

China's Growing Green Building Industry and How U.S. Companies Can Get Involved

BEE – Bisagni Environmental Enterprise

The U.S. Consulate General Shanghai Commercial Service

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EXECUTIVE SUMMARY

Since opening its doors to foreign trade in 1979, China has emerged as a significant economic power. China's rapid rise has transformed the country by sparking mass urbanization and development. With this development comes a host of environmental problems, including energy usage and emissions, deteriorated air quality, depleted resources, and increased scarcity of water for China's 1.3 billion citizens. A significant portion of these deep-rooted problems stems from conventional construction practices. With increased demands for a healthier environment and the subsequent efforts from both government and private organizations to establish the necessary infrastructure for the green building industry, many firms, both domestic and foreign, are taking advantage of this opportunity by introducing an array of innovative services and technologies.

Green building requires, considers, and reduces the life cycle costs of a building. Life cycle costs include the triple bottom line of social, environmental, and financial costs that are realized at every stage of a building's life. This concept is further defined by green rating and labeling systems. The two most widely used green building standards in China are China's Green Building Evaluation Labeling (GBEL), also referred to as China 3-Star, established by the Chinese Ministry of Construction, and Leadership in Energy and Environmental Design (LEED), which was founded by the U.S. Green Building Council (USGBC).

LEED and GBEL rated building registrations and certifications continue to grow exponentially every year, parallel with China's enhancing environmental objectives. LEED in China has a growth rate of 40% yearly with an increase in registrations from 363 in 2013 to 499 in 2014. Along with helping reach China's target of having 30% of new construction projects attaining a green certification by 2020, developers receive the additional benefits of numerous financial incentives in the form of government subsidies, increased sales and rent premiums, higher occupancy rates, and short and long-term savings. This growth in China's green building industry will sprout opportunities in all related sectors.

As green building rating systems proliferate throughout the country, they spread awareness of the environmental problems caused by conventional building practices. By doing so, they identify areas of such building practices that need to be addressed, incentivizing companies to enter the market and develop innovative solutions to tackle these issues. This development has created an opportunity for foreign companies entering China to introduce novel technologies and building practices from abroad.

There are four major sectors where companies have an opportunity to provide solutions: energy usage, indoor air quality (IAQ) management, resource management, and water usage. In the energy sector, the most promising areas of opportunity are in the markets for energy auditing and modeling, energy retrofitting, and energy efficient appliances. When implementing these services and products in the green building process, they have the potential to bring down energy consumption 30-50%.¹ In the IAQ management sector, the strongest emphasis is placed on ventilation and low-emitting

materials. The demand for these products is coupled with the demand for certification services to validate this new and growing market. USGBC states that a \$4/square foot investment in IAQ management can yield \$46/square foot in worker health benefits and company productivity.

In the resource management sector, the greatest demand in China is for improved waste management and an increase in repurposed and recycled materials. With China only recycling and reusing 5% of materials, as compared to 95% in many industrialized companies, the opportunities are widespread for American companies to get involved.ⁱⁱ With regards to the water sector, China is currently behind on water-efficient technology and will be working to catch up with global markets. Additionally, grey-water technology will be a primary focus in this market to address the issue of China's ever-shrinking supply of potable water. In China, buildings account for 60% of all wastewater, 70% of which can be classified as grey-water.ⁱⁱⁱ

The time is ripe for investment in China's green building sector and many US firms are already getting involved.

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1. Intro to the Green Building Industry in China

1.a. Costs of Urbanization

As China's population continues to boom along with its economy, people are moving to cities, stimulating an increase in urbanization and development. Today, 51% of China's population lives in urban areas.⁴ Between 1990 and 2005, the population of China's urban centers doubled, and during this time period, China's urban land area increased annually by approximately the size of the U.S. state of Maryland.⁵ This growing urban population has spurred on such a significant increase in development that by the end of 2006, 65% of China's urban buildings were constructed within a 10-yr span.⁶ This staggering growth is only projected to continue. In 2009, the McKinsey Global Institute estimated that China would build between 20,000-50,000 buildings of more than 30 floors by 2025.⁷ The consumption of energy, water, and resources necessary to meet this increased demand produces negative externality costs felt by society.

Included in these costs are all of the life cycle costs associated with buildings. From the very first steps of construction, through operation to demolition, the effects of energy usage, air quality, resource management and water usage incur societal and environmental costs. This creates much opportunity for China's green building sector. Perhaps the most prominent focus in this field has been on rating and labeling systems.⁸ The two most widely used green building standards in China are China's Green Building Evaluation Green Building Evaluation and Labeling (GBEL), also referred to as China 3-Star, established by the Chinese Ministry of Construction, and Leadership in Energy and Environmental Design (LEED), which was founded by the U.S. Green Building Council (USGBC). These two systems have established the infrastructure for the green building industry in China, ushering in a significant transformation within China's building sector. This rapid transition opens several unique opportunities for US companies to enter China's burgeoning green building industry by playing a pivotal role in addressing many of the most pressing ecological issues facing China and bringing the nation to its next stage of development.

1.b. Energy

In 2009, China became the world's largest energy consumer, accounting for 18% of total global energy consumption.⁹ China's demand for energy is increasing faster than a sustainable supply can be maintained. In 2011, more than 93% of China's energy came from non-renewable resources, and China produced more carbon emissions than the US and India combined.¹⁰ In fact, most of China's energy comes from coal-powered power plants, which costs approximately RMB 480 (\$78.2 USD) per kWh.¹¹ The life cycle costs associated with buildings greatly contribute to China's energy usage. These costs breakdown to include the energy used to produce building materials, transport these materials, construct the building, maintain the building's function, and ultimately to demolish the building.¹² According to Econet China, the energy required to produce and

transport materials and construct the building accounts for over 40% of China's overall energy consumption.¹³ This only includes the steps taken through to the construction of the building. Overall, buildings globally account for approximately 1/3 of total Green House Gas (GHG) emissions, and by country, China continues to be the largest contributor to GHG emissions.¹⁴ The impact of air pollution on human health is evident as respiratory illness is currently the second leading cause of death in China, not due to smoking.¹⁵ As little as 1% of the air breathed by urban residents in China is considered safe by EU standards.¹⁶

The Chinese government has acknowledged that it must make energy usage in China a main priority. The goals of China's 12th Five Year Plan (FYP) include reducing overall energy usage by 16% and CO₂ emissions by 17% per unit of GDP.¹⁷ China continues to prioritize sustainability as demonstrated by President Obama and President Xi Jinping's recent agreement to limit emissions by at least 26% from 2005 levels by 2025. For the past 10 years, China has increased investment in renewable energy, investing \$56.3 billion in 2013.¹⁸ Today, China is the largest global investor in green energy. One way the government promotes this is by offering subsidies for building-integrated PV installations greater than 50kW.¹⁹ Since 2006, the government has enhanced the requirements of energy usage reduction in buildings. Chinese residential building codes all require a reduction in heating energy consumption for both new construction and retrofit projects.²⁰ Additionally, the national Chinese commercial building code includes energy efficiency standards for lighting and HVAC systems.²¹

Currently, 30-50% of conventional buildings' energy consumption can be remedied through the application of green building practices.²² According to the United Nations Environment Program (UNEP), the green building sector holds the most promise for feasible and noteworthy GHG emission reductions.²³ In light of this regard, both LEED and GBEL award the most credit for energy efficiency, with the percentage being 32% and 23% of credit weight factors respectively.²⁴

Service opportunities include renewable energy exploration, energy auditing, energy modeling, private investment support through ESCOs, and building retrofitting. Of course, to make any of this possible, energy efficient products are necessary. Such products include construction technology, lighting, HVAC systems, water heating, insulation, and smart sensing technology.

One example of such a solution is the China Utility-Based Energy Efficiency Finance Program (CHUEE), which provides services and connections that enable energy efficiency and renewable energy programs. At the end of 2013, CHUEE had invested in 226 such programs, which together are estimated to reduce over 19 million tons of CO₂ emissions annually.²⁵ China Energy Conservation Investment Corporation (CECIC) runs off a similar model, and has helped make more than 3,000 energy efficient and environmental protection projects a reality.²⁶

1.c. Air

Buildings not only contribute to the deterioration of the atmosphere, but also create indoor spaces where air quality can be harmful. In a confined space, concentrations

of potentially toxic particles and gases can buildup and serve as another cause of respiratory illness. Lung cancer is the leading cause of death in China, and the WHO estimates that 300,000 premature deaths in China are caused by poor indoor air quality annually.²⁷ Moreover, conditions that compromise the health of employees in a work environment also drastically compromise the productivity of those workers and ultimately the business. Thus, the primary life cycle costs of poor indoor air quality (IAQ) are not only the wellbeing of the people, but also a company's productivity.

In 2001, the Chinese government cracked down on IAQ and established a series of compulsory national building standards. These standards include ventilation requirements, HVAC ventilation rate requirements, and concentration limits of twelve indoor air pollutants including CO₂ and Volatile Organic Compounds (VOCs).²⁸ Additionally, these standards target the products that these pollutants are released from by establishing limits of harmful substances contained in indoor decorative materials (LHSCIDM), such as formaldehyde in wood-based panels and indoor coating materials.²⁹ The LEED rating system supports this push by establishing minimum IAQ performance through basic mechanical and/or natural ventilation as a prerequisite for certification.³⁰ The interest from the Chinese government and building rating systems to improve IAQ supports the existing market demand for companies providing services and products to help meet these requirements.

Services that Chinese and foreign companies are pursuing to achieve acceptable levels of IAQ include certification of products, verification of air quality standards, and consulting services. Products relevant for improving IAQ include HVAC systems that operate at acceptable ventilation rates, low-emitting building materials, low-emitting indoor decorating materials, and monitoring systems for VOC and other pollutant concentrations.

1.d. Resources

Building life cycle costs also include costs related to resource management, beginning with the initial selection of building materials through to the waste management of those materials after demolition. Many resources used in the production of building materials are harvested unsustainably, leading to resource exploitation. This results in an ecosystem imbalance and a reduction in the resources available for human use. The use of virgin resources is not always necessary, and causes both shortages in resources and a build-up of waste. Much of this waste could be recycled, but is instead hauled to incinerators or to landfills, which contribute to GHG emissions, and soil and water contamination. Even after the construction is complete, material selection has an impact during the operational period of the building. For example, some materials are greater contributors to VOC emissions than others, impacting human health. Over the course of a building's life, a series of new tenants come through and renovate or make slight changes to the structure of the building, which requires more materials and the associated energy. Once a building comes to the end of its useful life, it is demolished, producing more waste. In China, construction and demolition waste accounts for 40% of the waste in landfills.³¹ This correlates to about 2 billion tons annually.³² Overall, besides the up-front financial cost of each good and service involved in the lifecycle of building materials, there are societal and environmental costs, a majority of which are caused by

material sourcing and poor waste management.

The substantial life cycle costs that buildings place on both the environment and society can be largely addressed through sustainable building practices. LEED and China 3-Star both maintain credit categories focused on the use of materials. Both aim to certify projects that pay close attention to proper waste management methods and sustainable procurement. According to China's 12th Five Year Plan (FYP), initiated in 2011, 20% of total new construction projects must meet green building standards. Regional procurement of resources and effective construction management will indirectly aid in surpassing this number.

This framework for the sustainable building materials market in China opens up new business opportunities including material sourcing, material assessment, adaptable design, waste management, efficiently produced materials, sustainably sourced materials, and reused or repurposed materials.

At present, waste management is an initiative pursued most notably by the private sector. One area being explored relates to recycling and reusing construction waste, an innovative field that could turn China's 2 billion tons of waste a year into additional construction materials or technologies. Recently, The Climate Group and China's leading concrete manufacturer, The China Advanced Construction Materials Group (China ACM), have teamed up to turn waste construction materials into reusable concrete.³³ Nevertheless, the Chinese government has acknowledged China ACM's efforts by providing a 6% VAT exemption and a 5% high-tech corporate income tax benefit for using recyclable materials.³⁴ China's government allows and supports the use of recyclable aggregates from construction waste for use in government projects.³⁵

There have also been many new Chinese companies that focus on replacing traditional wood materials with recycled plastic-wood composite materials. Such companies include Nanjing Dayuan WPC Material Co, Ltd, Shandong Huifeng Wood-Plastic Profile Co., Ltd, Jinhua Plastic Products Co., Forest Grass, Shanghai Haixing Plastic Industry Co. Ltd., and YW Systems.³⁶ These companies were all established within the past three years and have been meeting success with an increasing consumer demand for recycled and sustainable building materials.³⁷

1.e. Water

Water contamination caused by methods used to build conventional buildings further limits an already scarce resource. 60% of China's ground water is not potable due to contamination, and 300 of 657 major cities in China face water shortages.³⁸ Water is a human necessity, and its scarcity is one of the most pressing issues our society will have to face. Per capita water availability is approximately 2,140 cubic meters per person per year in China (1,720 in India and over 10,000 in the USA).³⁹ During the operational period, buildings consume large amounts of water necessary to operate.

Post-treatment waste tends to leak from disposal areas, and contaminate land and water sources. There are also energy costs and associated GHG emissions from water treatment and distribution.⁴⁰ Once water has been used and is classified as wastewater,

additional energy and chemical costs are required for the transportation to wastewater treatment plants and the associated treatment. Each step in this water usage life cycle is an expensive investment for local governments and causes previously mentioned social and environmental costs from energy usage and chemical contamination.⁴¹

The severe water scarcity issues China suffers from primarily stem from the uneven distribution of water demand and supply. There is a higher demand for water in the north of China, but this region only receives 20% of China's total moisture.⁴² To address this issue, efforts are currently focused on the South-North Water Diversion Project, which aims to use three canals to bring 44.8 cubic meters of water from the south to the north of China annually.⁴³ However, even if successful, this plan will be insufficient to alleviate the issue as water consumption and pollution continue to increase.⁴⁴ More emphasis needs to be placed on reducing water consumption and promoting water efficiency. Updated in 2002, China's Water Law emphasizes water efficiency and reduction in water usage.⁴⁵ The updated Water Law includes a volumetric water charge system in which a higher fee will be charged for greater water usage above the quota.⁴⁶

Buildings account for a large degree of water consumption in China, particularly in urban settings, which are rapidly growing in number in China. Water usage in commercial office buildings alone can account for up to 10% of urban water consumption.⁴⁷ One of the goals in China's 12th FYP is to reduce water intensity (consumed per unit of value-added industrial output) by 30%.⁴⁸ Additionally, the LEED rating system includes a prerequisite mandating that the building must use water efficiency strategies to reduce water usage of the building by as much as 25-50% as compared with baseline estimates for the building.

This is opening up a market for companies to supply services and products relating to water efficient appliances and technology. Such appliances and technologies include water efficient plumbing fixtures, low-flow flush valves on toilets, grey-water technology, irrigation systems for building landscaping, rainwater harvesting technology, and efficient water run-off management technology.

1.f. Green Building Rating Systems

Considering the numerous financial, environmental and social costs inflicted by buildings, there is a significant market and demand for sustainable building to both support progress and work towards a future that countless generations will enjoy. The LEED and GBEL rating systems were only introduced to China in the past 15 years, in 2003 and 2006, respectively.⁴⁹ Since then, significant progress has been made in China's green building sector.⁵⁰ Currently, 2,965 buildings in China are registered or certified as green buildings under the two aforementioned standards. The prominence of these rating systems has created a framework of opportunities for companies to get involved in China's growing green building sector.

Some companies have joined this market directly through the professional services sector by providing services such as sustainability consulting, architecture and design, project management, and market research and investment. These firms help

projects meet the standards set by the rating systems, such as architecture and design firms such as Gensler and M. Moser, and sustainable consultancy firms like BEE. Green building standards and labels also put an emphasis on rewarding credit for choices in building design that decrease the building’s contribution to the four major costs of conventional buildings outlined above (energy usage, air quality, resource management and water usage). Other companies have joined China’s green building market by providing direct solutions to components of these four issues. One example of such a company is Lutron, which produces energy-saving lighting products.

2. LEED & GBEL

LEED and GBEL (China 3-Star) continue to be the most prevalent green certification systems in China. LEED is currently the preference for green building certification, but the weight is beginning to shift to GBEL. LEED has twenty-one rating systems for different types of buildings including, but not limited to: New Construction & Major Renovation, Existing Buildings: Operation and Maintenance, Core & Shell, Commercial Interiors, Schools, Retail, Healthcare, Hospitality, Homes, Data Centers, Warehouses & Distribution Centers, Mid-Rise Residential, and Neighborhood Development. As per the newly released (January 2015) GBEL version, the system now has five building types: Residential and Commercial - which is then specified further into Office, Hotel, Hospital, and Exhibition/Convention.⁵¹ A Retail rating system for interiors is also in the process of being created. LEED’s rating system is a tiered certification program based off of 110 points and GBEL’s system offers different certification levels based off obtaining specified minimum points in each category. These levels for LEED and GBEL are defined in Table 1, below.

Table 1: LEED and GBEL Certification Benchmarks

GBEL	LEED
1-star: 50-60points	Certified: 40-49 points
2-star: 61-80points	Silver: 50-59 points
3-star: 81-110points	Gold: 60-79 points
	Platinum: 80 points and above

Source: Management Methods for Green Building Evaluation and Certification⁵²

Both LEED and GBEL have five overlapping categories related to land efficiency/sustainable sites, energy efficiency, water efficiency, resource/material efficiency, and indoor environmental quality. Additionally, GBEL has Operational Management and Construction Management categories, while LEED has Innovation & Design and Regional Priority categories. GBEL’s rating criteria carry similar weight between each category while LEED puts more emphasis on the Energy & Atmosphere and Sustainable Sites categories.

Types of stakeholders involved in the certification process also vary between the

two. The USGBC is a non-governmental organization made up of people from a diverse group of backgrounds. Certification is done by a third-party, called the Green Building Certification Institute (GBCI), in conjunction with USGBC. On the contrary, GBEL evaluation standards and certification are administered by government organizations.

Under these two systems, a building’s certification level is determined based on different factors. In GBEL, projects must meet the minimum credits in each category. For example, a 3-star rated commercial building must meet 8 out of 10 points for the energy efficiency category, with similar requirements for each category. In contrast, the total points summed over all categories determine LEED certification. Even though there are no minimum points for each category, LEED has *Prerequisites* in most categories that projects must adhere to if they seek to certify a project.

Lastly, the point at which a project reaches a LEED or GBEL certification differs. In many cases, LEED projects can achieve certification after having all documentation submitted and reviewed prior to operation (with the exception of LEED: Existing Operations and Maintenance, which must be operating under the new refurbishments for 3 months). GBEL projects undergo two evaluation periods. The first evaluation leads to the Green Building Design Label (GBDL), which is determined before construction. After the building has operated effectively for one year, it can receive the full Green Building Label (GBL), which focuses on sustainable implementation in addition to design. China’s Ministry of Housing and Rural Development (MOHURD) then gives the building a 1-,2-, or 3-STAR rating.⁵³

3. Growth of Green Building and Financial Incentives

3.a. Green Building’s Presence in China

LEED registrations continue to grow at a rate of 40% per year on average for the past twelve years. As seen in Table 2, USGBC projects that include LEED certified floor space will more than triple between 2013 and 2020 from 293.4 million square meters to 977.1 million square meters globally.⁵⁴ LEED certified buildings accounted for 20% of new floor space in 2011.

Table 2: Current and Projected Green Building Floor Space, Worldwide

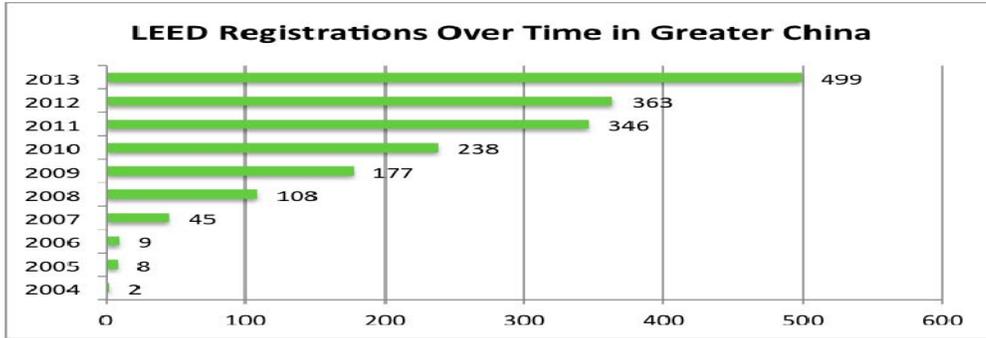
Square meters of certified floor space	Square feet of certified floor space	Timeline
293,371,000	3,158,000,000	2013 cumulative (Oct.)
977,061,000	10,517,000,000	2020 projection
2,630,364,000	28,313,000,000	2030 projection

Source: Green Building Market and Impact Report 2011⁵⁴

As seen in Figure 2, in China, LEED’s presence increased to 29 out of the 34 provinces in 2013 and registrations jumped from 363 in 2012 to 499 in 2013.⁵⁵ GBEL has been growing as well, but at a slightly slower pace.⁵⁶ With a rapid urbanization rate throughout China, green building growth will be the key to meeting market demand to

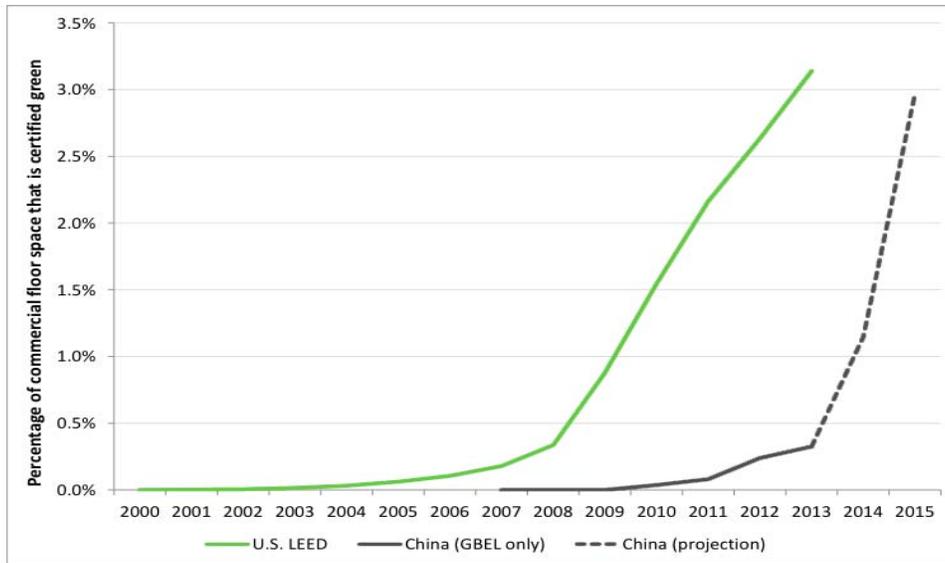
combat the stresses that are being placed on the built environment.

Figure 2



Source: *LEED In Motion Report: Greater China: China, Hong Kong, Taiwan*⁵⁷

Figure 3: Percentage of Commercial Floor Space Certified by LEED or GBEL, with projection of GBEL



Source: Comparative Policy Study for Green Buildings in U.S. and China⁵⁸

3.b. Looking Forward

China is ambitiously aiming for 1 billion square meters of green building floorspace by the end of 2015 and is mandating that 30% of all new construction projects attain green certifications by 2020.⁵⁹ Therefore growth in both GBEL and LEED is imminent. Thanks to financial incentives introduced in China to help reach the 12th FYP goals, developers may consider pursuing GBEL over LEED. Financial incentives are both provided by the central government and some provincial governments. A selection is listed below in Table 3:

Table 3: Central and Provincial Government Subsidies for GBEL Certifications

	3-Star Rating (per square meter)	2-Star Rating (per square meter)	Notes
Central Government	80 RMB	45 RMB	50 RMB million RMB designated for construction of eco-cities and eco-districts
Shandong	50 RMB	30 RMB	
Shanghai	60 RMB	60 RMB	<6 Million RMB per construction project <10 million RMB per affordable housing projects

Source: 12th FYP Building Energy Conservation Special Plan⁶⁰

In addition to central and local financial incentives, the pay-off in the long-term is proving to be appealing to developers as well. According to USGBC as seen in Figure 4 below, an investment of \$4 per square foot in a LEED building will result in a \$62 benefit within 20 years (or a difference of \$58 per square foot). This is broken down into \$46 estimated productivity and health benefits per square foot, an \$8.50 operation and maintenance savings, a \$5.80 water savings and energy savings, and a \$1.20 emissions savings.⁶¹

Figure 4: A \$4 Investment in Building Green Nets a \$58 Benefit Over 20 Years



Source: The Costs and Financial Benefits of Green Buildings⁶²

Moreover, as seen in Figure 5, buildings with green certifications experience higher sales and rent premiums than conventional buildings. Sales premiums experience increases between 0% and 30%, while rent premiums see increases between 0% and 17.5%.⁶³ Research shows that green certification boosts occupancy rates as well. When

combined with sales and rent premiums, the return on investment will be even higher.

Figure 5

