Hospitals Save Energy and Money by Optimizing HVAC Performance

Photo: DOE/NREL

Hospitals maintain high ventilation rates to lessen the risk of microbial contamination. Because requirements for outdoor air are substantial, HVAC can account for nearly half of a hospital's total energy use.[1] Hospitals can, however, achieve substantial energy savings and meet the demands of infection control.

Effective, energy-efficient technologies and practices reduce HVAC-related energy costs while enhancing infection control. Decisions regarding the HVAC system—for new construction and existing buildings—are most effective when undertaken as part of a facility-wide energy management program.

This fact sheet was developed by the U.S. Department of Energy's Hospital Energy Alliance to assist hospital facility managers and operators in using energy-efficient heating, ventilation, and air conditioning (HVAC) technologies and practices. Some hospitals may need to expand their HVAC system or make major renovations to achieve better performance. Simply improving components of an existing system can accomplish much.

Improving HVAC Components

Hospitals should schedule and perform regular maintenance on key HVAC components to identify opportunities for energy-efficiency improvements and upgrades.

Fans

- For non-critical spaces with lower ventilation requirements (such as medical-office floors), switch to a variable air volume system by installing variable frequency drives on all motors. Unlike constant air volume systems, variable systems modulate airflow based on the demands of the space being served, reducing power use in fans by as much as 50 percent.[2]
- Right-sizing is important for energy efficiency. Appropriately size fans so actual operation coincides with optimal efficiency points on fan curves based on actual pressure drop and flow rate.
- Upgrade to energy-efficient motors. A NEMA-rated premium efficiency motor is 2 to 9 percent more efficient than a pre-EPAct 2005 standard motor and 1 to 3 percent more efficient than newer standard motors. A 1 percent efficiency improvement on a new standard 100 hp motor serving a 24/7 CAV system and operating at 75 percent load could reduce hospital energy use by about 5,000 kWh annually.

Coils and Filters

- Perform consistent operations and maintenance functions to minimize pressure drops across the coils and filters; simply keeping the coils and filters clean can dramatically improve the efficiency of the entire HVAC system.
- Consider adding a coil bypass on both the heating and cooling coils. When the coil is not in operation, a bypass damper will open, allowing for the air to pass through with a substantially lower pressure drop. This can reduce fan energy significantly.
- Increase the filter cross-sectional area (angled filter bags, pleated filters) to provide more energy-efficient filtration.

Dampers and Ducts

- Verify proper damper operation regularly. Clean and repair (or replace) dampers as needed.

Controls

- Calibrate, check, and adjust thermostats to accurately heat and cool different building zones.
- Correct any HVAC systems that are in conflict by heating and cooling an area simultaneously.
- Reduce HVAC use when areas are unoccupied or in low use (and therefore are subject to lower indoor air-quality and temperature requirements). This can be done by employing energy-efficient scheduling—including setbacks, weekend settings, optimal start-stop settings, and temperature resets based on outside conditions. Such settings are particularly valuable in operating rooms because operating rooms do not need to constantly maintain the extreme temperatures required during surgery.

1. High Performance Hospital Partnerships, 2009 ASHE Planning, Design and Construction Conference, College of Built Environments, University of Washington.
2. http://www.energy.rochester.edu/efficiency/vav.pdf.

Major Renovations and Expansions

When undertaking new construction, or major renovations or expansions of the HVAC system, hospitals benefit by using a whole building system design approach.

- Optimize the HVAC system after load-reducing strategies have been implemented. This is because retrofitting facilities for energy efficiency—upgrading lighting and windows, for example—will affect heating and cooling requirements.
- Assess air-flow requirements for different hospital regions. Reducing use of 100 percent outside air in non-medical spaces (i.e., offices and storage areas) can result in substantial savings on construction and operations costs.
- Consider using a displacement ventilation system rather than traditional overhead ventilation. Such systems have the potential to improve both energy efficiency and infection control.

Case Study

Lewis County General Hospital and Residential Health Care Facility

Lowville, New York • 2006

Lewis County General Hospital and Residential Health Care Facility is a county-owned and -operated hospital with 54 acute-care and 160 long-term-care beds. Because the facility operates only on funds generated by services provided, hospital administration was seeking ways to decrease overall operating costs. The hospital's old, inefficient HVAC system provided many opportunities for saving energy and energy costs. In order to pay for needed improvements, the facility sought the help of the New York State Energy Research and Development Authority (NYSERDA).

Details

- Used computer-based EMS data to track temperatures and energy use to determine where improvements could be made. Fans that moved cool air through the system were determined to be a key problem, running continuously at 100 percent.
- Installed four new variable frequency drives (VFDs) on the supply and return fans of the air handler to reduce energy consumption. The new drives improve fan performance throughout the facilities, resulting in lower building operation costs.
- Total cost of the project was $32,000.
- NYSERDA's Energy Smart rebate program, which encourages purchase of energy-efficient technology, paid for 50 percent of the costs.

Results

- Energy used by the HVAC system was reduced by 15 percent, well exceeding an 8 percent estimated reduction.
- The hospital saves $7,500 per year.
- The payback period—when factoring in the NYSERDA rebate—was just over two years.

The Promise of Displacement Ventilation

Based on a relatively new technology, displacement ventilation systems introduce cool air at low velocity, improving ventilation effectiveness within the occupant zone. As a room becomes warmer through use, the air—and its contaminants—rise, generally resulting in better air quality than exists in traditionally ventilated areas. Additional benefits of displacement ventilation follow.

- Saves energy by reducing ventilation air change per hour (ACH).
- Decreases ducts, saving floor-to-floor height.
- Reduces chiller lift and improves efficiency because supply air is 65°F, rather than 55°F.

Recent findings of the Healthcare Ventilation Research Collaborative (based on actual measurements) indicate that displacement ventilation with 4 ACH provides the same or better air quality for patient rooms than mixing ventilation at 6 ACH.

Hospital Energy Alliance

HEA is a forum in which healthcare leaders work together with DOE, its national laboratories, and national building organizations to accelerate market adoption of advanced energy strategies and technologies.

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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