



DAYLIGHTING *initiative*

Design tools and information from PG&E

Industrial Application

Restaurant Application

[Retail Application](#)



School Application

Museum Application

Office Application

From sunrise to sunset — thi



PG&E'S DAYLIGHTING INITIATIVE

PG&E's Daylighting Initiative has two goals: to raise awareness of good daylighting practice within the design community and to improve the practice of daylighting design. This case study is one of a dozen case studies undertaken within the initiative. Together, they document a wide range of successful technical solutions demonstrated across a number of different commercial applications.

The Daylighting Initiative includes projects that will make better design tools available to the daylighting design community. The Desktop Radiance project, a collaborative effort of Lawrence Berkeley National Laboratory and PG&E, is bringing the powerful Radiance lighting simulation capabilities into the practical world of architectural CAD software. The Daylighting Initiative also includes a series of workshops and seminars at the Pacific Energy Center in San Francisco. For more information, visit the project's web site at www.pge.com/pec/daylight.

DAYLIGHTING AT ACE HARDWARE

MARTINEZ, CALIFORNIA

Searching for a new location, the local owner of ACE Hardware in Martinez found a former supermarket that, with some remodeling, would be suitable. He wanted to dramatically improve the lighting quality in the store and save on operating costs so he installed an innovative lighting system built around an active skylight system and a dedicated daylighting controller. He also conducted a standard lighting retrofit, upgrading fluorescent fixtures to T-8s with electronic ballasts.

DAYLIGHTING FEATURES

1 ACTIVE SKYLIGHT SYSTEM

An active skylight system provides more interior light than traditional skylights. It uses a series of unbreakable mirrors mounted atop a 4-ft. x 4-ft. skylight, a sun-tracking system, and a reflective light shaft.

Unlike traditional skylights, a movable mirror assembly and infrared sensor actively tracks the path of the sun—from sunrise to sunset—increasing interior daylight levels. During periods of low-angle sun, the mirrors reflect light into the store's interior—light it would not capture with traditional skylights. In summer, more sunlight enters the skylight in the morning and afternoon than with typical skylights, and in winter the mirror system increases daylight harvested by the skylight throughout the day. Whether direct or reflected, daylight entering the skylight



is diffused by a prismatic lens and emerges from a second diffuser lens into the store below. A single infrared sensor can operate up to 20 reflector units.

2 NORTH-FACING WINDOWS

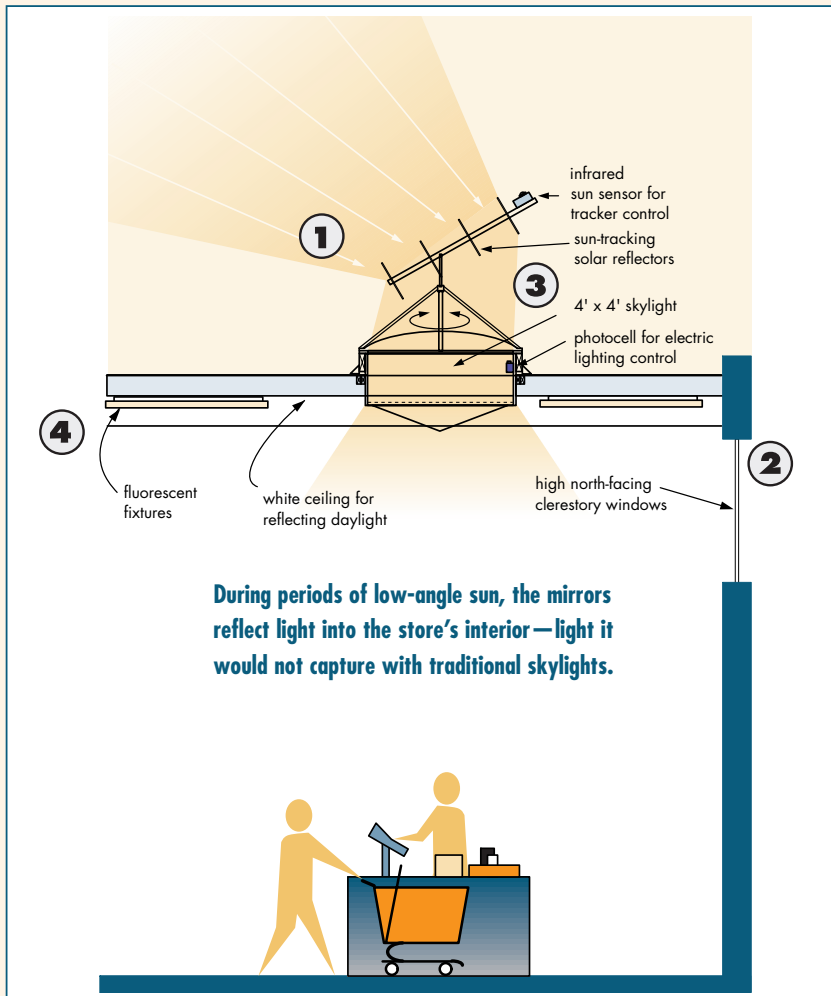
New windows in the north wall of the building, at a height above the floor displays, provide additional daylight at the store's entrance. Because they are favorably oriented, they do not need to be shaded.

3 LIGHTING CONTROLS

A lighting control system designed specifically for daylighting applications maximizes energy savings. Based on the amount of available daylight, electric lights are turned on or off by a photosensor located in the skylight well. Also, the store uses a step-dimming control strategy. The controller is programmed to turn off half of the lights when the interior illuminance rises above 100 foot-candles (fc). Aside from safety lights on all the time, the remaining lights turn off as the illuminance levels rise above the second set point. The goal is to maintain a minimum of 100 fc at all times. This strategy allows the use of standard electronic ballasts to save on the typically costlier continuous dimming ballast.

Additional features programmed via the daylighting control panel include: a) an override sensor (adjustable from 1 to 120 minutes); b) a cloud filter, (which prevents the cycling of lights during periods of shifting clouds); c) sensor calibration; d) an HID timer; and e) a skylight-to-room scaling factor.

is ACE[®] is a well-lit place



"The overall experience has been excellent. Ninety-five percent of our customers don't know the lights are off—most think the skylight diffusers are actually electric lights."

Wilma Hawkins
ACE Hardware Store Manager
Martinez, California

4 ENERGY-EFFICIENT FLUORESCENT LIGHTING

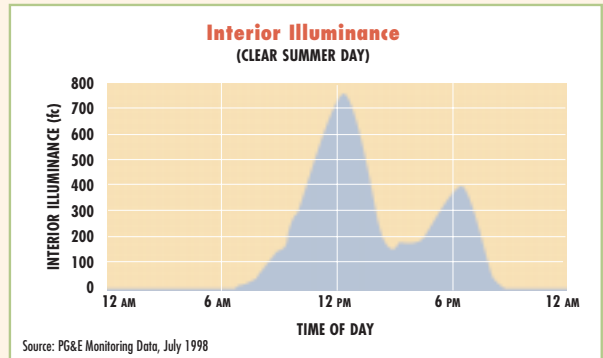
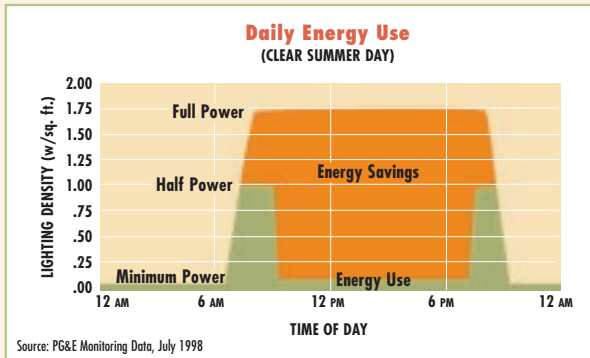
Energy-efficient fluorescent lighting is used when daylighting doesn't provide adequate illumination. Existing T-12 fluorescent lamps and ballasts were replaced with T-8 lamps and electronic ballasts. The electric lighting layout is designed to provide an interior illuminance of 100 fc without daylight at a lighting power density of 1.8 watts/sq.ft.

FINANCING

The franchise owner received a low-interest loan from SAFE-BIDCO for the sun-tracking skylight system and electric lighting upgrade. SAFE-BIDCO is a state-funded, nonbank lending agency that provides financing to small businesses and nonprofit organizations for energy efficiency projects. PG&E provided a rebate to support conversion of the T-12 fluorescent lamps to T-8s with electronic ballasts.



No electric lights are on in this photo, though the prismatic skylight diffusers are commonly mistaken for electric lights by customers.



This chart illustrates the dramatic energy savings on a typical clear summer day. On cloudy days, the system reduces energy consumption by at least half.

The illuminance data shows how interior light levels vary during the day from daylight contribution. The dip in the curve (a bell curve is typical) indicates where the tracking mirror system actually shades the skylight during the early afternoon when the sun is overhead. The illuminance level remains above 100 fc while heat gain is reduced at the time when air conditioners are working the hardest.

RESULTS

The daylighting features in this 14,400 sq.ft. retail building improve lighting quality and provide energy and financial savings. Electric lighting use has been greatly reduced. Short-term monitoring indicates a savings of 65% annually or 4.9 kWh/sq.ft. By better capturing low-angle sunlight with the unique skylight tracking system, the number of hours electric lights can be turned off is extended. Energy savings are maximized while providing increased interior light levels—150–700 fc on a clear day and 75–150 fc on a cloudy day. The variability in light level is actually considered a good thing at ACE and adds to the shopping experience by connecting shoppers to the outdoors. Electric lights in this store are designed to provide 100 fc without daylight contribution.

Overall, ACE is impressed with their new daylighting system. Customers enjoy the atmosphere, not fully aware that those bright square fixtures on the ceiling are actually skylights and not electric lights.

This program is funded by California utility customers and administered by Pacific Gas and Electric Company, under the auspices of the California Public Utilities Commission.

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RESOURCES

PG&E does not endorse particular products or services from any specific manufacturer or service provider. High efficiency products and services similar to those used in this project are available from multiple suppliers. For informational purposes, PG&E notes that the following companies provided equipment or services to the project:

Skylights:

So-Luminaire Daylighting Systems Corporation
Los Angeles, California
www.so-luminaire.com — 1-800-676-5276

Northern California Representative:

John Rangel, Martinez, California
925-229-4835

Daylighting Controls:

Day Light Controls, Moorpark, California
www.daylightcontrols.com — 805-529-0119

Low Interest Financing for Energy Efficiency Projects:

SAFE-BIDCO, Santa Rosa, California
1-800-273-8637

ADDITIONAL CONTACT INFORMATION

Pacific Energy Center, San Francisco, California
www.pge.com/pec/daylight — 415-973-7206