Why invest in high-performance green buildings?

Utilizing smart building strategies to reduce environmental impact, ensure occupant satisfaction, drive better business outcomes, and maximize asset value.

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Summary

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Executive summary

Property investors and developers are constantly seeking new strategies to deliver sustainable buildings that attract tenants and buyers while maximizing "green value." Investments in green buildings can produce measureable financial value, such as increased rental rates and asset value, reduced risk of depreciation, and higher tenant attraction and retention rates.

Meanwhile, occupants want buildings that help them attract and retain the best talent, foster collaboration and innovation, and increase employee productivity and well-being. At the same time, they need to reduce operating costs, energy use, and environmental impacts. All of these factors help organizations meet corporate social responsibility goals.

Increased market demand and clear financial rewards, coupled with mounting government regulations and shareholder pressures, provide multiple incentives to own and occupy high-performance green buildings that leverage innovation and deliver triple bottom line value throughout the entire building life cycle. The strategies outlined in this document will provide ideas on how to make green buildings perform on all levels—from profitability to sustainability, and everything between.

Introduction

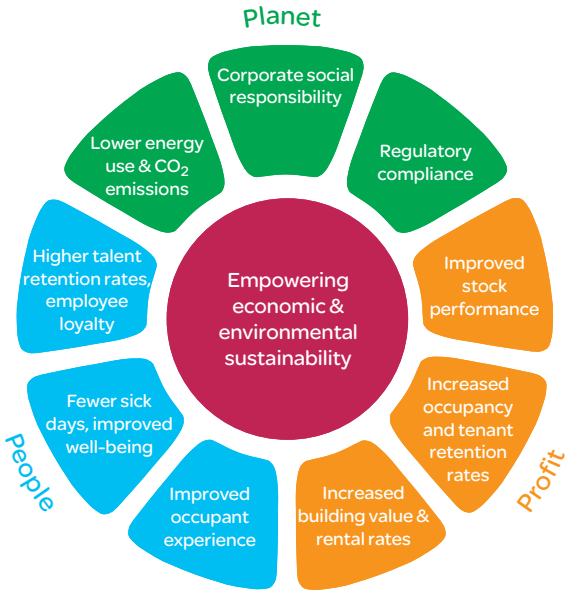
Conduct a quick internet search for the term "green buildings," and you will get 18.3 million hits in less than a second. Words like "sustainable" and "green" have long been associated with premium buildings. Today, these words have become part of our global conversation about everything from a worldwide movement towards energy efficient, environmentally sound buildings to enterprise-wide real estate portfolios. Acronyms like GBL, BIM, and IPD have entered the scene. We live in a time of global climate change challenges, increasing regulatory pressures for greater energy efficiency and carbon reduction, consumer interest, and employee pressure on corporations. These trends have fueled corporate social responsibility (CSR) programs, voluntary enrollment in non-governmental organization (NGO) initiatives like the Carbon Disclosure Project and the Climate Registry, and integration of sustainability into daily business practices.

> "The building is a citizen of the city and has an obligation to society."
>
> - Xiaowei Xu, PhD., LEED AP,
> Chief Engineer, Shenzhen
> Institute of Building Research

All of this, coupled with increased energy demand and rising energy costs, has created many challenges but few answers. Building owners, operators, and occupants are left to sift through mounting "green noise" to understand how to achieve environmental and economic benefits through smart building design and operation strategies.

So, what is a high-performance green building?

A high-performance green building can be thought of as a living organism, and as with all living things, it must have a nurturing environment to achieve sustained health and performance over its life. Such buildings are designed for economic and environmental performance over time, with an appreciation for unique local climate and cultural needs, ultimately providing for the health, safety, and productivity of building occupants. Architectural, systems, and end-use design, coupled with continual care and monitoring, lead to lower energy use, reduced CO_2 emissions, and focused environmental stewardship while providing long term value to the community, building occupants, and building owners. Triple bottom line benefits can be expected—measurable benefits for people, profit, and the planet.



In addition, high-performance green buildings have intelligent connections with energy sources, including the smart grid, and increasingly are vital components of sustainable, smart urban plans that leverage symbiotic, whole system design principles to minimize waste and maximize efficiency.

Green building pays

A fundamental change is taking place. With the rapid increase of renewable energy use, and the convergence of information technology and building technologies, we are on the path toward net zero energy or even positive energy buildings. This is reflected in the fact that smart grid, smart cities, eco-districts, and green campuses are already being built and retrofitted.

The green building movement is now mature enough to show proof of its economic green value in the real estate market for both building owners and tenants.[1, 2, 3, 4, 5, 6] Further, when implemented strategically, green construction and retrofits bring social as well as financial benefits.

However, green certification does NOT guarantee a high-performance building! (See section III for more on this topic). Increasingly, there is recognition that green buildings must be designed from inception to minimize environmental impact throughout the building life cycle. Designing for high performance from a life-cycle perspective is critical, and depends on several fairly recent innovations in the design/build process: Building Information Modeling (BIM) and Integrated Project Delivery (IPD), and ever more sophisticated energy and financial modeling tools and methods.

High-performance green buildings of the next decade will be designed by cross-functional teams using complex energy and building modeling tools, and applying the newest information gleaned from these models. Looking to the enormous potential within the green buildings movement and focusing on the triple bottom line, smart teams of people are collaborating, innovating, and partnering to bring a whole new breed of high-performance green buildings into the marketplace.

Smart teams of people are collaborating, innovating, and partnering to bring a whole new breed of high-performance green buildings into the marketplace.

[1] *Doing green by doing good? An analysis of the financial performance of Green Office Buildings in the USA*, RICS research, 2009
[2] Dow Jones Sustainability Index, SAM, 2010
[3] *Ethical Stock Indexes: Does Sustainability Pay Off?* C. Consolandia, P. Nascenzib, A. Jaiswal-Dale, Italy, US, 2008
[4] The US Mayors Climate Protection Agreement; http://www.usmayors.org/climateprotection/documents/mcpAgreement.pdf
[5] The American College and University Presidents Climate Commitment; http://www.presidentsclimatecommitment.org
[6] *Green Economy Post*, T. de Morsella, 2009

I. Why do we need to invest in high-performance green buildings?

For forward thinking building owners, operators, and tenants, the need for green buildings is clear. According to the World Business Council for Sustainable Development, buildings account for up to 40% of energy use in most countries.[7] With global energy demand outgrowing current production, there is a compelling reason to act with force. Using energy efficiency measures and a focus on sustainable practices, building owners and operators who invest in green building strategies will reduce the impact of climate change, preserve the quality of human life, improve business performance, and meet governmental regulations.

Following are some of the compelling factors that are driving investment in high-performance buildings:

The need to reduce climate change

The energy dilemma is here to stay. Our planet faces an unprecedented energy challenge, with global energy demand growing faster than current production capacity, resulting in diminishing supplies and increasing prices. By 2050, energy demand will double[8] in order to keep pace with demographic, economic, and industrial growth throughout the world. Within this same timeline, we must cut in half the amount of carbon gas emissions compared to 1990 levels[9] to avoid the dramatic consequences of climate change that will affect every citizen, business, and country.

The Intergovernmental Panel on Climate Change reports a projected population increase from 7 billion today to 8.3 billion in 2030. 70 million of these people live in developing or emerging countries which are growing eight times faster than industrialized nations. As this new urban middle class economy emerges with access to consumer goods and services, it is obvious there will be a tremendous increase in energy demand that must be satisfied.

According to studies by the International Energy Agency, by the year 2030, three quarters of our energy sources will remain CO_2-related, creating grave consequences if the global temperature rises by 3°C. As energy consumption continues to rise, it is imperative that we find a way to live with less reliance on fossil fuels, if we wish to protect the planet's climate and preserve the fuels for future generations.

High-performance green buildings directly affect this issue by reducing environmental impacts in water, materials, waste, energy, and carbon emissions, while also proving that sustainability does not mean people have to sacrifice functionality, productivity, or comfort. In fact, deploying innovative technology, in the context of holistic designs, leads to comfort for users, care for the community, and cash for the owner.

> "The health status of millions of people is projected to be affected through, for example, increases in malnutrition; increased deaths, diseases and injury due to extreme weather events; increased burden of diarrheal diseases; increased frequency of cardio-respiratory diseases due to higher concentrations of ground-level ozone in urban areas related to climate change."
>
> - Climate Change 2007 Synthesis Report, IPCC

[7] *Energy Efficiency in Buildings, Business Realities and Opportunities*, WBCSD, 2009
[8] International Energy Agency (IEA), 2009
[9] Intergovernmental Panel on Climate Change; http://www.ipcc.ch/index.htm

Ensure energy access and reliability

Quality of life is directly impacted by availability and reliability of energy. Today, 1.3 billion people[10] (20% of the world's population) have no access to electricity whatsoever. These people are essentially cut off from significant economic and social development, and they have limited access to educational opportunities and comprehensive healthcare.

Even in countries where people and businesses have access to energy, lack of reliability can disrupt daily life, negatively impact the economy, and even threaten life. Severe weather conditions like heat waves and cold snaps put intense pressure on electrical grid systems and can lead to power outages that threaten health and safety of individuals.

Kuwait already uses 98.5% of grid capacity, according to the Energy Information Administration, and the Middle East has one of the world's highest per capita consumption rates of electricity. The Gulf region is facing major investments to increase grid capacity to meet the rapidly rising power demand and avoid power outages. Europe is expected to invest 1 trillion Euros through 2020 in its power infrastructure to ensure reliability of service.[11] Many other areas of the world are experiencing equally challenging circumstances that make it difficult to provide predictable, reliable energy, which has a direct negative impact on the quality of life for individuals and on the ability of companies to conduct business efficiently.

As energy demand escalates all over the world, we need to make the grid greener and smarter—with more renewable energy sources and intelligence across the whole electricity network. In this context, high-performance green buildings can play an important role: buildings can both generate and store electricity, and push it back out to the grid when the grid needs it most. In other words, buildings can respond to the needs of the eco-district or smart city by both reducing use and releasing stored energy back to the grid—thus ensuring reliability and continuity of service, and contributing to improved quality of life for community members.

Mitigate risks of energy price volatility and supply security

As energy demands increase, so do prices. But the equation is much more complicated than that. Ongoing instability in the Middle East and North Africa has a direct impact on world energy markets, both in terms of price and supply. The Fukushima Daiichi nuclear power plant disaster not only effectively took about 30% of Japan's power supply offline (as the country shut down all 50 plants for maintenance after the 2011 meltdown),[12] it caused a backlash of fear in many parts of the world that are now reconsidering their own nuclear policies and potential associated risks. While Japan and other countries are still debating the role of nuclear power moving forward, it is easy to see how one incident can have major, lasting ramification on energy supply, security, and costs.

[10] World Energy Outlook 2011, International Energy Agency

[11] *Energy 2020—a strategy for competitive, sustainable and secure energy*, European Commission, November 10, 2010; http://ec.europa.eu/energy/publications/doc/2011_energy2020_en.pdf

[12] http://www.huffingtonpost.com/2012/05/25/japan-nuclear-energy_n_1544875.html

Designing and occupying high-performance green buildings is a great risk-mitigation strategy. In recent years, commodity speculators, in concert with increasingly erratic weather patterns, have played a major role in the volatility of energy prices in electricity, natural gas, and oil. Many companies spend immense funds to manage the risks of this volatility. High-performance green buildings reduce energy consumption—sometimes dramatically. Such buildings can modify the patterns of use to avoid expensive peak rates and to become more efficient overall, regardless of time of day. Buildings that generate energy through renewables can also sell energy back to the grid, thanks to the two-way communication inherent in the smart grid. A smart building knows how to respond to peak energy load and pull from the most renewable source of power.

Meet energy efficiency and sustainability regulations, incentives, and goals

Although government mandates are increasing, there are no clear directives on how to reach goals. It is clear that green buildings are an important part of the answer to the energy dilemma. As the built environment continues its move through a major transformation, it holds an incredible opportunity for process, technology and human innovation.

In 2010, the European Parliament and the Council of the European Union approved updates to the Energy Performance of Buildings Directive, in order to strengthen and clarify existing building performance legislation. Among the agreements reached by member states are:[13]

- By 2020, all new buildings will be designed to achieve "nearly zero-energy" results, with energy sources coming primarily from renewables
- After 2018, all new buildings occupied and owned by public authorities are nearly zero-energy buildings
- By 2020, 20% of energy supply for buildings must come from renewable sources
- Member states must implement mandatory certification (Energy Performance Certifications) of new buildings, upon construction, and existing buildings, at the time of sale or rent, along with periodic certification of public buildings

Regulation around the world

in the European Union

100% x 2020

all new buildings are nearly net zero

in China

40% x 2020

CO_2 reduction per GDP below 2005 levels

in Australia

★★★★★

Green Star rating required for new government buildings (5 stars) and existing buildings (4 stars)

in India

Mandatory compliance

with GRIHA (Green Rating for Integrated Habitat Assessment) rating system for buildings of the central government and public sector undertakings

in the US

15% x 2015

of all federal buildings >5000 ft^2 must conform to Zero-Net-Energy policy; all new buildings designed after 2020 must meet the policy by 2030

[13] http://www.eceee.org/buildings/EPBD_Recast http://eurlex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF

Each year, floor stock in China increases by another 2 billion square meters, which represents half of the world construction market.[14] This is driven by population growth, economic development, and dramatic and rapid urbanization. In 2009, China set a goal of 40%-45% CO_2 reduction (below 2005 levels) per GDP by 2020.[15] China has also set a goal of using 15% non-fossil fuels by 2020. In its 12th Five Year Plan, which covers 2011-2015, China continues to raise ambitions while shifting its focus to quality, rather than rate, of growth. The plan seeks to:

- Raise new building energy saving standards by 65-75%
- Complete a total of 400 million square meters of existing building energy efficiency renovation
- Expand building efficiency to the rural market
- Implement national green building plans
- Construct 1 billion square meters of new green buildings, including government office buildings, Eco-City attached projects, government subsidized projects, government investment projects, etc., and conduct mandatory GBL certification
- Issue 500 new green building certificates (100-200 projects each year)
- Provide financial, policy and land support to green building developers[16]

These are only a few examples of governmental initiatives that are taking place around the world, and their impact will only grow over time.

[14] GIM Research
[15] http://www.nrdc.org/international/copenhagenaccords/
[16] Data from GIM Research and APCO Worldwide http://www.apcoworldwide.com/content/pdfs/chinas_12th_five-year_plan.pdf

II. How do green buildings improve business?

With green building design and operation, business success is assured as buildings become both practical and profitable. This is true for several reasons, among them:

- Commercial tenants or owner/operators of sustainable green commercial buildings see tangible economic benefits including increased rental rates, improved occupant comfort, and increased stock prices[17] (See chart to the right for full benefits.)
- Greening existing buildings can increase property value while decreasing operating costs[18]
- A public entity, such as a city or a university, can make strides in improved image and demonstrate to citizens and students that the organization focuses on environmental issues

As an example of the last point, Experience Inc. surveyed nearly 2,500 university students and recent graduates who overwhelmingly expressed concern about climate change. 81% saw significance in working for an environmentally aware company, and 79% would probably accept a job at an eco-friendly company over a conventional one.[19]

Commercial building owners	Commercial building tenants
Increased rental rates	Lower operating costs
Attracting tenants	Healthier, cleaner indoor environmental quality
Cost effective	Immediate and measureable results
Competitive differentiation	PR and community benefits
Risk mitigation	Contribution to triple bottom line

Source: The US Green Building Council, *The Business Case for Green Building*

Lower energy use increases competitive edge and return on investment

Beyond moral and ethical considerations, there are tangible economic reasons why sustainable building practices are a good investment for the future. For one thing, payback improves as energy prices rise, so energy efficiency improvements become a better investment all the time.

Recent analysis shows that the Return on Investment (ROI) for green buildings is higher in both new construction and existing building projects, as compared to standard construction. Measuring, monitoring, and automating a building's energy systems maximizes this high ROI by ensuring equipment is only in use when needed and that all operations are at peak efficiency and effectiveness. ROI improvements reported by owners of green projects in the US were 9.9% on new construction and 19.2% existing building projects.[20]

This ROI is not surprising. There is strong evidence that green buildings positively affect capital expenses (CapEx) and Operating Expenses (OpEx). For example:

- Operating costs decrease 13.6% for new construction and 8.5% for existing building projects[21]
- Occupancy increases 6.4% for new construction and 2.5% for existing building projects[22]

[17] The U.S. Green Building Council, *The Business Case for Green Building*
[18] Building and Construction Authority (BCA) and the Department of Real Estate (DRE) in National University of Singapore (NUS) Study, 2011
[19] http://www.greenbiz.com/news/2008/08/05/green-allure-college-grads
[20] McGraw Hill Construction, Green Outlook 2011: Green Trends Driving Growth, 2010
[21] Ibid.
[22] Ibid.

- Rent increases 6.1% in new construction and 1% in existing building projects[23]
- In Australia, the first ever Property Council of Australia/IPD Green Property Investment Index shows that office buildings with environmental ratings do better (in growth and rental yield) than those without these ratings[24]
- Energy costs in the UK account for as much as 1/5 of business expenditures, so investing in efficiency can lead to gains in competitive advantage[25]

Companies incorporating sustainability perform better

Annual reports are overflowing with the words "green" and "sustainable," but does corporate social responsibility really matter to the bottom line? The answer is "yes." Global 500 companies demonstrating leadership in carbon disclosure or carbon performance yielded twice the average return as the index as a whole.[26] Studies also show a significantly negative impact on productivity and return on equity for abandoning corporate social responsibility standards.[27]

Looking at figure 1, we clearly see that stock performance of the world's most ethical companies is consistently higher than the S&P 500 Index. (Companies were measured in categories such as Corporate Citizenship and Responsibility; Corporate Governance; Innovation that Contributes to the Public Well Being; Industry Leadership; Executive Leadership and Tone from the Top; Legal, Regulatory and Reputation Track Record; and Internal Systems and Ethics/Compliance Program.)

The lesson is clear. Ethics, "doing the right thing," corporate social responsibility, environmental stewardship, community involvement, workplace well-being—they all matter and bring profitability.[28] High-performance green buildings support and facilitate all these factors.[29]

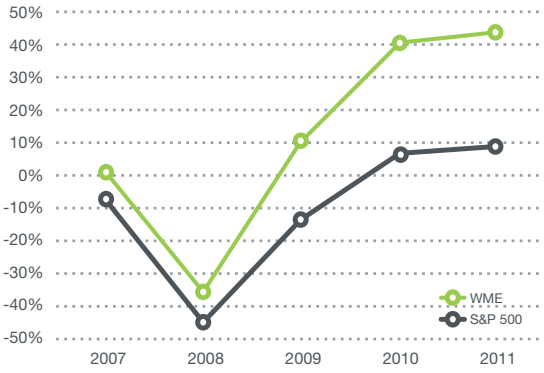


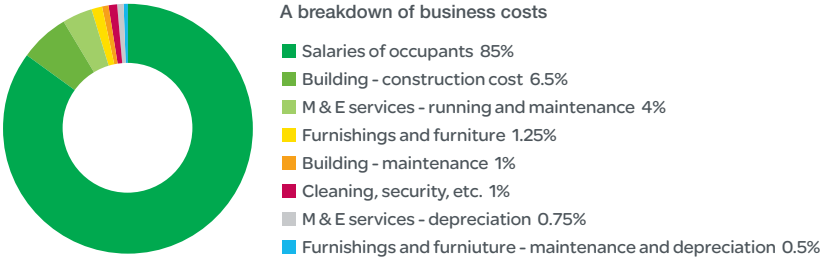
Figure 1. Source: Ethispshere, 2011 World's Most Ethical Companies

[23] McGraw Hill Construction, Green Outlook 2011: Green Trends Driving Growth, 2010
[24] http://www.propertyoz.com.au/Article/NewsDetail.aspx?p=16&id=4129
[25] *Guardian Sustainable Business*, N. Grant, February 2011 http://www.guardian.co.uk/sustainable-business/british-gas-energy-efficiency-competitive-advantage?INTCMP=ILCNETTXT3487
[26] *CDP's Annual Report Finds Sustainable Companies are More Profitable* T. Herrera, GreenBiz, September 2011
[27] *Ethical Stock Indexes: Does Sustainability Pay Off?* C. Consolandia, P. Nascenzib, A. Jaiswal-Dale, Italy, US, 2008
[28] Ethispshere, 2011 World's Most Ethical Companies. http://ethisphere.com/wme2011/
[29] *University of Notre Dame Study Finds Green Buildings Improve Company Financial Performance and Lower Operational Costs*, PRWEB, April 2012. http://www.prweb.com/releases/2012/4/prweb9390881.htm

High-performance buildings increase comfort, productivity, and learning

Working environments have a significant impact on employee productivity, and green buildings offer better day lighting, outdoor views, and indoor air quality for occupants to enjoy. These features of a healthy work environment help to attract and retain employees.

Moreover, occupant comfort and satisfaction reduces sick time, improves workplace occupancy rates (office spaces are typically unoccupied 30% of the time) and most importantly, improves productivity. Since salaries represent 85% of total office buildings business cost over a 25 year period,[30] productivity is by far the highest financial factor in office building performance. In fact, according to *The Impact of Office Design on Business Performance*, it has been estimated that "a 2-5 percent increase in staff performance can cover the total cost of providing their accommodation."[31]



Source: *The Impact of Office Design on Business Performance*

That same report states that "differences in productivity as high as 25 per-cent have been reported between comfortable and uncomfortable staff."[32] Green buildings can improve staff comfort by reducing drafts, minimizing floor-to-ceiling temperature stratification, controlling noise, improving indoor air quality, and providing daylighting and views. Furthermore, many green buildings enable room level control and direct personal control of individual spaces and offices, thus meeting the diverse needs of occupants. Additionally, individuals often benefit psychologically from knowing they have control over their workspace environment.

In fact, the healthier environment provided by green buildings has been shown to result in less illness, reduced absenteeism, and lower employee turnover. At Genzyme's headquarters in the U.S., several environmental features have made employees happier and more productive: sick time was reduced by 5%, 88% of employees reported improved well-being, and 72% of employees reported improved alertness and productivity.[33]

Photo credit: Peter Vanderwarker

LEED Platinum certified landmark green building: Genzyme Center, USA

- Integrated building control, with energy monitoring and management
- 900 blinds, 7 heliostats and indoor chandeliers reflect natural light
- Daylight harvesting
- Outdoor views from every seat
- 15% renewable energy
- Operable windows
- Indoor gardens and green roof
- Brownfield site remediation

Benefits to occupant

- Reduced energy by 42%
- Reduced water usage by 34%
- Reduced sick time by 5%
- Excellent indoor air quality
- Improved employee well-being, alertness, and productivity
- Improved employee attraction and retention

[30] *The Impact of Office Design on Business Performance*, published by The Commission for Architecture & the Built Environment (CABE) and Brtiish Council for Offices, May 2005. This report was based in part on research done by DEGW.
[31] Ibid.
[32] Ibid.
[33] Findings from a post-occupancy survey, reported on Genzyme Center's website on the Value page. http://www.genzymecenter.com/

Building green increases property value and reduces liability risk

Reducing the operating costs of a building or real estate portfolio increases the net operating income in more ways than direct savings alone. In fact, according to the New Buildings Institute, increasing net operating income increases a building's appraised value by ten times the annual cost savings. And according to a McGraw Hill Construction study, building green leads to an increase in building values—10.9% for new construction and 6.8% for existing building projects.[34]

Green buildings may also reduce the risk of lawsuits over mold-related and other health issues. Through the use of moisture-control detailing, pollution-and-contamination rejection strategies, and ventilation tactics, green buildings are healthier for occupants. Since most U.S. citizens, Europeans, and city dwellers globally spend about 90% of their time indoors, the quality of the indoor environment is extremely important.

[34] McGraw Hill Construction, Green Outlook 2011: Green Trends Driving Growth, 2010

III. Where do we stand today?

We've seen the cost benefits and goals of high-performance green buildings and why they are integral to addressing the energy and environmental challenges of today. The question is, how are we doing on delivering the green building value, and what more is needed to maximize this value?

For the past 20 years or so, transformation in the built environment has been driven largely by green building certification programs, which have both created awareness and driven demand in the market for green buildings.

The Evolution of Green Building Certification

When certification rating systems became viable, the initial green buildings focus was on the environmental impact of construction and design. This has evolved to include a focus on actual operational performance and energy use reduction, as evidenced by the development of LEED for Existing Buildings (2004) into LEED for Existing Buildings: Operations and Maintenance (2009). LEED v4 (scheduled for release in 2013) is expected to continue this trend of emphasizing energy efficiency and operational performance.

Major policies can transform the markets almost instantly and cause a spike in certification rates. Such is the case with the U.S. Government Services Agency (GSA) requirement that federal building achieve LEED Gold certification for all new construction and major renovations, and Australia's Commercial Building Disclosure program that requires a Building Energy Efficiency Certificate[35] for all transacting office buildings.

The following is a summary of leading certification standards in use today.

BREEAM and BREEAM In-Use
The Building Research Establishment Environmental Assessment Method (BREEAM) was the first comprehensive green building assessment system introduced in the world. BREEAM positions itself as being "the world's foremost environmental assessment method and rating system for buildings, with 200,000 buildings with certified BREEAM assessment ratings and over a million registered for assessment." Established in the UK in 1990, it is now a global voluntary measurement rating that uses standard metrics against established benchmarks to rate a building's environmental performance.

Established in 2009, BREEAM In-Use is an assessment method that helps building owners evaluate building operational costs and environmental performance after occupation. It consists of an online self-assessment tool and 3rd party certification, and provides a clear roadmap to sustainability improvements for building owners by highlighting problem areas, recommending improvements, and validating corporate social responsibility commitments. BREEAM In-Use is designed to reduce operational and running costs, reduce carbon and improve sustainability, enhance the value and marketability of property assets, give a transparent platform for negotiating building improvements with landlords and owners, and demonstrate compliance with environmental legislation and standards.[36]

[35] Australian Government's Commercial Building Discloser website: http://www.cbd.gov.au/
[36] http://www.breeam.org/page.jsp?id=66

Leadership in Energy and Environmental Design (LEED)

According to the U.S. Green Building Council (USGBC) website, "LEED certification provides independent, third-party verification that a building, home or community was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality."[37]

This mature rating system is comprehensive, covering both the design/construction and operations phases of the building lifecycle, while providing the flexibility of several categories, including new construction/major renovation, core and shell, commercial interiors, retail, hospitals, schools, homes, and neighborhood development.

Originally released in 1998 by the USGBC, LEED is now a global standard utilized all around the world through the LEED International Program, in countries such as China, India, Brazil, Russia, Italy, and Canada. As previously mentioned, the certification is constantly evolving to reward both green design and energy and operational efficiencies.

Green Star and NABERS

Australia has two—some say competing—rating systems: Green Star and NABERS. Launched in 2003 by the Green Building Council of Australia, Green Star is a building rating system that ranks green buildings from 4 to 6 green stars. A "4 Star Green Star" scores a facility as a "Best Practice," while the higher score of 6 signifies "World Leadership." The World Green Building Council reports that the Green Star System has also been adopted in New Zealand and South Africa.

The National Australian Built Environment Rating System (NABERS) is a national initiative to measure and compare the environmental performance of buildings. Of the two systems, it appears that the NABERS system measures what a building actually achieves, while Green Star is based on the environmental potential of a facility.[38] The Australian government, which leases 15% of all commercial building space in the country, has instituted a policy to lease only spaces with a 4.5 NABERS rating or higher. In addition, the national government requires a minimum of 5 stars for new office buildings and 4 stars for green leases, fit-outs, and refurbishments in the Green Star system for all national governmental buildings, according to Pike Research.[39]

Green Building Label (GBL)

China's Ministry of Housing and Urban-Rural Development (MOHURD) administers the Green Building Label (GBL) through the Green Building Label Management Office (GBLMO). Established in 2008, GBLMO is entrusted by MOHURD to manage, regulate, and promote China's GBL, which is gaining in popularity over the LEED rating in the nation.[40] GBL consists of the Green Building Design Label (awarded at the design phase and valid for two years),

First 6 Star Green Star Rating in Australia: Mirvac School of Sustainable Development at Bond University, Australia

- Building management system integrates all systems and aggregates environmental data
- Sub-meters continually compare actual performance to energy benchmarks
- Automated lighting control includes occupant detection and daylight adjustment
- 85% renewable energy sources: solar, wind, and regenerative drive lift
- First educational institution to earn 6 Star Design Rating by the Green Building Council of Australia

Benefits to owner/occupant

- Reduced energy by 75%
- Reduced carbon emissions by 82%
- The building itself is a Living Lab that supports the school's sustainability education mission, and includes a self-guided, interactive energy display

[37] http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1988
[38] Wikipedia, Green Building Council of Australia http://www.gbca.org.au/, NABERS http://www.nabers.com.au/, and www.change2.net
[39] Pike Research, *Global Certification Programs for New and Existing Buildings in the Commercial and Residential Sectors: Market Analysis and Forecasts*, May 2010.
[40] http://www.slideshare.net/geoff848/mohurd-three-star-system-how-does-it-work?type=presentation

and the Green Building Label (awarded after one year of occupancy and valid for three years). These voluntary certifications are for public and residential buildings, and cover similar topics as LEED, including considerations of land use, energy, water, and materials, as well as indoor air quality and performance.

Green Rating for Integrated Habitat Assessment (GRIHA)
GRIHA is a system developed jointly by the Indian Ministry of New and Renewable Energy (a government agency) and The Energy and Resource Institute (TERI), a prominent Indian non-governmental organization. GRIHA has established a growing presence in the public building sector. Although the requirements of GRIHA are similar to those of LEED, the documentation process is significantly different. It uses a star system ranging from one to five and the GRIHA can be used for both new and existing applications.

GRIHA has made strides to appeal to Indian designers and policymakers alike. For instance, the program offers credits for designing a naturally ventilated building. The final certificate is only awarded after building performance is verified based on one year of utility data, making this certification one that is based on proven performance metrics.[41]

When certification is not enough

Figure 2[42] shows how certification alone is not the answer: several LEED certified buildings are performing worse than energy code baseline! While green building certifications are a part of an important movement towards

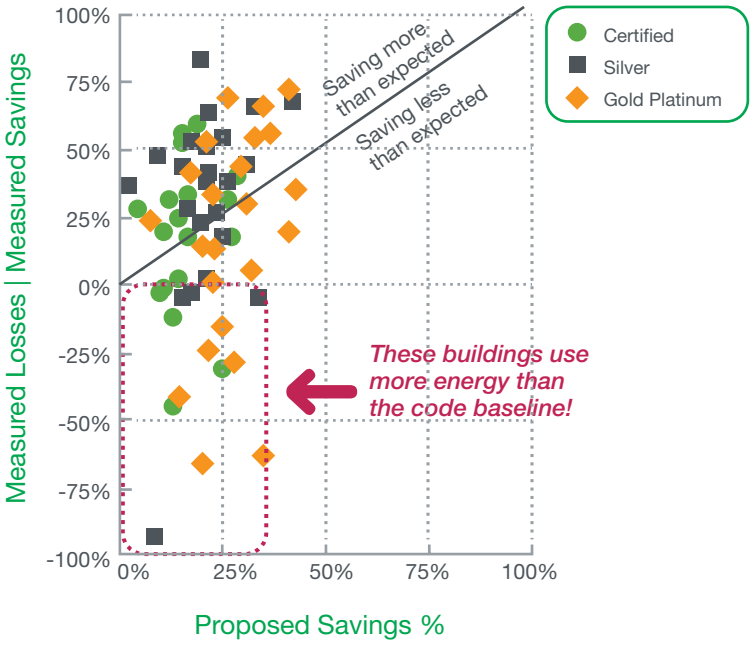


Figure 2. Source: New Buildings Institute report, *Energy Performance of LEED® for New Construction Buildings*, March 4, 2008

[41] Dr. Satish Kumar and www.grihaindia.org
[42] New Buildings Institute report, *Energy Performance of LEED® for New Construction Buildings*, March 4, 2008

energy efficiency and sustainability—and greatly increase awareness in this space—they are not the only solution. As mentioned previously, certifications such as BREEAM In-Use and LEED, have been updated to promote performance during the ongoing operation period of buildings. This is a big step towards ensuring high performance throughout the building life cycle.

In addition to evolving green building standards, energy performance standards are becoming increasingly important in driving energy-efficient operation throughout the building life cycle. Some important standards include:

- **ISO 50001:** Introduced in 2011 to establish requirements for energy management systems (EMS). ISO estimates that by "targeting broad applicability across national economic sectors, it is estimated that the standard could influence up to 60 % of the world's energy use."[43]
- **BBC and BBC EFFINERGIE:** These French "low energy" building labels specify minimal energy use: 50 kWh/m^2/year for residential new construction, and 50% below baseline for commercial construction. Since the labels are tied directly to French energy regulations, the thresholds continue to be lowered and are moving toward net zero and positive energy standards.
- **Bureau of Energy Efficiency's (BEE) Star Labeling Program:** The premise of this Indian program for existing buildings is that building performance, more than anything else, needs to be linked with actual energy use data.[44]
- **ENERGY STAR:** This US program lends its ENERGY STAR label to energy-efficient products and practices and boasts $18B in utility bill energy savings in 2010 alone.[45]

The worldwide adoption of dozens of green building and energy standards has certainly helped to raise awareness about the potential of a transformed built environment. And pioneering projects like Green Office Meudon, TNT Centre, and Earth Rangers Centre—by taking a holistic approach and achieving net zero / positive energy results—are inspiring building developers, operators, and occupants to achieve ever higher levels of performance. So how do we take these accomplishments into the mainstream?

photo credit: Ludovic Molinier

Schneider Electric R&D and manufacturing functions co-locate to boost innovation and collaboration: Horizon Building, France

- Low energy design; consumes only 40 kWh/m^2/year
- Low Energy Certified (Effinergie BBC)
- High-Performance Energy and Associated Qualities Certified (HPE QA)
- 100% on-site generated renewable energy meets all consumption needs for net zero results
- Guaranteed energy performance contract
- Grand Prix SIMI 2011 Winner

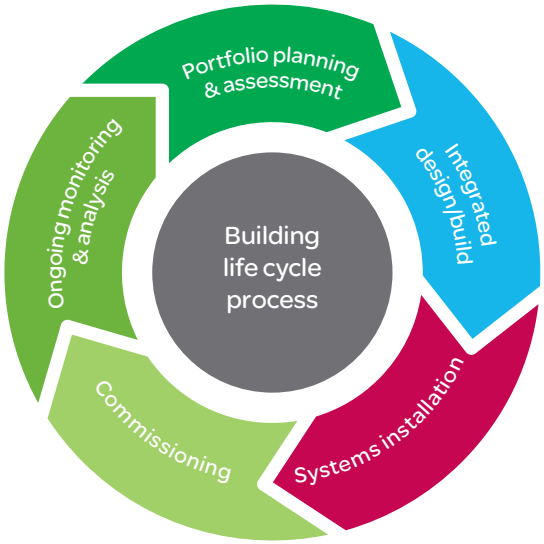
Benefits to owner/occupant

- Optimized space utilization
- Enhanced cooperation between R&D and production
- Improved occupant well being
- Reduced operating costs
- Flexible, future forward architecture
- Achieved corporate social responsibility goals

[43] International Organization for Standardization: http://www.iso.org/iso/iso_50001_energy.pdf
[44] Dr. Satish Kumar and http://www.beeindia.int
[45] http://www.energystar.gov/index.cfm?c=about.ab_index

IV. How do we deliver smarter, converged solutions designed for high performance?

According to the International Engineering Consortium, only about 25% of total life cycle cost[46] of buildings in the U.S. occurs at the design and construction phase. Unfortunately, this is when many decisions are made that will affect the performance of a building for many years into the future. Since most of a building's cost is associated with its ongoing operations, it is clear that to reduce energy use and CO_2 emissions of buildings, we must move toward a new "design for life cycle performance" paradigm—from conception to ongoing operations and maintenance—infusing high-performance measures throughout every stage in the process.



As the green building marketplace evolves, high-performance buildings are becoming more intelligent entities that sustain results over time. Mirroring the human body which changes and adapts automatically to its environment, a high-performance green building can make better and better automatic decisions with converged solutions. Learning from the messaging of its "nervous system," these buildings make more intelligent decisions and strategic changes over time.

A simple example of self-adapting systems would be "optimum start," in which an algorithm uses historical data in conjunction with internal and external building conditions to predict the optimal time to start the building's systems to achieve operational conditions at the beginning of occupancy. Conversely, "optimum stop" calculates the right time to stop a building's systems while maintaining minimal drift in environmental conditions by the end of the building's occupancy period.

Intelligent tools and processes at the design phase facilitate successful integrated design/build outcomes

As the demand for high-performance buildings gets stronger, the need to build and design with a holistic approach becomes more relevant. Mirroring a concept similar to how an aircraft is built, a high-tech and high-performance building can leverage building information modeling (BIM). The National Building Information Model Standard Project Committee defines BIM as "a digital representation of physical and functional characteristics of a facility." By harnessing the power of a real, live data model, where information is added throughout the design process, one can immediately see the results of design approaches and how they affect future building performance. The BIM process helps close the gap between the green building vision and actual building performance, as does Integrated Project Delivery (IPD).

In its guide on the topic, the AIA defines IPD as "a project delivery approach that integrates people, systems, business structures, and practices into a process that collaboratively harnesses the talents and insights of all participants to optimize project results, increase value to the owner, reduce waste, and maximize efficiency through all phases of design, fabrication, and

[46] This ratio differs in other parts of the world, due to labor costs.

construction." Building Information Modeling and IPD are closely interrelated, as SmartBIM states that the BIM model is the "centerpiece of Integrated Project Delivery."

The IPD process calls for early incorporation of predictive energy and financial modeling, with regular iterations as the design progresses. A team of designers used this process, in a proof-of-concept project, to create a zero-emissions design called Net Zero Court for a site in St. Louis, Missouri. The goal was to create a market-rate building design "that produces and exports at least as much emissions-free renewable energy as it imports and uses, from emission-producing energy sources annually."

The design team performed comparative modeling of more than 90 different strategies at the predesign stage. Then, using follow-up analysis, the team was able to select a "bundle" of strategies that incorporated literally hundreds of specific green opportunities, with predicted carbon emission and cost implications. The analysis covered a wide range of factors, from insulation and window design, to lighting, cooling and heating, to fans, pumps, and plug loads.

The team was able to model the complex interaction of all these variables iteratively throughout the design stage, with constant improvement and refinement, resulting in a building design where performance drove design, instead of the other way around. (More on this project can be viewed at www.netzerocourt.com.)

Ongoing monitoring, analysis, and improvements drive sustained performance

Even if a building is designed or retrofitted for high performance, it won't remain that way without active energy management. The most effective energy management plan is comprised of four key steps, shown in figure 3. These four steps are:

- Measure energy usage
- Fix the basics
- Automate
- Monitor, control, and improve

A critical component of this life cycle involves monitoring, maintaining, and improving building operations. This can be achieved with continuous commissioning, which is different from commissioning. Commissioning is the process of ensuring that building systems are installed and operated to provide the performance envisioned by the owner, and primarily focuses on bringing the building's operations to the original design intent. Continuous commissioning, on the other hand, focuses on optimizing operation and control of building systems. It often identifies issues related to the original system commissioning and highlights the difference between design intent

Retrofit designed for life cycle performance: Musgrove Park Hospital, UK

- Performance contract guarantees €21M (£17M) in energy savings over the next 20 years
- Reduced carbon emissions by 43%
- Reduced energy use by over 40%

Benefits to owner/occupant

- Best-in-class technologies to maximize energy performance
- Improved environment of care and patient safety
- Reduced maintenance costs
- Minimized business risk from energy price volatility
- Money from energy savings can be reinvested in other estate projects
- More control over estate operating systems and energy costs

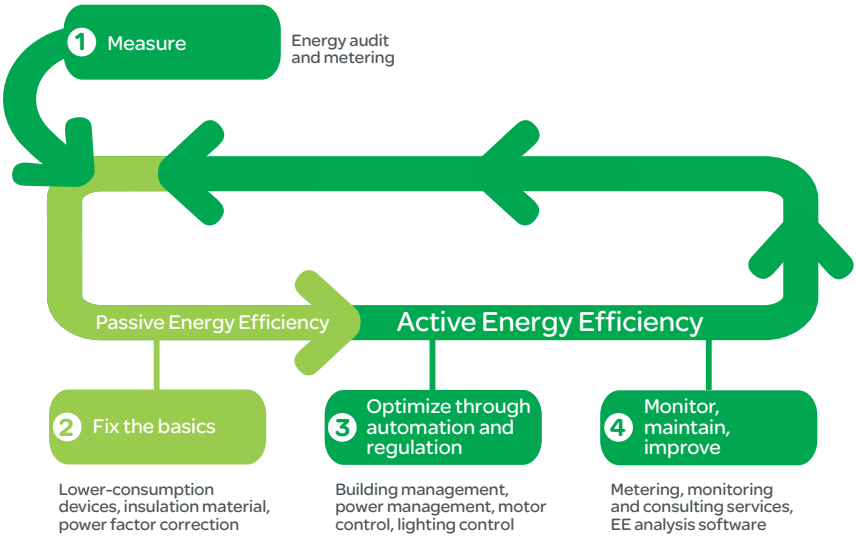


Figure 3.

and actual utilization. Continuous commissioning is an ongoing process that can resolve operating problems, improve comfort, optimize energy use, and identify energy conservation opportunities. It focuses on overall system control and operations in real-time based upon occupancy profiles, and provides actionable information to facility management staff—often including financial data that helps you prioritize corrective actions and conservation opportunities based on ROI calculations.

As discussed, highly integrated buildings are self adapting: they can automatically respond to external and internal conditions (weather, energy price, sun position, indoor air quality), occupant needs (temperature comfort, lighting level, access control), and building equipment conditions (chillers, boilers, ventilation systems). All this data is collected, synthesized, and managed in real time to continuously optimize building performance, reduce energy usage, improve security, and provide healthier conditions and more satisfaction for occupants.

V. What is the future promise of green building?

Buildings are connected to man-made and natural ecosystems, which must work in harmony in order to mitigate environmental impacts of the built environment. One of the ecosystems that will have a significant impact on our ability to deliver buildings that sustain high performance over time is the smart grid. “Smart grid” is a popular name given to the concept of adding communications and data handling infrastructure to the existing electric grid. The smart grid and smart buildings will play a pivotal role as we move towards eco-districts and smart cities.

The electrical network faces many constraints, such as energy demand continuously increasing, aging infrastructures, lack of capacity, and energy theft in some areas of the world (particularly South America and India). Installations must become more environmentally friendly, and renewable energy sources, though intermittent and unpredictable, must be integrated seamlessly into the grid. The network must evolve into a high-performance electrical infrastructure combined with an intelligent IT infrastructure. This is the intelligent network or smart grid that will continue to ensure the balance between energy production and consumption in a more complex environment.

Tapping the power of the smart grid to reduce risk, and realize financial gain for building owners and operators

The smart grid enables two way communication between the grid and buildings—providing relevant information to operators, planners, and customers about how the grid is performing. This information has a number of impacts:

- For grid operators (utilities and Independent System Operators), the information will improve reliability, provide much earlier warnings of grid stress or failures, improve the quality of power for customers, and enable the use of the most economical mix of generation sources to meet current demand. In addition, significant renewable resources, such as wind and solar, are coming online. These generation sources produce power with lower quality characteristics due to variability in wind and sunlight. A smart grid would allow operators a number of ways to compensate for this so that customers are not affected.
- For building owners and operators, the smart grid allows participation in the electricity market for financial gain and environmental stewardship recognition. As energy costs rise over the coming decades, smart grid information will enable energy users to modify patterns of use to avoid expensive peak rates and even sell energy back to the grid if they have on-site generation. If customers do not generate energy on-site, but still want to tap the greenest sources of generation, smart grid information enables a choice of fuel sources. For example, customers could alter energy use patterns to fit times of day when the renewable contribution to the grid is at its highest.
- Electric vehicles bring new challenges to building owners, as governments are buying EV fleets while individuals are showing increased interest. Uncontrolled, an individual EV can have the same demand impact as a small house. Smart grid telematics can manage both the time and rate of charge to meet both the driver’s and the facility manager’s needs.

Smart Grid

- Creates two-way communication between the grid and load (building)
- Allows two-way energy flow between the grid and load (building)
- Distributes energy intelligently across a region to manage the load better

Connecting smart buildings with the smart grid

The term “microgrid” describes smaller interconnected areas that can stand alone. Examples would include the systems within a building, a collection of facilities on a campus, or even a residential subdivision. Traditionally, building management systems are sensitive to temperature, humidity, occupancy, and outside air, but they lack any feedback on energy use or cost. In the microgrid concept, the building management system would incorporate information from electric meters, security systems, sensors on motors and drives, continuous building analytics, and external feeds for energy prices and weather forecasts. The result would be a “self-aware” building that would follow and learn occupancy patterns, supply power only where and when needed, and be able to use thermal mass to confine HVAC use to less expensive times of day.

Many markets today have “smart grid-like” activities such as demand response programs, which are basically an agreement between the building and the grid. The building automatically (or manually if desired) reduces its energy consumption when there is a high demand for energy on the grid (for example, during peak use times). Although these programs are not yet widely adopted, the industry has learned two valuable lessons so far. First, complex and manual processes dramatically lower program participation and results. Second, participants lose interest when they can’t see the results of their efforts. A smart grid has the potential both to automate customer participation and to provide real-time information about money saved, payments earned, carbon eliminated, and so forth.

The U.S. Green Building Council published its first demand response LEED pilot credit,[47] and is open to all projects using the following LEED 2009 rating systems: New Construction, Core & Shell, Commercial Interiors, Schools, as well as EBOM 2009, LEED for Healthcare, and LEED for Retail. The intent of this credit is to “increase participation in demand response technologies and programs that make energy generation and distribution systems more efficient, increase grid reliability, and reduce greenhouse gas emissions.”[48]

Connecting smart buildings to the smart grid will be a common occurrence in the built environment of the future, but that is just the beginning. Governmental regulations and new research[49] are paving the way to significant growth in net zero, positive energy, and carbon neutral buildings. Emerging trends point to enterprise-wide green portfolios, green campuses, micro-grids, and eco-districts, and to the incorporation of renewable energy and electrical vehicle charging as standard elements in high-performance green buildings. Processes like building information modeling, integrated project delivery, and energy modeling will make building design and operation smarter, and new technologies like water footprinting and use of social media in energy efficiency will further change the green building landscape.

[47] Schneider Electric, Lawrence Berkeley National Laboratory, and Skipping Stone collaborated to enhance an existing demand response credit for LEED. The revised credit was released in June, 2011.

[48] USGBC: https://www.usgbc.org/ShowFile.aspx?DocumentID=18920

[49] According to Environmental Building News, a recent report from the New Buildings Institute (NBI) indicates that net-zero-energy commercial buildings are becoming more common, don’t necessarily cost more than traditional buildings, and don’t require any special technology or solutions outside of what is currently available.

Transformation for a sustainable future

As we have seen, green building strategies are evolving rapidly, as people, processes, technology, and partnerships combine to drive innovation and create a truly sustainable future. Partnerships—even between traditional competitors—are emerging to leverage expertise and "leap frog" to solutions at an accelerated pace.

Building owners, operators, and occupants must rely on the expertise of multiple parties when developing green property. High-performance green building specification is often lost in traditional design/build processes; having a green building solutions architect involved in the design phase of a new building or on retainer for building retrofit scenarios can be a valuable benefit for the life cycle of a green portfolio.

It's important to work with a green building partner who can sustain results over time and who demonstrates a mature, holistic approach that includes:

People

- Highly skilled engineers who specialize in energy management
- Green building certification expertise
- Converged systems integration expertise
- Commitment to providing triple bottom line value

Process

- Expertise in the full integrative design/build process, a crucial first step in delivering on the promise of green
- Scalable energy management solutions that are flexible to customers' budgets and risk tolerance

Technology

- Integrated products and services addressing critical domains of an enterprise: Power Management, IT Room Management, Process and Machine Management, Building Management, and Security Management
- Commitment to an open systems approach, to maximize existing investments, and allow for adoption of emerging technology solutions
- Continuous energy monitoring/score carding, and visibility through dashboards

Innovation

- R&D and participation in net-zero buildings, eco-districts, eco-cities
- Collaboration with customers, architects, engineers, global alliances, and local partners—to co-create the right solution for the long term, for all stakeholders

The world's largest positive energy building: Green Office® Meudon, France

- 23,000 m^2
- Energy production: 64 kWh/m^2/yr
- Energy consumption: 62 kWh/m^2/yr
- New construction energy performance contract
- 10 years ahead of regulations
- Early collaboration between developer, property manager, occupant, and Schneider Electric

Benefits to developer

- Achieved high level of occupant satisfaction
- Met positive energy target
- Maximized asset value
- Strengthened brand as leader in sustainable development

Benefits to occupant

- Reduced environmental impact
- Improved employee satisfaction and well-being
- Achieved corporate social responsibility goals
- Reduced operating costs

V. Conclusion

Multiple factors are converging at this time, escalating the need for continued and rapid transformation in the built environment. The unprecedented rate and scale of urbanization, population and economic growth, aging infrastructure and building stock, market demands, shareholder and public pressure, and regulatory conditions are all driving the demand for a new breed of high-performance green buildings. As this demand accelerates and new strategies are developed, the need for building owners and occupants to understand the options available to them becomes crucial.

The benefits of building green can be significant, but only if best practices are followed—not just at the design/build stage, but throughout the entire building life cycle. Owners can expect their green buildings to enable better business outcomes, such as improved stock performance, increased asset value, and higher rental, occupancy, and tenant retention rates. Occupants can expect improved employee productivity and well-being, lower operating costs, reduced environmental impacts, improved public image, and fulfillment of corporate social responsibility goals.

Building owners, operators, and occupants who invest in high-performance green buildings can realize triple bottom line benefits when they partner with innovative, collaborative companies that look at buildings holistically, are willing and eager to engage with all stakeholders early in the process, and employ design-for-performance principles.

Schneider Electric was named in the 2011 and 2012 World's Most Ethical Companies Index. Companies are evaluated on Corporate Citizenship and Responsibility; Corporate Governance; Innovation that Contributes to the Public Well Being; Industry leadership; Executive Leadership and Tone from the Top; Legal, Regulatory and Reputation Track Record; and Internal Systems and Ethics/Compliance Program.

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