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NREL Recommends Ways to Cut Building Energy Costs in Half

Building designers and operators could cut energy use by 50% in large office buildings, hospitals, schools, and a variety of stores—including groceries, general merchandise outlets, and retail outlets—by following the recommendations of researchers at the National Renewable Energy Laboratory (NREL).

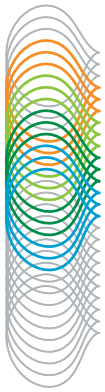
The energy-saving recommendations are contained in technical support documents (TSDs) compiled by NREL with support from the U.S. Department of Energy (DOE), under the direction of DOE's Building Technologies Program. The reports describe the assumptions, methodologies, and analyses used to achieve higher energy performance. Since 2008, NREL has published eight TSDs, all of which describe a pathway to 50% net energy savings over baseline buildings, that is, buildings built to minimally comply with international standards. Three more TSDs are planned for publication in 2011 and 2012.

The technical reports analyze buildings in 16 cities representing all the climate zones in the United States. NREL researchers used EnergyPlus, a whole building energy simulation software, to model the energy performance of both the baseline buildings and the proposed low-energy buildings to verify that 50% net site energy savings can be achieved. Energy-efficiency measures employed to hit the 50% target included: reducing lighting power density; adding occupancy sensors in infrequently used spaces; daylighting; providing control of plug-in devices; combining high-performance walls, roofs, doors, and windows; and installing high-efficiency equipment for heating, ventilating, and air conditioning. Findings typically showed variation by regions.

For example, the TSD for large hospitals found that while 50% energy savings can be achieved across all eight U.S. climate zones (ranging from Miami, Florida, to Fairbanks, Alaska), the smallest savings were in humid climates and extremely cold climates, while the largest energy

NREL's Research Support Facility is an embodiment of many of the energy-saving principles included in NREL's Technical Support Documents. Photo by Dennis Schroeder, NREL/PIX 17820

The Spectrum of Clean Energy Innovation



Through deep technical expertise and an unmatched breadth of capabilities, NREL leads an integrated approach across the spectrum of renewable energy innovation. From scientific discovery to accelerating market deployment, NREL works in partnership with private industry to drive the transformation of our nation's energy systems.

This case study illustrates NREL's analysis and decision-support capabilities, which enhance innovation across the spectrum. This example highlights analysis contributions in Market-Relevant Research through Testing and Validation.

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

savings were achieved in marine climates. In general, for each climate type (humid, marine, and arid), savings decreased as the climate became progressively colder. Some of the TSDs are posted on the DOE Commercial Buildings website at: www.buildings.energy.gov/commercial_initiative/guides.html.

Three of the NREL TSDs provide the basis for the 50% Advanced Energy Design Guide (AEDG) books. These user-friendly guides are the second part of a series aimed at promoting energy efficiency and are scheduled to be published sequentially by spring 2012. Although based on TDSs, AEDGs expand upon the information archived in the technical reports, and offer strategies, constructive tips, and examples on how to deploy the research to make efficiency gains. The three 50% savings guides based on NREL TSDs cover:

- K–12 schools
- Medium–big box retail stores
- Large hospitals.

The combined recommendations will enable building owners, architects, designers, and builders to achieve advanced levels of energy savings without detailed calculations or analyses. The guides are useful nationally because each of the eight U.S. climate zones has its own page of energy savings recommendations. Additionally, the AEDGs provide a prescriptive path to achieving "energy and atmosphere" credits under the Leadership in Energy and Environmental Design (LEED) certification for new construction and major renovation projects. LEED is a leading certification program for green buildings.

The guides are an on-going attempt to promote improvements in energy efficiency and are generated in collaboration with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers; the American Institute of Architects; the Illuminating Engineering Society of North America; and the U.S. Green Building Council.

The guides will be available as a resource to owners, architects, engineers, contractors, and designers who are seeking ways to control energy costs. These documents will be available for free PDF download from http://www.ashrae.org/aedg, where print copies can also be ordered.

Overall, DOE and its collaborative partners have commissioned a wide range of AEDGs focused on specific building types. Initially, a series of six focused on 30% energy reduction, with two—schools and small hospitals—based on NREL TSDs.

In general, the AEDGs provide TSD-based recommendations organized by categories: envelope; electric lighting; daylighting; heating, ventilating, and air-conditioning; and service water heating. They include straightforward recommendations and use case studies to illustrate examples of how the guide's recommendations have been implemented. However, the authors note that the recommendations are simply one path to reach the energy savings target and do not identify all possible savings solutions.

NREL's Research Support Facility features open office spaces with low dividers to maximize the building's use of available daylight.
Photo by Dennis Schroeder, NREL/PIX 18638

NREL's RSF Sets the Tone for Energy Efficiency Buildings

NREL's Research Support Facility (RSF) is the living embodiment of energy efficiency and renewable energy technologies. The RSF, which opened in June 2010, incorporates innovative design features and renewable energy strategies developed at NREL. The 222,000-square-foot, H-shaped office building is occupied by about 800 NREL and DOE employees who are experiencing this experimental showcase first hand.

High-performance design features, passive energy strategies, and renewable energy technologies are in the building's DNA. It is a prototype for the future of large-scale, ultra-efficient buildings. Among its features is a narrow 60-foot-wide floor plate that enables daylighting and natural ventilation for all occupants.

A technology developed by NREL allows outside ventilation air to be passively preheated by a solar collector on the RSF's south-facing wall before going to the labyrinth. This maze of massive concrete structures in the RSF crawl space helps heat the incoming air in the winter and helps cool it in the summer. Air then flows to the occupied space.

Precast concrete insulated panels on the exterior walls moderate the RSF's internal temperature. And for times when adjustments are needed, some 42 miles of radiant piping runs through all floors of the building, using water as the cooling and heating medium.

The third and final wing of the RSF is scheduled for completion in 2011. This 138,000-square-foot expansion uses smaller windows and a solar air pre-heater that is 50% larger than the pre-heater used in the first phase. These changes will help increase the energy efficiency of the expansion by 17%.

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