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Case Study

Deep Energy Savings in Existing Buildings

Overview

Site Details

- Owner: Alliance for Sustainable Colorado
- Location: Denver, CO
- Building Type: Office
- Project Description: Major Renovation
- Size SF: 38,000
- Stories: 6
- Project Completion: 2006
- Year Built: 1908

Recognitions

- LEED-EB Gold and LEED-CI Silver
- Energy Star Leader
- USGBC National Award for Education by an Organization
- Colorado Energy Champion Award
- Mayor's Design Award: It Ain't Easy Being Green

ALLIANCE CENTER

The Alliance for Sustainable Colorado is a nonprofit organization started in 2004 to "advance sustainability through collaboration among nonprofits, business, government and education." To advance this mission, the Alliance purchased a 100-year-old warehouse, previously renovated in the 1970s, in Denver's historic Lower Downtown; a major renovation to the building in 2006 created the Alliance Center. The building provides tenant space for 35 sustainably focused nonprofits, fostering communication and collaboration and serving as a demonstration project of advanced design strategies in a rehabilitated historic building. The Alliance for Sustainable Colorado recently launched a project titled "Modeling a NetZero Future: Energy Efficiency in Existing Buildings" to explore options that will enable it to approach a zero-net energy goal. Several documents developed for the project were referenced in this report.

The Alliance Center performs very well in terms of actual energy use when compared with other buildings. The actual energy use of the building is currently 42 kBtu/sf/yr, which is 55% better than the average for U.S. office buildings.

Motivations

Project goal: Before the Alliance purchased it in 2004, the building was known as the Otero Building and served as the shipping and receiving warehouse for a local bookstore. As was the case with other buildings in this historic neighborhood, this building was purchased by the Alliance with the intention of converting it to a new use. Striving to meet its mission of achieving sustainability

By converting an old warehouse with historic character and value into offices, the scope of the project focused on implementing strategies that would promote building health, energy and water efficiency while preserving historic integrity.

through collaboration, the Alliance converted this former warehouse to a multi-tenant nonprofit center that would provide multiple organizations a "healthy, efficient, quality, mission-enhancing workspace."

"The building creates synergies and fosters partnerships that accelerate progress on issues that affect the Triple Bottom Line, ensuring consideration of impacts on Colorado's people, environment, and economy."
– Alliance for Sustainable Colorado

Rationale and economic criteria: By converting an old warehouse with historic character and value into offices, the scope of the project focused on implementing strategies that would promote building health, energy and water efficiency while preserving historic integrity. The project consisted of reconfiguring the interior spaces, updating the building HVAC, telecom and electric systems and adding new finishes.

When the project was submitted for LEED certification (EB and CI) in 2006, a post-project survey comparing low-cost/no-cost action to significant cost actions relating to specific LEED credits determined that all of the Energy and Atmosphere credits for which the Alliance Center qualified were considered "significant cost actions," thus demonstrating the Alliance's commitment to promoting sustainable design approaches.

Barriers and resolutions to energy efficiency measures: While the Alliance Center is a high-mass brick building, its construction is not very tight and it experiences considerable infiltration and heat loss. Because preserving the historic integrity of the building was a priority, only the more contemporary lobby windows received any kind of design treatment; the focus was shifted to improving the mechanical and electrical systems within the building.

Technologies and Design Strategies

HVAC: The commissioning on the existing HVAC system determined a need to increase the ventilation level and identified an opportunity to install economizers. Pneumatic temperature controls were replaced with direct digital controls (DDC) which allow the building operators to set heating and cooling levels via computer. This system has the capability for both interior temperature monitoring and "load shedding", saving the Alliance money on peak demand rates.

Envelope: A Mylar film was applied on the interior of the east and west lobby curtain wall system. This curtain wall was part of a more contemporary addition executed in the 1970s to provide greater accessibility to the upper floors. Because these windows face east and west, the design team was able to effectively reduce glare and reflect 60% of the heat on sunny days. In the winter, the film reduces heat loss by reflecting internal heat back into the space.

The mechanical engineering firm that upgraded the HVAC system to digital controls also conducted the retro-commissioning process. The firm quickly learned that the mechanical plans provided to its staff were not accurate.

Efficiency Measures

- Direct Digital HVAC Control system
- Occupancy sensors
- Photocells for daylight harvesting (fifth floor only)
- High-Efficiency glazing
- Commissioning
- T8 fixtures with dimmable ballasts
- Commissioning
- Photovoltaics
- Translucent Wall Panels
- Increased insulation
- Sun Shades (sixth floor only)
- Un-refrigerated water fountains

Lighting: Nearly 1,000 40-watt T-12 lamps with magnetic ballasts were replaced with 32-watt T-8 lamps with high-efficiency electronic ballasts. This measure alone reduced the lighting energy consumption by approximately 40% and paid for itself in approximately 2.5 years.

Daylighting: Super-efficient ballasts installed on the fifth-floor east wing include photocell sensors that dim the lights when sufficient daylight is present. Many office suites include translucent wall panels which allow the interior office spaces to receive natural daylight. The sixth-floor windows feature window shade screens which help to control light and glare levels and reduce heating gains and losses.

Controls: The lighting control system includes wall- and ceiling-mounted occupancy sensors in the private offices and meeting rooms. The time schedules for the air handling unit are set by a building automation system (BAS) which interfaces through the DDC system.

Retro-Commissioning: The mechanical engineering firm that upgraded the HVAC system to digital controls also conducted the retro-commissioning process. The firm quickly learned that the mechanical plans provided to its staff were not accurate. Much of the work involved on-site investigation and documentation, which resulted in the replacement of a rooftop unit, the addition of economizers and increased ventilation levels.

Renewables: The 2.04 kW rooftop photovoltaic array was installed in 2009 through a grant from a local solar company.

Monitoring systems: The Alliance Center is installing sub-meters in the building to provide detailed information on energy use. A recently completed retro-commissioning report includes a disaggregation of the utility bills, offering some insight into how energy is consumed. Area lighting uses 27%, followed by space heating at 25% and space cooling at 21 percent. The Alliance Center gets about 1,000 visitors a year given its role as a resource for implementing energy-efficient measures in businesses and homes.

Energy Performance

The Alliance Center is an all-electric building and uses utility bills to track its energy usage. Since the Center opened in 2004, its occupancy has nearly doubled while it has continued to reduce its energy use through targeted conservation measures such as keeping plug loads low through the sharing of resources like printers and copiers. Through energy savings initiatives the Alliance Center has reduced its energy consumption by 22% since 2004. It now uses 55% less energy compared to the average for offices in the U.S.[1] at

1 CBECS – The Energy Information Agency's Commercial Buildings Energy Consumption Survey 2003.

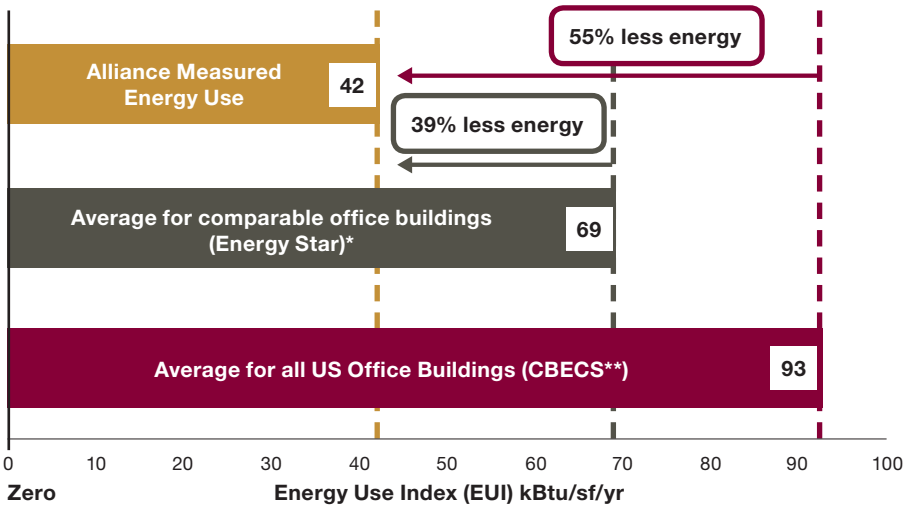
Energy Performance

% Better than Baseline	55%
Baseline	**Average for U.S. Offices***
Measured Energy Use (KBtu/SF/yr)	42
Energy Star Score	85

** CBECS – U.S. DOE Energy Information Agency's Commercial Building Energy Use Index 2003*

42 kBtu/sf/yr (EUI[2]). The U.S. average for all offices is a good basis for quickly comparing buildings of the same type. A more specific comparison can be made through the Energy Star Portfolio Manager program, which determines the energy use of comparable buildings of like type, size, hours of use and climate. In this example, the Energy Star program calculation showed that comparable buildings would use less energy than the average for U.S. office buildings. The Alliance outperforms this reference set as well, using 39% less energy than the Energy Star estimate. The building's Energy Star rating of 85 (out of 100) places it in the top 15% of office buildings nationally.

Energy Use per square foot Comparison



* Comparable office average energy use from the Energy Star Portfolio Manager program based on like type, size, occupancy, hours, and climate - determined from statistical analysis of the CBECS dataset

**Average energy use for all U.S. Office buildings through the Commercial Building Energy Consumption Survey (CBECS)

Financial

Total project cost: $117,000 $3.07/sf (after incentives)

Funding and Incentives: The Alliance Center participated in the local utilities Demand Side Management program for the bulb and lighting ballast upgrades. The daylight harvesting ballasts on the fifth floor were installed independently of this program. The photovoltaic installation was funded through an $11,200 grant from a local solar company.

The Alliance Center received a $25,000 grant in 2006 from the Colorado Governor's Office of Energy Management and Conservation for installing informational and educational signs throughout the building, and for developing a self-guided tour and brochure.

2 An Energy Use Intensity (EUI) is the total energy (gas and electric) used in thousands (k) of British thermal units (Btu) divided by the square feet (sf) of the space – resulting in a commonly used metric of kBtu/sf/yr.

Project costs

Below are specific project costs of 200 Market that were disclosed.

- $25,000,000 (1989) for boiler upgrade, variable-speed drives added to all pumps and fans and asbestos removal, the reconfiguring of the ground floor and upgrading of the life-safety systems.
- $11,000 (2000) for pressurized water tank/pressure sensor replacement of water pumps.
- $1,000,000 (2004) for elevator upgrade including conversion to alternating current drives and new controls.
- $180,000 (2008) for garage lighting upgrade.

In 2010, the Alliance Center was awarded a $15,000 grant from the State Historic Fund in Colorado to provide a historic structure assessment and preservation plan, including detailed guidance on historic renovations, upgrades, and general upkeep. The Alliance determined that the upgraded lighting system alone would reduce that portion of its energy costs by over 40%, and that the retrofit would pay for itself in 2½ years.

Estimated Annual Cost Savings: The Alliance Center estimates the building energy upgrades provide annual cost savings of $8,800.

Project Results

User Satisfaction: A report completed by students at the University of Colorado Denver titled "Measuring Sustainability: Quantifying Greenhouse Gas Emissions and Assessing the Value of Shared Services and Collaboration at the Alliance Center" contained a number of occupant surveys. When asked to describe the direct benefits of being associated with the Alliance Center, responses included:

"Added organization legitimacy and credibility, recognition to organization name, a sense of unification and prestige, added recognition for dedication to the environment, built-in fundraising and networking opportunities, an enhanced organization profile as a sustainability leader."

Innovation: In an interview, Alliance Center director Phillip Saieg cited the DDC installation in the Alliance Center as especially innovative. This system has allowed the building operators to continue to fine-tune the heating and cooling requirements in this historic structure.

Acknowledgements and Sources

Project Team:

- Owner Representative: Phillip Saieg, The Alliance for Sustainable Colorado
- General Contractor: Sprung Construction, Inc
- Architect: ShearsAdkins Architects
- LEED Consultant: Ambient Energy
- Mechanical Engineer: E Cub

Sources:

- The Alliance for Sustainable Colorado: Phillip Saieg
- TMCx Colorado Retro-Commissioning & Energy Analysis Report
- Slaterpaull Architects Historic Structure Assessment and Preservation Plan
- The Alliance for Sustainable Colorado Website
- Design Cost Data Case Study

Photos: Courtesy of Slaterpaull Architects

Research and Development:

- New Buildings Institute (NBI): Mark Lyles, Cathy Higgins, Liz Whitmore

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Existing Building Renewal Initiative

This work is part of NEEA's regional Existing Building Renewal initiative to accelerate the market's adoption of deep, integrated energy-efficient renovations. The initiative currently focuses on office buildings but will add other market sectors with large potential energy savings. This is one of the ways the region can rapidly revamp existing stock to achieve 30–60% energy savings — on the way to netzero-energy use by commercial buildings.

For more information on the Existing Building Renewal Initiative contact: Peter Wilcox pwilcox@neea.org or www.betterbricks.com

For additional case studies highlighting high performance commercial buildings, visit NBI's Getting to 50 Database:
buildings.newbuildings.org/

For more information about NBI's efforts to improve the energy performance of existing buildings, visit:
newbuildings.org/advanced-design/existing-buildings

New Buildings Institute

New Buildings Institute (NBI) is a nonprofit organization working collaboratively with commercial building professionals and the energy industry to improve the energy performance of commercial buildings.