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A Landmark Sustainability Program for the Empire State Building

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Tony Malkin is chairman, president and CEO of Empire State Realty Trust, the real estate investment trust that owns the Empire State Building, as well as 18 other properties in New York City. Mr. Malkin has been a leader in existing building energy efficiency retrofits through coordinating the team of Clinton Climate Initiative, Johnson Controls, JLL, and Rocky Mountain Institute in a groundbreaking project at the Empire State Building.

Abstract

This paper underscores the extraordinary commitment that Empire State Realty Trust, Inc. has made to establish the Empire State Building as one of the most energy efficient buildings in New York City. Just as extraordinary as ownership's commitment to making the Empire State Building sustainable is the decision to provide a high degree of transparency so that other building owners have a model to follow in pursuing their own sustainable projects.
Just as it did when it opened in 1931, the Empire State Building has raised the bar for the future of office space, this time in a sustainable fashion. This paper looks at how the goals established by the Empire State Building team have been met, how the model has reverberated in private markets, and what the team leaders are doing to ensure these lessons are converted into effective and ground breaking public policy.

Keywords: Energy Efficiency, Sustainability, Sustainability Certification

Empire State Building – One of a Kind

The Empire State Building is no ordinary tower. It is but an international icon of aspiration and achievement. As the "World's Most Famous Building," it draws over four million visitors annually to its Observatories. At a height of 1,454 feet (443 meters), its spire is used for broadcasting by most of the region's major television and radio stations. Its 2.8 million square feet (260,129 square meters) of leasable office space hold a range of large and small tenants, drawn by the building's prestige, its unmatched skyline views and its convenient location in the heart of Manhattan.

Vision Beyond the Empire State Building

"Buildings in New York City make-up 65 to 70 percent of the city's entire carbon footprint," Empire State Realty Trust's Chairman and CEO, Anthony E. Malkin, told Metro Green + Business in June 2008. "Constructing new green buildings won't move the needle in mitigating this problem. It is far more important to address the existing building stock."

About 43 percent of all the office space in New York City was built before 1945, including a majority of the 10 million square feet (929,030 square meters) portfolio owned by Empire State Realty Trust. Empire State Realty Trust has instituted sustainable practices across its portfolio, and the Empire State Building has been designated an Energy Star building. Empire State Realty Trust believes that sustainable buildings have a competitive edge in attracting companies interested in reducing their own carbon footprints as well as providing work environments that promote the health and well-being of employees.

A Multi-Phase Analytical Process to Establish a Replicable Model

The first chapter of this story made headlines throughout the world: the Empire State Building became a great test to determine the business case of the costs and benefits of a major energy efficient retrofit. "If we can make it work here, we can make it work anywhere," said [Mr. Malkin]. As the most famous office building in the world receives international attention, the building's retrofit should result in more adoption of its model. Starting in February 2008, ownership worked closely with consulting, design and construction partners Jones Lang LaSalle (JLL), Johnson Controls (JCI) and Rocky Mountain Institute (RMI) to develop the combination of projects that would produce the optimal balance of greatest benefit (in terms of reducing greenhouse gases and energy costs) per dollar of upfront cost.

The project was announced on April 5, 2009 by President Bill Clinton, Mayor Michael Bloomberg, and Mr. Malkin. The retrofit was designed to reduce the building's thermal and electrical energy consumption of watts and BTUs by a guaranteed 38.4 percent (the guarantee covered 90 percent of the savings, so actual savings are anticipated to exceed 40 percent and $4.4 million annually, with a recoupment of expense in three years.)

Between April and November 2008, the collaborative team followed a comprehensive process to determine which energy and sustainability strategies could be implemented at the building, and what costs and obstacles might arise for each strategy. The purpose was to determine where cost and benefit intersected to result in the most sustainable building possible within reasonable cost parameters.

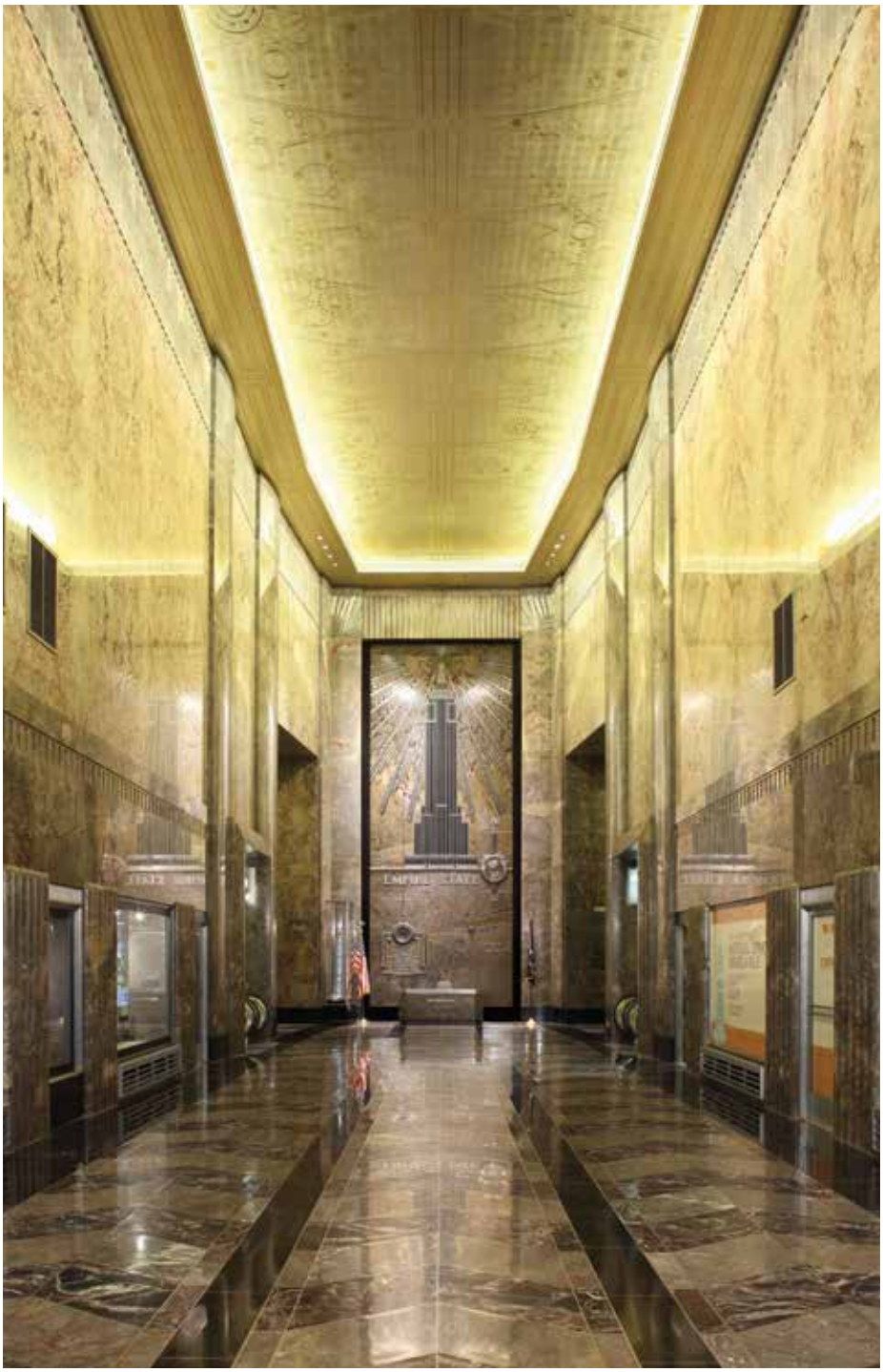

Figure 1. EBS Fifth Avenue Main Lobby (Source: Empire State Realty Trust)

Before the multi-phase program got under way, an initial presentation laid out program goals, the anticipated roles of each team participant and the framework for ensuring an organized, thorough process. Goals included:

- Develop a replicable model for retrofitting pre-war buildings in a cost-effective way;
- Develop practices to lower energy consumption costs by as much as 20 percent;
- Increase overall environmental benefits of building retrofit through an integrated sustainability approach to maximize opportunities and market advantage;
- Encourage the team to be objective, creative and provocative in its approach;
- Develop a model that is marketable to existing and prospective tenants;
- Coordinate with the ongoing capital projects within the building; and
- Develop a financial structure that is efficient and achievable.

Program Manager JLL led team collaboration, stakeholder communication and timely execution, as well as performance measurement and documentation for the repeatable model for industry-wide use. JLL also led development of the Sustainability Metrics Model for Greenhouse Gas Emissions, using internationally accepted, scientifically based data and calculations to evaluate the reduced impact on global warming and local environment resulting from the implementation of sustainability measures. After assessing 67 energy efficiency ideas, eight projects in combination were ultimately selected for implementation. The eight projects included:

Window Refurbishment

Typical single or double pane windows provide very little insulation and protection against solar heat gain - leading to large heating and cooling loads. This project involved upgrading 6,514 windows at the Empire State Building. Each window was removed and "remanufactured" within the building. The remanufacturing involved the insertion of a thin film and gaseous mixture

Figure 2. WPC 1 (Source: Empire State Realty Trust)

Figure 3. WPC (Source: Empire State Realty Trust)

Figure 4. Window Replace 3 (Source: Empire State Realty Trust)

Figure 5. Window Replacement (Source: Empire State Realty Trust)

between the existing two panes of glass, which brings down the overall energy use by reducing heat loss or gains between the outside and inside of the building. 96 percent of the original glass and frames were reused.

Radiator Insulation Retrofit

One steam radiator is located beneath all of the 6,514 windows at the Empire State Building. Previously, nearly half of the heat from the radiator went into the building, while the other half escaped through the wall. This project involved the installation of "radiative barriers" behind each of the radiators to ensure most of the heat goes into the building instead of out into the New York air.

Lighting, daylighting and plug upgrades

This measure involved reducing lighting power density in tenant spaces using ambient, direct/indirect, and task lighting, installing dimmable ballasts and photo sensors for perimeter spaces that can operate with electric lights off or dimmed depending on daylight availability, and providing occupants with a plug load occupancy sensor for their personal workstation.

Air Handler Replacements

This project required the replacement of over 300 existing air handling units with newer and more efficient units. As a result, the new digital variable air volume units are easier to maintain, provide greater occupants comfort and save more money.

Chiller Plant Retrofit

With more efficient, better insulated windows, the cooling needs of the building are greatly reduced. So instead of installing new chillers or replacing the existing chillers, the Empire State Building retrofitted four of its existing electric chillers. The shells of each of the chillers were recycled, while the interior parts were removed and replaced. This retrofit dramatically improved the energy efficiency and controllability of the electric chillers.

Whole-Building Control System Upgrade

Upgrading existing and installing new building controls helped to optimize the HVAC operation as well as provide more detailed sub-metering of electricity use. The building's new control system is the largest wireless building control system in the world and provides continuous real time data to the operators of the Empire State Building.

Ventilation Control Upgrade

New York City building code requires delivery of fresh air to occupied spaces, ensuring adequate air quality. CO2 sensors modulate the amount of outside air in occupied spaces based on number of occupants. Cool exterior air is brought in and cleaned by filters, saving on the building's chiller plant operation, while improving indoor air quality. Everything is controlled by integrated building energy management systems, saving energy and creating a healthier work environment.

Tenant Energy Management Systems

One of the first steps in reducing loads is getting a better understanding of how energy is used. The tenant energy management program engages existing tenants in the building's sustainability efforts to realize energy savings over the next several years.

With sub-metering, tenants are able to access accurate and transparent energy use data online as well as benchmark themselves against other tenants and obtain real-time energy savings and sustainability tips.

The recommended strategy for the retrofit was called the "net present value" (NPV), because it considered strategies based on a balance of NPV with the amount of energy consumption avoided. The NPV midpoint was compared with other options, including one that would maximize NPV, and another that would maximize energy consumption reductions regardless of NPV. Comparing the midpoint option to the two extremes would help identify best-case scenarios.

The results pointed to a clear solution: The team ultimately decided to pursue a program projected to reduce energy use by 38 percent The question now is: has it worked?

On Time, Within Budget, Results Ahead of Forecast

The Empire State Building to date has exceeded its interim energy reduction goals. Surpassing the energy savings guaranteed through its innovative energy-efficiency program for the third consecutive year, the iconic property beat its energy-efficiency guarantee by 15.9 percent, saving $2.8 million. Over the past three years, the program has generated a total of approximately $7.5 million in energy savings at the landmark building.

Empire State Realty Trust's contract with ESCO Johnson Controls, developed by JLL, JCI and CCI to create a BOMA standard agreement that transparently reflects costs and includes rigorous measurement and verification protocol, guarantees this level of thermal and electrical energy reduction, including a total projected savings of 90 percent.

The combination of the eight initiatives has resulted in an overall energy reduction including some additional unexpected benefits. Let us take the chiller plant for example. The greatest cost savings came from the ability to retrofit the chiller plant rather than replace it. This was made possible by the reduction of the cooling load by 1,600 tons. Initial plans to install an additional chiller to expand the capacity of the building's cooling system were rendered unnecessary because insulation and better tuning through controls actually lowered the cooling load by more than 33 percent of the chiller's capacity. Corridors will be permanently cooled with the same number of chillers, which were also retrofitted to optimize efficiency, with supplemental chilled water remaining to serve tenants.

Perhaps the most significant evidence of the Empire State Building energy retrofit in achieving its demand-reduction targets is the improvement in its ENERGY STAR rating. Established under the authority of the Clean Air Act, the ENERGY STAR program aims to promote energy conservation through technological innovations. By providing objective information about products used in their buildings or homes, consumers can make the informed decision to reduce their thermal and electrical energy consumption by purchasing ENERGY STAR appliances. The ENERGY STAR rating is the method used to measure an ENERGY STAR building's energy performance compared to those outside of the program. The team's analysis showed that an ENERGY STAR rating of 90 – among the top 10 percent of buildings in terms of efficiency – would be attainable once the major retrofit work was completed in 2011. In fact, in May 2010 the building achieved a 90 ENERGY STAR rating, well ahead of schedule. This achievement is even more remarkable because at that time it was a 79-year-old building, given that ENERGY STAR's benchmarking criteria does not take a building's age into account.

Figure 6. Chiller (Source: Empire State Realty Trust)

Figure 7. Green prebuilt (Source: Empire State Realty Trust)

Figure 8. Sustainability Exhibit (Source: Empire State Realty Trust)

Tenant Enthusiasm

Aggressive as ownership has been toward energy reduction opportunities under its control, the success of the program also relies on actions taken by the building's tenants. Tenants consume 55-65 of all energy in office buildings, so energy efficient spaces further reduce energy consumption. Ultimately, this work will stimulate economic growth, innovation and job creation, while at the same time providing a measurable payback financially and environmentally.

Participation of tenants in the building's program would deliver 17 percent of the total energy reduction per the original analysis. In order to capture the 17 percent of energy savings involving tenant spaces, the Empire State Building team presented a program that would include both aggressive guidelines and incentives for tenants to achieve energy savings of about six percent. Ownership engaged new and existing tenants in the energy reduction process. To do so, ownership developed data to prove that tenants who design and install energy efficient spaces recover their investment and profit from their savings in energy costs.

New tenants have been enthusiastic about occupying sustainably designed and built space with reduced energy cost. The retrofit also enhances the building's appeal to occupants in terms of thermal comfort, indoor environmental quality and ventilation to suit individual needs. These factors, plus the enhanced reputation of being in a sustainable building, have attracted several large tenants that might not have considered the building previously, including Shutterstock, LinkedIn, Coty Inc., Global Brands Group, Bulova, HNTB, Media General and Federal Deposit Insurance Corporation.

Some tenants have even gone far beyond the performance specifications developed by the team in creating leading-edge sustainable workplaces. Multinational construction company, Skanska, relocated its U.S. headquarters to the Empire State Building in 2009. In adopting and surpassing the building's efficiency standards, Skanska reduced total energy consumption by 57 percent compared to its previous space in another building. Skanska has stated that it anticipates $500,000 in energy savings over the life of the lease, and a payback of its initial 4.7 percent incremental investment within five years.

A Replicable Model

The energy retrofit has gained widespread attention from the business world, government decision-makers and the general public. At a time when there is tremendous interest in commercial building energy retrofits but a lack of capital to fund them, the Empire State Building is the highest profile demonstration of the financial payback that can be achieved. Perhaps the largest audience is the millions of annual visitors to the building's observation deck, who can now also visit a new interactive, multi-media exhibit highlighting the building retrofit and why it is important to the environment.

Over the past three years, the energy retrofit model has been replicated throughout the United States. JCI and JLL jointly implemented the program at all 13 properties in Empire State Realty Trust's New York metropolitan-area commercial portfolio, as well as One Worldwide Plaza in New York. JCI continues to implement this model at public and private sector buildings around the world and actively promotes the approach and results in leading global publications and conferences. JLL has also instituted the model at more than 50 other properties across the nation, including The Moscone Center in San Francisco and Chicago Union Station, doubling the number of projects it has worked on in the past year alone.

Sustainable Retrofits Pay

In summary, there is no quicker route to reducing our nation's overall energy consumption than to retrofit existing buildings – especially large ones – to be sustainable. The Empire State Building is just one drop in an ocean of commercial buildings that must undergo some form of rational energy and sustainability retrofit in the next several years if we as a society are committed to reducing the impact of buildings on the environment. While not necessarily inexpensive, such improvements dramatically reduce energy consumption so that the projects are paid for through those savings. They offer reasonable payback periods and generate large financial savings for years afterward.

In 1931, in the midst of the Great Depression, the Empire State Building became the tallest building in the world. Now it is one of the most energy efficient. The Empire State building continues to inspire us to push the limits of technical progress and improved performance, finding a way to save and make money in a challenging economic environment while improving the spaces in which we work. Through a quantitative and transparent process, and with the support of public policy and financial incentives, the replicable process can be successfully implemented to make a tremendous and measurable impact on the reduction of energy use in the United States and globally while delivering real economic returns.