



Green retrofitting of buildings is one of the most significant development activities going on today.

Six leaders in the new real estate arena of green retrofitting discuss how to conduct such retrofits and how much they cost. Contributing their expertise are Iain Campbell, vice president, global energy and workplace solutions, Johnson Controls, based in Milwaukee, Wisconsin; Stephen Doig, vice president, energy and resources, Rocky Mountain Institute, based in Snowmass, Colorado; Doug Gatlin, vice president, marketplace development, U.S. Green Building Council in Washington, D.C.; Anthony E. Malkin, president, Malkin Properties, based in New York City; David L. Pogue, national director, sustainability, CB Richard Ellis, Los Angeles; and Ray Quartararo, international director, Jones Lang LaSalle, based in Chicago.

BUILDING retro

CHARLES LOCKWOOD



URBANLAND

fits



IAIN CAMPBELL

vice president, global energy and workplace solutions, Johnson Controls, Milwaukee, Wisconsin.



STEPHEN DOIG

vice president, energy and resources, Rocky Mountain Institute, Snowmass, Colorado.



DOUG GATLIN

vice president, marketplace development, U.S. Green Building Council, Washington, D.C.



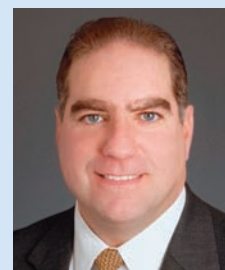
ANTHONY E. MALKIN

president, Malkin Properties, New York City.



DAVID L. POGUE

national director, sustainability, CB Richard Ellis, Los Angeles.



RAY QUARTARARO

international director, Jones Lang LaSalle, Chicago.

What exactly are green retrofits?

DOUG GATLIN: That depends on whom you ask. In the U.S. Green Building Council [USGBC] view, green retrofits are any kind of upgrade at an existing building that is wholly or partially occupied to improve energy and environmental performance, reduce water use, and improve the comfort and quality of the space in terms of natural light, air quality, and noise—all done in a way that it is financially beneficial to the owner. Then, the building and its equipment must be maintained to sustain these improvements over time.

ANTHONY E. MALKIN: My premise is that overall upgrades and practices are qualitatively the right thing, but not quantitatively. You gain benefits toward sustainability, but you cannot determine a payback period from overall green practices. A true retrofit requires a fact-based, benchmarked, quantitatively oriented, energy-efficiency retrofit with a clear payback analysis on an integrated multicomponent effort with performance guarantees.

How large a potential market do these retrofits represent?

IAIN CAMPBELL: There are about 5 million commercial buildings in the United States consisting of 72 billion square feet [670 million sq m] of floor space. Cost-effective retrofit potential remains for over 80 percent of these buildings. As much as 10 percent of our building stock was constructed in the last five years. These buildings are early in the capital life cycle of their major building systems, and whole-

building retrofits are unlikely to be cost-effective. There may, however, be an opportunity for commissioning and operational green improvements in these buildings. Also, there is a proportion of buildings at or near the end of their useful life that would not achieve a financial payback from a green retrofit.

Pike Research, based in Boulder, Colorado, estimates that the 2009 market for major green renovations in the United States is \$2.1 billion a year and will grow to over \$6 billion a year by 2013. Pike Research also estimates that 2 percent of existing space is renovated each year, and that 10 percent of these renovations include state-of-the-art energy efficiency.

DAVID L. POGUE: We have been able to demonstrate that it is often just as easy to get a LEED-EB [Leadership in Energy and Environmental Design—Existing Building] rating on 40-year-old buildings as a new building. At a 40-year-old building, much of the equipment has often reached the end of its useful life, so it can be—or already has been—replaced with new, more efficient systems. Most newer buildings already have good design and equipment in place, so LEED-EB is often achievable. Sometimes, the 15-year-old building falls into an awkward in-between time span where owners are sometimes reluctant to invest in those improvements.

What are the typical costs and return on investment for comprehensive, buildingwide green retrofits?

CAMPBELL: Whole-building green retrofits can cost anywhere between \$2 to \$7 per square foot [\$21 to

\$75 per sq m], depending on the building's age, existing design, purpose, and the level of savings being targeted. We also see wide variation in the return on investment [ROI], with simple payback periods ranging widely from two to 15 years.

The most recent annual Energy Efficiency Indicator survey conducted in March by Johnson Controls found that 50 percent of commercial building owners require projects to have a simple payback period of three years or less, translating to an internal rate of return greater than 30 percent.

What types of users or tenants are driving green retrofits?

POGUE: Three types of tenants are at the forefront in demanding green workplaces. First are the Fortune 500 multinational corporations with corporate sustainability reports. Second are the “gazelles,” the new companies that want to recruit the cutting-edge young talent that sees sustainability as a given, not an add-on. Finally, government tenants are pushing the demand because their own policies require such facilities.

At the “big middle,” we are still not there yet. We are still on the edges. Many markets are lagging because they don't have the Fortune 500 corporations or the gazelles, and the rest of the users haven't made sustainability a driving point.

RAY QUARTARARO: Single-user commercial properties are likely to be busy because it's easier to get buy-in for a retrofit program and to show the benefits of the operational savings. You have fewer tenants to coordinate with or ask for approval. In some cases, these buildings are owner occupied, so the decision to retrofit can be easily justified. It's also easier to get access to information around planned upgrades and capital improvements, utility costs, occupancy strategy, etc.

STEPHEN DOIG: There is significant movement related to the American Recovery and Reinvestment Act of 2009, but much of it is focused on piecemeal solutions using very traditional methodologies. In particular, in small to mid-sized commercial properties, whole-building retrofits are lagging or nonexistent due to less experience, uncertainty on the return on investment, and a lack of established business models by providers.

A true retrofit requires a fact-based, benchmarked, quantitatively oriented, energy-efficiency retrofit with a clear payback analysis on an integrated multicomponent effort with performance guarantees.

What are other financial benefits of green retrofits besides energy savings?

POGUE: Increased workforce productivity ultimately holds the greatest potential savings—far greater than energy or water savings. Generally, utility costs are approximately \$2.50 a square foot [\$27 per sq m], and if we reduce energy use by 20 percent, we've saved 50 cents a foot [\$5.40 per sq m]. A tenant's average rent is around \$25 [\$270 per sq m]. But a tenant can spend as much as \$250 a foot [\$2,700 per sq m] for employee costs. If you get a 10 percent increase in productivity, you have saved their rent.

We are now seeing some demonstrable increases in rents and occupancy rates for green buildings. Once more tenants recognize the potential savings resulting from increased productivity, they will demand new and upgraded green buildings. The building industry is largely a responsive industry, so they will provide the product.

GATLIN: Productivity is the greatest saving by far. Many recent academic studies have relied on small amounts of data, so you get wide variation of results. But if you take the average and look for statistical significance, you see that two attributes most greatly affect the occupant: lighting quality and control of the thermal systems. At USGBC, we have summarized all the studies. The result is about a 3 percent increase in productivity with those two factors.

retrofits

and the Future of Green Office Development

THOUGH INVESTORS and lenders are unlikely to become involved in new sustainable development deals during the current downturn, green retrofitting of existing income-producing buildings is one area they may endorse during this period. In tumultuous economic times, financiers would prefer to fund projects that reposition operating assets, according to conclusions prompted by a survey conducted by the Concord Group this past May and June.

Retrofits do not yield the same profit margin as do construction projects begun from the ground up, but they are a safer play in the current economic climate. Green renovations are generally less risky because they involve fewer material expenses since the structural components are already in place; in-place tenancy, in many cases; and an overall smaller scale.

A green retrofit of an existing commercial asset, for example, can be as simple as installing new heating, ventilating, and air-conditioning components, mounting solar panels on a roof, or placing a bike rack outside the building. Many times, though, a retrofit involves multiple complex renovations on both the building's interior and exterior.

If they are active at all, investors will be principally involved in green retrofit projects in the near term, the survey found. In the long term, the balance of sustainable projects gradually will shift back toward development from the ground up, yet retrofits will continually play a role in green development as owners of conventionally constructed buildings seek to keep pace with their energy-efficient competition.

Investors and developers who become involved in green projects during the downturn—either from the ground up or retrofits—likely will have experience with sustainable construction practices. While understandably eager to join the green development trend, players who are new

to sustainability will be forced to wait well into the recovery before getting involved in green projects because of the risk associated with inexperience and a lack of credentials compared with their more experienced competitors. The minimal green development activity during the downturn will be dominated by those who have significant previous experience with sustainable commercial properties, the survey suggested.

The major exception will be the emerging involvement of the public sector in green development. Municipalities will be one of the few groups involved in sustainable development during the downturn, despite governmental inexperience in this sector. The public sector will increase efforts to pass new sustainable development legislation and retrofit public buildings with energy-efficient features.

New legislation that encourages sustainable development practices will bring about a shift in the decision-making paradigm of a green project team, the survey suggests. When the concept of sustainable development was first introduced to the real estate world over a decade ago, the fundamental driver behind a project going green was the reduction in energy use, with environmental ethics nearly trumping the importance of bottom-line financials.

In the context of current economic conditions, the financial gains that can be achieved through green commercial development are becoming increasingly important, while environmental benefits such as a reduced carbon footprint and improved air quality have become secondary drivers.

As state and local governments increase efforts to pass legislation mandating energy-efficient construction during the downturn, the reasons for which developers and investors “go green” will shift again, this time driven by public

agency incentives and regulations, the survey suggests. Developers will produce green commercial properties, whether swayed by strict commercial development guidelines or by incentives for employing sustainable building practices; tenant/user requirements for healthier buildings will also play a role in prompting action.

Also affected by the downturn are premiums associated with green commercial properties over conventional properties, including construction costs, asset transaction prices, and lease rates. As the sustainable development industry and overall economy change, so too do the premiums. Though green premiums will remain relatively stable through the downturn due to minimal activity in all sectors of real estate, they are likely to shift during the recovery in the following ways:

▷ **A decline in construction cost premiums.** Green construction costs have fallen in the past few years and will continue to fall because of better technology, cheaper materials, and increasing competition among materials providers, construction companies, and certification agencies.

▷ **A decline in operating expense premiums.** Technological advances and a larger competitive marketplace will also lead to decreased operating expenses in sustainable commercial properties.

▷ **A rise in asset price premiums.** The sale price differential between a green building and a comparable conventional structure is also likely to change. Green assets will be in high demand during the recovery as investors position themselves for a green-dominated future, driving up sales prices and their associated premiums over conventional properties.

The increase in the asset price premium will be momentary and, in fact, will be reversed in the long term. As a result of advances in technology and increased

competition, green project costs and operating expenses will fall, creating a domino effect that puts downward pressure on lease rates and, in turn, asset values.

While green asset prices are going to experience a sharp increase at the end of the downturn, they will begin to fall with time as cost savings associated with energy efficiency are transferred from the property owners to the tenants.

Green development no longer simply represents an environmentally friendly label, but instead constitutes a new technology that has the capability to create larger profit margins for real estate professionals while simultaneously reducing the energy use and environmental impact of buildings around the world. Though developers and investors are less likely to adhere to green development practices in the current recessionary economic climate, sustainable development will become an industry standard in the long term, with a continued emphasis on real cost savings and government-mandated environmental benefits associated with green technology.

The Concord Group survey—intended to gauge sentiments concerning the outlook of sustainable development practices in commercial real estate in the context of the current economic recession—involved 101 respondents, 45 percent in development, 25 percent in architecture/planning, 16 percent in investment/lending, 7 percent in consulting/law, and 7 percent in construction.

RICHARD M. GOLLIS is cofounder and principal and **JESSE L. TURCOTTE** is associate consultant with the Concord Group, a national real estate advisory firm with offices in Newport Beach and San Francisco, California; and Boston, Massachusetts.

What are some of the dos of green retrofits?

POGUE: Whole-building retrofits, in theory, are the best thing to do, because they allow you to complete the most extensive, more expensive final steps that you may not be able to tackle in a piecemeal approach. With a whole-building approach, you can use the savings of easy stuff to give the payback for the whole project.

That said, in this economy where there is so little capital, few owners are interested in spending any capital, which they must preserve for other uses. By necessity, at least for now, we have become incrementalists. Carry out the proven lower-cost steps first, then change your workforce's behavior, improve training for building managers, and make the best use of the existing equipment.

QUARTARARO: Look at the program as it relates to the whole building, not just individual elements. Do integrate the tenants since more than 50 percent of the energy reduction can come from them. Don't get too complicated because most of the savings can probably be generated with simple improvements, often without introducing alternative energy or pricey cutting-edge technologies. Finally, the most effective time to pursue a major green retrofit is as part of an ongoing or planned capital improvement program.

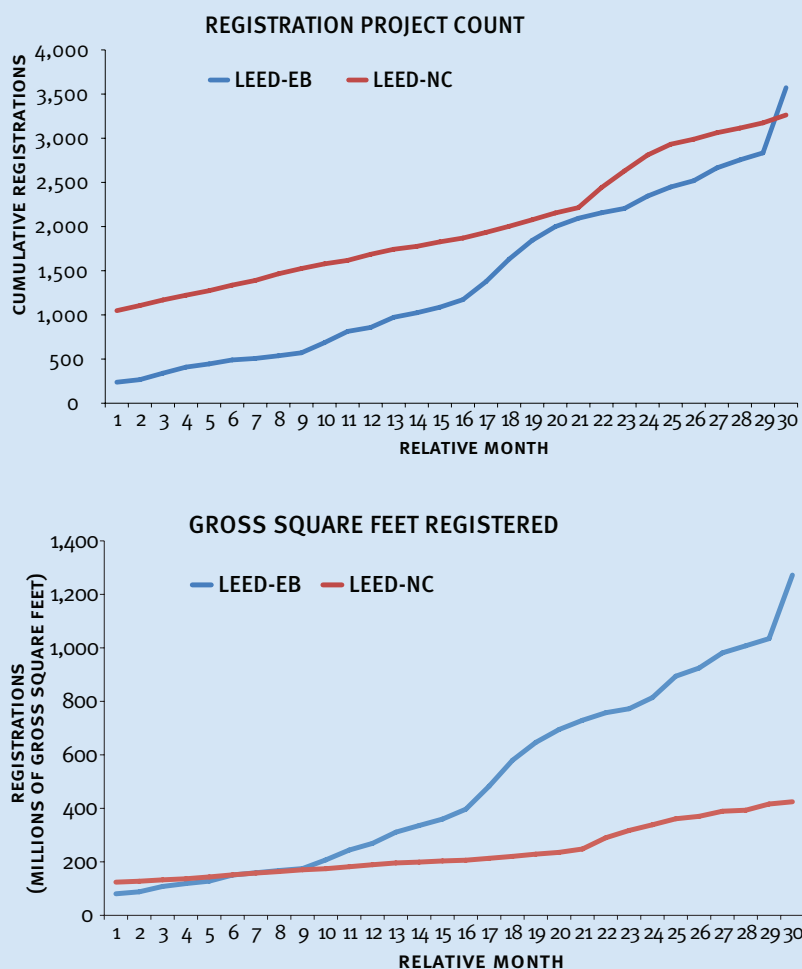
GATLIN: Use LEED or Energy Star or a third-party rating system baseline assessment to get the numbers for the building's performance before you start. You can't manage what you can't measure. You don't know what your most cost-effective opportunities are unless you score it against a third-party standard.

What are some of the don'ts of green retrofits?

MALKIN: Following a silo-based effort. The typical energy-efficiency retrofit looks individually at lighting and comes up with the most efficient lighting program. It looks at the HVAC [heating, venting, and air conditioning] to get the most efficient HVAC system. Ditto pumps and motors, and on down the list.

With an integrated design, you not only evaluate the systems by themselves, but also as part of the overall energy consumption picture so that every action

GROWTH COMPARISON: LEED-EB VERSUS LEED-NC



Note: LEED—Existing Buildings (LEED-EB) is for January 2007 through June 2009; LEED—New Construction (LEED-NC) is for January 2004 through June 2006.

Source: U.S. Green Building Council.

reinforces the others. As part of this work, you look for sources of energy waste, too. Many HVAC systems are heating or cooling the perimeter walls due to lack of insulation. You put in the insulation. That means less heat or cold going into the building depending on the season, and less heat or cool going out.

Using the individual silo approach typically gets a 10 to 15 percent energy reduction—good, but not good enough. With the integrated approach, includ-

ing frequent critiques of proposed decisions, we achieved a 38 percent reduction in energy use at the Empire State Building. [See page 56.] This is very new and different.

GATLIN: Don't assume that everything is expensive or has to be outsourced. Use your staff on some things. Let them start to look at the training and professional development in the LEED requirements like preventative maintenance and system. Have them look at how they can improve the building's performance for low and no cost before you decide to spend the money on consultants or large capital improvements.

What are some of the greatest challenges to carrying out a green retrofit?

CAMPBELL: In our [Johnson Controls] annual survey of more than 1,400 building managers and executives, the greatest barriers cited by respondents were capital availability, 42 percent; insufficient payback or ROI, 21 percent; lack of dedicated attention or ownership, 12 percent; landlord/tenant split incentives, 10 percent; and lack of available technical expertise, 7 percent.

DOIG: First, to carry out a "deep" retrofit—one that achieves energy savings of up to 50 percent or more—you must overcome an inconsistent or unproven business case, including often remedial understanding of the potential for significant capital operating cost savings. In addition, there is yet no assurance that energy-efficiency upgrades increase building valuation, guarantee higher rents, or lower vacancies. Finally, rapid building turnover, short hold periods, short-term investment criteria like high ROIs—coupled with unpredictable future energy costs and the simple fact that utility costs are a small portion of operating costs—stack the deck against owners and investors even investigating the full value that energy efficiency can provide.

Second, projects are challenged by split incentives. That means the owner pays for building efficiency while the tenant reaps the rewards. Furthermore, allocating savings for efficiency done by tenants is often difficult due to a lack of accurate submetering.

Third, lack of experience on the part of design participants—architects, engineers, building manag-

LEED-certified buildings and other demonstrably sustainable buildings will **outperform** their competitors as the **economy** heals and improves.

ers, tenants, and energy service companies—can throw roadblocks in front of a potentially successful green retrofit project. That issue is compounded by the lack of streamlined tools and processes, including audit and analysis, multiparty goal setting, misaligned incentives, and the recurring effort to “cream-skim” the easy stuff and avoid the upfront effort for a whole-system solution that maximizes long-term benefits.

Finally, it is imperative to ensure that buildings are retrofitted at the right point in their upgrade cycle rather than on a timeline driven by government incentives or piecemeal upgrade programs. This is the case because deep retrofits must piggyback on already existing plans and needs for capital and operational upgrades. Otherwise they won't be cost-effective.

Once an owner completes a green retrofit, what are the greatest challenges to maintaining those benefits?

POGUE: Sometimes, it's the tenants. With most well-built, well-engineered buildings, the first day they go into service you have tenants, and the building runs to the whim of the tenant, not the design of the equipment. You must keep that equipment operating at best efficiency, and you must work with the tenants [so they] understand what you are doing and why.

GATLIN: Proper management of the building provides an equivalent amount of the sustainability benefits as are typically gained from the new systems and technologies. Performance degrades when there is a mismatch between systems and the operator's abilities and training.

Often, the buildings with the most advanced technologies have the worst operations performance because the system gets overridden so often or the operators turn off the computer and try to manage it manually. Sometimes the override has a legitimate reason, like some people working odd hours and you

want to provide HVAC. But if nobody sets the system back, building comfort and operations benefits will diminish immediately, and many people will blame the new equipment, not the improper management of that system.

Will green retrofits help pull commercial real estate markets out of their slump?

QUARTARARO: Not on their own. But it's a key factor in ending the slump. There are various sources of public and private funding to encourage green retrofits that will serve as a catalyst. Tenants are demanding it, which will induce landlords to speed up their programs. Many landlords see it as good business and think they will be at a competitive disadvantage if they don't do it.

POGUE: LEED-certified buildings and other demonstrably sustainable buildings will outperform their competitors as the economy heals and improves. They will have a definite advantage in rents, occupancy rates, and values. Ultimately, green buildings—whether new or retrofits—will be the standard. You won't be ahead, but eventually if you are not green, you will lag. **UL**

CHARLES LOCKWOOD is a green real estate authority and consultant based in southern California and New York City.

ULI's new book *Retrofitting Office Buildings to Be Green and Energy-Efficient: Optimizing Building Performance, Tenant Satisfaction, and Financial Return*, is available at the ULI bookstore, www.uli.org/bookstore. Also available are the ULI books *Green Office Buildings: A Practical Guide to Development* and Charles Lockwood's *The Green Quotient: Insights from Leading Experts on Sustainability*, as well as the ULI InfoPackets *Retrofitting Buildings to Be Green* and *Cost and Benefits of Energy-Efficient Building*.

Could LEED for Existing Buildings Transform the building industry?

ALTHOUGH TROUBLE in the credit markets has stilled building construction cranes throughout the country, a transformation in the buildings industry has begun in earnest over the past year in the field of “greening” of existing buildings. It is a trend beginning with some of the highest-profile existing office buildings in the country, including the Empire State Building in New York City and the Willis Tower (formerly the Sears Tower) in Chicago, and it could accelerate the multitrillion-dollar annual buildings industry’s move toward higher efficiency and greater sustainability.

Many even believe the greening of existing buildings will substantially affect the national response to climate change. The outsized potential impact of greening existing buildings is attributable to the fact that the overwhelming majority of buildings that will be in use over the next ten or 20 years in the United States have already been built. In 2008, existing buildings made up 98.2 percent of the built environment, and new construction the other 1.8 percent, according to the McGraw-Hill Construction Building Stock Database. Moreover, buildings are responsible for 72 percent of U.S. electricity consumption and 38 percent of carbon dioxide emissions, according to the U.S. Green Building Council.

Consequently, it is not surprising that management consulting firm McKinsey & Company, in a report titled “Reducing Greenhouse Gas Emissions: How Much at What Cost?” found that existing building-related energy-efficiency efforts provided both the lowest-cost and biggest opportunity to reduce greenhouse gas (GHG) emissions nationally by 2030.

The U.S. Green Building Council, which administers the Leadership in Energy and Environmental Design (LEED) building certification system, launched LEED for Existing Buildings (LEED-EB) in 2004. This

LEED certification standard has not yet proved nearly as popular as LEED for New Construction (LEED-NC), but among the more than 2,000 buildings that have won LEED-NC certification, a substantial portion have been criticized for not necessarily being leaders in energy efficiency. Mireya Navarro reported August 30 in the *New York Times* in an article titled “Some Buildings Not Living Up to Green Label.” Unlike LEED-NC, however, LEED for Existing Buildings: Operations and Maintenance (LEED-EBOM) specifically requires energy efficiency in the operations of a building, and has begun to be embraced by some top leaders in the U.S. existing building market.

LEED-EBOM is concerned with the retrofit, operation, and management of existing buildings. While it is intended distinctly for existing buildings, in its structure and application it parallels LEED programs for new construction, core and shell, and commercial interiors. As with those systems, LEED-EBOM rates buildings as certified, Silver, Gold, and Platinum according to performance in seven areas: energy and environment (35 percent of credits), indoor air quality (15 percent), materials and resources (10 percent), water efficiency (14 percent), sustainable sites (26 percent), regional (four of ten bonus points), and innovation (six of ten bonus points). After reviewing extensive data submitted by the building for up to a year, the USGBC rates it on a scale of 1 to 100. An aggregate score of more than 40 wins a designation of certified; 50 earns Silver; 60, Gold; and 80 or above, Platinum.

Even though, at 350, the number of building certified under LEED-EB or LEED-EBOM is only a tiny percentage of all U.S. buildings, the number of buildings registered to seek LEED-EBOM certification is increasing rapidly—from 96 in 2006, to 725 in 2007, to the current 2,368.

This dramatic increase in annual registrations for certifications includes some of the highest-profile office buildings in the country and is all the more impressive in view of the fact that it is continuing even during the current credit crisis in commercial real estate. In a recent, unpublished Massachusetts Institute of Technology graduate thesis titled “Greening Existing Buildings with LEED-EB,” Tyson Dirksen and Mark McGowan assert that 40 percent of the Class A building stock in the Boston downtown office market is planned for, registered for, or certified as LEED-EBOM.

Corporations that own and occupy their own buildings are among the best positioned to use LEED-EBOM because they do not require the cooperation of third-party tenants. Consequently, some of these U.S. corporations are using LEED-EBOM as a management tool to drive efficiencies, particularly in their headquarters buildings, while enhancing their brand both internally—with employees and prospective employees—and externally. Adobe Systems’ LEED-EB Platinum certification for its three-office-tower headquarters in San Jose, California, for example, is largely attributable to its documentation of the 64 green retrofit projects it conducted over two years to achieve Platinum-level certification—and a 121 percent return on investment (ROI).

Increasingly, owners of multitenant office buildings are also taking the opportunity to advertise their commitment to greener and higher-performing buildings and pursuing LEED-EBOM certification. Some firms with extensive real estate holdings, including real estate investment adviser Kennedy Associates of Seattle, Liberty Property Trust of Philadelphia, and USAA Real Estate Company of San Antonio, have even committed to greening their entire portfolios, which through economies of scale has brought

about considerable decreases in the cost of certification on a square-foot basis. In many cases, firms have found that the costs of certification have been lower than expected.

There also has been growth in the number of local, state, and federal mandates and incentives encouraging the greening of both new and existing buildings, often prompting concern that conventional less-efficient, less-healthy buildings will become functionally obsolete. Underscoring the national nature of the move to mandate or provide incentives for greener buildings, the USGBC as of September lists 195 municipalities that have new incentives and regulations for green construction and renovation.

As with any rating system, however, LEED has its limitations. LEED-EBOM, for example, requires an Energy Star score of 69 as a prerequisite. Consequently, to qualify for certification, a building must rank among the top 31 percent of all buildings in energy efficiency. Though this demanding standard is consistent with the goal of LEED-EBOM serving as a code for leadership, it does make it an unlikely standard for owners who do not believe

their buildings—without significant expense—can be upgraded in systems and management to perform in the top third of buildings in energy performance.

In part as a consequence of this, large building owners and users of corporate real estate have expressed an interest in helping LEED-EBOM evolve into a system that has broader application throughout their portfolios, and that is focused less on achieving certification for particular buildings and more on continuous improvement throughout their portfolios. The USGBC is also working to help make the use of the LEED-EBOM standard easier for managers of large portfolios through a pilot portfolio program and the development of efficient online tools.

The Portland, Oregon-based nonprofit Green Building Institute (GBI) offers a competitive alternative to the LEED program with its Green Globes system, which awards one to four Green Globes based on an owner's report of a building's performance. Growth in LEED-EBOM and Green Globes for existing buildings, especially among the highest-profile office buildings

in the United States, is being augmented by an unprecedented public sector commitment to greening existing buildings led by the Obama administration.

President Obama has been an influential champion of more efficient buildings. In his State of the Union Address on February 24, he stated, "We will put Americans to work making our homes and buildings more efficient so that we can save billions of dollars on our energy bills." Consequently, even with the development market moribund, it would appear that a revolution may be at hand that could transform one of the world's largest industries, moving it toward greater sustainability.

JAMES F. BOYLE is president and CEO and **HARRY M. OSTRANDER**, a LEED-accredited professional, is vice president of research at the Sustainability Roundtable Inc., a shared research and consulting firm based in Cambridge, Massachusetts.

empire state building:

Energy-Efficient Retrofit Model for Optimizing Performance in New and Existing Office Buildings

WORK IS UNDERWAY on the \$550 million Empire State ReBuilding program, which involves development of a groundbreaking transparent, well-documented, replicable energy-efficiency retrofit program that is broadly applicable to all office buildings. The current work, touching on \$120 million of the total program, with \$13.2 million in additional, energy-efficiency retrofit measures, results in 38.4 percent in energy savings, a new form of savings-guaranteed contract, and a three-year payback.

All new tenant spaces and prebuilt spaces will be connected to a central building energy-monitoring system from which tenants can learn how their energy use can be managed and reduced through changes in behavior. Refurbishment of the building's 6,500 windows and installation of new insulation has begun, designed to reduce external climate impact on cooling and heating.

The project ranges from the largest wireless building management systems installation in any office building in the world, with variable frequency drives on all air handlers, to the use in tenant spaces of motion-sensor/automatic-dimming, energy-efficient lighting, which will limit lighting use to occupied spaces that do not have adequate daylighting. An overhaul of the chiller plant will take place this winter.

Overall, the project management team is making progress toward its ultimate goal of estimated annual utility bill savings of \$4.4 million and reduction in energy use and the carbon footprint by 38.4 percent per year at the 102-story, circa-1931 structure.

Among the goals of the Empire State Building's sustainability program are to reduce dramatically the building's energy use and demonstrate the related savings in a transparent and verifiable way, to improve tenant comfort and reduce tenant energy use via improved design and en-

ergy awareness, and to improve the building's marketability.

A major part of the program is a tenant education program in which building representatives are helping tenants in their design and fitout, including in many instances performing buildouts on behalf of tenants that incorporate energy savings measures and Leadership in Energy and Environmental Design (LEED) certification.

After the retrofit announcement last spring, the Federal Deposit Insurance Corporation (FDIC) committed to a major lease, with a buildout performed by the building. In addition, Skanska USA, the U.S. division of Swedish construction firm Skanska AB, confirms that energy and sustainability factors were a major part of its decision to relocate to the Empire State Building. Skanska, which earned a LEED-Commercial Interiors Platinum rating this past summer for its 24,000-square-foot (2,200-sq-m) offices on the 32nd floor, is consuming 1.65 watts per square foot above air-conditioning demand.

Owners of other buildings are now looking to the analytical process undertaken at the Empire State Building as a replicable model for justifying energy retrofits at their own buildings. The idea was born from conversations between Empire State Building owner Anthony E. Malkin and executives at the Clinton Climate Initiative to create a model for developing deep retrofit projects in large multitenant office buildings, both new and existing, that can be applied throughout the world using the Empire State Building as the high-profile test site.

A team of consultants—including Johnson Controls, a global company focused on creating effective interior environments; Jones Lang LaSalle, a global real estate services firm; and the Rocky Mountain Institute, a nonprofit organization involved in providing energy-efficient solutions—assessed, quantified, and documented the

costs and benefits of potential strategies for enhancing energy efficiency at the building. The team examined the cost and environmental/cost benefits of more than 60 potential retrofit projects, settling on eight projects that would provide the optimal balance of financial and environmental return on investment.

These projects include retrofits of the windows; insulation; upgraded heating, ventilation, and air-conditioning equipment; enhanced air quality; tenant education on design and systems; and an integrated approach to tenant energy management that reduces peak consumption to create aggregate benefits over a more traditional, siloed approach. Team members reviewed the building's mechanical systems and equipment, calculated tenant energy use, and developed a baseline energy benchmark report and a preliminary system for measuring energy efficiency.

The integration of a capital team and a sustainability team allowed the latter to pursue a whole-building approach, modifying \$120 million of existing capital projects to increase energy efficiency. Expertise from members of the sustainability team suggested ways to lower the cost of several capital projects while improving energy efficiency and tenant comfort. The renovation plan, for example, had called for replacement of the chiller plant, which needed to be upgraded in order to provide air conditioning to hallways throughout the building. The energy retrofit team determined that through improvements such as retrofitting the existing thermo-pane windows on site—including removing windows, separating the two panes, inserting a mylar sheet, and resealing the windows with krypton-argon gas—replacement of the chiller could be avoided. Instead, the team is making upgrades to the existing chiller, saving millions of dollars that had been budgeted.



Skanska USA, the U.S. division of Swedish construction firm Skanska AB, relocated to the Empire State Building and earned a LEED-Commercial Interiors Platinum rating for its offices on the 32nd floor.

Critical to the project is use of the building as an open laboratory, with all the work available for study and replication, which has attracted the attention of the U.S. Congress, the Obama administration, New York City's Office of Long-Term Planning and Sustainability, cities around the world, and numerous real estate investors, managers, and industry groups.

Among the benefits anticipated from the retrofit are the following:

▷ **Carbon dioxide reduction.** The greatest reduction in carbon dioxide emissions from the baseline is expected to come from completing installation of digital demand controls that had begun in the capital projects. This strategy alone is capable of reducing energy use by 9 percent from the baseline. Tenant daylighting—working with tenants to ensure that layouts maximize the use of natural light—would save 6 percent from the baseline. Three other strategies would save 5 percent each:

installing air-handling units with variable air volume controls, retrofitting the chiller plant, and addressing window glazing. Other strategies contributing to the 38 percent reduction include tenant energy management, addition of insulated panels behind radiators to keep heat in the building in the winter, and tenant demand-controlled ventilation.

▷ **Savings from chiller plant retrofit.** The greatest cost savings come from the ability to retrofit the chiller plant rather than replace it. This would be made possible by the reduction of the cooling load by 1,600 tons. The load reduction resulting from the sustainability program's demand-control ventilation project, which reduces outside air infiltration, and the window light retrofit, which reduces solar heat gain, would allow the chiller plant to be updated rather than replaced entirely.

▷ **Peak electricity use reduction.** Under the proposed plan, peak electricity use would be reduced by 3.5 megawatts, from its current peak and capacity of 9.6 megawatts, to just over six megawatts. At the same time, the team looked at several options for additional capacity, including cogeneration, natural gas-fired generation, fuel cells, renewable energy, and purchasing capacity. With the reduction, the team canceled plans for a two-megawatt, gas-fired cogeneration plant and for obtaining additional electricity supply from the local utility.

▷ **Enhanced tenant environment.** In addition to reducing energy and carbon dioxide emissions, the sustainability program is expected to deliver an enhanced environment for tenants, including improved air quality resulting from tenant demand-controlled ventilation; better lighting conditions that coordinate ambient and task lighting; and improved thermal comfort resulting from better windows, the radiative barrier, and better controls.

The net present value (NPV) of the mid-point option is estimated at \$22 million over 15 years, compared with \$32 million if NPV is maximized, and negative \$17 million if carbon dioxide emissions are reduced as much as possible regardless of NPV. A key variable in the NPV calculation is the rent premium that could be gained from establishing the Empire State Building as a green building. The baseline calculation assumes that sustainable features will allow the building to gain rents 1 percent higher than if no such program were implemented.

Submetering encourages tenants to follow the building guidelines on recommended strategies such as daylighting and use of efficient lighting techniques such as task lighting. Also recommended was exploration of tenant incentive programs such as a "feebate" plan through which tenants that missed sustainability targets would pay fees that might be redistributed to those tenants that surpassed sustainability targets.

The analytical process, the first step toward achieving an optimal energy and sustainability profile at the Empire State Building, was critical to the ultimate success of the program. The strategies selected from this process are expected not only to have a significant impact on the building's carbon footprint, but also to open doors to additional cost-effective avenues of financing the project.

The retrofit of the Empire State Building offers a prototype for the multitude of commercial buildings yet to undergo some form of rational energy and sustainability retrofit in the next several years as part of the country's commitment to reducing the impact of buildings on the environment.

For additional information on the ongoing energy-efficiency retrofit work at the Empire State Building, including contract forms and full project descriptions, visit www.esbsustainability.com.