

# Research Support Facility

Leadership in Building Performance



U.S. DEPARTMENT OF  
**ENERGY** | **RSF**  
RESEARCH SUPPORT FACILITY  
at the NATIONAL RENEWABLE ENERGY LABORATORY

# Net Zero Energy Building

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

The building, the Research Support Facility (RSF) occupied by the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) employees, uses 50% less energy than if it were built to current commercial code and achieves the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED®) Platinum rating.

With 19% of the primary energy in the U.S. consumed by commercial buildings, the RSF is changing the way commercial office buildings are designed and built.



# RSF Fast Facts

**Size:** 360,000 sq. ft.

**Occupants:** Approximately 1,325

**Energy Use:** 34.4 kBtu/sq. ft./yr  
(includes high-performance data center)

**Energy Performance:** 50% better than ASHRAE 90.1

**LEED Rating:** Platinum

**Cost:** \$91.4 million (construction cost)\*

**Cost Comparison:** \$254/sq. ft. vs. average cost of \$335/sq. ft. for newly constructed commercial buildings designed to achieve LEED ratings

\* PV costs not included

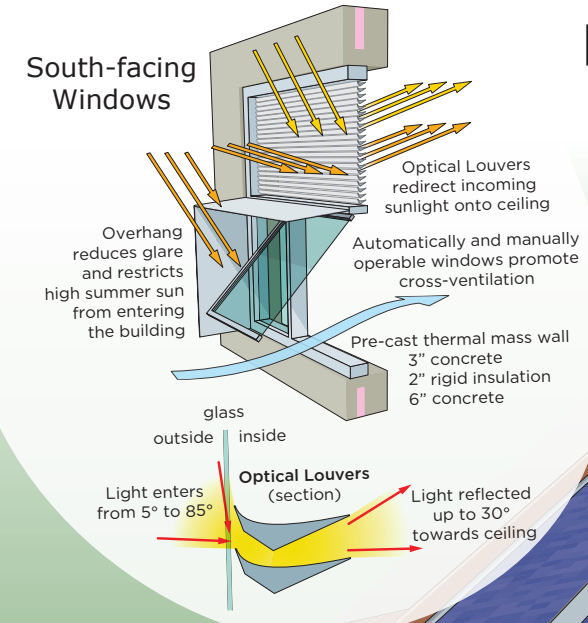


# High-Performance Features

The RSF showcases numerous high-performance design features, many of which are a direct result of NREL research efforts, including passive energy strategies and renewable energy technology.

1. Building orientation and geometry provide daylighting while minimizing unwanted heat losses and gains.
2. A labyrinth thermal storage concrete structure in the crawl space provides passive heating and cooling.
3. Transpired solar collectors passively preheat outside air on the building's south face before delivery to the labyrinth and occupied space.
4. Daylighting from south-facing windows is reflected to the ceiling and deep into the space with light-reflecting devices. All workstations are daylight.
5. Triple glazed, operable windows bring in fresh air to cool the building naturally. Individual window sunshades provide shade when needed.
6. Precast concrete insulated panels provide significant thermal mass to moderate the building's internal temperature.
7. The building is hydronically heated and cooled using thermal slabs in the ceiling instead of forced air. Approximately 70 miles of radiant piping runs through all floors.
8. Underfloor ventilation is distributed via a demand-controlled dedicated outside air system when windows are closed on hot and cool days. Evaporative cooling and energy recovery systems further reduce outdoor air heating and cooling loads.
9. An energy-efficient data center uses a combination of evaporative cooling, outside air ventilation, waste heat capture, and more efficient servers to reduce the data center's energy use by 50% over traditional approaches.
10. RSF on-site solar energy (2.5 MW) is installed on the RSF rooftop, visitor parking lot, and staff parking garage.

# Research Support Facility



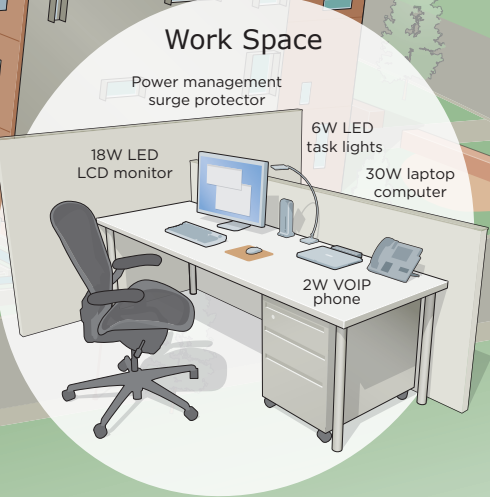
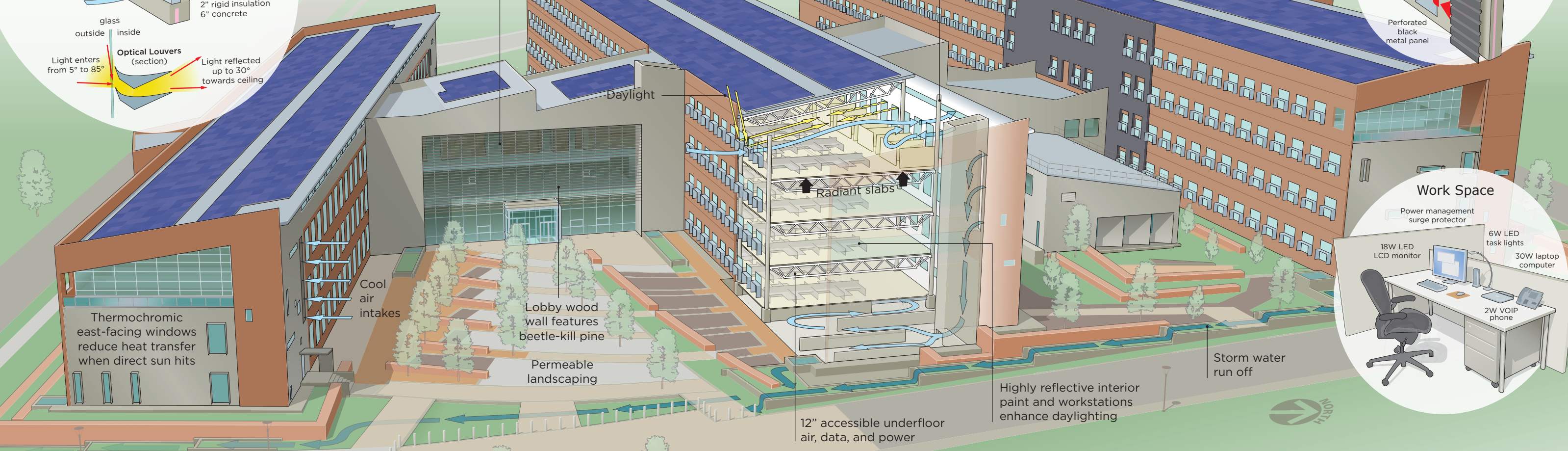
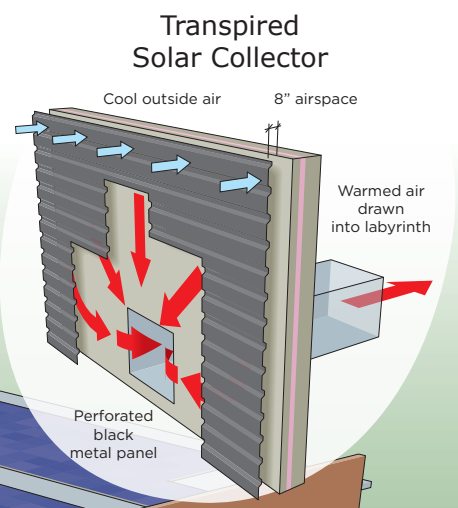
Electrochromic west-facing windows (not shown) tint on command

Louvered sunshade blocks high-angle summer sunlight

2.5 MW of photovoltaics on RSF site, 857 kW on rooftop

Repurposed natural gas pipe used for structural support

Transpired solar collectors on southern facade of building



## LEED Platinum

The RSF received a Leadership in Energy and Environmental Design (LEED®) Platinum designation for the southern and middle wings completed in 2010, and the north wing completed in late 2011 will achieve the same rating. Through a whole-building integrated design approach, the building incorporates sustainable features, including ultra-efficient energy practices. LEED points achieved include:

- Daylighting
- Building materials contain recycled content, rapidly renewable products, or are regionally produced
- On-site renewable energy
- Water efficient landscaping
- All ten "reduced energy use" points
- Alternative transportation.

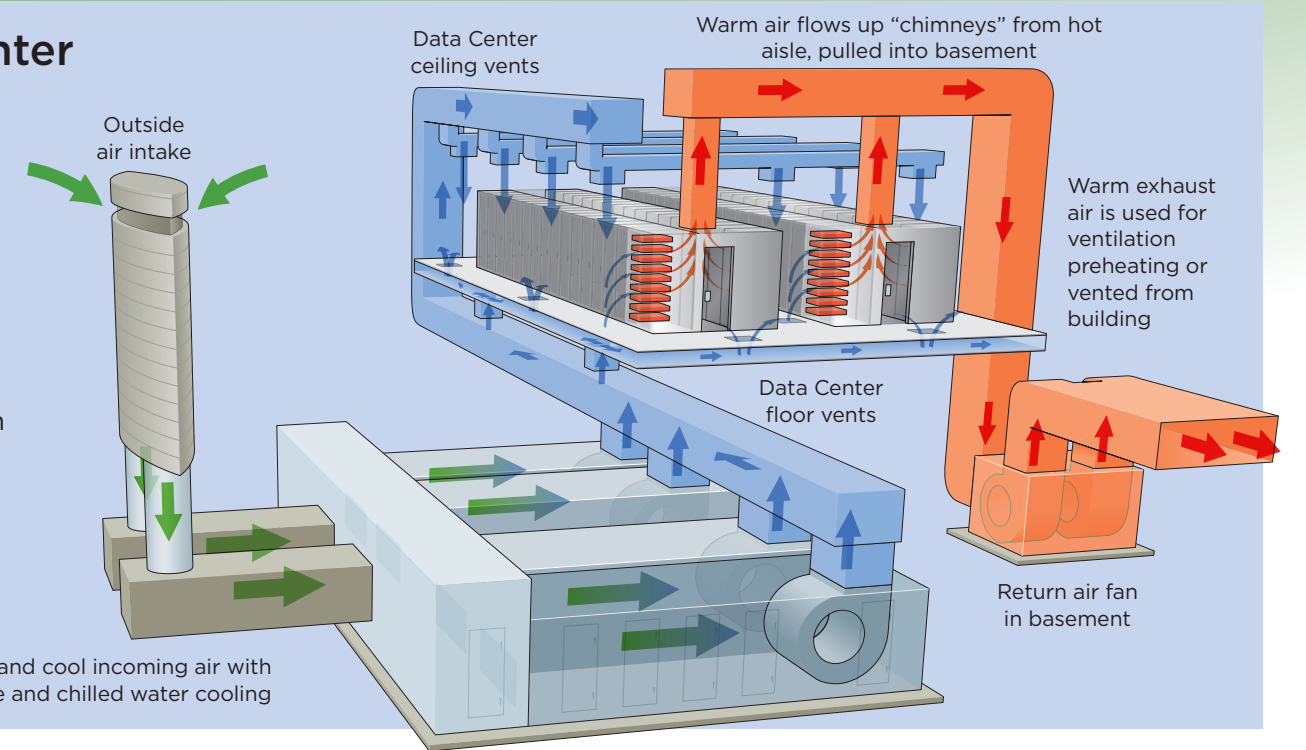
## Workplace of the Future

The RSF provides employees with a new type of office space—one that is open and encourages interaction and collaboration. Low profile, modular work stations allow daylight and views for all occupants. Workstations are located within 30 feet of the nearest window, and employees can open windows when conditions permit, allowing for natural ventilation and improved indoor air quality. Highly efficient laptop computers, monitors, and all-in-one print/fax/scan devices contribute to lower energy use. An entire workstation uses about 70W while in use, compared to 300-500W per workstation at a typical office building.

## Green Data Center

The RSF data center is highly efficient with many unique features, including:

- Hot aisle containment
- Reuse of data center waste heat to preheat building ventilation
- Hybrid cooling system
- State-of-the-art power systems
- Energy efficient equipment with virtualization.



# A Living Laboratory

The RSF is a living laboratory and researchers use real-time building performance data to study building energy use and make adjustments. Design changes in the RSF expansion based on research data include:

- Less window area, while still fully daylighting office spaces
  - Improved thermal breaks in the window frames drive down energy consumption and increase comfort
  - Natural passive cooling in stair wells vs. mechanical ventilation in the original wings
  - Triple pane east/west curtain walls, as compared to double glazing in the original wings
  - Simplified labyrinth design and reduced costs through enhanced thermal modeling
  - Daylighting controls in daylit stairwells, allowing increased energy savings during the day
- These improvements and enhancements result in a 17% increase in energy efficiency in the RSF expansion.

Cover photo by William Gillies NREL/PIX19567, inside photo by Dennis Schroeder NREL/PIX17826.

More information about the RSF can be found on NREL's website: [www.nrel.gov/rsf](http://www.nrel.gov/rsf)



Energy Efficiency &  
Renewable Energy

EERE Information Center  
1-877-EERE-INF (1-877-337-3463)  
[eere.energy.gov/informationcenter](http://eere.energy.gov/informationcenter)

DOE/GO-102011-13311 • September 2011

Prepared by the National Renewable Energy Laboratory (NREL) NREL is a national laboratory of the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy NREL is operated by the Alliance for Sustainable Energy, LLC