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Calculating Return on Investment in Sustainable Design
The Sheward Partnership, LLC

The LEED Rating System is the internationally-accepted benchmark for high-performance green buildings. The intent of the program is to promote environmental and human health in all stages of design, construction, and operation of buildings. According to the US Department of Energy, buildings consume approximately 39% of the energy and 75% of the electricity produced annually in the United States. The LEED Rating System is a data-driven process, requiring quantitative analysis to provide measurable impacts and create a foundation for continuous improvement. For example, a comprehensive stormwater management program reduces cubic feet of stormwater run-off leaving the site, and resulting potential to pollute local waterways. High-efficiency heating and cooling systems provide an optimal thermal comfort environment, while using less kBtu of electricity and fossil fuels than a standard system.

An important part of evaluating sustainable design in a new construction project is understanding return on investment. Energy conservation strategies may require greater upfront investment; however, reduced utility savings shall offset added costs. With many new construction projects, it may be difficult to estimate the predicted savings of the high-efficiency system; therefore, computer simulation models and calculations aid in understanding the impact of the upgrades and their anticipated savings. Using computer simulation programs provides designers with the ability to understand design decisions and then make changes for added improvement.

In 2009, The Sheward Partnership renovated their Philadelphia office suite in response to renewing the lease for an additional ten years. The existing tenant fit-out was originally constructed in 2001. Energy optimization was a major goal for the renovation and The Sheward Partnership targeted the existing lighting design to maximize efficiency. According to the LEED for Commercial Interiors Reference Guide, “For commercial interior projects, the reduction of interior lighting power stands to be the greatest energy conservation method available.” Using lighting power density calculations and three-dimensional modeling, the team anticipated over 50% electricity savings in lighting alone. The following strategies were incorporated into the project.

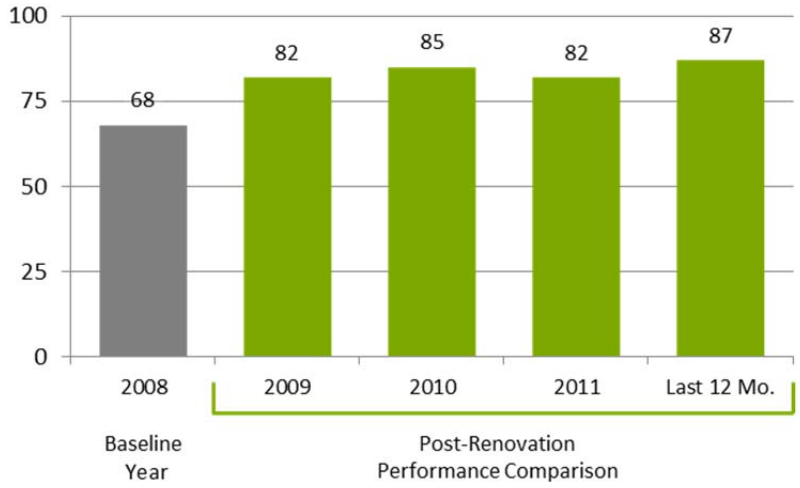
- The Sheward Partnership investigated the installed lighting power density and found that it was well above code allowances. To decrease the installed lighting power to a more efficient level, the team removed lighting fixtures that were not integral to occupant workspaces. Each workstation is outfitted with an individual task light; therefore, much of the ambient and decorative lighting was not necessary. By removing fixtures alone, The Sheward Partnership decreased installed lighting power by over 50%. The team created a three-dimensional lighting model to verify that the proposed lighting design would provide sufficient lighting levels for employees to complete work-related tasks.

- Integration of lighting controls was another strategy to reduce lighting power. To maximize the benefit of existing windows, a daylight harvesting system was installed at all regular occupied areas within 15' of exterior glazing. The system utilizes photocells to measure the amount of daylight entering the space and turns the electrical light fixtures on or off based on incoming light levels. The Sheward Partnership created a three-dimensional model and simulated daylighting entering the space. The model was evaluated across all four seasons and throughout a typical workday. This process confirmed anticipated footcandles of daylighting in various locations, assisting the team with determining optimal photocell locations. Included below is a plan view of the daylight modeling results in the north end of the office.

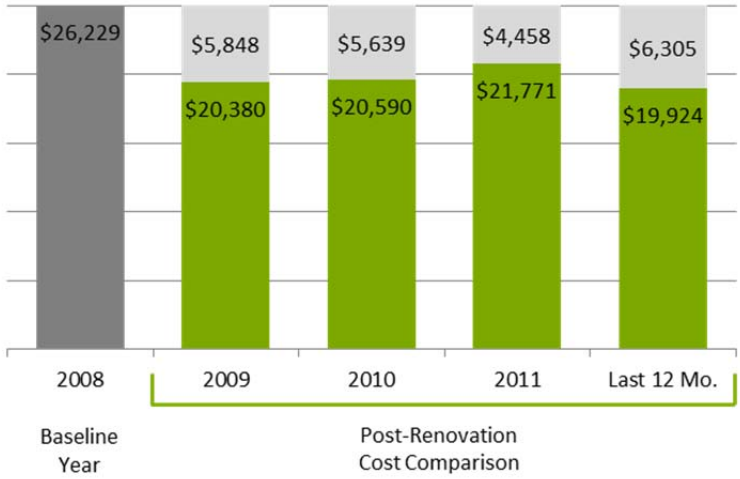
- Lastly, The Sheward Partnership explored alternative lamping options to decrease wattage and maintain proper light levels, especially in fixtures that utilize inefficient, incandescent lamps. All 50W Par 20 incandescent lamps were replaced with 35W lamps. In addition, The Sheward Partnership tested LED technologies to retrofit incandescent fixtures. Instead of utilizing a 50W incandescent MR-16 lamp, the team installed a 3.5W LED fixture. The Sheward Partnership compared the energy savings of utilizing LED fixtures versus MR-16 bulbs in the lobby area over a two year period, factoring in the cost of replacement bulbs/fixtures and energy consumption. The LED fixtures reduce operational costs by over 29% compared to the incandescent lamps.

Over the next four years, The Sheward Partnership tracked electricity and natural gas consumption in the office suite to verify anticipated savings. ENERGY STAR Portfolio Manager utilizes normalization to understand changes in weather trends, occupancy patterns, and energy-consuming equipment. A score of 1 indicates poor energy performance and a score of 100 indicates superior energy performance.

- ENERGY STAR Comparison



- Annual Utility Cost Savings



The total cost of lighting modifications, including parts and labor was $9,588. The Sheward Partnership achieved a full return on investment in less than 2 years. Math plays an important role in designing and evaluating high-performance green buildings.