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Case Study

Deep Energy Savings in Existing Buildings

Overview

Site Details

- Owner: JBDG Inc
- Location: Seattle, WA
- Building Type: Office
- Project Description: Equip Upgrade
- Size SF: 8,000
- Stories: 2
- Project Completion: Ongoing
- Year Built: 1984

Recognitions

- Pursuing LEED - O &M Platinum
- EPA Small Business Innovation Award

JOHNSON BRAUND DESIGN GROUP

Johnson Braund Design Group, Inc., is a full-service architecture, landscape architecture and interior design firm located in Seattle, Washington. In 2002, JBDG purchased a two-story office building built in 1984 to house its growing practice. The 8,000 square foot office space consumed over 400 kWh of electricity per day, with a majority of that consumption coming from the building's original HVAC system, which was nearing the end of its life cycle. The owners sought to reduce this energy use by half while maintaining a realistic budget. By choosing to upgrade the HVAC system, lighting and controls, as well as adding rooftop photovoltaics, JBDG was able to dramatically improve the building's energy performance, reduce operating costs and provide a test ground for energy-efficient design strategies to influence its clients. The JBDG Building now uses 69% less energy than the average for U.S. office buildings.*

Motivations

Project goals: JBDG developed the following goals for the building renovation:

1. Reduce electrical grid consumption by 50%
2. Reduce water grid consumption by 50%
3. Receive a reasonable financial payback on all improvements
4. Improve occupant comfort

The energy focus of this project was initiated in 2007 when the original HVAC rooftop units failed. In considering its replacement and upgrade, the firm saw an opportunity to increase efficiency by cutting energy consumption in half while meeting a return on investment (ROI) goal of between five and six years. This basic principle was applied to all subsequent equipment replacements and upgrades.

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Rationale and economic criteria: At the time of the HVAC replacement, a larger list was drawn up and included other energy efficiency upgrades that could be implemented to further reduce the building's energy load. A majority of these items have been acted upon with a focus primarily on HVAC, lighting and plug load measures. Envelopemeasures such as window replacement did not meet JBDG's five- to six-year ROI goal.

Barriers and resolutions to energy efficiency measures: Working with their in-house designers and engineers, JBDG had enough technically-qualified staff to identify, implement and track key measures and successes. The firm did run into some bureaucratic barriers with utility coverage. Due to its location at the "end of the line," JBDG did not qualify for fuel switching which would have enabled them to become an all-electric building and therefore offset more of their load through the use of on-site renewable power generation.

Technologies and Design Strategies

The building was occupied during the various stages of work. Most of the obtrusive work occurred during non-business hours.

HVAC: The project team worked with a major manufacturer to specify a residential multi-fuel, highefficiency heat pump in a side-by-side arrangement. The benefits of this selection included greater control flexibility, increased ventilation rates and a wider selection of high-efficiency heat pumps. This system is responsible for a majority of the building's energy savings. JBDG has also implemented an energy recovery strategy that reduces the cooling load to the server and uses the recovered heat to warm areas within the office.

Envelope: A glazed entrance was added to the front of the building to create a buffered transition space between the interior and exterior.

Lighting: Lighting was upgraded to T5-based fixtures with programmable start/stop ballasts that include occupancy sensors for the restrooms and kitchen area. In the open work area, individual work stations include built-in task lighting and an ambient uplighting element. The lighting control package includes daylighting and occupancy sensors. The connected lighting load is approximately 1.25 W/ft^2 (code at the time) but the daylighting and occupant controls significantly reduce the actual energy use.

Daylighting: Daylighting controls are incorporated in the open portion of the office.

Controls: Metering occurs at three primary panels. JBDG is able to monitor HVAC and server loads using an electricity management monitoring system. The lighting package provides data on lighting energy use.

Renewables: A photovoltaic system on the roof provides an annual output of 7,897 kWh, which offsets energy consumption by 14 percent.

Plug Load Management: Individual computer workstations are transitioning to laptops and LED monitors.

Monitoring systems: JBDG tracks overall office energy in three ways:

1. Electricity management monitoring system
2. Utility bills used to track performance in Portfolio Manager
3. Individual plug-in meters used to track the energy consumption of individual pieces of equipment

Energy Performance

The JBDG office building has seen continuous energy use improvements since the firm began tracking energy use in late 2004. Its energy use intensity (EUI) for their first year of occupancy in 2004 was 71 kBtu/sf/yr (EUI[1]). The most dramatic improvement occurred after the fall of 2007 with the installation of the new HVAC system. Based on its energy utility billing data, the current energy use for the JBDG office building is just 29 kBtu/sf/yr – a 59% reduction compared to its first year of occupancy. The JBDG building uses 69% less energy when compared against the average for offices in the U.S.[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

Energy Performance

% Better than Baseline	69%
Baseline	**Average for U.S. Offices***
Measured Energy Use (KBtu/SF/yr)	29
Energy Star Score	94

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

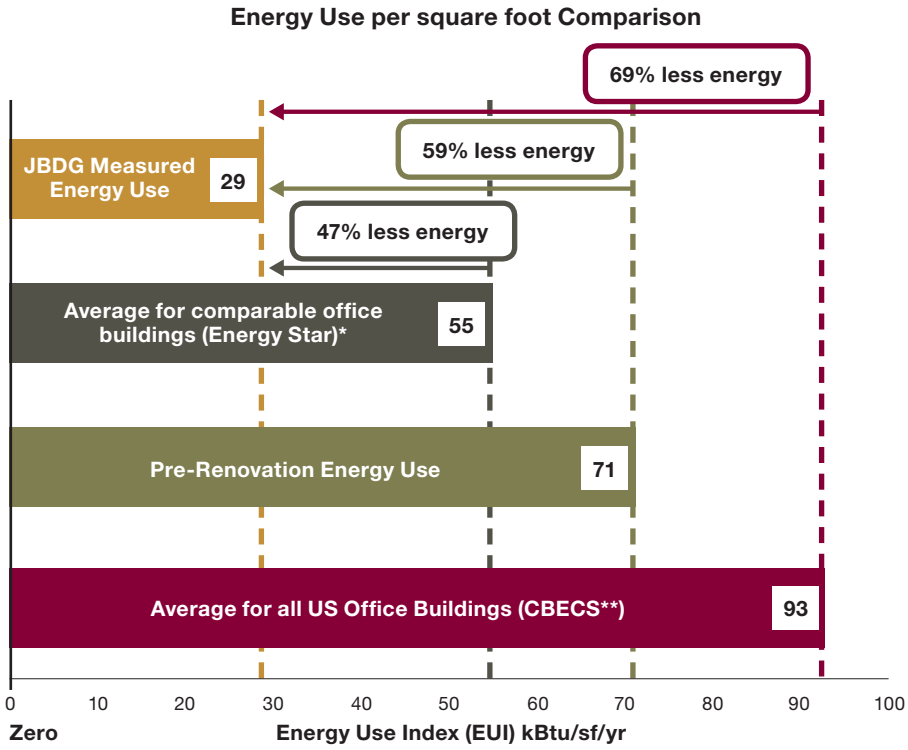
1 An Energy Use Intensity (EUI) is the total energy (gas and electric) used in thousands (k) of British thermal units (Btu) divided by the square feet (sf) of the space – resulting in a commonly-used metric of kBtu/sf/yr.

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

Efficiency Measures

- High-efficiency HVAC heat pump
- Heat recovery
- Replaced entry doors
- Sealed and caulked existing windows
- Lighting upgrade to T5 fixtures
- Daylighting controls
- Occupancy sensors
- Electricity management monitoring system

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 JBDG Building uses 47% less energy than the Energy Star average estimate. The building's Energy Star rating of 94 (out of 100) places it in the top 6% of office buildings nationally.



* 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: $250,000 $31/sf (after incentives)

Funding and Incentives: Funding for the upgrades was provided through conventional bank financing typical to capital improvement projects. Incentives granted for the photovoltaic installation were:

- 30% Federal Tax Credit for photovoltaic installation
- Washington Renewable Energy Production incentive: $5,000/year

Estimated annual cost savings: These improvements reduced annual operating costs by $3,840, or $.48/sf.

The strategy was especially innovative as it captured heat from the computer servers, reduced the need for cooling and recirculated the heat to reduce the heating load.

Project Results

Innovation and Lessons Learned: As a design firm, these projects and improvements have provided JBDG with what Steve Allwine, owner representative for JBDG, calls "real world expertise" and a high level of legitimacy when it comes to encouraging clients to undertake such projects. Allwine pointed specifically to the heat recovery solution installed as part of the HVAC upgrade, which has since been included in two bank projects on which the firm has worked. He believed the strategy was especially innovative as it captured heat from the computer servers, reduced the need for cooling and recirculated the heat to reduce the heating load.

In a case in which the design team was unable to convince a client to include a renewable energy source on its project, JBDG's experience with photovoltaics helped the firm make the case for ensuring the project is solar-ready.

Allwine views Seattle's *energy disclosure ordinance*[3], adopted in January 2010, as an important requirement for building owners to seriously evaluate energy performance and act upon what they learn.

Acknowledgements and Sources

Project Team:

- Owner Representative: Steve Allwine, Johnson Braund Design Group
- Construction Manager: Johnson Braund Design Group
- Architect: Johnson Braund Design Group
- Lighting Designer: Johnson Braund Design Group
- Mechanical and Electrical Engineer: Robison Engineering

Sources:

- Johnson Braund Design Group: Steve Allwine, Facility and Project Manager
- www.jbdg.com
- USDOE Buildings Database
- Energy Star Portfolio Manager
- JBDG Case Study - "Small Office Renovation"

Photos: Courtesy of Johnson Braund Design Group

Research and Development:

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

3 At the end of 2010 the Seattle City Council passed legislation (CB116731) requiring regular energy performance measurement and reporting for non-residential and multi-family buildings.

Funding:

- The BetterBricks program of the Northwest Energy Efficiency Alliance (NEEA): Mark Rehley, John Jennings
- NBI's work is also supported by the Doris Duke Charitable Foundation and the Kresge Foundation

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.