



The BigHorn Home Improvement Center

Silverthorne, Colorado



Highlighting high performance

In the mountain town of Silverthorne, Colorado, cold temperatures pose challenges to any building design. At the BigHorn Retail Center, owners and developers took the challenge one step further, making energy efficiency, renewable energy, and minimal environmental impact the focus of the building's design.

Working with the U.S. Department of Energy's National Renewable Energy Laboratory, BigHorn designers used a whole-building approach—looking at the way that the building's site, windows, walls, floors, electrical, and mechanical systems could work together most efficiently. The center includes a hardware store and building materials warehouse space, and features a 9.0-kilowatt capacity photovoltaic system to provide a portion of the building's electricity.

The BigHorn Center is one of the nation's first commercial buildings to integrate daylighting and natural ventilation cooling systems into a retail space. It is expected to reduce energy costs by 62% compared to similar conventionally designed retail buildings.

Low-energy design and renewable energy at the BigHorn Retail Center

Building Envelope

Using **whole-building design**, an energy-efficient building is created with many interrelated features to improve the quality and efficiency of lighting, heating, and cooling. The envelope, or the structure of the building, is itself part of the building's lighting, heating, and cooling system. The building has a **translucent skylight** along the length of the warehouse roof and north- and south-facing clerestory windows along the length of the retail space to provide lighting. The **clerestory windows** also provide some passive solar heating in the winter and natural ventilation for cooling in the summer.

Insulation is an integral part of the building envelope. Because the building is heated using radiant heating in the concrete slab floors, completely insulating the bottom of the floor and foundation walls was important to minimize heat loss to the ground. The roof and walls are also more insulated than conventional commercial buildings.

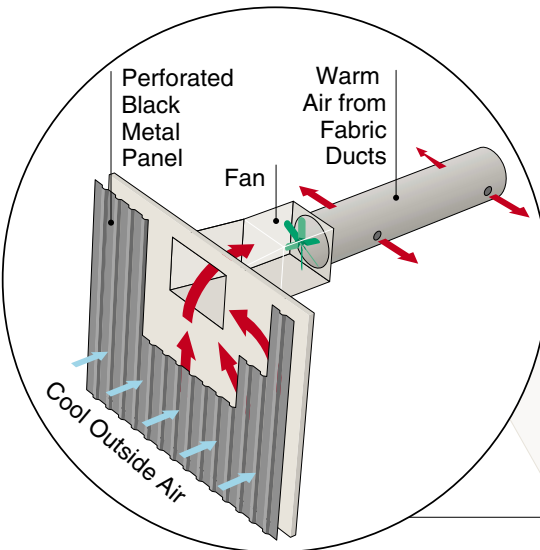
Heating

In the retail space, **radiant floor heating** provides comfort without heating the air in the space. Tubes in the concrete floor circulate hot water that has been heated by natural gas. In addition, south-facing clerestory windows allow some solar heat into the space in the winter when the sun is low in the sky (**passive solar heating**). Computer simulations helped design the windows and overhangs to collect the right amount of light and heat. Special glass reduces heat loss from the building while allowing light and heat to enter.

In the open warehouse, two separate systems provide heating. A **transpired solar collector** heats ventilation air by trapping heat from the sun in a dark, perforated, metal wall on the south side of the warehouse. This heated air is then distributed to the warehouse with fans and through a fabric duct. Overhead **gas-fired radiant heaters** meet remaining heating loads.

Cooling

Because of careful building design, no air-conditioning system is needed at the BigHorn Center. The **clerestory windows**, controlled by computer, open to allow hot air to escape while low window openings allow cool air in. **Window overhangs** shade the windows and prevent the high summer sun from entering and heating the space.

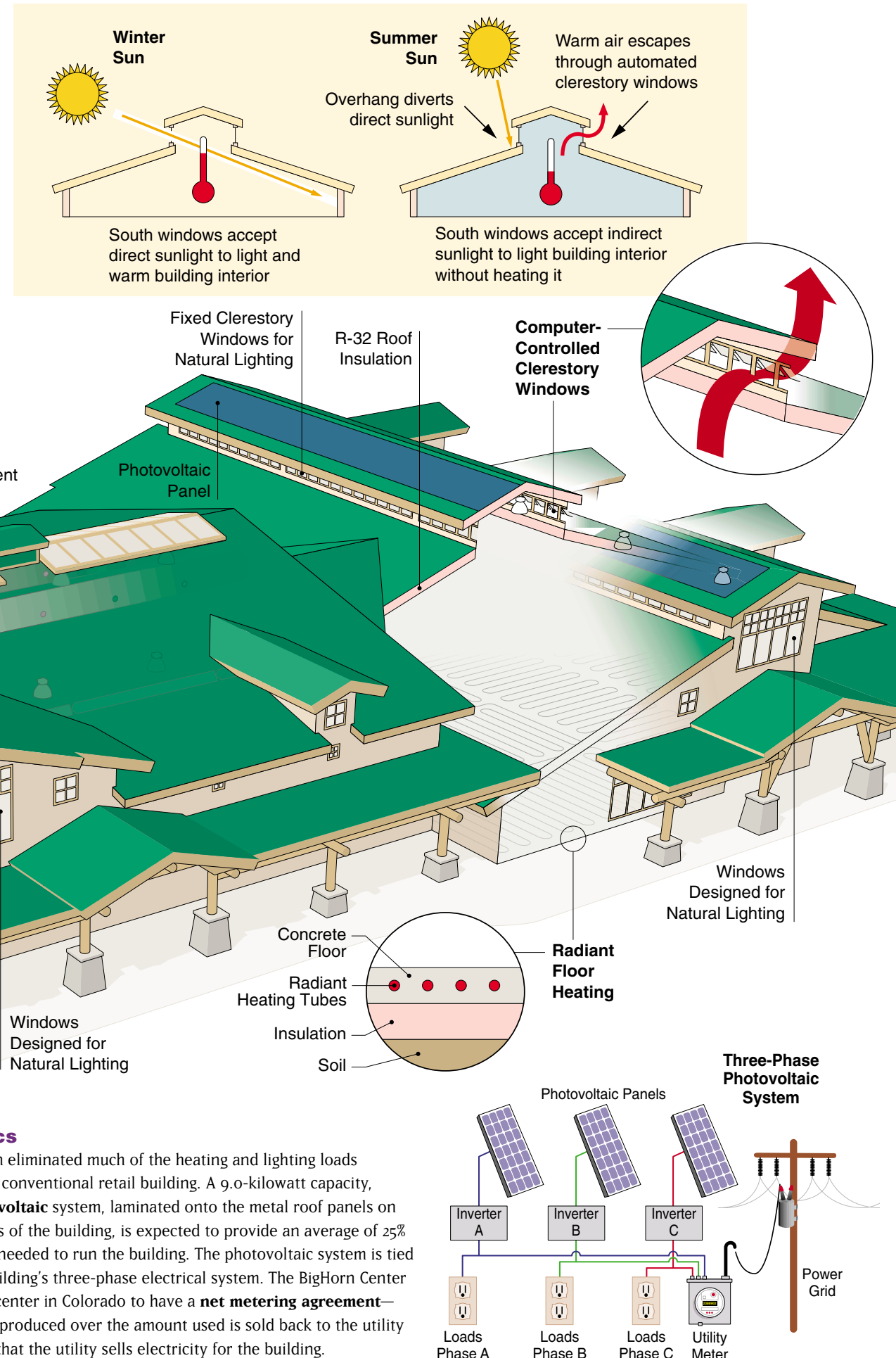


Lighting

Natural light from the translucent skylight and clerestory, dormers, and other windows, called **daylighting**, meets most of the building's lighting needs.

Additional lighting needs in both the retail store and the warehouse are met with **compact fluorescent lamp** fixtures. The fixtures are made of eight 26-watt lamps grouped within a domed glass shade. Motion sensors turn on the lights in the interior offices, employee break room, and restrooms. In the rest of the building, an energy management computer automatically balances the electric lighting with the daylighting for maximum savings.

Using daylighting and the compact fluorescent fixtures to light the building is expected to reduce energy use for lights by 79%, compared to conventional retail buildings.



Photovoltaics

Efficient design eliminated much of the heating and lighting loads experienced by a conventional retail building. A 9.0-kilowatt capacity, integrated **photovoltaic** system, laminated onto the metal roof panels on south-facing roofs of the building, is expected to provide an average of 25% of the electricity needed to run the building. The photovoltaic system is tied directly to the building's three-phase electrical system. The BigHorn Center is the first retail center in Colorado to have a **net metering agreement**—where electricity produced over the amount used is sold back to the utility at the same rate that the utility sells electricity for the building.

Buildings for the 21st Century

Buildings that are more energy efficient, comfortable, and affordable ...that's the goal of DOE's Office of Building Technology, State and Community Programs (BTS). To accelerate the development and wide application of energy efficiency measures, BTS:

- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Works with state and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use
- Provides support and grants to states and communities for deployment of energy-efficient technologies and practices.



OFFICE OF
BUILDING TECHNOLOGY,
STATE AND COMMUNITY PROGRAMS

OFFICE OF ENERGY EFFICIENCY
AND RENEWABLE ENERGY



Whole-Building Approach

Preparation, talent, and teamwork contribute to high performance. Designing high-performance, energy-saving buildings is no different. Designers use a computer to simulate energy use throughout the design process, finding the most energy-efficient design. Whole-building design examines how a building interacts with its systems, activities, and surrounding environment. By optimizing the building's standard components—site, windows, walls, floors, and mechanical/electric systems—building owners can substantially reduce energy use without increasing construction costs.

More Information

The U.S. Department of Energy's High-Performance Commercial Building Program is monitoring the building described in this brochure to evaluate its performance and advance the technologies used. The following table shows some of the energy-efficient features of the building as designed, compared to a similar, conventionally built retail building. R-values and U-values measure how well the insulation or windows transfer heat — the higher the R-value or lower the U-value, the more resistance. Window solar heat gain coefficients measure the amount of heat allowed to pass through the glass. Low coefficients allow less heat to pass through.

Key Energy-Efficiency Features

	Base Case	BigHorn
Wall insulation	R-value = 16	R-value = 16
Roof insulation	R-value = 23	R-value = 38
Floor insulation		
— Perimeter	R-value = 13	R-value = 13
— Slab	R-value = 0	R-value = 10
Window solar heat gain coefficient	0.61	0.77 clerestories 0.45 all others
Window U-values	0.32	0.3 clerestories 0.24 all others

U.S. Department of Energy

Energy Efficiency and Renewable Energy Clearinghouse (EREC)

1-800-DOE-3732

www.eren.doe.gov

Office of Building Technology,
State and Community Programs
www.eren.doe.gov/buildings/highperformance

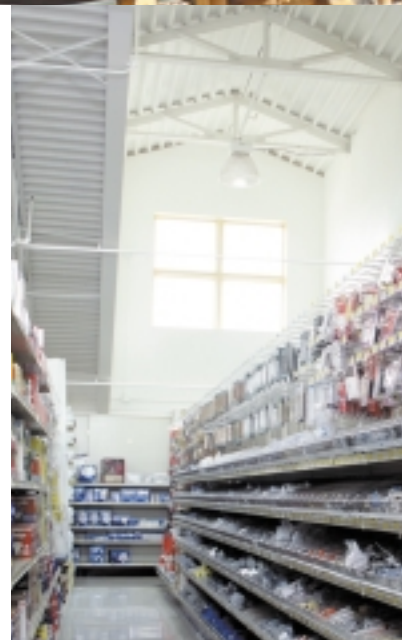
National Renewable Energy Laboratory

Center for Buildings and Thermal Systems

www.nrel.gov/buildings/highperformance

BigHorn Retail Center

Owners and developers Don and Betsy Sather and Charlie Cole. Twelve blocks north of Highway 9 in Silverthorne, Colorado.



Top: BigHorn's clerestory windows and roof-mounted, integrated photovoltaic array. Bottom: Daylighting provides most of the light needed for the retail store.

Front cover—Top: The retail building's east-facing storefront provides morning daylighting. Bottom: The translucent skylight in the foreground provides light to the warehouse.



Produced for the U.S. Department of Energy by the National Renewable Energy Laboratory, a DOE national laboratory

DOE/GO-102000-1143

December 2000

Photo Credits

Jim Yost Photography: Cover—PIX09201; Cover inset—PIX09208; Top back—PIX09199; Center back—PIX09217



Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste