technology today

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Net-Zero Buildings

A net-zero building creates all the energy that the structure needs to run its own heating, air-conditioning, plumbing, and electrical systems. To be truly net-zero, the building must also generate enough electricity to meet the specific requirements of all of its tenants. The new Department of Energy NREL (National Renewable Energy Laboratory) building in Golden, CO, is currently listed as one of our planet's most energy-efficient buildings. (See Photo 1.) It generates as much energy as it consumes.

Photo 1—The new NREL building uses 50% less energy than a new conventionally designed building.

A net-zero building can be a new construction or, with a great deal of modification, a retrofitted structure. The developers of a new net-zero building see to it that every design and construction decision gives top priority to energy efficiency. In this type of construction, even the aesthetics of the building's architecture are designed to enhance how energy efficient the building will be when construction is completed.

Why are technologists suddenly very interested in building extremely efficient "green" net-zero buildings? When it comes to cleaning up our environment and removing greenhouse gases from our atmosphere, the major polluters that get the most attention are automobiles and industrial facilities that belch out greenhouse gases from their smokestacks. I was very surprised to learn that cars create less greenhouse gas than city buildings. According to Chad Vender Veen, in *Government Technology* magazine, when you add up all the greenhouse gas that is produced by school buildings, residential high rises and family homes, office buildings, museums, and government buildings, their total output of greenhouse gas actually surpasses that produced by automobiles.

The Alliance for Clean Energy, L.L.C., a Washington, DC, advocacy group for clean energy, lists net-zero construction not only as a way to reduce the production of greenhouse gas but also as a way to reduce our dependence on foreign oil. They report that our present inefficient buildings consume 40% of the fossil fuels that we use each year.

Net-zero buildings are connected to the electric grid and feed power into the grid when they generate more electricity than they need. They then draw electricity from the grid when local conditions prevent them from meeting their own needs. The goal for a net-zero building is that the net sum usage over time mathematically equals zero. The architects, engineers, and scientists involved in designing these buildings and their systems hope to see the day when a net-zero building at all times produces more power than it needs.

To design and construct a new modern building that could exist without being connected to the electric grid takes a lot of planning. The efficiency of the new building is affected by the materials used in construction, the architectural design of the building, local weather conditions, and how the building is positioned to take advantage of natural resources such as sunlight and wind.

NREL is the U.S. Department of Energy's national laboratory dedicated to research into efficient energy systems. It was natural that the construction of its newest building, on its Golden, CO, campus, would incorporate as many energy-efficient systems as possible. The construction goal was to build a world class net-zero building that could serve as a laboratory for testing new energy saving systems. Now that construction is completed, the Department hopes to share its technology so that it can be used to build other net-zero buildings throughout the world.

NREL used energy saving strategies at every point of construction. To increase the amount of sunlight that could enter the building, architects designed it to consist of three narrow 60'-wide connected sections. They selected this width because it

Photo 2—To maximize sunlight entering the building, each section of the facility is only 60' wide.

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is the widest a structure can be if it is going to take maximum advantage of natural sunlight. (See Photo 2.)

On the south side of the building, they used special louvers on the top section of each window. These louvers reflect sunlight up to the rooms' ceilings so rooms can be lit with sunlight rather than artificial lighting. Architects also incorporated new overhead reflective technologies to capture, defuse, and reflect the sunlight down into the rooms. Because of these louvers and reflective technologies, on most days the entering sunlight meets lighting needs without anyone flipping a light switch.

NREL placed the building on its designated land so that the west side of the building will get the hot afternoon sun. To keep the afternoon solar heat and glare out of the building, all windows on this side of the building have electro-chromatic glass. All it takes is a small electric charge to automatically darken these windows to keep out heat and glare. The windows can actually be switched from clear to dark to full mirror to handle just about any sun heat and glare situation. You might think of these windows as transition eyeglasses on steroids.

The outer walls on the south side of the building are covered with a dark corrugated metal that is aesthetically pleasing to look at. This wall covering is actually part of NREL's transpired solar air collection system. (See Photo 3.) Fans in this system drive hot air during the day and cool air during the night into a labyrinth collection facility. The collected air is circulated back into the building for heating and cooling as needed. NREL also installed windows that can be opened by hand, an old technology not usually found in new office buildings. Other windows throughout the facility have windows that are opened or closed automatically to assist in the heating and cooling of the building.

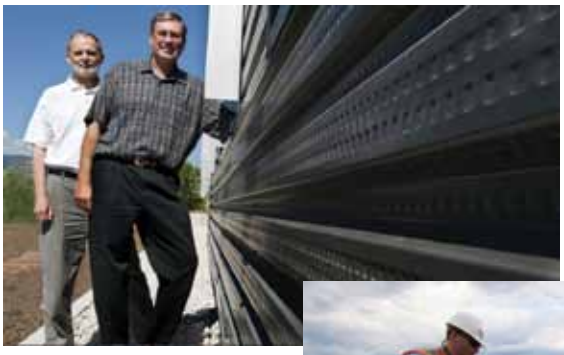

Photo 3—Fans push air through the transpired solar collection system built into the south wall. Hot and cold air is stored in a basement labyrinth system for later use.

Photo 4—Installation of the solar panels that cover the building's roof

To be net-zero, a building also needs to generate electricity. The roof of the NREL building is covered with solar panels that convert sunlight directly into electricity. These panels are all aimed to maximize electric generation. (See Photo 4.)

Recalling the Facts

1. What determines whether a building can be classified as a net-zero building?
2. Describe what the NREL transpired system does. Explain how it performs this function.
3. Why are technologists now very interested in building extremely efficient "green" net-zero buildings? Name two significant reasons.

