



NightBreeze Cuts Peak Demand, Keeps Residents Cool

PIER Buildings Program

Research Powers the Future

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The Problem

Keeping the approximately 100,000 new homes built in California each year cool and comfortable adds about 280 megawatts (MW) of peak load to the state's overtaxed electrical system, increasing the need for new power plants and requiring utilities to import expensive peak power. Currently, 37 percent of California's peak electrical demand is driven by residential loads. It has become common practice for homebuilders to install air-conditioning equipment in new homes, even in mild coastal climates where air conditioning is typically needed only a few days of the year.

The Solution

The NightBreeze system integrates heating, ventilation cooling, and air conditioning and provides fresh-air ventilation for maintaining indoor air quality. The system circulates cool nighttime air through a home to remove the heat stored during daytime hours in the home's thermal mass. By pre-cooling this mass during off-peak hours, comfortable temperatures can be maintained throughout the day with little or no need for conventional air-conditioning equipment.

When the outside temperature has dropped sufficiently to cool the home, the NightBreeze system's controller opens a damper in the outside air intake and energizes the high-efficiency, electrically commutated motor (ECM) in its blower to introduce cool, filtered fresh air into the home. Coils mounted inside the unit's air handler use hot water from a high-output tankless water heater, and—if needed—a conventional air-conditioning system, to provide heating and supplementary cooling (Figure 1).

For high-volume production housing developments, the system's incremental costs are estimated at \$1,500. At this price, monthly energy cost savings would exceed the increase in the monthly mortgage payment, resulting in positive net cash flow and immediate payback.

Features and Benefits

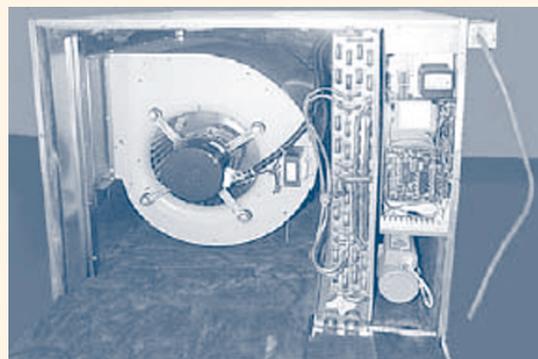
The NightBreeze system offers savings in both the first cost and the operating costs of a home's cooling system.

Significantly reduced cooling energy and peak power demand.

To demonstrate this technology's effectiveness, the

Figure 1: The NightBreeze air handler

The NightBreeze system is composed of an outdoor air intake with a damper and an air-handling unit containing a high-efficiency fan, heating and cooling coils, and motor controls.



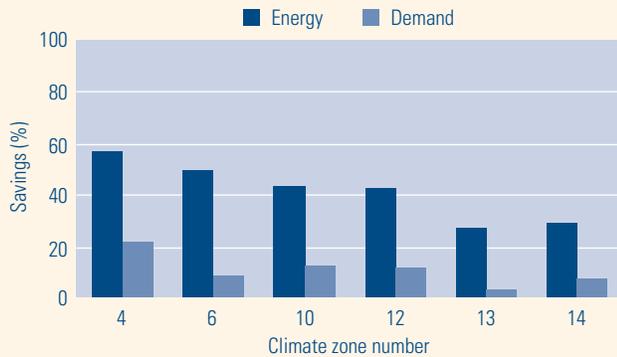
NightBreeze system was installed in two new homes, which were then monitored for one year. One house, located in Watsonville, California, maintained comfortable temperatures year-round, entirely without traditional air conditioning. The other house, in Livermore, California, operated its two air conditioners (one for each zone) for a combined total of 8.9 hours over the monitoring period. On a typical 95° Fahrenheit (F) summer day, the Livermore house used about 80 percent less cooling energy than a "control" house of identical floor plan located in the same development. Moreover, all of the cooling energy consumed by the NightBreeze system occurred during off-peak hours, so the system contributed significant demand reduction as well. Results from these two houses were used to calibrate a building simulation model, which indicated significant energy and demand savings in most of California's 16 climate zones (Figure 2, next page).

Reduced cooling equipment costs. The NightBreeze system reduced the cooling load on the Watsonville house enough to completely eliminate the need for conventional air-conditioning equipment. At the Livermore house, the cooling load was reduced to the degree that only two tons of cooling capacity were needed to maintain comfort, just half of the installed capacity.

User-friendly control interface. A user-friendly thermostat with graphical feedback capabilities integrates control of heating, ventilation cooling, air conditioning, and fresh air

Figure 2: Simulated NightBreeze energy and demand reductions

Building simulations were run in six California climate zones to compare the energy and demand requirements of a home compliant with the basic California energy code (Title 24) to those of the same home using the NightBreeze ventilation cooling system. In each of the simulated climate zones, which represented a range of climates and geographic locations, the NightBreeze system provided significant energy and demand reductions.



ventilation and provides feedback on the consequences of user settings. The control interface provides information to the user about optimal comfort settings and adjusts ventilation rates to minimize fan energy use, avoid overcooling, and minimize air-conditioner operation.

High-efficiency, variable-speed blower motor. The NightBreeze air handler uses an electrically commutated motor that operates at high efficiency throughout its speed range. This allows the unit to deliver quiet, variable-speed heating, cooling, and ventilation with fan energy consumption that is less than half that of typical furnaces. Variable-speed operation means that the unit can bring in winter fresh-air ventilation that precisely meets ASHRAE (the American Society of Heating, Refrigeration, and Air-Conditioning Engineers) Standard 62 requirements with less fan energy than any other mechanical fresh-air system available.

Applications

Although it can be retrofitted, the NightBreeze system is intended primarily for new residential construction. Building simulation modeling has demonstrated that

NightBreeze can significantly reduce cooling energy costs and peak load, and that it can reduce or completely eliminate the need for supplementary air conditioning in relatively dry climates with diurnal temperature swings of 30°F or more. Outside of California, initial analysis indicates that NightBreeze will be an attractive alternative in Colorado, Idaho, Oregon, Montana, Nevada, New Mexico, upstate New York, North Dakota, Washington, Wyoming, and portions of Arizona.

What's Next

The Public Interest Energy Research (PIER) program is already supporting development of a furnace-based version of NightBreeze. In June 2004, Davis Energy Group, which developed the NightBreeze concept with PIER support, announced that it had launched a new business venture called Advanced Energy Products (AEP) to commercialize and market NightBreeze. Preproduction NightBreeze units are now available in limited quantities from AEP. Volume production is expected in late 2005.

Collaborators

The organizations involved in this project include Davis Energy Group, RCS/ZTECH, Enviromaster International, and Pacific Gas & Electric Co.

For More Information

Reports documenting this project and providing more details may be downloaded at www.energy.ca.gov/pier/final_project_reports/500-04-009.html.

To view Technical Briefs on other topics, visit www.esource.com/public/products/cec_form.asp.

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About PIER

This project was conducted by the California Energy Commission's Public Interest Energy Research (PIER) program. PIER supports public-interest energy research and development that helps improve the quality of life in California by bringing environmentally safe, affordable, and reliable energy services and products to the marketplace.

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