ROCKY MOUNTAIN INSTITUTE® | *RetroFit*

Project Case Study: Byron Rogers

Overview Section

Location: Denver, CO
Building owner: General Services Administration (GSA)
Building type: Historic high-rise office building
Building Size: 18 stories; 494,156 square feet
Retrofit Project Cost: TBD
Annual Cost Savings: TBD
Completion Date: 2013
Annual Energy Use Reduction: 63kBtu/sf/year saved
Annual Energy % Savings: 70% annual energy savings anticipated
Recognition Status (each building): Targeting LEED NC Platinum

Retrofit Design Project Team

Owner: GSA
Design/Build Contractor: Mortenson Construction
MEP Engineer: RMH Group
Lead Architect (Core and Shell): BWG
Interior Designer and LEED Champion: HOK
Green Building Consultant: Rocky Mountain Institute

Overview

Byron Rogers is an outstanding demonstration project since it is on track to become one of the most energy-efficient office buildings in the U.S., more efficient than the National Renewable Energy Laboratory's (NREL) new-build Research Support Facility: http://www.nrel.gov/sustainable_nrel/rsf.html. The Byron Rogers retrofit will result in a 70 percent energy reduction from existing energy use from efficiency alone (from 90kBtu down to 27 kBtu from efficiency, 25.7kBtu with renewable).

The government can get more bang for its American Recovery and Reinvestment Act (ARRA) buck by using an integrated design approach. A 2008 post-occupancy evaluation of 12 sustainable buildings shows that a fully integrated approach is helping the General Services Administration (GSA) meet its mandates by delivering buildings that use substantially less energy, cost less to operate and maintain, and lead to greater occupant satisfaction. The performance of this building, with the help of cutting edge technologies like chilled beams and LED lighting, should be outstanding, reaching toward Net Zero energy consumption.

RMI is working with GSA and its tenant agencies housed within the Byron Rogers building on important sustainability issues to break down institutional barriers that traditionally prevent federal buildings from achieving a truly integrated design. For instance, in the renovation of the Byron Rogers Federal office building, RMI is attempting to implement a green leasing program that will allow the tenants to be charged based on their individual energy consumption, and is also addressing the GSA's concerns regarding chilled beams application in federal buildings. Breaking down multiple barriers on a single project will enable more sustainable solutions to be employed on future GSA retrofits.

Financial

Several measures are in the works to help ensure a sound financial decision-making process and outcome for GSA and the tenant agencies in the Byron Rogers project.

- Applying Life Cycle Cost Analysis (LCCA), which evaluates packages of related measures as opposed to individual measures so that the greatest possible energy and cost savings is captured
- Incorporating energy modeling into the design process to identify options of energy efficiency measures
- Incorporating tenant agency energy reduction measures

At this stage of design, there is not yet concrete financial information regarding anticipated budget or payback of green technologies. This information will be revealed as the design is further developed.

There is a $6 million allocation from ARRA that is specifically designated for innovative green technologies to be incorporated into the building systems. Included in this allocation are window upgrades, chilled beams, and perhaps rooftop solar PV.

Design Specifics

This building has been slated for some time now for a full internal deconstruction and replacement of everything but the structure, and it finally got its chance at funding through ARRA. In conjunction with increasingly stringent federal mandates and executive orders requiring energy efficiency (and a clear path to Net Zero by 2030), GSA holds sustainability and efficiency as a priority. The design/build team was awarded the project after a design competition for the building renovation because of the team's aggressive pursuit of sustainability. In addition to efficiency goals, this building also requires a full asbestos abatement, structural and window upgrades to meet federal blast requirements, and will be undergoing structural system upgrades to accommodate new high-density file system storage in the tenant spaces. As the building is just shy of 50 years old, historic preservation is also mandated to preserve this classic example of mid-century modern architecture. Safety, health, history, and sustainability must find common ground in this renovation. It is also important to note that despite being an existing building, this building must comply with LEED-NC as a whole, meaning in order to achieve GSA's sustainability goals, tenant participation is critical for success.

Federal Mandates and Requirements:

- GSA Mission ("Zero environmental footprint is this generation's moon shot. And so, it must be ours at GSA. It is not only the right thing to do environmentally, it is also the right thing to do from a business perspective, from a social perspective, and from a strategic perspective." – Martha Johnson, Andministrator of General Services)
- EPAct 2005 (Metering, energy efficiency criteria must be consistent with ENERGY STAR and FEMP, 30 percent below ASHRAE for all new government buildings, must comply with renewable energy consumption criteria.)
- EISA 2007 (Reduce energy consumption by 55 percent/sf compared to 2003 baseline, 30 percent of hot water met with solar thermal.)
- EO 13423 (Reduce energy use 3 percent/yr leading to 30 percent by 2015 as compared to 2003 baseline, reduce water use by 2 percent/yr leading to 16 percent by 2015 relative to 2007 baseline.)
- EO 13514 (Reduce potable water consumption, divert solid waste, meet sustainability requirements.)
- GSA guiding principles (Include a minimum 2 percent daylight factor in 75 percent of interior spaces.)

Photo provided by Bennett Wagner & Grody Architects

Envelope

All envelope insulation and window work must be done from the inside of the building so historic façade and window frames are not altered. A full asbestos abatement and the addition of nanogel and mineral wool insulation are planned.

Mechanical

Due to orientation, one side of the building is frequently too hot and the other, too cool. An innovative mechanical design by the RMH Group is allowing the design team to take advantage of what is normally considered a hindrance to good thermal design by installing a unique heat reclaim and thermal storage system that will capture heat from the warm side and use it to heat the cool side of the building in the winter.

Ultra low levels of energy consumption will be achieved using a totally unique system that stores and transports heat around the building, virtually eliminating winter heating energy and dramatically reducing summer cooling energy. The cycle reverses in the summer. A thermal storage tank in the basement of the building allows captured waste heat to be stored for future use. Although boilers, chillers, and cooling towers will be installed, they will only be needed in extreme hot or cold conditions.

A chilled beam system will be provided throughout the building. One of the primary benefits of chilled beams is that they operate with chilled water as opposed to a fan coil system that operates with chilled air. Chilled water pipes take up significantly less space than conditioned air ducts for the same cooling capacity. This allows for greater floor-to-ceiling heights throughout the building. Advanced zoning capabilities accommodate the need for more individualized control. Chilled water fed to the chilled beams does not have to be cooled to as low a temperature as would an equivalent variable air volume (VAV) or fan coil unit (FCU) system. Therefore, the chillers and cooling towers don't need to work as hard.

Water Heating and Consumption

The government requites 30 percent of hot water demand to be met with solar thermal heat sources, but GSA and the design/build team are targeting to meet 100 percent of the hot water from solar thermal. Federal mandates require water savings of 20 percent in the building, but the design/build team is tracking a 40 percent reduction in water use.

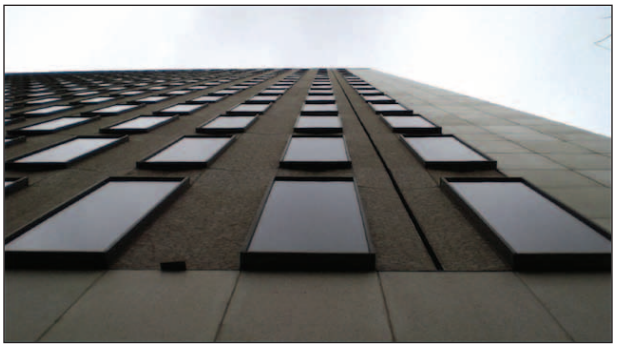

Photo provided by Bennett Wagner & Grody Architects

Windows

The design/build team is experimenting with several different window glazing configurations to maximize the amount of visible light and insulative properties and to minimize solar heat gain. The exterior window must also meet federal blast requirements, and maintain its original gray color to meet historic preservation requirements. The southwest façade of the building is inherently exposed to more direct sunlight than the northeast façade. Therefore the design/build team is evaluating two different glazing solutions – one for the NE and another for the SW façade – in order to maximize the amount of daylight that enters the building while optimizing the solar heat gain.

Daylighting and Views

Given the disadvantageous orientation of the building, daylighting solutions that might be effective elsewhere are not effective in the Byron Rogers building. For example, light shelves do not effectively block direct glare at workstations near the windows and will not be installed. The design/build team is evaluating options for manual or motorized shades.

Given the existing building geometry and orientation, the floor plate will not receive enough daylight to meet the requirements of LEED EQ c8.1 and daylighting requirements outlined in GSA's Guiding Principles. Both documents require a 2 percent daylight factor in 75 percent of interior spaces. Although 75 percent of interior spaces is not achievable, the design/build team will strive to get as close to this number as possible.

It is important to note that many building tenants require private offices to be able to do their job effectively. Acoustical privacy and security are of the utmost concern to the building tenants. As a result, the design/build team is providing translucent or transparent partition walls where possible to maximize the influx of daylighting into interior spaces and to maximize the amount of workstations that have a line-of-sight view to the outside. The design/build team is confident that the project could meet the requirements of LEED EQ c8.2 for views, and will continue working with building tenants to maximize views in their workspaces. The goal is to satisfy the requirements of this LEED credit.

Lighting

GSA received a separate line item funding allocation for the procurement and installation of LED lighting throughout the building. LED fixtures will be used for 100 percent of the lighting, making it one of the largest LED projects in the country.

The design/build team is evaluating low lighting power density (LPD, or watts per square foot) solutions for the building. LED lighting, in conjunction with a task/ambient lighting solution allows for a great reduction in LPD. Task/ambient solutions reduce the amount of lighting from overhead lights, and relies on task lighting at each workstation to bring the light level up to the recommended light level for office space. Each task light has a switch or occupancy sensor for individualized control at each work station.

All enclosed rooms, including private offices, storage rooms, conference rooms, etc. will have bi-level switching with an occupancy sensor control. All perimeter spaces near windows will have additional daylight harvesting controls that will dim the LED lighting when sunlight is available to maintain a predetermined light level while reducing electric lighting energy consumption.

Plug Loads

Many of the building tenants will be bringing existing office equipment (computers, copiers, coffee makers, etc.) with them when they return to the building after the renovation. Therefore, energy reductions for plug load efficiency won't be realized until right-timing replacement of equipment occurs for all tenants. The design/build team will compile a recommended equipment specification guide to provide guidance to tenants as to what equipment they should procure when it is time for a replacement. Appliances, computers, and other miscellaneous equipment should be EnergyStar rated. Laptop computers consume less power than desktop computers, and they support GSA's (and many other agency's) remote workplace philosophy. In addition to efficient equipment replacements, new technologies such as plug load controls and smart power strips will be incorporated into the design. Plug load controls include occupancy sensors for computer monitors, vending machines, desk task lighting, etc. Smart power strips can be set to turn off certain outlets at a preset time.

Photo provided by Bennett Wagner & Grody Architects

Tenant Sustainability

Building Tenants in the Byron Rogers building include:

- US Attorneys (USAO)
- Social Security Administration (SSA) (has four sub-agencies)
- DOJ, Environment and Natural Resources Division (ENRD)
- Executive Office for Immigration Review (EOIR)
- DHS, Immigration and Customs Enforcements (DHS-ICE)
- DHS, Federal Protection Service (DHS-FPS)
- U.S. Commission on Civil Rights (CCR)
- GSA Field Office

RMI is working with GSA and tenants to conduct tenant interviews and education and develop a *Tenant Sustainability Guide*. The guide will include strategies for efficiency with plug loads, behavior, lighting and HVAC controls, submetering, shading on windows, light-colored interior finishes for maximum light reflectance, etc.

Tools

LCCA

A LCCA study is highly beneficial to this project, as it will help GSA and the tenant agencies understand the economic justification for the inclusion of specific measures or packages of measures into a project. To do this analysis, RMI is coordinating with the project's cost estimator (Mortenson) to define incremental capital costs for each measure or package of measures, and with the RMH Group to define annual energy costs from the energy model. The analysis will determine if the incremental capital cost can be justified through a combination of energy savings, rebates, incentives and/or operational savings.

A rigorous LCCA process, involving several different parties and verification check points will include the following steps:

- Gathering inputs for the LCCA;
- Defining the capital cost baseline;
- Researching potential rebates and incentives;
- Evaluating various packages of measures that represent different scenarios, such as the best net present value or lowest carbon footprint;
- Quantifying results in terms of cost and carbon metrics;
- Guiding the design/build team in the use of the LCCA as a decision making tool;
- Providing a comprehensive LCCA report at the conclusion of the project.

The LCCA is under development and will continue to advance as the design progresses. Final LCCA data will not be available until the final cost estimate is completed at the end of the Construction Document phase. Throughout the design process, it will be used to help GSA and the tenant agencies make design decisions.

Energy Modeling

The design/build team is doing rigorous energy modeling on the project using DOE-2 software and the eQUEST user interface to create a whole building energy model. DOE-2.2 is a set of computer programs that analyze a building's energy consumption and predict the hourly energy use and annual energy cost of a building. This analysis is based on hourly weather data and a detailed description of the building's geometry and envelope, internal loads, HVAC equipment, and utility rate structures. The focus of the energy modeling is to evaluate different options and to ensure that the following energy specific project goals are met:

1. Target an Energy Star score of 80 or higher with a 55 percent reduction in fossil fuel.
2. Achieve at least 20 percent reduction in energy usage from the 2003 baseline for the building.
3. Achieve at least 30 percent reduction in energy usage compared to ASHRAE 90.1-2007.

The design/build team will use the energy model to examine a number energy efficiency measures (EEMs). Further, energy modelers will produce up to three packages of measures to show various scenarios for consideration, such as the optimized return on investment, or the lowest possible carbon footprint. The packages of EEM's provide an opportunity to tunnel through the cost barrier and achieve integrated solutions.

Energy Use Operating Data

Energy target:

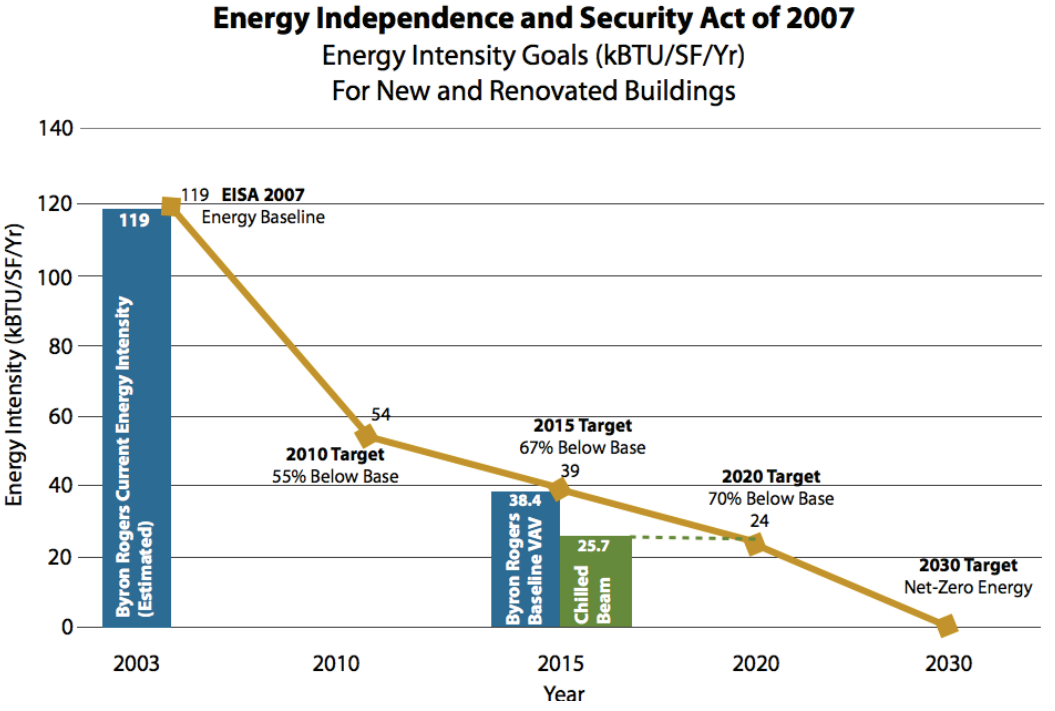

Chart by RMH Group • *Red line shows EUI reductions required by federal mandates over time, all the way to Net Zero in 2030. The existing EUI of the building is shown as 119 kBtu/sf/yr. A baseline code-compliant VAV system will reduce that number to 38.4 kBtu/sf/yr, but with this project's chilled beam system, that number will be further reduced to 25.7 kBtu/sf/yr, bringing this building to 80 percent below baseline when the renovation is complete in 2013. Along the path to Net Zero, this brings the Byron Rogers FOB to 2020 levels.*

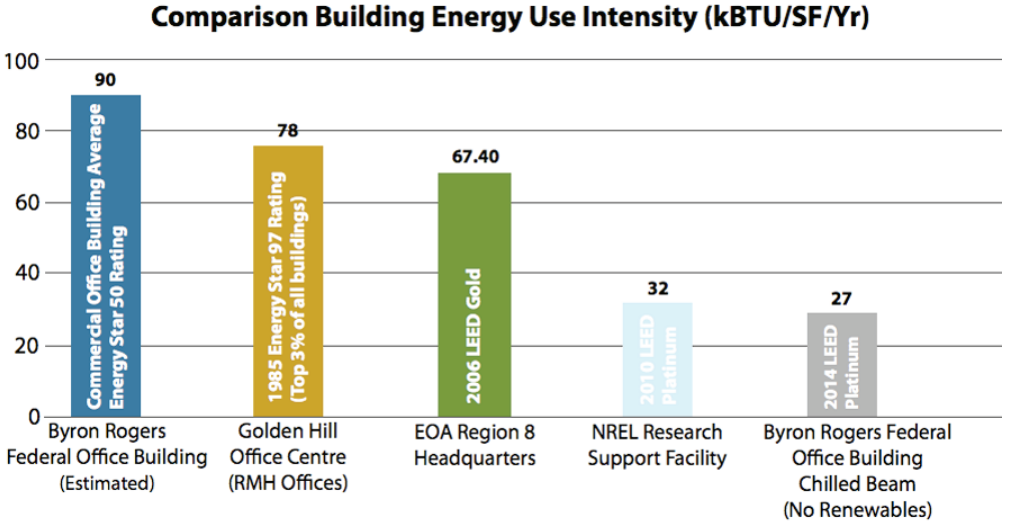

Chart by RMH Group • *Existing Byron Rogers (estimated), Golden Hill Office Centre (Lakewood, CO), EPA Region 8 HQ (Denver, CO; achieved LEED Gold in 2006), NREL Research Support Facility (Golden, CO; achieved LEED Platinum in 2010), Retrofit Byron Rogers (estimated, without renewables, LEED Platinum anticipated in 2013).*