NREL
NATIONAL RENEWABLE ENERGY LABORATORY

Technology Assessment

NREL provides technical know-how for highly energy-efficient data centers

The National Renewable Energy Laboratory (NREL) opened the doors to its Research Support Facility (RSF) in June 2010, debuting some of the best technologies available for energy efficiency and environmental performance for buildings.

The highly energy-efficient, 222,000-square-foot office building achieved the Leadership in Energy and Environmental Design (LEED) Platinum rating and is a worldwide showcase for office-building energy efficiency. One of the building's premier features is its energy-efficient data center.

How it Works

The RSF's "green" setup was designed to optimize efficiency by using data center best practices that obtain world-class power utilization effectiveness (PUE) ratings, and to support the RSF's energy goals. Through innovative air handling using "free cooling" and "evaporative cooling" courtesy of Denver's climate, the data center significantly reduces the need to use traditional air conditioning to remove the extensive heat generated by equipment housed in the facility. The data center is configured with hot aisle containment, ensuring that supply air is not mixed with the hot air vented from the equipment. Additionally, hot aisle containment allows waste heat from the RSF data center to be recovered and used to heat other areas of the building. This has resulted in an energy reuse effectiveness (ERE) of 0.91.

NREL's green data center, shown here, was designed with the most energy-efficient best practices, reducing per-user data center energy requirements by 71%, and realizing annual cost savings of $82,000 in utility bills and an annual reduction in carbon dioxide emissions of nearly 3 million pounds.
Photo by Dennis Schroeder, NREL/PIX 18784

What makes the RSF data center unique?

- Innovative low-energy cooling techniques
- State-of-the-art power management systems
- Data center heat recovery
- Energy-efficient IT equipment and virtualization

In addition to features in the design of the data center, NREL replaced 90% of its legacy server environment with blade servers that use variable speed fans and energy-efficient power supplies. Nearly 70% of NREL's server environment is now virtualized, with a more than 20:1 ratio of legacy physical machines to virtual servers. This results in a 96% reduction in the energy footprint of computing equipment through virtualization. Data center design, virtualization, use of efficient uninterruptible power supplies (UPS), and an energy-efficient computing environment resulted in a 55% to 71% per user reduction in data center energy requirements and a world-class

annual power usage effectiveness rating of 1.16 (varies between 1.12 and 1.22 depending on the season).

NREL's data center also was recognized with the 2011 GreenGov Presidential Award for Green Innovation in October 2011. The center was recognized for its "innovative design that minimizes its energy footprint and reduces costs, without compromising service quality." For more information, access www.nrel.gov/docs/fy12osti/52785.pdf.

Technical Assistance and Training

NREL leads the effort to change how energy is used worldwide by helping identify and eliminate barriers to energy efficiency and clean energy technology deployment. The laboratory takes a portfolio approach that explores the full range of technology options for developing and implementing innovative energy performance solutions. The RSF data center is a prime example of NREL's capabilities and expertise in energy efficiency. But, more important, its features can be replicated. NREL provides custom technical assistance and training for improved data center performance to help our customers realize cost savings. Our capabilities include:

- Low-energy design practices for data centers
- Energy reuse practices for data centers
- Best management practices for information technology infrastructure, such as virtualization, consolidation, networking equipment, and servers and storage
- Data center energy auditing (results often include cooling energy use reductions of 90% and simple cost payback of less than 5 years)
- Training

Contact

To learn more about NREL's customized technical assistance and training for data centers, contact Otto VanGeet, 303-384-7369, otto.vangeet@nrel.gov

NREL's Data Center Customers

NREL has successfully provided technical assistance and audits on data centers for numerous customers, including:

- Environmental Protection Agency
- General Services Administration
- National Science Foundation
- National Aeronautics and Space Administration
- U.S. Department of Homeland Security
- U.S. Department of Energy
- U.S. Department of Defense

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NREL's deployment and market transformation (D&MT) activities encompass the laboratory's full range of technologies, which span the energy efficiency and renewable energy spectrum. NREL staff educates partners on how they can advance sustainable energy applications and also provides clients with best practices for reducing barriers to innovation and market transformation.

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