

Research Support Facility—Zero Energy Building Moves Closer to Reality

Imagine an office building so energy efficient that its 800 occupants consume only the amount of energy generated by renewable power on and near the building.

When employees of the U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL) move into the new Research Support Facility in Golden, Colorado, this summer, the idea of a net-zero energy workplace will come closer to reality. The building will use 50 percent less energy than if it were built to current commercial code and will achieve the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Platinum rating.

With 19 percent of the primary energy in the U.S. consumed by commercial buildings, DOE's goal for the Research Support Facility (RSF) project is to help change the way commercial office buildings are designed and built.

Fast Facts

Size: Approximately 222,000 sq ft

Occupants: Approximately 800

Energy Use: 35 kBtu/sq ft/year*

Energy Performance: 50 percent better than ASHRAE 90.1 2004 standard

LEED Rating: Platinum** (including the maximum points for energy)

Cost: \$57.4 million (construction cost); \$64 million including furnishings

*Includes high-performance data center

**Targeted



PIX 16250

Upon completion, the RSF is expected to be the nation's largest net zero energy building.

Design-Build Approach

To meet stringent time and performance goals—while mitigating costs and risks—the RSF project team developed an innovative approach that relied on an integrated design and construction approach, extensive up-front planning, a national design competition, energy modeling, and a firm fixed-price contract. DOE and NREL invited nearly a dozen design-build teams to submit proposals. Three teams were short-listed to develop concept designs and submit proposals. The Haselden Construction and RNL team won the design-build competition and began work in July 2008.

Renewable Energy and Energy Efficiency Features

The RSF building showcases numerous high-performance design features, passive energy strategies, and renewable energy. It is a prototype for the future of large-scale net-zero energy buildings.

- 1. Building orientation:** The relatively narrow floor plate (60' wide) enables daylighting and natural ventilation for all occupants. Building orientation and geometry minimizes east and west glazing. North and south glazing is optimally sized and shaded to provide daylighting while minimizing unwanted heat losses and gains.
- 2. Labyrinth thermal storage:** A labyrinth of massive concrete structures is in the RSF's crawl space. The labyrinth stores thermal energy and provides additional capacity for passive heating of the building.
- 3. Transpired solar collectors:** Outside ventilation air is passively preheated via transpired solar collectors (a technology developed by NREL) on the building's south face before delivery to the labyrinth and occupied space.
- 4. Daylighting:** 100 percent of the workstations are daylighted. Daylight enters the upper portions of the south-facing windows and is reflected to the ceiling and deep into the space with light-reflecting devices.
- 5. Triple glazed, operable windows with individual sunshades:** Aggressive window shading is designed to address different orientations and positions of glazed openings. Occupants can open some windows to bring in fresh air and cool the building naturally.
- 6. Precast concrete insulated panels:** A thermally massive exterior wall assembly using an insulated precast concrete panel system provides significant thermal mass to moderate the building's internal temperature.
- 7. Radiant heating and cooling:** Approximately 42 miles of radiant piping runs through all floors of the building, using water as the cooling and heating medium in the majority of workspaces—instead of forced air.

8. **Underfloor ventilation:** A demand-controlled dedicated outside air system provides fresh air from a raised floor when building windows are closed on the hottest and coolest days. Ventilation is distributed through an underfloor air distribution system. Evaporative cooling and energy recovery systems further reduce outdoor air heating and cooling loads.

9. **Energy efficient data center and workstations:** A fully contained hot and cold aisle datacenter configuration allows for effective air-side economizer cooling with evaporative boost when needed while capturing waste heat for use in the building. Plug loads are minimized with extensive use of laptops and high efficiency office equipment.

10. **On-site solar energy system:** Approximately 1.6 MW of on-site photovoltaics (PV) will be installed and dedicated to the RSF. Rooftop PV power will be added through a Power Purchase Agreement, and PV power from adjacent parking areas will be purchased with 2009 American Recovery and Reinvestment Act funding.

Materials

Materials used in the RSF contain recycled content, rapidly renewable products, or were regional, meaning they were procured within a 500-mile radius of Golden. Examples include:

- Wood from Colorado's pine trees killed by beetles used for the lobby entry;
- Recycled runway materials from Denver's closed Stapleton Airport used for aggregate in foundations and slabs; and
- Reclaimed steel gas piping used as structural columns.

Construction waste materials are being diverted from landfills: As of February



The low profile of modular workstations allows for maximum daylighting.

2010, about 78 percent of construction waste has been diverted.

Workplace of the Future

When finished, the RSF will provide employees with a new type of office space—one that is open and encourages interaction and collaboration. Low profile, modular work stations will allow daylight and views for all occupants. Workstations are located within 30 feet of the nearest window, and employees will be able to open windows when conditions permit, allowing for natural ventilation and improved indoor air quality.

Highly efficient computer laptops, monitors, and all-in-one print/fax/scan devices will contribute to lower energy use.

Cost Comparison

Does a net zero energy building cost more to build? A look at other large office buildings recently completed in Colorado shows that it's comparable. While government buildings typically cost more because of enhanced safety, security, and telecommunications requirements, RSF construction costs are in line with other large office buildings in the state. The building will be extensively monitored to see if performance matches design.

For More Information

More detailed information about the RSF can be found on NREL's Web site: www.nrel.gov/rsf or by calling NREL's Public Affairs: (303) 275-4090.

Colorado Buildings	Sq Ft	Cost/Sq Ft	LEED Rating
Commerce City Civic Center	90,000	\$310	Silver
Research Support Facility	222,000	\$259*	Platinum
Signature Center	186,000	\$247	Platinum
Ft. Carson Brigade & Battalion HQ	140,000	\$225	Gold

*Construction cost.

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