NREL Research and Support Facility

Project Type:	Office and Administration
Building Owner:	National Renewable Energy Laboratory (NREL); Department of Energy (DOE); United States Federal Government
Certification Goals:	LEED NC Platinum
Construction Cost:	$57.4 million
Square feet:	222,000 SF
Number of Floors:	One three story and one four story wing with connector
Completion:	June 2010

Project Team:

Design/Build Team	RNL / Haselden Construction
MEP Engineer:	Stantec Consulting
Structural:	KL&A, Inc
Civil Engineer:	Martin/Martin Engineers
Energy:	Stantec/Xcel Energy
Solar Consultant:	Namaste
Landscape Architect:	RNL
Sustainability:	RNL

Information and renderings courtesy of RNL

a complete integrated project process yields net zero energy

high performance goals

- Commercially viable, ultra-high efficient building using a net zero design approach.
- Quality work environment.
- High performance strategies that can be shared with the building industry.

project description

The NREL Research and Support Facility (RSF) is a design build, fixed price, turn-key project. Planned from the start by the owner to be one of the most energy efficient buildings of its type in the world, the facility is also a showcase for sustainable design, integrated project delivery, first and life cycle cost analysis, and new high performance technologies.

aggressive owner requirements from the start

NREL's Building Research and Development program gathered and reviewed data from high-performing buildings across the country. This information helped set an energy performance benchmark of 25 kBtu/sf/year that was 50% more aggressive than required by code. This was not just a goal, but a specified contractual requirement for the project team. To identify a team capable of meeting the owner's rigorous requirements a competition was held to select the project team for the facility.

moving forward as a team to zero energy

The energy benchmark became a design driver for the project. In order to meet this requirement, the design team and the owner implemented a completely integrated project design and delivery process. A multi-day eco-charrette quickly developed a building section that addressed the relationship between building, site, program, plan and roof. Light and passive energy from the sun was another key driver in establishing the building plan and orientation. Taking the energy benchmark further, the team was able to identify how to take the developing concept and make it a Zero Energy Building (ZEB). As the plan developed the benchmark was adjusted to 35.1 kBtu/sf/yr due to 100 additional staff anticipated in the building and a required data center. This still outperforms building code requirements by 50%.

integrated strategies toward zero energy

building plan / orientation:

The "H" shaped plan of the building is oriented so the east and west wings are elongated to optimize daylight harvesting and passive heating. The east and west facing façades are much narrower to reduce exposure to intense summer sun.

building envelope:

The walls are an integral part of the heating and cooling system. The wall system is made up of two pre-cast concrete panels with a layer of rigid insulation in between. In the summer, a night air flush out strategy cools the thermal mass of the walls which helps to maintain daytime comfort levels.

transpired solar collector and thermal storage:
Located on the building's south facing wall, the collector pre-heats outside air and transfers it to a concrete labyrinth sub-basement for thermal storage. During the winter, this heat is released to the ventilation system and back into the workspaces. During the summer, the labyrinth takes in cool night air, and releases it during the day. Heat from the data center is also transferred to the labyrinth for later release.

daylighting:
The building section was optimized so that all workstations are within 30 feet from a natural light source. Light louvers are used to reflect daylight deep into the work space along with shading devices tuned to mitigate seasonal heat gain. An open office layout with reduced partition height helped to assure that 100% of the workspaces are daylit.

natural ventilation:
Manual and automated windows are a key part of the ventilation strategy. A temperature monitoring system lets staff know when it is appropriate to open certain windows during the day. Automated windows open during the night for building flush out. Additionally, a demand controlled under floor air distribution systems provides fresh air when the windows are closed.

on-site energy:
To close the remaining gap to a zero energy building, a power purchase agreement and American Recovery and Reinvestment Act funding will enable a 1.6 MW photovoltaic array to be installed on the building roof and adjacent parking areas. The building is also connected to a NREL campus-wide woodchip biomass boiler that heats the building.

IT strategies, plug load, and behavior:
Laptops replaced desktop workstations and only use 1/3rd the energy while reducing internal heat load. All-in-one print/copy/scan stations reduced individual and repetitive plug loads. An energy efficient internet phone system was installed. Cooling for the data center was linked to the passive building systems and is supported with evaporative cooling to reduce the use of traditional chillers. To set expectations, employee meetings and training were held to get feedback and train users on building operations.

high performance features

In addition to the efficiency measures, other high performance features help to make this a showcase project. Gas pipeline for columns, rock extracted from the site for retaining walls, and beetle kill pine for wall finishes are examples of regional, recycled or reused materials on the project. A stormwater management system that provides a slow release back into the soil is used for irrigation. Soil moisture and weather conditions are monitored by the control system for any supplemental irrigation required.

aggressive targets – higher performance

owner required targets

- 25 kBtu/sf/year – initial specified energy use.
- 35.1 kBtu/sf/year – adjusted for increased occupancy and data center.

projected performance

- 10.3 kWh/sf/year – modeled energy use.
- 10.3 kWh/sf/year – on-site renewable energy.
- 0 kWh/sf/year – total energy use.

commercially viable

- $225 to $310/sf – range of construction cost for recent Colorado high performance buildings.
- $259/sf – NREL RSF construction cost.