NREL FACTS

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NREL Facilities

NREL's Thermal Test Facility

...developing technologies to reduce energy use in buildings

By incorporating advanced energy efficiency and renewable energy technologies that reduce energy use into building designs, the U.S. building sector is achieving significant energy and cost savings. And with more than 60 percent of the electricity consumed in the U.S. used to heat, cool and operate buildings, the potential savings is enormous. Many of today's most advanced energy-saving technologies are being developed, tested and optimized at NREL's Thermal Test Facility (TTF).

In addition to providing state-of-the-art laboratory space for research activities, the TTF building serves as a large-scale research project. The building is a showcase for integrated energy efficiency features that are expected to reduce energy use by 70 percent. NREL researchers closely monitor the energy saving features—including high-efficiency lighting, space conditioning (heating, ventilating and air conditioning), water heating and daylighting design—to determine how well the features perform as an integrated system.

The Thermal Test Facility

Completed in August of 1996, the 10,000 square-foot TTF consolidates NREL's active solar, passive solar and ventilation test facilities in a central location, a move that will reduce operating costs, increase efficiency and improve productivity. The facility also strengthens NREL's collaboration with industry by offering industry partners easy access to a broad range of research capabilities.

The TTF is an open-space, high-bay area divided into laboratories. The facility's layout gives researchers tremendous flexibility—experiments can easily be set-up, modified or torn down to accommodate the changing needs of industry partners.

TTF Research Activities

Research activities focus on increasing the use of energy efficiency and renewable energy technologies in the building sector by developing new, cost-effective and environmentally friendly building equipment and energy systems. The goal is to develop and evaluate building system designs; develop building commissioning, maintenance and retrofit tools; develop an optimum balance between renewable energy and energy efficiency technologies to meet a building's energy needs; and test advanced building components.

Specific research activities include:

Solar Heating Laboratory—In the Solar Heating Laboratory, NREL researchers measure velocity, temperature and heat transfer to determine how heat is transferred and stored in solar collectors and thermal storage systems.

A low-cost solar ventilation system that preheats air by as much as 30°C (54°F) was developed in this laboratory. The system, called a transpired solar collector, reduces heating costs by preheating air drawn into a building. The system received an *R&D 100 Magazine* Award and *Popular Science* magazine's "Best of What's New" award in 1994, and is commercially manufactured by Conserval, a solar heating and energy conservation company.

A multi-system hot water collector test loop mounted on the roof of the building is used to support the Solar Rating and Certification Commission's efforts to develop performance certification procedures for active solar domestic hot water systems.

Ventilation Test Facility—The Ventilation Test Facility evaluates system level effects of advanced building technologies under realistic and controlled conditions. The test room can be configured to evaluate residential and commercial building ventilation systems and includes a two-component Laser Doppler Anemometer to measure flow velocities during tests.

A thermal imaging system simultaneously measures air temperature at more than 100,000 points in the test room. Because air flow accounts for about 30–40 percent of electricity used in commercial buildings, measuring and understanding air flow is an important step in improving a building's energy performance.

NREL and industry partners are currently using the Ventilation Test Facility to test air cleaning and air distribution strategies that improve indoor air quality and occupant comfort.

Heating, Ventilating, and Air-Conditioning (HVAC) Equipment Test Facility—Part of NREL's Advanced Desiccant Cooling and Dehumidification Program, the HVAC Test Facility measures the realistic performance of desiccant dehumidifiers and other enhanced efficiency air-conditioning components, such as heat exchangers, heat pipes, enthalpy exchangers, liquid desiccant absorbers and regenerators, and evaporative elements.

This facility houses state-of-the-art humidity and pressure instrumentation that provide the highest available accuracy for psychometric measurements and is capable of providing a broad range of temperature and humidity conditions to full-scale commercial devices.

The TTF as a Research Test Bed

The TTF serves as a test bed for integrating passive solar and energy efficiency technologies. Passive solar research focuses on building design strategies that improve energy performance by incorporating features such as daylighting, passive solar heating, shading and natural cooling. The TTF's energy features will help validate passive solar design strategies while reducing the building's energy consumption. NREL researchers will monitor and analyze the features to obtain valuable performance data.

The TTF's energy features include:

Daylighting—Except for the central service area, the building is lit entirely by daylight entering through the clerestory windows. The windows are designed to help heat the building in the winter. In the summer, the building shades the windows from the high-angled sun to keep out excess heat.

High-efficiency lighting—During the limited time artificial lighting is needed, high-efficiency lights are used. The lights are controlled by daylighting and motion control sensors that turn off the lights when enough daylight is present or when no one is in the room.

Heating, ventilating and air-conditioning system—Passive solar heat partially warms the building in the winter, with ceiling fans controlled by the energy management system distributing the heat throughout the building. Heat recovery is used in the ventilation air streams. In addition, heat generated by research projects will help heat the building. Taking advantage of Denver's dry climate, cooling is done by a direct/indirect evaporative cooler.