to more than 7,000 projects in the United States and 30 other countries, covering more than 11.4 billion square feet of building space, and more than 1.7 million feet are being certified per day around the world. [4]

Energy Star Building Certification

ENERGY STAR is a U.S. Environmental Protection Agency (EPA) voluntary program that helps businesses and individuals save money and protect the climate through energy efficiency. The ENERGY STAR program was established by the EPA in 1992, under the authority of the Clean Air Act. The program is aimed at, "identifying and promoting energy-efficient products and buildings in order to reduce energy consumption, improve energy security, and reduce pollution through voluntary labeling of or other forms of communication about products and buildings that meet the highest energy efficiency standards."[5] The first ENERGY STAR building certification occurred in 1999 and since then tens of thousands of buildings across America have earned the ENERGY STAR certification for superior energy performance.

Currently, more than 30 types of facilities can earn the ENERGY STAR. Commercial buildings start by entering their utility bill data and building information into Portfolio Manager, EPA's free online tool for measuring and tracking energy use, water use, and greenhouse gas emissions. Industrial plants start by entering key plant operating data into another set of free tools, called Energy Performance Indicators.

Both tools calculate an ENERGY STAR score between 1 and 100. Facilities that score 75 or higher are eligible to apply for ENERGY STAR certification. Before facilities can earn the ENERGY STAR, a professional engineer or registered architect must verify that the information contained within the certification application is accurate.

Living Futures Institute

In 2006 the Living Futures Institute created the world′s most ambitious international sustainable building certification program known as the Living Building Challenge. The Challenge is comprised of seven performance categories which they term as Petals:[6]

[4] About Us. (2014). U.S. Green Building Council. Retrieved June 2, 2015, from http://www.usgbc.org
[5] About ENERGY STAR. (n.d.). ENERGY STAR. Retrieved June 2, 2015, from http://www.energystar.gov
[6] Living Building Challenge 3.0. (2014). Living Futures Institute. Retrieved June 2, 2015, from http://living-future.org

- Place
- Water
- Energy
- Health and Happiness
- Materials
- Equity
- Beauty

Petals are subdivided into a total of twenty Imperatives, each of which focuses on a specific sphere of influence. Some categories or "Petals" have more subcategories or "Imperatives" than others. So, for example, the water category or "Water Petal" has only one subcategory or "Imperative," "Net Positive Water." This Imperative requires that the building have net positive water for 12 months prior to certification. The materials category or "Materials Petal," on the other hand, has five subcategories or "Imperatives," ranging from "Red List" (pertaining to not using materials that are found on a list that compiles unsustainable materials), to "Net Positive Waste" (pertaining to a requirement to divert construction material waste to other uses).[7] This compilation of Imperatives can be applied to almost every conceivable building project, of any scale and any location; be it a new building or an existing structure.

As of mid 2014, the Living Building Challenge has been on version 3.0 and currently has three different levels of certification:

- Living Building Challenge Certified Projects
  - A Living Building, the highest possible certification, has achieved the feat of not only minimizing its negative impact on the built environment, but is actively helping to restore the natural environment. A project achieves Living Building Certification by attaining all twenty Imperatives that the program requires for its specific building type.
- Petal Certified Projects
  - One step below the pinnacle Living Building Certification is the Petal Certification. This certification option provides an opportunity for a project to make advancements in technologies and practices through adoption of some restorative principles while not necessarily addressing all of the Imperatives. Project teams may pursue Petal Certification by satisfying the requirements of three or more Petals, at least one of the following must be included: Water, Energy, or Materials. Further, both Imperative 01: Limits to Growth and Imperative 02: Inspiration and Education must be achieved.
- Net-Zero Energy Certified Projects
  - This certification is yet another step down from the living building certification and the petal certification. This certification requires that a project achieve the Energy Petal, along with a subset of Imperatives within the Place, Equity and Beauty Petals. The argument for this certification is that the Imperatives in this specific subset are simpler to understand and many have added benefits such as energy cost savings.

[7] Living Building Challenge 3.0. (2014). Living Futures Institute. Retrieved June 2, 2015, from http://living-future.org

Local Example: Living Building Challenge

The Bullitt Center is a six-story, 52,000-square-foot commercial office building in the Capital Hill Neighborhood of Seattle, WA. Officially opening on Earth Day (April 22nd) 2013, the center was built by the Bullitt Foundation, a Seattle based non-profit that focuses on urban ecology. The building is designed to have to a 250-year lifespan and is equipped with the following green attributes:

- A heating and cooling system consisting of water pipes in the floors that use 26 closed-loop wells to grab geothermal energy
- A series of 575 solar panels on the roof that stores access energy during the summer on the City grid and allows it to realize net zero energy
- Toilets and urinals that use only two tablespoons of a water/biodegradable soap mixture when flushing and onsite aerobic composters
- Water from sinks and showers are cleaned in onsite constructed wetland and infiltrated back into soil to recharge local aquifer
- An integrated system of triple-pane glazing and deployable exterior shades to help regulate building temperature with minimal heating and air conditioning
- A heat recovery technology allows the building to use tempered exhaust air form the building to pre-heat incoming air

Unlike LEED, which certifies based solely on design aspects, the Living Building Challenge has a twelve month certification process, as it is required to demonstrate that the building operates at the sustainability levels it was designed for. Like LEED′s rating systems, the Living Building challenge is separated into typologies of projects. For this program there are four including:

- Renovation
- Landscape + Architecture
- Building
- Community

This program has a much smaller group of completed certified projects than the two programs previously described. Because this program is less than a decade old, has exceedingly stringent guidelines, and requires a year of operation before certification, there are currently five projects living buildings certified, four projects petal certified, and nine projects that are net zero energy certified. There are also a handful

of projects currently in the midst of their twelve month certification period, but the International Living Building Institute does not make this information readily available.

2030 Challenge

In 2002 Architecture 2030, a non-profit, non-partisan and independent organization, was established in response to the climate change crisis.[8] They held that the "Building Sector" was a major source of demand for energy and materials that produce by-product greenhouse gases (again 41% of all primary source energy consumption). They believed that stabilizing and reversing emissions in this sector was key to slowing global climate change. To achieve their goals, the organization began by defining a baseline starting point for their target goals as the national average/median energy consumption of existing U.S. commercial buildings as reported by the 2003 Commercial Building Energy Consumption Survey (CBECS). Then they issued The 2030 Challenge, asking the global architecture and building communities to adopt the following targets:[9]

- "All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% below the regional (or country) average/median for that building type.
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 70% of the regional (or country) average/median for that building type.
- The fossil fuel reduction standard for all new buildings and major renovations shall be increased to (% is in terms of the regional (or country) average/median for that building type):
  - 80% in 2020
  - 90% in 2025
- Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate). These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy.
- All new and renovated developments / neighborhoods / towns / cities / regions immediately adopt and implement a 50% reduction standard below the regional average/median for: CO2 from auto and freight water consumption.

  The reduction standard shall be increased to (% is in terms of the regional (or country) average/median for that building type):
  - 20% in 2020
  - 35% in 2025
  - 50% in 2030"

This program, in contrast with those previously described, is primarily focused specifically on fossil fuel energy reduction. In June 2006 the U.S. Conference of Mayors approved the adoption of the "2030 Challenge" for all buildings, and the program has attracted hundreds of projects.

In recent years, Architecture 2030 has expanded the program to include districts in a program they call, "2030 Districts." 2030 Districts are private/public partnerships that attempt to address urban sustainability at a larger scale. Property owners and managers, local governments, businesses, and community stakeholders collaborate to leverage financing and share resources. It is effectively an open source for the pursuit of creative strategies as these many stakeholders progress towards a common goal.

[8] The Challenge 2030. (2011). Architecture 2030. Retrieved June 2, 2015, from http://www.architecture2030.org
[9] iBid.

Seattle is home to the first 2030 District and has been followed by districts in seven other US cities: Cleveland, Pittsburgh, Los Angeles, Denver, San Francisco, Dallas, and Stamford, Connecticut. In total, these eight 2030 Districts comprise of over 178 million square feet of commercial space.

Local Example: Seattle's 2030 District

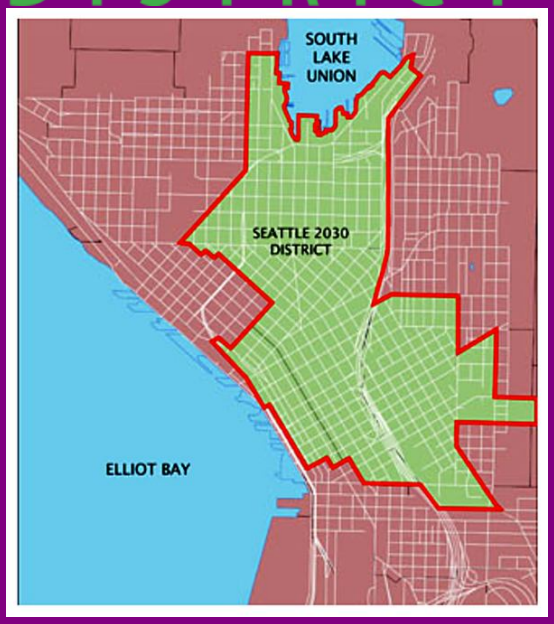
The Seattle 2030 District is a groundbreaking high-performance building district in downtown Seattle that is the first of eight districts participating in the Architecture 2030 program. It aims to dramatically reduce environmental impacts of building construction and operations through education and collaboration across every sector of the built environment. The district has a series of goals including:
Existing Buildings

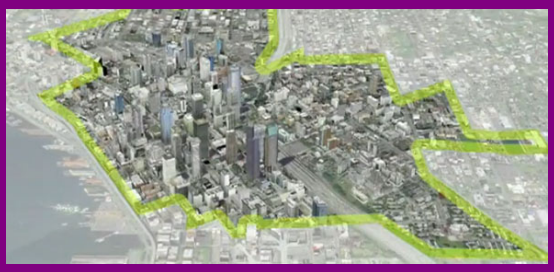
- Energy Use: A minimum of 10% reduction below the National median by 2015 with incremental targets, reaching a 50% reduction by 2030
- Water Use: Manage storm water peak discharge and potable water use within the District by 50% below the District baseline by 2030, with incremental targets of 20% by 2020, 35% by 2025, reaching 50% by 2030
- CO2e of Auto and Freight: A minimum of 10% reduction below the current District average by 2015 with incremental targets, reaching a 50% reduction by 2030

New Construction

- Energy Use: An immediate 60% reduction below the National average with incremental targets, reaching carbon neutral by 2030
- Water Use: Immediately manage the combination of storm water peak discharge and potable water use by 50% below the District baseline
- CO2e of Auto and Freight: An immediate 50% reduction below the current District Average

2030 DISTRICT™





Building Owners and Managers Association 360

Founded in 1907, BOMA represents the owners and managers of all commercial property types including nearly 10 billion square feet of U.S. office space that supports 3.7 million jobs and contributes $205 billion to the U.S. gross domestic product.[10] Its mission is to, "advance the interests of the commercial real estate industry through advocacy, education, research, standards and information."[11]

[10] BOMA 360 Performance Program. (2014). Building Owners and Managers Association. Retrieved June 2, 2015, from http://www.boma.org
[11] iBid.

In 2009 the Building Owners and Managers Association created BOMA 360, which is a commercial real estate designation that, "recognizes all-around excellence in building operations and management." The program accesses six categories of building performance that are then broken down into a number of more specific objectives. While most of the categories and objectives are irrelevant to the focus of this paper, two categories, "Energy" and "Environmental/Sustainability," are directly relevant:

Building Owners and Managers Association Certification Categories and Criteria

Building Operations and Management	**Tenant Relations/Community Involvement**
Use of the BOMA Floor Measurement Standard	Community Impact
Financial Management	Tenant Relations/Tenant Communication
Insurance	Advocacy on Industry-Related Issues
Green Purchasing	
Training and Education	**Life Safety Security Risk Management**
Professional Designations	Emergency and Disaster Preparedness and Recover Plan
Licensing	Automated External Defibrillators in Buildings
Continuing Education/ Professional Development	Established Emergency Communication Network with Contiguous Properties and Law Enforcement
Professional Development Plan	Code Compliance - Certificate of Occupancy or Business License - federal, state and local
Professional Memberships	Fire and Life Safety Systems Inspected and Certified Annually
BOMA Education and Events	Evacuation Drills Conducted at Least Annually
TOBY Participation	Written Security Procedures Manual
	Access Control and Surveillance Systems
	ADA Compliance Plan
Energy	**Environmental/Sustainability**
ENERGY STAR Benchmarking	Waste Management and Recycling Policies
ENERGY STAR Products for Building and Tenants	Indoor Air Quality
Building Energy Management	Green Cleaning
Energy Audit/System Commissioning/ Re-Commissioning	Exterior Maintenance Management
	Water Management
	Traffic Reduction Initiatives

Since the programs inception nearly 700 commercial properties have achieved the BOMA 360 label.

Green Globes

In 2004, the Green Buildings Institute, a Portland, OR based 501(c)(3), purchased the US rights to a Canadian certification program and adapted it to better suite the US market. Green Globes is a web-based program for green building guidance and certification that includes an on-site assessment by a third party. The program is marketed as a certification

program that offers a streamlined alternative to LEED, advancing the overall environmental performance and sustainability of commercial buildings.

The program has modules supporting:

- New Construction - Green Globes for New Construction (NC)
- Existing Buildings - Green Globes for Continual Improvement of Existing Buildings (CIEB)
- Existing Healthcare Buildings - Green Globes CIEB for Healthcare
- Interiors - Green Globes for Sustainable Interiors (SI)

The Green Globes software tools and ratings and certification system assess environmental impacts on a 1,000 point scale in six assessment areas, which are shown in the table below. Green Globes offers four different levels of certification base on how many of the 1,000 possible points a project achieves:

- 1 Globe
- 2 Globes
- 3 Globes
- 4 Globes

Green Globes markets itself as being superior to LEED certification because they assert that it: is based on American National Standards (ANSI), has flexibility for non-applicable criteria, has no prerequisites, comes with sustainability recommendations in an automated report, has a certification process approximately one-third as long, and is approximately one-third the price.

WELL Building Standard

The International WELL Building Institute (IWBI) is a public benefit corporation which was founded by Scialla and Delos in an effort to fulfill a Clinton Global Initiative commitment to improve the way people live. The IWBI is interested in exploring ways to enhance and improve the human health and wellbeing within the built environment. This includes residents, employees, visitors, and patrons. The WELL Building Institute believes that, because humans spend most of their lives working, sleeping, and generally existing in buildings (90% of our time in fact), they should be designed with the human experience at the core. To help realize this vision, the IWBI administers the WELL Building Standard, which is an evidence-based system for measuring, certifying, and monitoring the performance of building features that impact health and wellbeing.

The WELL Building Standard works in alignment with LEED, the Living Building Challenge, and other green building rating systems and focuses on seven aspects of the built environment: air, water, nourishment, light, fitness, comfort, and mind. Currently in its pilot stages, the WELL Building Standard is grounded in six years of research and development that demonstrates the connection between the buildings, their attributes, and their health and wellness impacts on occupants. WELL Certification requires an on-site post-occupancy performance audit followed by re-auditing every three years to maintain certification thereafter. This rating system has three levels of certification: Silver, Gold, and Platinum.

The WELL standard offers certifications for eight different building typologies:

- Residential
- Hospitality

Green Globels Certification Assessment Areas and Descriptions

Assessment Area	Description	New Construction Points	Existing Building Points
Project Management-Policies & Practices	Integrated design, environmental purchasing, commissioning, and emergency response plan.	50	100
Site (not applicable for CIEB)	Site development areas, reduce ecological impacts, enhancement of watershed features, and site ecology improvement.	115	
Energy	Energy consumption, energy demand minimization, right sized energy-efficient systems, renewable sources of energy, energy -efficient transportation.	390	350
Water	Flow and flush fixtures, water-conserving features, reduce off-site treatment of water.	110	80
Resources, Building Materials and Solid Waste)	Materials with low environmental impact, minimized consumption and depletion of material resources, re-use of existing structures; building durability, adaptability and disassembly; and reduction, re-use and recycling of waste.	125	110
Site (Emissions, Effluents and other impacts	Air emissions, ozone depletion and global warming, protection of waterways and impact on municipal waste water treatment facilities, minimization of land and water pollution, integrated pest management, and the storage of hazardous materials.	50	175
Indoor Environment	Effective ventilation systems, source control of indoor pollutants, lighting design and integration of lighting systems, thermal comfort, acoustic comfort.	160	185
Total Points		1,000	1,000

- Office
- Mixed-Use
- Healthcare
- Retail/Restaurant
- Education

- Student Housing

Within these typologies WELL distinguishes between several different project types:

- New Construction
- Existing Buildings
- Core + Shell
- Tenant Improvement

As can be observed by this list of rating systems, a new generation of green building evaluation mechanisms has been gaining popularity in the United States in recent years. In review, some now have very narrow scopes such as the 2030 Challenge focusing on fossil fuel consumption and the WELL certification focusing on the user experience. Older certification programs like LEED have continue to implement new revised versions of their program that add both new building typology opportunities and more encompassing categories such as location and transportation. There are newer programs, such as the Living Building Challenge, whose ambitions require many building features that may conflict with current codes and standards such as isolated, self contained sewage systems. In an effort to stay relevant and maintain market differentiation, certification programs are pressured to keep pushing the fold. All the while the commercial real estate marketplace is increasingly having to negotiate the complexities and effects of these certifications along with new building codes, additional ratings systems, and performance measures.

Review of Academic Literature

The first field of research that was reviewed was academic study. There have been extensive studies on green buildings, as evidenced in the rapid growing number of academic papers that have been published in recent years. As this report is focused on the different dimensions of financial performance added through green building certifications, this review will focus on aspects of valuation as well. Once the search was narrowed to this pool of reports, information regarding the subject, findings, methodology, and variables of each of 35 pertinent articles was recorded.

Findings

This critical review of the existing body of knowledge revealed that there are generally three common focuses of value and green building: energy and ecology, occupant experience and general economics. These themes are discussed in detail in the following sections.

Energy & Ecology

Performance is a subject that transcends the motivational boundaries of green buildings. Developers, building owners and tenants are all interested in the asset value enhancement that comes as a result of lower operating costs, reduced waste sent to landfills, water and energy conservation, healthier and safer environments for occupants, reduced greenhouse gas emissions, tax rebates, zoning allowances and other incentives. Environmental advocates are interested in the benefits to the environment that these savings equate to. Planners are interested in performance savings because they spend a significant effort generating codes and regulations and want to ensure that those efforts are generating the intended results. Thus, a vast majority of the research done regarding the effectiveness of green building revolved around performance accomplishments.

It is simplest to understand the evolution of this subject through chronological progression. The first major report found of this kind was provided by the Sustainable Building Task Force of California in late 2003.[1] As LEED certified buildings were still few and young, metrics consisted mainly of hypothetical or potential savings. Nevertheless, this report asserted that the benefits of building green including cost savings from reduced energy, water, and waste; lower operations and maintenance costs; and enhanced occupant productivity and health; indicated a total financial benefits of green buildings are over ten times the average initial investment required to design and construct a green building. Figure 2 is a summary table of their findings:

By 2006 researchers were beginning to be more critical of the lack of effective data from which to investigate green building performance.[2] While some were optimistic about the effectiveness of green building, skepticism was growing. In 2008 and 2009 a plethora of research was published on green building performance. Results laid on both sides of the fence; some found green building was achieving

[1] Kats, G., Alevantis, L., Berman, A., Mills, E., & Perlman, J. (2003, October 3). The Costs and Financial Benefits of Green Buildings: A Report to California's Sustainable Building Task Force. Retrieved June 2, 2015, from http://www.usgbc.org/

[2] Diamond, R., Opitz, R., Hicks, T., Neida, B., & Herrera, S. (2006). Evaluating the Energy Performance of the First Generation of LEED-Certified Commercial Buildings. Retrieved June 3, 2015, from http://www.southface.org AND Turner, C. (2006, January 30). LEED Building Performance in the Cascadia Region: A Post Occupancy Evaluation Report. U.S. Green Building Council.

Figure ES-1. Financial Benefits of Green Buildings Summary of Findings (per ft^2)

Category	20-year NPV
Energy Value	$5.79
Emissions Value	$1.18
Water Value	$0.51
Waste Value (construction only) - 1 year	$0.03
Commissioning O&M Value	$8.47
Productivity and Health Value (Certified and Silver)	$36.89
Productivity and Health Value (Gold and Platinum)	$55.33
Less Green Cost Premium	($4.00)
Total 20-year NPV (Certified and Silver)	**$48.87**
Total 20-year NPV (Gold and Platinum)	**$67.31**

Source: Capital E Analysis

Figure 2: Financial Benefits of Green Buildings

its intention of superior efficiency in energy and water use while others did not. One study by New Buildings Institute investigated measured energy performance for 121 LEED certified New Construction buildings and found significant energy savings from this subset of buildings. Figure 3 represents their findings:[3]

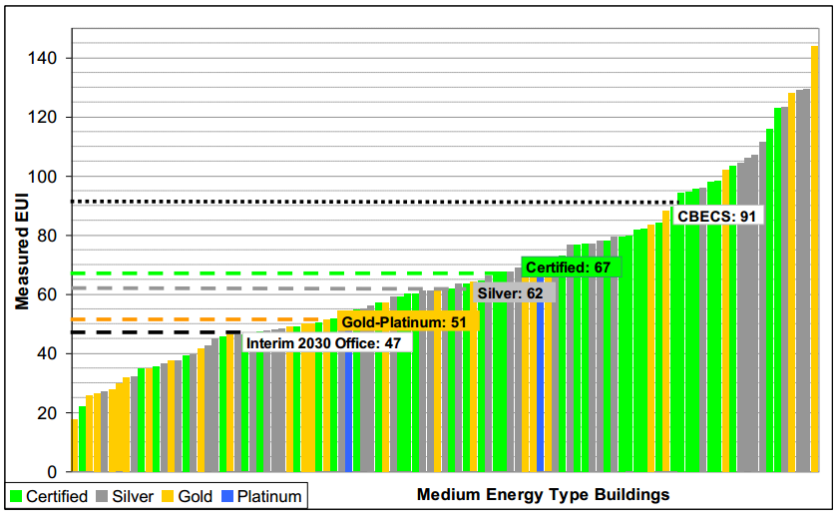


Figure ES- 2: EUI (kBtu/sf) Distribution

Figure 3: Energy Use by LEED Certification

Another study conducted by the Pacific Northwest National Laboratory studied 19 buildings managed by the General Services Administration (GSA). A handful of building performance aspects were analyzed when compared to an industry baseline developed from the GSA. While most of the performance measures were inconclusive, energy performance was better than the baseline for all buildings studied.[4] A paper published in "Energy and Buildings," conducted a re-analysis of the New Buildings Institute study and found that while 18-39% used less energy per floor area than their conventional counterparts, 28-35% actually used more.[5] Six months later "Energy and Buildings" published another paper critiquing the

[3]Turner, C., Frankel, M. (2008, March 4). Energy Performance of LEED for New Construction Buildings. U.S. Green Building Council.

[4]Fowler, K., Rauch, E. (2008, July 1). Assessing Green Building Performance: A post occupancy evaluation of 12 GSA buildings. GSA Public Buildings Service office of Applied science: Applied Research. Retrieved June 3, 2015, from http://www.gsa.gov

[5]Newsham, G., Mancini, S., & Birt, B. (2009, August). Do LEED-certified buildings save energy? Yes, but.... Energy

aforementioned article stating that the previous study, "... hang[s] on a particular definition of the mean energy intensity of a collection of buildings that is not related to the total energy used by those buildings. Furthermore, site energy considered by Newsham et al. and NBI, unlike source energy used for the EPAs building Energy Star rating, does not account for the energy consumed off-site in generating and delivering electric energy to the building, whose inclusion is crucial for understanding greenhouse gas emission associated with building operation."[6] Finally, an evaluation done of 11 U.S. Navy LEED-Certified buildings found that while buildings generally realized marginal energy savings 9 out of the 11 buildings did not reach their intended goal of 30% reductions.[7]

Both sides were critical of each others′ research methods.[8] Did they look at the appropriate comparable properties? Did they research site energy rather than primary or source energy? General conclusions were that research was still suffering from two important shortcomings:[9]

1. Relative scarcity of energy performance data for both a representative and significant number of LEED-certified buildings; and

2. Lack of appropriate comparison group of non-LEED buildings, i.e., development of credible metric to be used in evaluating LEED building energy consumption.

In the last few years reports continue to lack consensus on conclusive performance results for green building energy efficiency. An Air Force Institute of Technology study sampled 160 LEED certified buildings and found that: operating costs in LEED certified buildings were $0.70 per square foot less than non-LEED buildings, and energy costs were 31% lower.[10] Conversely "Energy and Buildings" published article that analyzed 953 New York City office buildings, of which 21 were LEED-certified, found that the LEED and non-LEED certified buildings had the same energy consumption and green house gas emissions levels.[11] A "Journal of Construction Engineering and Management" article looked at 25 LEED certified buildings in Arizona and found than while the LEED buildings outperformed the national average, they under-performed with regard to other buildings located in similar climates. (Sullivan, 2013) Most continue to assert that data is lacking and that results are very much dependent on how the question is framed and how the participating projects are selected.[12]

Occupant Experience

This subject is primarily of interest to building owners, developers and tenants. Developers and building owners are interested in the opportunities and challenges faced by the occupants of green buildings because it is hypothesized that if a relationship can be shown between satisfaction, and even productivity, there is stronger marketing power and higher premiums to profit on. Likewise, tenant companies may be willing to spend more if it means higher employee satisfaction and productivity.

Social Scientists first began investigating occupant satisfaction and productivity in green buildings in the early 2000s. In 2006 the Center for the Built Environment's Industry Consortium sponsored a study on

and Buildings, 41(8), 897-905.

[6] Scofield, J. (2009, December). Do LEED-certified buildings save energy? Not really.... Energy and Buildings, 41(12), 1386-1390.

[7] Menassa, C., Mangasarian, S., Asmar, M., & Kirar, C. (2008). Energy Consumption Evaluation of U.S. Navy LEED-Certified Buildings. Journal of Performance of Constructed Facilities J. Perform. Constr. Facil., 26(1), 46-53.

[8] Gifford, H. (2008, August 18). A Better Way to Rate Green Buildings. Retrieved June 3, 2015, from http://www.solaripedia.com

[9] Scofield, J. (2013, December). Efficacy of LEED-certification in reducing energy consumption and greenhouse gas emission for large New York City office buildings. Energy and Buildings, 67, 517-524.

[10] Nyikos, D., Thal, A., Hicks, M., & Leach, S. (2012). To LEED or Not to LEED: Analysis of Cost Premiums Associated With Sustainable Facility Design. Engineering Management Journal, 24(4), 50-62.

[11] Scofield, J. (2013, December). Efficacy of LEED-certification in reducing energy consumption and greenhouse gas emission for large New York City office buildings. Energy and Buildings, 67, 517-524. AND Oates, D., & Sullivan, K. (2012, June). Postoccupancy Energy Consumption Survey of ArizonaâĂŹs LEED New Construction Population. Journal of Construction Engineering and Management, 138(6), 742-750.

[12] Scofield, J. (2013, December). Efficacy of LEED-certification in reducing energy consumption and greenhouse gas emission for large New York City office buildings. Energy and Buildings, 67, 517-524.

satisfaction.[13] The report, via occupant survey, found that on average, occupants in green buildings were more satisfied with thermal comfort and air quality in their work-space, equally satisfied with acoustic quality, and less satisfied with light levels and sound privacy than occupants in non green equivalent buildings.

More recently in 2013 two separate studies were done on this same subject. The first looked at 12 green and 12 conventional office buildings across Canada and the northern United States using both an occupant survey and physical measurements where appropriate.[14] This report found that green buildings generally exhibited superior performance compared with similar conventional buildings. Areas of superior satisfaction included: environmental, thermal conditions, view to the outside, aesthetic appearance, less background noise, workplace image, night-time sleep quality, mood, physical symptoms, and reduced number of airborne particulates. While the report did not document any categories where LEED certified buildings were out performed by non-LEED certified buildings, it did suggest that two areas of focus for improvement included: acoustic performance and air particulate reduction. The second analyzed in 65 LEED and 79 non-LEED buildings, primarily utilizing the survey database held by the Center for the Built Environment.[15] This report found that while there was not a significant influence of LEED certification on occupant satisfaction with indoor environmental quality, occupants of LEED buildings tend to be slightly more satisfied with air quality, and slightly more dissatisfied with amount of light. Figure 4 synthesizes the studies highlighted above.

Category	Abbaszadeh (2006)	Newsham (2013)	Altomonte (2013)
Environmental Satisfaction	N/A	GREEN	N/A
Thermal Comfort	GREEN	GREEN	SAME
Air Quality	GREEN	GREEN	GREEN
Acoustics	SAME	GREEN	SAME
Lighting	NON-GREEN	GREEN	NON-GREEN
Sound Privacy	NON-GREEN	GREEN	NON-GREEN
Views to Outside	N/A	GREEN	N/A
Aesthetic Appearance	N/A	GREEN	N/A
Workplace Image	N/A	GREEN	N/A
Nighttime Sleep Quality	N/A	GREEN	N/A
Mood	N/A	GREEN	N/A
Physical Symptoms	N/A	GREEN	N/A
Access to Windows	N/A	GREEN	N/A
Office Layout	N/A	N/A	SAME
Office Furnishings	N/A	N/A	SAME
Cleanliness and Maintenance	N/A	N/A	SAME

Figure 4: Summary of Studies on Occupant Satisfaction

The table shows that while each study reviewed slightly different categories, there were five that each had in common: thermal comfort, air quality, acoustics, lighting, and sound quality. In review of these five categories, the table shows that there is generally inconsistent findings to be able to make any clear conclusions of how LEED certification effects occupant satisfaction.

General Economics

This final area of research culminates by utilizing findings from the two subjects discussed previously and attempts to go a step further and begin putting a value on green building. Based on higher performance and occupant satisfaction, what kinds of ultimate effects does building green have on the real estate side of these ventures? Early reports described difficulties in valuing green building. With a lack of good comparable properties in a rapidly changing culture, appraisers, lenders and insurers are having extreme difficulty accurately addressing the value and risks of certified green projects.[16]

[13] Abbaszadeh, S., Zagreus L., Lehrer D., & Huizenga, C. (2006). Occupant Satisfaction with Indoor Environmental Quality in Green Buildings. Proceedings of Healthy Buildings 2006, Lisbon, Vol. III, 365-370. Retrieved June 3, 2015, from http://www.yourbuilding.org

[14] Newsham, G., Birt, B., Arsenault, C., Thompson, A., Veitch, J., Mancini, S., ... Burns, G. (2013, August 1). Do âĂŸgreenâĂŹ buildings have better indoor environments? New evidence. Building Research & Information, 41(4), 415-434.

[15] Altomonte, S., & Schiavon, S. (2014, July). Occupant satisfaction in LEED and non-LEED certified buildings. Building and Environment, 77, 66-76.

[16] Loban, T., & Jones, T. (2008). Valuation Issues in a Greening World. Journal of Green Building, 3(3), 42-56.

In 2008, CoStar released a report analyzing 1,300+ LEED and Energy Star buildings consisting of 351 million square feet in CoStar's commercial property database against non-green properties with similar size, location, class, tenancy and year-built characteristics to generate the results. The report touted that buildings carrying LEED or Energy Star certifications exhibit higher lease and occupancy rates than their conventional peers.[17] While the original CoStar report was unavailable for review, Burr summarizes that is suggested that, "LEED buildings command rent premiums of $11.33 per square foot over their non-LEED peers and have 4.1 percent higher occupancy. Rental rates in Energy Star buildings represent a $2.40 per square foot premium over comparable non-Energy Star buildings and have 3.6 percent higher occupancy...Energy Star buildings are selling for an average of $61 per square foot more than their peers, while LEED buildings command a remarkable $171 more per square foot."

Other research has shown that green certified buildings, as compared with non green certified buildings, have: higher rental rates,[18] higher resale value,[19]higher occupancy rates,[20] lower operating expenses,[21] higher Net Operating Incomes,[22] lower capitalization rates,[23] and improved productivity.[24]

The Institute for Building Efficiency has reviewed the seven reports cited above - Pivo & Fischer, 2008; Eichholtz et al., 2009; Eichholtz et al., 2010; Fuerst & McAllister, 2009; Wiley et al., 2008; Miller et al., 2008; and Loftness et al., 2003 - and summarized their findings. Earlier this year they published a report promoting the following:[25]

"In comparison with conventional buildings, studies in the U.S. have found that certified buildings have:

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[17]Burr, A. (2008, March 26). CoStar Study Finds Energy Star, LEED Bldgs. Outperform Peers. CoStar Interview. Retrieved June 4, 2015, from http://www.costar.com

[18]Pivo, G., & Fisher, J. (2008, October 10). Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2007. Retrieved June 4, 2015, from https://kelley.iu.edu AND Eichholtz, P., Kok, N., & Quigley, J. (2009, January). Doing Well by Doing Good? Green Office Buildings. American Economic Review, 100(5), 2492-2509. AND Eichholtz, P., Kok, N., & Quigley, J. (2010, August 1). The Economics of Green Building. Economics & Statistics, 95(1), 50-63. AND Fuerst, F., & McAllister, P. (2009, April 3). New Evidence on the Green Building Rent and Price Premium. Annual Meeting of the American Real Estate Society. Retrieved June 3, 2015, from http://immobilierdurable.umapresence.com AND Wiley, J., Benefield, J., & Johnson, K. (2008, July 30). Green Design and the Market for Commercial Office Space. Journal of Real Estate Financial Economics (2010) 41:228-243.

[19]Pivo, G., & Fisher, J. (2008, October 10). Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2007. Retrieved June 4, 2015, from https://kelley.iu.edu AND Miller, N., Spivey, J., & Florance, A. (2008). Does Green Pay Off?. Journal of Real Estate Portfolio Management, 14(4), 385-400. AND Eichholtz, P., Kok, N., & Quigley, J. (2009, January). Doing Well by Doing Good? Green Office Buildings. American Economic Review, 100(5), 2492-2509. AND Eichholtz, P., Kok, N., & Quigley, J. (2010, August 1). The Economics of Green Building. Economics & Statistics, 95(1), 50-63. AND Fuerst, F., & McAllister, P. (2009, April 3). New Evidence on the Green Building Rent and Price Premium. Annual Meeting of the American Real Estate Society. Retrieved June 3, 2015, from http://immobilierdurable.umapresence.com AND Wiley, J., Benefield, J., & Johnson, K. (2008, July 30). Green Design and the Market for Commercial Office Space. Journal of Real Estate Financial Economics (2010) 41:228-243.

[20]Pivo, G., & Fisher, J. (2008, October 10). Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2007. Retrieved June 4, 2015, from https://kelley.iu.edu AND Miller, N., Spivey, J., & Florance, A. (2008). Does Green Pay Off?. Journal of Real Estate Portfolio Management, 14(4), 385-400. AND Eichholtz, P., Kok, N., & Quigley, J. (2010, August 1). The Economics of Green Building. Economics & Statistics, 95(1), 50-63. AND Wiley, J., Benefield, J., & Johnson, K. (2008, July 30). Green Design and the Market for Commercial Office Space. Journal of Real Estate Financial Economics (2010) 41:228-243.

[21]Pivo, G., & Fisher, J. (2008, October 10). Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2007. Retrieved June 4, 2015, from https://kelley.iu.edu AND Miller, N., Spivey, J., & Florance, A. (2008). Does Green Pay Off?. Journal of Real Estate Portfolio Management, 14(4), 385-400.

[22]Pivo, G., & Fisher, J. (2008, October 10). Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2007. Retrieved June 4, 2015, from https://kelley.iu.edu AND Fuerst, F., & McAllister, P. (2009, April 3). New Evidence on the Green Building Rent and Price Premium. Annual Meeting of the American Real Estate Society. Retrieved June 3, 2015, from http://immobilierdurable.umapresence.com

[23]Pivo, G., & Fisher, J. (2008, October 10). Investment Returns from Responsible Property Investments: Energy Efficient, Transit-oriented and Urban Regeneration Office Properties in the US from 1998-2007. Retrieved June 4, 2015, from https://kelley.iu.edu AND Miller, N., Spivey, J., & Florance, A. (2008). Does Green Pay Off?. Journal of Real Estate Portfolio Management, 14(4), 385-400.

[24]Loftness, V., Hartkopt, V., Gurtekin, B., Hansen, D., & Hitchcock, R. (2003). Linking Energy to Health and Productivity in the Built Environment. Center for Building Performance and Diagnostics, Carnegie Mellon 2003. Greenbuild Conference. Retrieved June 4, 2015, from http://www.usgbc.org

[25]Multiple Studies Document Green Buildings Add Value. (2013). Institute for Building Efficiency: an Initiative of Johnson Controls. Retrieved June 3, 2015, from http://www.institutebe.com

- Rental rates higher by 2 to 17 percent
- Resale value improved by 5.8 to 35 percent
- Occupancy rates higher by 0.9 to 18 percent
- Operating expenses lower by 30 percent
- Net operating income higher by 5.9 percent
- Capitalization rates lower by 50 to 55 basis points
- Productivity improved by 4.8 percent"

Recently the hospitality industry has taken specific interest in the effects of green building certification on rates. As early as 2008, hotels were noticing their ability to charge higher rates if they had green building certifications.[26] They suggested that consumers would almost certainly continue to demand that hotels, similar to other commercial real estate operators, take part in the green building trend. More recently, a 2014 report suggested that the prices of hotel rooms are 5.15-percent higher for each environmentally sustainable measure implemented in the hotel; in some cases, the price increase could be as much as 36.05 percent. [27]

Measures	Hotels in the Sample that Implement These Measures (%)
1. The establishment quantifies environmental costs and savings	24.6
2. The establishment provides employees with training on environmental issues	31.8
3. The establishment applies "green purchasing" policies	32.8
4. The variable environment is used in marketing strategies and campaigns	40.9
5. The establishment applies energy and water saving measures	75.6
6. The establishment recycles waste	66.9
7. The establishment encourages environmental awareness among employees through meetings and advice	33.9

Figure 5: Hotel Measures

Case Study

In 2006 the owners of the Empire State Building partnered with the Clinton Climate Initiative, Johnson Controls, Jones Lang LaSalle, NYSERDA, and Rocky Mountain Institute to green retrofit one of the tallest buildings in the world. Originally built in 1931, the Empire State Building is 102 stories tall, has 2.6 million square feet of office space, 6,500 windows, and 73 elevators. When ownership sought to reposition the building they explored many options, and ultimately chose to fight the transitional frictions - such as upfront costs and auditing difficulties - of a green approach.

They recognized that while they earned points with certification programs, elements such as bike racks, showers, and green features on walls, would not yield the kind of savings return needed to make the upgrade feasible. Lighting, cooling, and heating posed the largest energy drains, producing the largest utility costs, so they focused on remedying these aspects. Accordingly, major aspects of the project

[26]Butler, J. (2008, August 1). The Compelling "Hard Case" for "Green" Hotel Development. Cornell Hospitality Quarterly, 49(3), 234-244.

[27]Sanchez-Ollero, J., Garcia-Pozo, A., & Marchante-Mera, A. (2013). How Does Respect for the Environment Affect Final Prices in the Hospitality Sector? A Hedonic Pricing Approach. Cornell Hospitality Quarterly, 55(1), 31-39.

included installation of an insulating lining between panes and windows for all 6,500 windows, and rebuilding of the cooling system, tying it into a building energy management system.

These upgrades were projected to drop energy usage by 38%, save $4.4 million annually, and cut CO2 emissions by 105,000 tons annually by 2013. If these projects held true the cost savings would pay back the investment in just 3 years time. No further information on the results has been found.

From the perspective of a potential tenant, the building offered a series of steps that could be taken such as lighting controls and tying into the buildings energy management system which would all have a payback period of less than 5 years. The premium to tenants for occupying space was 2-3%.

Since the project was completed the building has had two consecutive years of surpassing its guaranteed energy efficiency by nearly 4%, saving $2.3 million thus far. This particular example shows that regardless of green certifications, if a project is thoughtful about the kinds of upgrades it makes it can advertise considerable savings for potential tenants and future building owners, adding considerable value to the real estate.

Research Limitations

It has been broadly accepted that building green requires a substantial additional investment and risk up front.[28] Unfortunately many owners and occupiers rarely consider full life cycle costs or undertake a costbenefit analysis. In the absence of well investigated financial incentives such as those offered above, the participation of a voluntary labeling scheme, such as LEED, depends on the benefits perceived by the client in terms of marketing advantage. Hence, a large part of this report utilizes interviews in an attempt to uncover developers′ true motives for the added upfront risk and investment.

[28]Portland Energy Office. (2000, June 18). Green City Buildings: Applying the LEED Rating System. Retrieved May 12, 2015, from http://www.axiomsustainable.com

Media Search

As discussed in the literature review, early green certification programs are still less than two decades old. Accordingly, the body of research remains thin. The research that does exist finds little consensus germane to the both the perceived and actual monetary value added to real estate through green building certification. To better understand the current and historical relationship between green building certification and value, a search on these subjects of the popular press was performed.

A comprehensive search was done using various combinations of the following terms: green building, building green, green certification, LEED certification, valuation, economics, value, cost, and benefit. These searches resulted in over 2,000 articles. The results were then skimmed to eliminate clearly miss-picked articles based on the headlines and contextual excerpts provided in the search results. After the initial elimination, 146 articles remained. An analysis of the remaining articles was preformed as described below.

Framework for Analysis

The 146 remaining articles were skimmed for additional contextual relevance. During in-depth analysis 16 of those remaining 146 articles were ultimately found to have no information pertinent to this research and were eliminated, leaving the final 130 articles. Information regarding the tone, content, and source of each of the remaining 130 articles was then recorded. The different aspects of content that were recorded are as follows:

- **Year** it was published
- **Title** of article
- **Publication** in which the article was found
- **Stance** the article took toward green building and certification:
  - **(F) For:** The author wrote generally favoring and encouraging of green building and certification
  - **(A) Against:** The author wrote generally opposed to and discouraging of green building and certification
  - **(N) Neutral:** The author wrote generally neutral of opinion with regard to green building and certification
  - **(B) Both Sides:** The author argued both for and against green building and certification
- **Argument** type on which the authors views were founded:
  - **(H) Hypothetical:** The article argued either for or against green building and certification with strictly speculative assertions
  - **(A) Anecdotal:** The article argued either for or against green building and certification with qualitative research and interviews

  - **(D) Data:** The article argued either for or against green building and certification with hard data and empirical evidence
  - **(S) Survey:** The article argued either for or against green building and certification with survey results

- **Study Type** used in the article:
  - **(G) General:** The article spoke generally about green buildings and certifications
  - **(CS) Case Study:** The article spoke specifically about one green building or certification

- **Building Type** explored in the argument:
  - **(G) General:** The article spoke generally about green buildings and certifications
  - **(CO) Commercial/Office Buildings:** The article spoke specifically about green building and certification of commercial and/or office buildings
  - **(H) Single Family Homes:** The article spoke specifically about green building and certification of single family homes
  - **(E) Educational Institutions:** The article spoke specifically about green building and certification of school and universities
  - **(P) Public Buildings:** The article spoke specifically about green building and certification of non school government owned buildings
  - **(HC) Healthcare Facilities:** The article spoke specifically about green building and certification of hospitals and other health care facilities
  - **(CH) Churches:** The article spoke specifically about green building and certification of churches and other religious buildings

- **Factors** used in article as basis for argument
  - **Constuction Costs:** The article spoke either in a positive or negative light about the additional costs required to implement green elements in building construction
  - **Operational Costs:** The article spoke either in a positive or negative light about the change in operational costs due to green elements present in a building
  - **Energy Use:** The article spoke either in a positive or negative light about the different in energy and water use, as well as the costs associated with that change, in buildings that incorporate green building elements
  - **General Economics:** The article spoke either in a positive or negative light about the general economics of green buildings and certification. This included things like: resale value, occupancy rate, capitalization rate, net operating income, etc.
  - **Environment:** The article spoke either in a positive or negative light about the environmental impacts associated with green building and certification
  - **Social:** The article spoke either in a positive or negative light about the social impacts associated with green building and certification. This included things like: occupant satisfaction, occupant productivity, occupant health and safety, patient recovery rate and time, etc.
  - **Values:** The article generally mentioned either personal or societal values being a factor in the decision and value of green building and certification
  - **Public Initiative:** The article spoke of the impact of public initiative on green building and certification. This included things like: building codes, tax incentives, etc.
  - **Financing:** The article spoke either in a positive or negative light about the financing hurdles associated with green building and certification

- **Quotes** that stood out from several of the articles were recorded for addition to the report

Through analysis of the articles, several sustained themes presented themselves. The following section explores initial hypotheses as well as findings.

Findings

At the onset, based on the academic literature review, there were several expectations the popular press search was expected to find. These hypotheses regarded three subjects: the time distribution of articles, the arguments used within the articles, and general view of green building and certification that the articles found. The following table explores those hypotheses and the results of those hypotheses.

Media Search Hypotheses and Results

Subject	Hypothesis	Results
Time Distribution	The academic literature review revealed an exponential increase in green building certification programs over the last several decades. Thus, it was hypothesized that general interest in these subjects by the popular press has been exponentially increasing as well. If this is the case, the bulk of articles pertinent to the subject would be found in more recent years.	As seen in Figure 6 below, there was an exponential increase right up until about 2007 where it rapidly decreases. This is likely due to The Great Recession. When money was scarce and construction halted there was little need to talk about the value of green building.
Arguments Used	With the increasing interest in green building, more data would theoretically become available to base arguments on. Hence, it was hypothesized that earlier articles would build their arguments on hypothetical grounds while more recent articles would be founded on empirical evidence.	As seen in Figure 7, as time went on the percentage of articles that utilized data to support their arguments increased, but only slightly and generally inconsistently.
General Views of Green Building Certification	It was hypothesized that green certification programs may be a societal trend. If this was true, like all trends, it would reach a saturation point an eventually excitement would wane. Green building would then have to prove itself economically advantageous to continue being employed. This would most likely be seen in this media search if more recent articles began questioning the need/value of certifications.	As seen in Figure 8, during the first decade, articles written in a skeptical tone did not exist. Around the peak of the articles found, in 2007 and 2008, skepticism began to grow within articles. But since, even as the economy has begun to recover, articles continue to remains overwhelmingly in favor of the benefits of green building. If it is a societal trend, it is not showing signs of slowing down.

Hypotheses aside, this media review provided a lot of other interested information. The remainder of this section will explore each of the categories defined above in the framework for analyzing the review. First

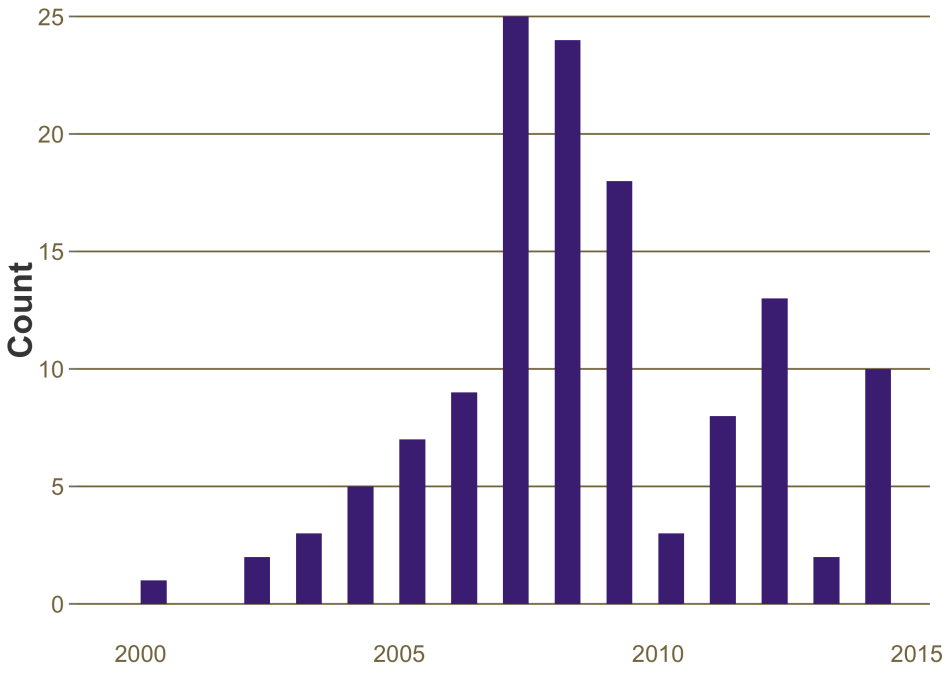

Figure 6: Time Distribution of Articles Written

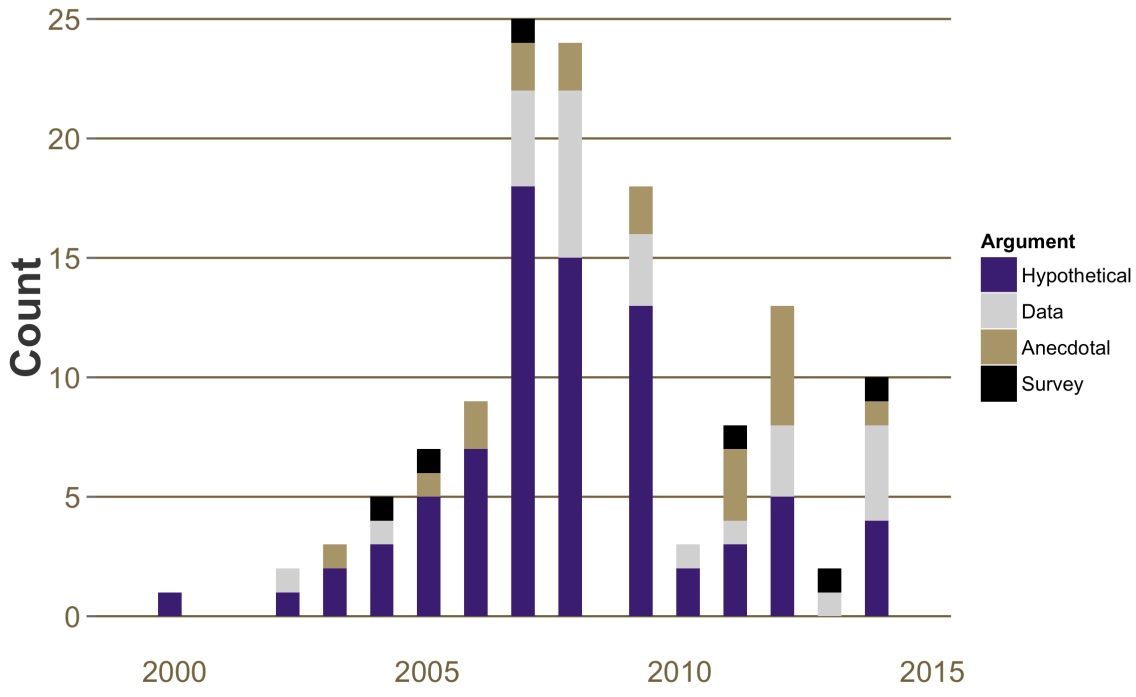

Figure 7: Time Distribution With Argument Type

each individual category will be examined and then several will be combine to show other interesting findings make through this search.

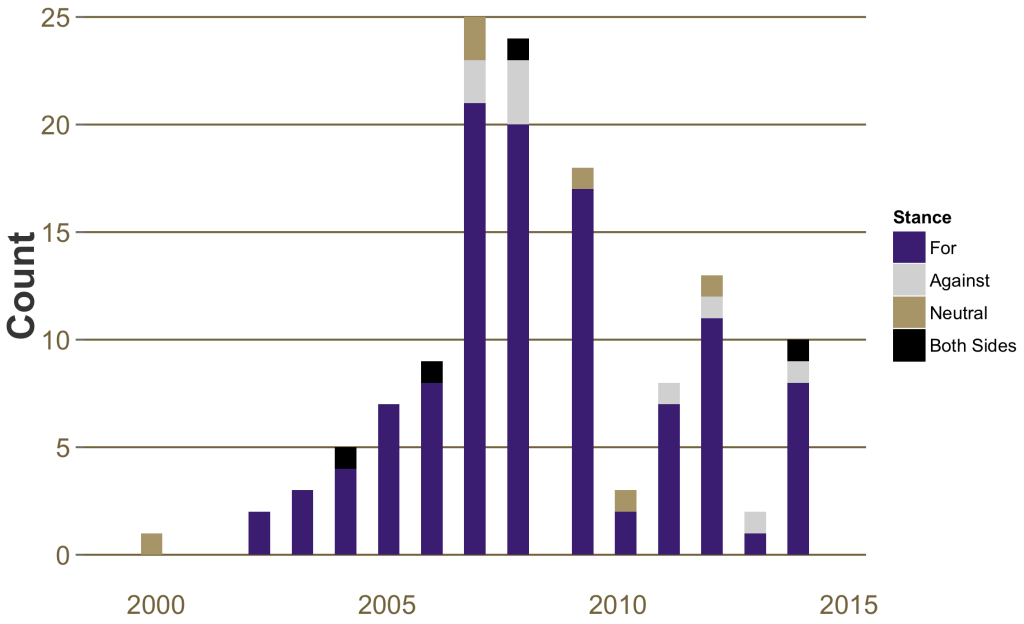

Figure 8: Time Distribution With Stance Taken

Stance of Articles

As shown in Figure 9 A vast majority of articles either came out in direct support of green building and certification or left the reader believing they were in support based on the information and interviews presented. There were about a dozen of the 130 articles that were outright against green building and certification for a variety of reason and another handful of articles that either objectively argued both sides or remained entirely neutral.

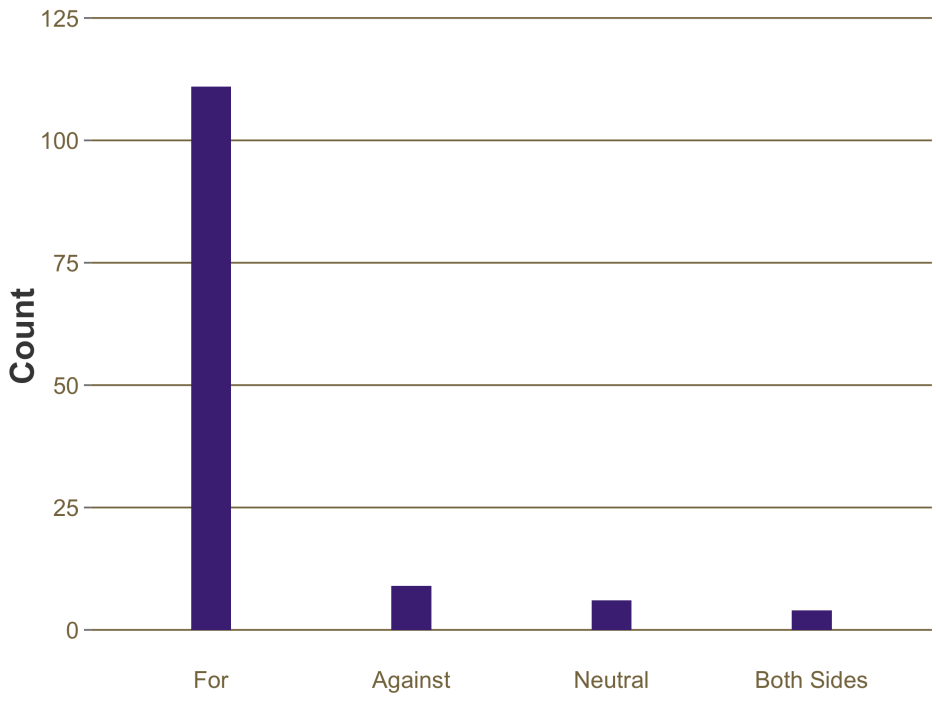

Figure 9: Stance Taken by Article Author

Argument Type

As Figure 10 shows, more than half of the articles analyzed founded their stance on hypothetical or assumed arguments. These articles would make assertions about what green building and certification might do, but without any kind of data to support the claim. About a fifth of the articles used gathered data to support their arguments and about another fifth used anecdotal information such as expert interviews. A very small group of articles used survey results to base their claims.

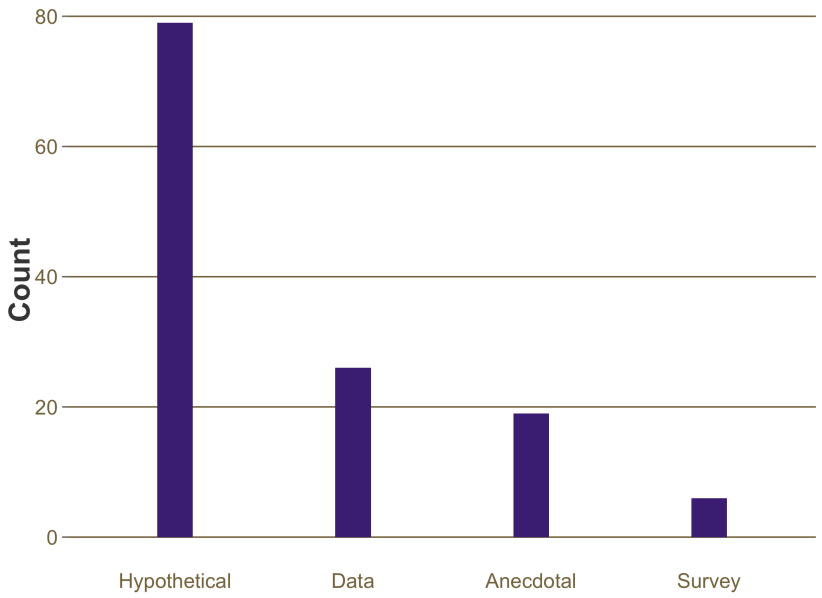

Figure 10: Argument Used by Article Author

Study Type

Figure 11 shows that almost three quarters of the articles spoke generally about green buildings and certification while the remaining quarter used specific case studies to explore the subject.

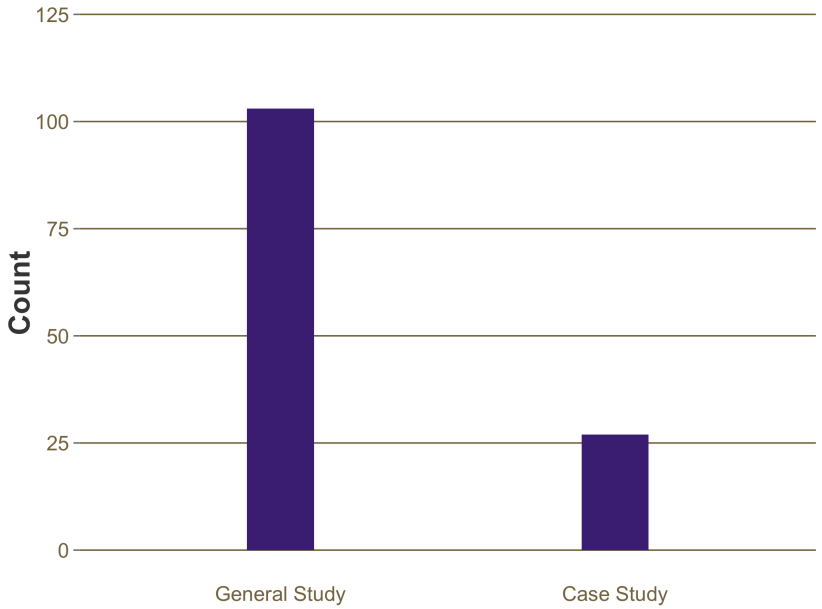

Figure 11: Study Type Reported On by Article Author

Building Type

In Figure 12 it is shown that while almost half of the articles spoke generally about green building and certifications, many of the articles spoke specifically about green building and certification within a particular building type. About a quarter of articles spoke about single family homes and another quarter about commercial and/or office buildings. There were a handful of articles specifically on education buildings and a few each for public buildings, churches, and health care facilities.

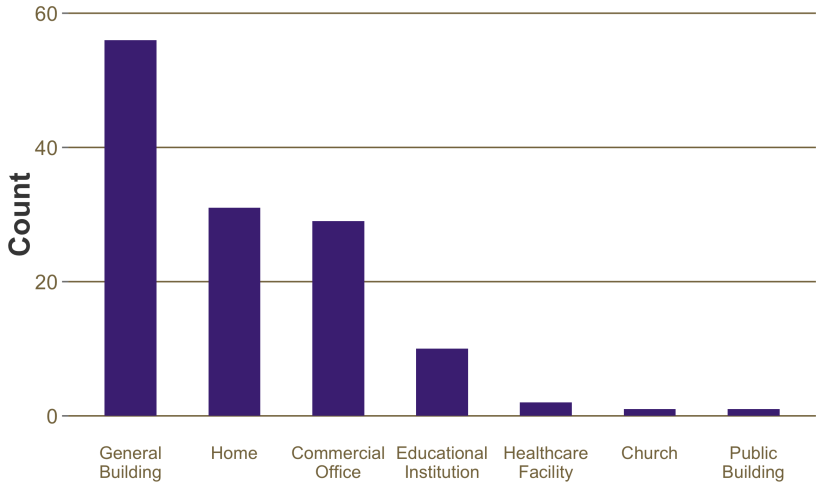

Figure 12: Building Type Reported On by Article Author

Factors

Each article, whether it was for, against, neutral, or argued both sides, utilized either one or a series of factors to substantiate their stance. Figure 13 summarizes these factors. Almost 80% of articles mentioned energy use in their arguments, followed by environmental, social concerns, and construction costs each found in about 40% of articles. General economics and operational costs were found in about 25% of articles and financing, public initiative, and general values were were each found in less than 10% of articles.

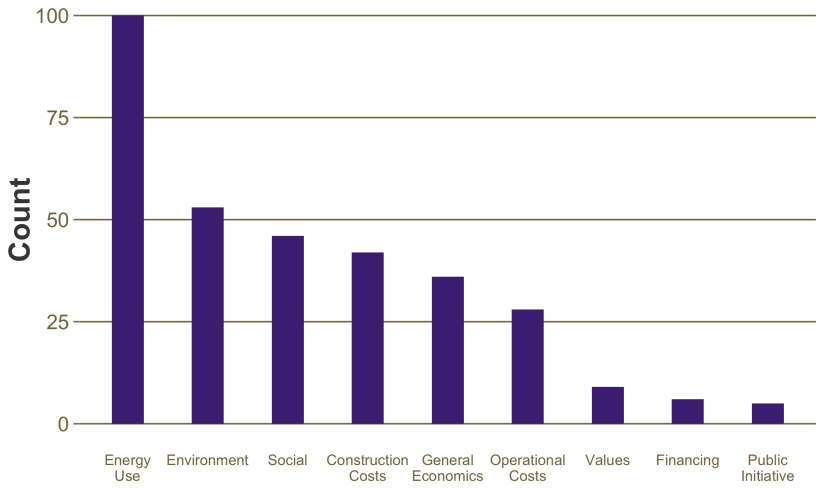

Figure 13: Factors Reported On by Article Author

Discussion and Summary

Generally, this review on popular press agrees with the findings of the academic literature review discussed in the chapter above, that green building and certification are beneficial to building owners, occupiers, and the public at large. It is revealing that with both reviews the majority focus within green building and certification was energy and water use (their potential monetary savings, and their environmental health benefits) followed by the social and environmental aspects, and finally the construction costs and general economics.

To contrast the two, while all academic articles used some form of data, few media articles actually used hard data to substantiate their stance. As Figure 10 shows, well over half of the 90% of media articles that spoke in favor of green building and certification were based on hypothetical arguments. Thus, in total, about half of the 131 articles found argued in favor of green building with hypothetical arguments, as shown in Figure 14.

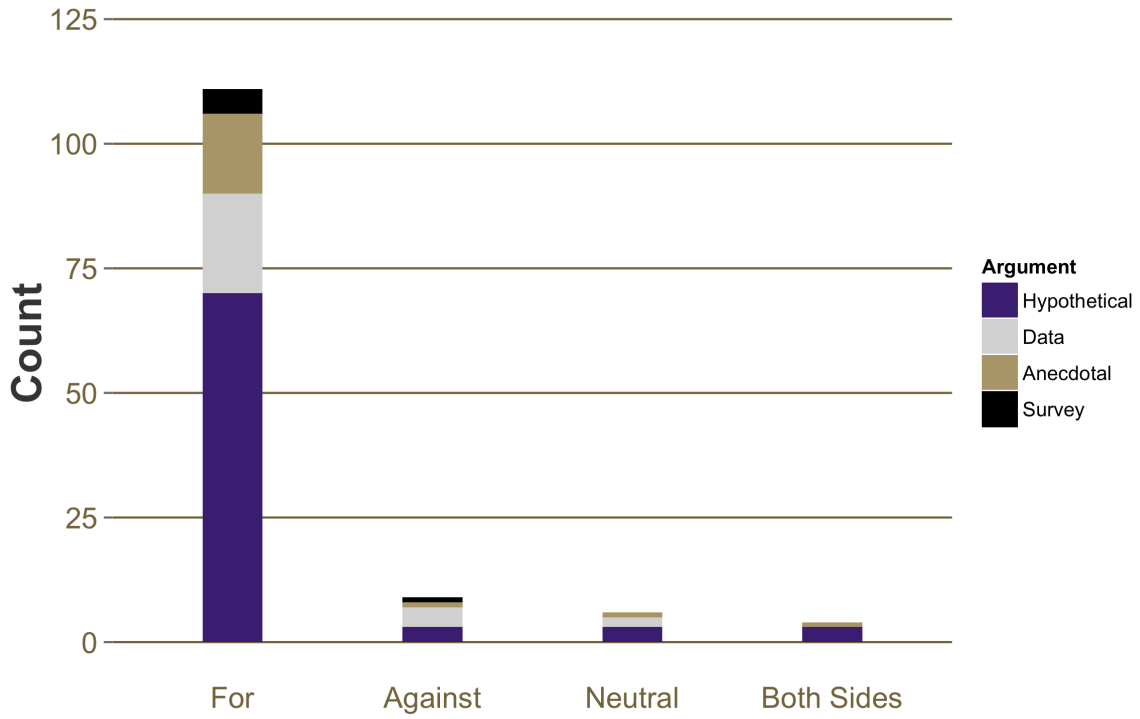

Figure 14: Stance Taken With Argument Used

Figure 14 also shows that about 50% of the articles written opposing and about 50% of the articles neutral to green building and certification were supported by data. So the popular press authors either looked at the data and did not find it as convincing, in general, as the academics did, or perhaps they were intent on writing an article against green building and certification and felt it necessary to better substantiate their claims.

In summary, newspaper articles, which have been seen in higher frequency in recent years, generally take a positive stance toward these programs, rarely use data to substantiate their claims, but usually site the building water and energy efficiency elements in their arguments.

Finally, as found in the academic literature review, while popular press articles explored many of the potential benefits of green building and certification, not one of the articles explicitly asked the developers who build the building where they believe the value is found in building green and certification. Thus the next section of this report will explore a series of interviews made in attempts to better understand the conversations decision makers are having surrounding green building.

Industry Interviews

During early stages of research development it became clear that it would be prudent to gather some anecdotal information from industry leaders in an effort to better understand the conversation, if there is one, about the perceived value of green building certification. Thus, through the Board and other connections established by the Runstad Center, a series of interviews were conducted with architects, appraisers, brokers, developers, contractors, and investors in the Seattle area. Interviewees included:

- GGLO (Architect)
- Kidder Matthews (Appraisal)
- Metzler (Institutional Advisor)
- Molly McCabe (Author and Instructor on Economics of Green Building)
- NBBJ (Architect)
- Talon (Developer)
- Vulcan (Developer)
- Unico Properties (Real Estate Investor and Full-Service Operator)
- Washington Partners (Tenant Broker)

The following is a summary of the many opinions we heard. While initial research included all of the different certification programs defined above, conversations had during interviews consistently became about LEED. This is likely due to LEED′s prominence as one of the pioneering programs and undoubtedly the most heavily used today. Thus much of what will be discussed in the following section will be in terms of the LEED program.

Understanding the Dynamics of Time and Space

It is important to understand that the conversations surrounding LEED are extremely dynamic with regard to both space and time. More specifically space refers to locational sensitivity and time regards the rapid change of real estate markets as well as the evolution of certification programs. This section explores the roll that these two variables play in the conversation about green building certification.

First, municipal codes such as building and energy codes differ from one municipality to another. Thus, a given certification may be geographically sensitive and the amount of additional capital and energy required to obtain a certain certification may be considerably different from one city to another. This creates a situation where the financial investment needed to go from base building codes to certification levels will likely be much smaller in a place with stringent codes, whereas in a city with less stringent codes, the gap between standards and certification is greater.

Second, related to the first point, in a city such as Seattle where certification can have a small marginal cost due to stringent base building and energy standards, there has been near-complete market adoption

of some LEED green design aspects, independent of the decision to certify. Construction practices have adopted many of these methods and developers must build to this additional standard to remain competitive with neighboring buildings. Thus, due to government regulations and incentives in these places, it is becoming harder to distinguish a building through use of certifications like LEED alone.

Third, in an effort to remain an industry certification leader and to continue raising the bar for green building, LEED has continually updated its certification standards with new versions of the program. At the same time, but not necessarily correlated, building and energy codes continue to become more and more stringent. So, for example, when LEED′s version v2009 came out its standards were considered ambitious. As v2009 became more heavily used and understood, building and energy codes evolved into more stringent versions, and many of its components became standard practice. It became easier to achieve levels that satisfied certification. It could then be argued that the easiest time to achieve v2009 certification was right before the next version of LEED certification was released. Then when LEED v4 was released in 2013 this cycle started over. So a building built in 2012 likely had a much smaller marginal cost to upgrade from base Seattle building and energy codes to levels that warranted LEED certification than in 2009, and definitely easier to get certified than in 2013 when a newer, stricter set of standards was instated.

Take a hypothetical example of a toilet to explain this phenomenon. First, it must be assumed that new, more efficient technologies are more expensive. So, for example, a toilet that uses 1 gallon of water per flush is more expensive than one that uses 5 gallons, which is more expensive than one that uses 10 gallons. Say in 2009 that Seattle building codes required a toilet that used no more than 16 gallons of water per flush while the LEED v2009 certification required a toilet that used no more than 12 gallons of water per flush. The marginal cost to go from a base code building to a LEED certified building would be the cost difference of a toilet that used 16 gallons per flush and one that only used 12 (so, for this example 4). Assume that between 2009 and 2012, Seattle's building codes evolved and in 2012 the code require toilets that used no more than 14 gallons per flush. The LEED certification was still under v2009, so 12 gallons per flush or less. Now the marginal cost to go from a base code building to a LEED certified building would only be from 14 gallons to 12 gallons (so, for this example 2). This would likely be a smaller marginal cost. Then in 2013, assume that Seattle codes now required toilets that used no more than 13 gallons per flush. In 2013 LEED came out with a new version v4. Assume that version required toilets that used no more than 8 gallons of water per flush. Here, between 2012 and 2013, with the new LEED version, that marginal cost for the LEED toilet would jump significantly higher. So the cheapest time in this scenario, to go from a building whose toilets satisfied base Seattle codes to one warranting LEED certification would have been in 2012. Figure 15 offers a separate visual hypothetical of the same phenomenon.

Finally, many of the points that are available toward certification pertain to the physical site of the building, not the buildings themselves. For example, thirteen available points in the new LEED version 4 (v4) are not earned through any measure of design by the architects, but by the location in which the project is found. Sensitive land protection, site priority, access to transit, surrounding density, and diversity of adjacent uses all earned points in a typical Seattle neighborhood while a similar project in a different part of the city, or in a smaller city such as Bellevue or Spokane, may not have access to sites that are eligible for those points. Thus to achieve the same level of certification, projects in those places would need to make up those points elsewhere in the project. This makes certification sensitive to at the micro-scale (within a particular city), and the macro-scale (from one city to another).

Breakdown of Category Types

Interviewees seemed to, consciously or not, categories the components that offered points toward LEED certification. These categories could be summarized as:

1. site, location, and transportation elements,
2. building water and energy efficiency elements, and
3. amenity type elements

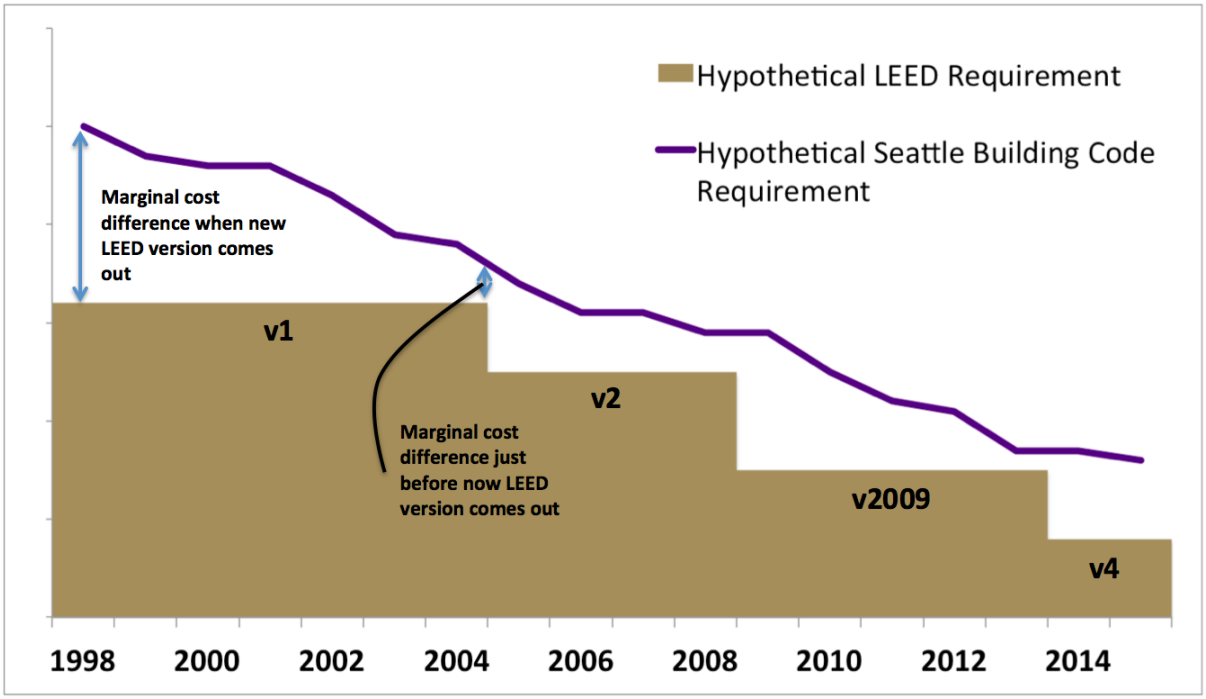

Figure 15: Hypothetical Figure of this Phenomenon

As discussed in the previous section, many of the site, location, and transportation standards are achieved solely from the location of the project. Therefore if a developer is interested in achieving LEED certification, site selection, and the presence of these attributes, were likely part of the conversation. Coincidentally, these categories were rarely spoken about during the interview process. Whether these factors played a roll during site selection or not, a site that offers more of these points brings a building closer to certification without needing to invest the extra capitol in building components.

The second category of standards pertain to water and energy efficiency. These factors are appropriately categorized because, regardless of desire to achieve certification, they may have the potential to save building owners and occupiers money (lower utility bills), increase their revenue stream and ultimately realize higher returns. During interviews, it was expressed on several occasions that decisions to pursue these components were removed from certification ambitions. In other words, whether a developer had any intention of pursuing LEED certification, they had a conversation about the use of energy and water saving techniques and technologies separately. It should be noted that when developers choose to pursue these categories from a strictly operational and management savings standpoint, it is still putting the building that much closer to certification levels.

Finally, the third category pertains to amenities. This includes aspects such as bike infrastructure, recycling programs, air quality, and views. These elements are the "sexy" elements of building design that building occupants can see and enjoy. They are different from the previous two categories because they will only realize value if they are valuable to the users. This category of elements was difficult for industry leaders to make concrete observations on because there it is exceedingly difficult to put a value number on each element. Many systems have been created to measure water and energy use and their costs, few people, if any, have created reliable ways to quantify the value of individual building amenities.

These categories will be important to keep in mind moving forward as the opinions of industry leaders are explored.

Industry Leader Opinions

A large contingent of those interviewed spoke about LEED as though in-and-of-itself it is no longer a significant market differentiator. Building owners and occupiers typically have lists, whether formal or informal, of the most important building aspects that they look for in a building. Several interviewees

contended that while a decade ago, LEED certification was in the top two or three items of those lists, they are now down at spot 9 or 10, if on the list at all.

This group argued that replacing LEED at the top of the list, value is found in the amenities offered by the building the potential occupant experience. These types of amenities included aspects such as: fitness centers, innovative lobby space, green roofs with occupant access, and bike lockers. Ironically many of these building elements earn points toward certification and are represented well in the LEED certification program. This suggests that there may be some movement toward an ethos that still wants LEED certified quality buildings but does not necessarily need the plaque that says LEED certified.

Another, smaller, contingent spoke more enthusiastically about LEED certification. Many of these opinions seemed to come from a place of image and company ethos.

Another justification some interviewees gave for their continued use of LEED certification regarded how close base Seattle building and energy codes got a new construction building to certification levels. In this case, several of the facets discussed previously are integrated:

1. site selection and locational attributes can be inherent in large commercial office buildings depending on the market;
2. the prospect of operational and management savings, as well as public incentives on energy and water use savings, make economic sense outside of the certification discussion; and
3. potential new owners and occupiers demand certain amenities that other new construction buildings in the area are all providing.

Thus the only remaining hurdle is the process and fees attributed to the certification process. Many of the buildings built over the last decade are certified due to LEED′s market position, and the small relative cost of the certification process as compared to building costs. Thus this contingent of interviewees asserted that the decision to get certified is easily justified.

The attentive reader at this point will notice that nothing shared so far gives much credence to the value attributable to green building certification. While energy and cost savings can be realized with or without certification, the rest of the program seems to remain monetarily ambiguous. Appraisers interviewed had an extremely difficult time identifying actual numbers that could be attributed to the piece of paper that said, "LEED Certified." They compared it to a properties view. They know it adds value (if all else were the same the property with the view would be worth more) but they don't know specifically how much more. Further, industry leaders who chose to certify their projects to higher levels of certification such as LEED Gold or Platinum as compared to lower ratings, could not pinpoint the monetary value justifications for those additional efforts.

Concluding Observations

Based on what was heard in these interviews, it seems likely that two opposing forces are at work.

On one hand, it could be argued that green building certifications may have served the purpose for which they were created and are no longer necessary. The popularity of these programs over the last decade has empowered the industry to make huge strides in the advancement of green and sustainable real estate. Systems have become more advanced and efficient. Industry actors have become more knowledgable and capable. Municipal codes have become stricter and more ambitious. Many parts of the system have been proven to be both possible and advantageous. So while some popular opinion may be waning on programs like LEED, they have already succeeded in their task to make sustainable building and operations a reality.

On the other hand, as discussed above, it could be argued that certifications programs such as LEED remain relevant by continuing to push the fold with new, more aggressive, standards. These newer versions have the potential to continue unlocking newer opportunities for improvements in techniques and

technologies. Further, newer programs like the Living Future Institute′s, "Living Building Challenge," have taken their ambitions to a whole new level. Composing toilets, net zero energy operations, and parking-free office space are just some of the building components required by this certification that are not even legal by Seattle codes. Pilot programs may pave the way for new and exciting opportunities for buildings to actually sell electricity back to the city grid, for example.

Phase II Methods

The variety of literature searches and interviews examined above have provided a solid foundation from which to build a method for exploring the monetary value of LEED certification. This chapter will describe the phase II methodology that was produced during this exercise. Because a significant contingent of those interviewed suggested that, at present they are far less concerned with certifications like LEED, and more interested in the specific amenities a building has to offer, this methodology attempts to provide an opportunity to analyze those facets of this subject as well.

Method Framework

To compare LEED certified buildings to non-LEED certified buildings, actual certification status must be momentarily put aside and individual building components must be explore instead. So simply put, this method, should it be implemented, would attempt to give every building being studied its own exercise-derived LEED score (which will be referred to throughout the rest of this methodology as an index score). This would be done for all buildings whether they are LEED certified or not. It should be noted here that this score in no way reflects that actual LEED score that this building would, or has, achieved. This score can be thought of more like an index, solely for the purposes of this exercise.

To achieve this, the Runstad Center consolidated two resources: a LEED v4 scorecard/handbook for independent variables, and the work done by the Institute for Building Efficiency for dependent variables. For the remainder of this exercise, the methodology will refer to a Google spreadsheet that has been created for the purposes of study. This Google spreadsheet can be accessed here: https://docs.google.com.

Independent Variables

The, "LEED v4 for Building Design and Construction" handbook and scorecard was examined point by point to create a series of independent variables pertaining to each building.[1] A list was created of all 12 prerequisite categories and 45 point scoring categories. This list along with notes on how each category will be quantified and scored can be found below in Appendix A. If a category requires some form of analysis (ie. GIS work), brief instructions are given on how to perform that task. If a category requires retrieving information from the people who own/operate the building, the pertinent survey question is stated in bold and caps. So for example under the subject of "Energy and Atmosphere" there is a "Building-Level Energy Metering" category in the LEED scorecard. For the sake of the exercise-derived index score, this will be accounted for by asking building engineers, "Do you have energy submetering in this building?" If yes, they receive a point, in not, they do not. Once all categories are accounted for the sum of a buildings points will determine its index score. It should be noted that a number of categories were eliminated for a variety of reasons, each of which can be found in the list in Appendix A (these can be found in red).

[1] LEED v4 for Building Designing and Construction. (n.d.). U.S. Green Building Council. Retrieved June 9, 2015, from http://greenguard.org AND LEED v4 for Building Design and Construction Checklist. (2014, June 6). U.S. Green Building Council. Retrieved June 9, 2015, from http://www.usgbc.org

Dependent Variables

For the dependent variables, the building economics subjects explored by the Institute for Building Efficiency as discussed in the Literature Review, were used.[2] This list can be found below in Appendix B. Each of these categories, with the exception of productivity, will likely need to be retrieved via survey of building owners/managers. It should also be acknowledged that resale value will be difficult to normalize for the purposes of this methodology but may provide some interesting situational substance once the analysis is complete. The researcher will need to decide how to approach the productivity subject. If it is decided that this category will remain as a dependent variables, the methods used in the academic studies explored in Chapter 3 should be reviewed.

So each of these variables was named and defined in a Google spreadsheet tab "Meta Data," along with meta data and documentation of each variable. The remainder of this chapter will describe the steps to be taken to complete the analysis.

Step 1: Identifying Buildings

Once the study area is defined, a database of buildings must be created. The ease of this task will depend entirely on the study area. For example, the King County Assessor office keeps complete, up-to-date records, making it easy to retrieve building specifics like address and building size. Other municipalities, do not make their data as readily accessible and so this step would then take significantly more time and energy. Then, because this study would be interested in exploring large commercial buildings, a minimum threshold square footage needs to be decided upon. This is, in large part, to remove buildings from the database such as a single story, free standing bank, which would be categorized as a commercial building but not of interest to this study. This list of buildings and information can then be inserted into the Google Spreadsheet in each of the following tabs: "Building Database," "Building Names and Contacts," "Interviews," "Analytic Variables," and "Interview Variables."

Once the buildings are compiled for each study area and those that do not meet the minimum square footage threshold are eliminated, phone numbers must be collected. The content of phone calls will be explore in subsequent sections, but for the time being, it is likely that, to get all of the information required, contact numbers for both a building manager and a building engineer will likely be needed. This contact information can be inserted into the Google Spreadsheet "Building Names and Contacts" tab.

Step 2: Interviews

Once the building list has been solidified and contact information has been collected, a series of phone call must be made. The "Interviews" tab in the Google spreadsheet provides a framework for conducting surveys and documenting responses. Again it should be noted that, to complete this spreadsheet, both owners/managers and building engineers will likely need to be contacted.

Step 3: Processing Interview Responses

Using the results documented in the "Interviews" tab of the Google spreadsheet, along with the documentation in the "Meta Data" tab on scoring the results, the interview variables cans be processed into the "Interview Variables" tab. So for example, say a building answered "Yes" to the question, "Does the building have energy submetering?" In the "Meta Data" tab, the researcher will find the corresponding variable called, "BldngLvlEnrgMtrng." This variable describes that, "This variable describes whether the building has energy submetering; 0-No, 1-Yes." So in the "Interview Variable" tab, under the column named "BldngLvlEnrgMtrng," that building would receive a "1."

[2]Multiple Studies Document Green Buildings Add Value. (2011, October). The Institute for Building Efficiency. Retrieved June 9, 2015, from http://www.institutebe.com

Step 4: Processing Analytic Variables

For this step, the researcher will need to perform a series of GIS exercises. In the "Analytic Variables" tab of the Google spreadsheet, each variable for analyzing is listed. Once a variable has been analyzed it can then be processed to fill in the spreadsheet in the "Analytic Variables" tab. Recall that directions for this analysis can be found below in Appendix A. So for example, when analyzing the "Sensitive Land Protection" variable, the instructions (in Appendix A) describe that the researcher must use GIS with layers for farmland, floodplains, habitat, water bodies, and wetlands. Once all of these layers are present in the study area, the researcher must decipher whether or not each building falls within any of these areas. In the "Meta Data" tab of the Google Spreadsheet, under the "SensLandPro" variable it describes that, "This variable describes whether or not the building is located on prexisting farmland, floodplain, habitat, water bodies, or wetlands; 0-yes, 1-no." So if a building exists within any of these layers, the building will receive a "0" in the "Analytic Variables" tab. Likewise, if the building does not exist within any of these layers, the will receive a "1" in the "Analytic Variables" tab.

Step 5: Creating Exercise-Derived Index Scores

Once both the "Interview Variable" tab and the "Analytic Variables" tab have been filled out to completion, it is time to create exercise-derived Index scores. To do this, the researcher must take each of the Independent Variables (EXCEPT the LEEDcert variable) and sum them. The results of these can be inserted into the "LEED Scores and Dependent Variables" tab along with the LEED cert variable and each of the dependent variables. At this point the research will be ready for analysis.

Step 6: Analysis

First, the researcher has the ability to compare the exercise-derived index score to a buildings actual LEED certification level (for the buildings that have actually been certified), which would give some indication of how accurate the method developed here was at giving buildings index scores. To do this the researcher should compare the "Exercise-Derived Index Score" values with the "LEEDcert" values. It should be remember that the "LEEDcert" values correspond with a buildings actual certification level, but not with how many points in earned toward its certification (A "LEEDcert" value of "3" suggests LEED Gold Certification but does not describe whether the building achieved 60 points or 110 points, or somewhere in between). Likewise, the "Exercise-Derived Index Score" values are a crude representation of the building components present that might score points toward LEED certification; these values are not meant to suggest what LEED certification level a building might achieve. So a direct comparison of the two numbers is not appropriate. Their should, however, be some correlation between "LEEDcert" values and "Exercise-Derived Index Score" values. So for example if a building has a "LEEDcert" value of "2" (LEED Silver certified) it should have a lower "Exercise-Derived Index Score" value than a building with a "LEEDcert" value of "4" (LEED Platinum certified).

Two important points should be kept in mind here. First, buildings with a "LEEDcert" value of "0" have not been certified. This either means the building did not earn enough points to achieve certification or that it never attempt to get LEED certified. For example, a building could have scored very high in its "Exercise-Derived Index Score" but have a "LEEDcert" value of "0." This does not suggest that this building did not have enough points to actually get LEED certified but that the building may just not have had an interest in the certification. Thus, "Exercise-Derived Index Score" values for buildings that have a "LEEDcert" value of "0" are inappropriate for this comparison. Second, because buildings may have received their certifications under different version of LEED (newer ones being more stringent that older ones), and under different types of certifications within LEED (ie. Building Design and Construction vs. Building Operations and Maintenance), the findings of this portion of the exercise may be skewed.

Then with an exercise-derived index score as an independent variable, regressional and statistical analyses can be performed against each of the dependent variables to see how an accumulation of LEED building components correlate with building economics. So, for example, whether or not a higher index score equates to statistically significant increases in rent per square foot, occupancy rates, operating expenses, net operating income, capitalization rates, and resale value, can be explored.

Further, the researcher can identify whether buildings that are actually LEED certified see better building economics than those that do not, even though they have the same exercise-derived index scores. So for example, if two buildings each received an index score of 50 it can be assumed that they generally have the same number of LEED building components present. If one building is LEED certified and realizes higher rent per square foot, while the other building is not LEED certified and realizes lower rent per square foot, the LEED certification may be the missing factor. It should be noted that there are countless factors that this exercise does not account for so it is also very likely that the difference in this example may lie in some of these other factors. Thus it would be inappropriate to compare just two buildings. If, however, a large database was created, with plenty of representation of both LEED and non-LEED certified buildings present, a comparison of all of them could result in some statistical significance. At this point the research would have some grounds to discuss whether or not a LEED certification, aside from all of the components that achieved the certification, had any economic significance.

Finally, this method would also allow the researcher to break regressions down by component (or amenity) and see how each of those correlate with the dependent variables. Here, any combination of individual variables could be analyzed against any of the dependent variables to see if statistical significance exists. So, for example, if the researcher hypothesized that bike facilities, green roofs, and natural light were the three amenities that truly added value to a buildings economics, he or she could test the combination of those variables against the dependent variables. If a series of these analyses were completed the research might then have the ability to better identify whether certain building components (or amenities) add value to a buildings economics, and if so, which ones and how much.

Concluding Remarks

This report has summarized the roll and significance that green certifications such as LEED have played in the building environment, it has explored and defined many of the currently used certification programs in the US, and it has documented the general body of knowledge that has been researched in academia. The report has further explored portrayals and notions presented in the popular press on green building over the last two decades, and summarized interviews with industry leaders in an effort to better understand current conversations surrounding green building and certification programs. Finally, in the previous chapter, this research lead to an outline, a methodology, for a process that will allow a future researcher to explore the value of green building certifications.

Based on industry interviews as described in previous chapters, it is the belief of the Runstad Center that the continuation of this line of research is unnecessary. In cities like Seattle, where near complete market adoption of green building principles and certifications has been realized, many have asserted that there is little monetary value in the certificate itself. Whether buildings are certified or not, most, if not all, buildings are being built to standards that warrant certification. This is due to continually evolving building and energy codes, market expectation, company ethos, and the need for building owners to stay competitive.

It has been stated several times that many industry leaders are currently far more interested in the types of amenities a buildings has to offer. Building aspects pertaining to environment and ecology remain prevalent because they have been proven to save building owners and operators money on energy, emissions, and water use. Site characteristics likewise remain prevalent but are out of the control of the developer of a single property (a developer cannot increase public transit services near their parcel to earn the "Access to Quality Transit" points). It is the "sexy," visible building aspects such as weight rooms, bicycle facilities, and innovative common spaces, that many industry leaders have identified as what actually adds value to a buildings economics.

It should be acknowledged that while many of these amenities are accounted for in LEED's certification programs (such as bicycle facilities), some are not (such as weight rooms). It is the belief of the Runstad Center that an exploration of the value of separate, individual amenities would be a much more fruitful exploration in the future. Fortunately, the methodology proposed above could be utilized with only small modifications to achieve this research. Further, as more ambitious green certification programs like the "Living Building Challenge" begin to have more market use, those buildings may provide a significant enough contrast to the rest of the market to explore their value difference.

Appendix A

Independent Variables

- Location and Transportation
  - LEED for Neighborhood Development Location
    - binary variable for certified or not,
    - need list of LEED for Neighborhood Development sites in Seattle and Bellevue).
    - need to turn locations into polygons
    - spatial query for whether buildings are in polygons.
    - note do want to be in polygon
  - Sensitive Land Protection
    - binary for whether the site is in farmland, floodplain, habitat, water bodies, or wetlands.
    - GIS question based on County data
    - spatial query for whether site is in any of the polygons.
    - note don't want to be in polygon
  - High Priority Site
    - Binary for whether something is in zones or not
    - need shapefiles for Historic Districts, and long list of federal things we probably don't have including: EPA ntl priorities list, federal empowerment zone, federal enterprise community, federal renewal community, dept of treasury low income community, dept of treasury community development financial institutions, fund qualified low-income community, HUD qualified census tracts or difficult development area
    - spatial query for whether building is in areas.
    - note do want to be in polygon
  - Surrounding Density and Diverse Uses
    - calculate quarter mile euclidean buffer around all buildings
    - Calculate residential density within the buffer
  - Access to Quality Transit
    - categorical based on number of transit trips
    - build half and quarter mile buffer of building
    - spatial query for which transit routes go through buffer
    - sum up number of weekday trips for all routes in buffer
  - Bicycle Facilities
    - metric is distance to bike network
    - get bike networks for Seattle and Bellevue, include anything other than sharrows.
  - **DOES THE BUILDING HAVE BIKE STORAGE OR SHOWERS–NEED TO GET FROM BUILDING OWNERS OR MANAGERS**
  - Reduced Parking Footprint
    - metric is parking spaces per sf

    - **NEED TO GET NUMBER OF PARKING SPACES**
  - Green Vehicles
    - **NUMBER OF PARKING SPACES WHERE ELCTRIC VEHICLES CAN PLUG IN**

- Sustainable Sites
  - Construction Activity Pollution Prevention
    - not including because we are dealing with built things and this relates to construction.
  - Site Assessment
    - not including because we are dealing with built things and this relates to construction.
  - Site Development - Protect or Restore Habitat
    - not including because we are dealing with built things and this relates to construction.
  - Open Space
    - metric is percent of lot that is open space
    - get building outlines from Seattle and Bellevue
    - subtract outlines from parcels
    - calculate percent.
  - Rainwater Management
    - metric is percent of open space NOT impervious
    - NEED LIDAR FROM URBAN ECOLOGY.
  - Heat Island Reduction
    - metric is percent of parcel including building (green roof) that is vegetation
    - NEED LIDAR FROM URBAN ECOLOGY.
  - Light Pollution Reduction
    - **NEED TO ASK BUILDING MANAGERS IF THEY USE LIGHT FIXTURES THAT TILT TO GROUND**
  - Tenant Design and Construction Guidelines
    - **ASK BUILDING MANAGERS IF THEY PROVIDE DOCUMENT ON TENANT BUILOUT BEST PRACTICES**

- Water Efficiency
  - Outdoor Water Use Reduction
    - **ASK MANAGERS IF THEY WATER THEIR LANDSCAPING**
  - Indoor Water Use Reduction
    - **ASK MANAGERS IF THE BUILDING HAS LOW WATER USAGE TOILETS AND URINALS**
  - Building-Level Water Metering
    - not including because everyone would get meter reports from utility company–consider it good enough.
  - Outdoor Water Use Reduction
    - redundant of previous one
  - Indoor Water Use Reduction
    - redundant of previous one
  - Cooling Tower Water Use

    - **HAS A POTABLE WATER ANALYSIS BEEN DONE FOR COOLING TOWERS AND EVAPORTATIVE CONDENSORS IN THIS BUILDING?**
  - Water Metering
    - **DOES THIS BUILDING HAVE WATER SUB METERING?**

- Energy and Atmosphere
  - Fundamental Commissioning and Verification
    - not including because we are dealing with built things and this relates to construction.
  - Minimum Energy Performance
    - not including because we are dealing with built things and this relates to construction and renovation.
  - Building-Level Energy Metering
    - **DO YOU HAVE ENERGY SUBMETERING IN THIS BUILDING?**
  - Fundamental Refrigerant Management
    - **DO ANY OF YOUR HVAC OR REFRIGERATION SYSTEMS USE CFC CHLOROFLUROCARBON BASED REFRIGERENTS? YES=0, NO=1**
  - Enhanced Commissioning
    - **DOED THE BUILDING HAVE A COMMISSIONING AUTHORITY?**
  - Optimize Energy Performance
    - not including because we are dealing with built things and this relates to construction and renovation.
  - Advanced Energy Metering
    - **DO YOU HAVE *ADVANCED* ENERGY SUBMETERING IN THIS BUILDING? RELATES TO EARLIER QUESTION**
  - Demand Response
    - **DO YOU HAVE A DEMAND RESPONSE PROGRAM?**
  - Renewable Energy Production
    - **DO YOUR BUILDING HAVE ANY RENEWABLE ENERGY SYSTEMS?**
  - Enhanced Refrigerant Management
    - **DO YOU USE ENVIRONMENTALLY FRIENDLY REFRIGERANTS? FOLLOW UP TO PREVIOUS QUESTION.**
  - Green Power and Carbon Offsets
    - **DO YOU BUY CARBON OFFSETS OR OTHER CREDITS?**

- Materials and Resources
  - Storage and Collection of Recyclables
    - not including because true for all buildings in our sample
  - Construction and Demolition Waste Management Planning
    - not including because relates to construction not buildings under operation
  - Building Life-Cycle Impact Reduction
    - not including because relates to construction not buildings under operation
  - "Building Product Disclosure and Optimization - Environmental Product Declarations"
    - not including because relates to construction not buildings under operation
  - Building Product Disclosure and Optimization - Sourcing of Raw Materials
    - not including because relates to construction not buildings under operation

  - Building Product Disclosure and Optimization - Material Ingredients
    * not including because relates to construction not buildings under operation
  - Construction and Demolition Waste Management
    * not including because relates to construction not buildings under operation

- Indoor Environmental Quality
  - Minimum Indoor Air Quality Performance
    * not including because asks if buildings are up to code.
  - Environmental Tobacco Smoke Control
    * not including because illegal to smoke indoors in WA State.
  - Enhanced Indoor Air Quality Strategies
    * **DO YOU HAVE ANY AIR QUALITY SYSTEMS BEYOND THOSE TRADITIOANALLY REQUIRED BY CODE?**
  - Low-Emitting Materials
    * not including because relates to building improvements not buildings under operation
  - Construction Indoor Air Quality Management Plan
    * not including because relates to construction not buildings under operation
  - Indoor Air Quality Assessment
    * **HAVE YOU DONE AIR QUALITY TESTING?**
  - Thermal Comfort
    * **DOES YOUR HVAC SYSTEM MEET THE STANDARDS FOR HUMAN COMFORT?**
  - Interior Lighting
    * **DO YOUR LIGHT SWITCHES HAVE MOER THAN AN ON/OFF SWITCH?**
  - Daylight
    * **DOES YOUR BUILDING INCLUDE SHADES FOR WINDOWS?**
  - Quality Views
    * **DO 3/4 OR MORE OF YOUR ROOMS HAVE WINDOWS TO THE OUTDOORS?**
  - Acoustic Performance
    * **DO YOU HAVE ANY SYSTEMS IN PLACE TO MINIMIZE NOISE POLLUTION?**

- Innovation
  - Innovation
  - LEED Accredited Professional

- Regional Priority
  - Regional Priority: Specific Credit
  - Regional Priority: Specific Credit
  - Regional Priority: Specific Credit
  - Regional Priority: Specific Credit

Appendix B

Dependent Variables

- Rent per SF
- Rental rates
- Resale value
- Occupancy rates
- Operating expenses
- Net operating income
- Capitalization rates
- Productivity