Managing Energy Costs in Hospitals

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Hospital energy managers can use energy-efficiency strategies to offset high costs caused by growing plug loads and rising energy prices. A typical 200,000-square-foot (ft²), 50-bed hospital in the U.S. annually spends $680,000—or roughly $13,611 per bed—on electricity and natural gas. By increasing energy efficiency, hospitals can improve the bottom line and free up funds to invest in new technologies and improve patient care.

How Hospitals Use Energy

An average U.S. hospital uses 27.5 kWh of electricity and 109.8 cubic feet of natural gas per ft² annually. (Data are calculated using a 2003 U.S. Energy Information Administration survey of commercial buildings.) Using average commercial energy prices of $0.10 per kWh and $8.59 per hundred cubic feet (ccf), the average cost of power per ft² for hospitals in North America is approximately $2.84 for electricity and $0.94 for natural gas. **Figure 1** details healthcare energy consumption by end use in the U.S. For a customized benchmark rating of your facility, use the Energy Star National Energy Performance Rating system via Portfolio Manager software (**www.energystar.gov/index.cfm?c=evaluate_performance.bus_portfoliomanager**).

Quick Fixes

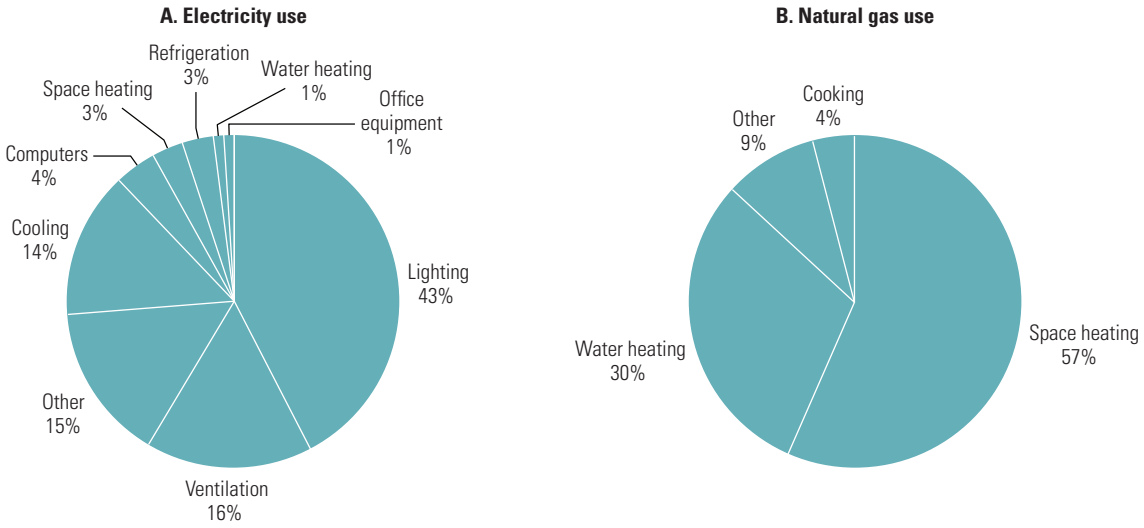
Many hospitals have tight facility budgets, so low- or no-cost reductions in energy expenditures are especially important.

Turning Things Off

Lighting. In a typical healthcare facility in the U.S., lighting represents 42 percent of electricity consumption, not including its impact on cooling loads. Posting "Please turn the lights off when not needed" stickers above light switches will remind both staff and visitors to do so. Another option is delamping where illumination is excessive.

Figure 1: Healthcare energy consumption by end use in the U.S.

Data from the U.S. Energy Information Administration show that cooling, lighting, and ventilation account for 72 percent of electricity use (A), and space heating dominates natural gas use at 57 percent (B).



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Office equipment. Desktop computers can use more than twice the energy used by a flat-screen monitor, so it is important to sleep or power down computers that are not in use. The Energy Star Power Management program (**www.energystar.gov/index.cfm?c=power_mgt.pr_power_management**) provides free software that automatically places active monitors and computers into a low-power sleep mode through a local area network.

Kitchen appliances. Good habits such as preheating ovens no more than 15 minutes prior to use and using fan hoods only when cooking can reduce energy use in kitchens.

Turning Things Down

Lighting controls. Automatic controls such as occupancy sensors, timers, photosensors, and dimmers save energy and help reduce maintenance costs. For staff desks, a combination of occupancy sensors and time switches can accommodate people who arrive early or stay late. A recommended strategy for hallways is to use a combination of scheduled lighting and dimming plus occupancy sensors after hours.

Operating-room air-handling setbacks. Many operating rooms have air-handling units that draw 100 percent of their supply from outside air, which needs to be heated or cooled depending on the season. Occupancy sensors or manual switches can be installed in these rooms that will reduce the operating speed of the supply and exhaust fans when the rooms are unoccupied.

Vending machine controls. Use occupancy sensors to power down vending machines when the area is unoccupied, or consider upgrading to Energy Star–certified vending machines. Both of these measures can reduce energy use by up to 50 percent, resulting in annual savings of around $150.

HVAC Operation and Maintenance

Regularly scheduled maintenance and periodic tune-ups save energy and extend the useful life of equipment. Create a preventive maintenance plan for your hospital that includes regularly scheduled tasks such as cleaning, calibration, component replacement, and general inspections. Ensure that information on setpoints and operating schedules is readily available for reference when equipment is checked or recalibrated.

Check the economizer. Many air-conditioning systems use a dampered vent called an economizer to draw in cool outside air when it is available to reduce the need for mechanically cooled air. If not regularly checked, the linkage on the damper can seize up or break. An economizer stuck in the fully opened position can dramatically inflate a building's energy bill by allowing in hot air during the air-conditioning season and cold air during the heating season. About once a year, have a licensed technician check, clean, and lubricate your economizer's linkage, calibrate the controls, and make repairs if necessary.

Follow a steam trap inspection and maintenance plan. Steam traps remove water from the steam distribution system once it has cooled and condensed in a radiator or other heat exchanger. Mechanical steam traps can become stuck open, which wastes heat. A single failed trap can waste more than $50 per month, and hospitals can have hundreds or even thousands of steam traps.

Sequence chillers on and off. Operators often run too many chillers for a given load. Because every chiller has a range of loading conditions wherein it operates most efficiently, turn chillers off to keep the remaining operating ones in their most efficient zone—typically, above the 30 to 50 percent loading mark.

Operate multiple cooling towers to save fan power. Most chilled-water plants have excess capacity, so that one or more cooling towers aren't operating during low-load hours. To make the most of existing cooling towers, simply run condenser water over as many towers as possible, at the lowest possible fan speed, and as often as possible.

Kitchen Equipment

Energy Star equipment. Look for Energy Star–qualified commercial food service equipment when making new purchases. Dishwashers, fryers, griddles, hot food holding cabinets, ice machines, ovens, refrigerators, freezers, and steam cookers

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are now available in energy-efficient models. Energy Star–qualified steam cookers use about 2 gallons of water per hour compared with the 25 to 30 gallons used by standard models, and they are about 60 percent more efficient. A combination oven, operating in moist heat mode, can consume 30 to 40 gallons of water per hour, whereas an Energy Star model reduces water use to about 10 to 15 gallons per hour—saving more than 100,000 gallons per year.

Pre-rinse spray valves. Replacing a 2.6-gallon pre-rinse spray valve with a 1.6-gallon low-flow model can save about 66,000 gallons per year when operated three hours per day.

Longer-Term Solutions

Although the actions covered in this section require more time and investment, they can dramatically increase the efficiency of your facility without compromising patient care or comfort. Whenever faced with major equipment replacement, consider the full lifecycle costs, including maintenance and energy. Because hospitals tend to occupy the same facility for decades, considering lifecycle costs can help you to save money over the long run.

Commissioning

Commissioning (Cx) is a technical procedure that encompasses building inspection and systems testing to ensure facility performance according to equipment specifications and the owner's performance expectations. The majority of problems identified by commissioning tend to concern HVAC systems—in particular, air distribution systems. Hospitals can benefit substantially because of their complexity and intensive energy use. A 2009 study by Lawrence Berkeley National Laboratory found that 75 percent of retrocommissioning projects had a payback period of 2.4 years or less.

If your building was previously commissioned, consider investing in recommissioning every three to five years. Spaces should always be commissioned when their use changes. As part of your contract, require your commissioning agent to provide instructions and documentation that can be used for future staff training and maintenance checklists.

Building Automation System

Approximately 73 percent of healthcare sector floor space is controlled with a building automation system (BAS), also known as an energy management system. Hospitals often have older, pneumatic-control systems that can be recalibrated or replaced with electronic systems. BASs can also be useful for continuous monitoring and commissioning. In that case, data analysis software or a third-party diagnostic service can help to identify operational anomalies.

Lighting

Hospital lighting retrofit projects can have an average payback of less than 1.9 years, according to a study of 10 hospitals in New York. A design strategy that uses a mix of both natural and artificial light sources increases comfort and reduces energy costs. Appropriate window shading and separate shades on high windows are relatively low-cost retrofit options to increase daylighting. Light pipes and skylights can bring sunlight into interior spaces on top floors. Photosensor controls should be used to dim or turn off lights when there is sufficient natural light. High-performance T8 lamps and ballasts (also called super T8s) can cut energy use by more than 20 percent compared to standard T8 technology. Indirect or direct fixtures using T5 lamps can be effective in areas where ceilings are at least 8.5 feet high. Compact fluorescent lamps (CFLs) can replace incandescent lamps in a variety of applications and save up to $25 per lamp, per year in energy and maintenance costs.

Autoclaves

Autoclaves require steam to be at higher temperatures than do most other steam appliances found in hospitals. By installing steam temperature boosters for autoclaves or spot steam generators that serve only autoclaves, your facility can reduce the temperature of the steam generated at your central plant and thus reduce energy costs.

Cogeneration and Other Sources of Heat Recovery

Cogeneration systems provide both heat (for space or water heating) and power. They have more applications and offer more savings potential for hospitals than for any other class

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of commercial building. Capturing and using the waste heat from medical waste incinerators can be cost-effective in some cases. The University of Michigan saved $400,000 in yearly steam bills by coupling medical waste incinerators with cogeneration. Laundry and kitchen equipment as well as showers and boilers can benefit from heat-recovery systems, which can be added as a retrofit.

HVAC

HVAC systems are typically responsible for 33 percent of the electricity and 56 percent of the natural gas consumed in healthcare facilities.

Variable-frequency drives (VFDs). VFDs can be added to pumps and fans in HVAC systems, saving energy by allowing motors to adjust their output to fluctuating heating and ventilation needs. Further savings are possible by using energy-recovery equipment, demand-controlled ventilation, and efficient fan motors.

Boilers. Condensing boilers achieve high efficiency by capturing additional heat released from condensing flue gas and can last for 25 years longer than noncondensing versions. Although more expensive, the average simple payback period for a condensing boiler is five years with a 20 percent return on investment. The energy performance of existing boilers can be enhanced with stack gas heat recovery (also known as condensing heat exchangers), air preheaters, water recovery equipment, outdoor temperature controls, and piping insulation.

Chillers. Chilled-water systems are custom designed for each application, and employing efficient auxiliary equipment and operating strategies can often be more important than selecting an efficient chiller. Annual energy costs of a chiller can amount to one-third of the purchase price. In descending order, the most efficient chiller compressors are centrifugal, screw, scroll, and reciprocating.

Resources

Energy Star for Healthcare, www.energystar.gov/index.cfm?c=healthcare.bus_healthcare. Energy Star is an excellent resource to inform your purchasing policy for lighting, computers and copiers, and kitchen, heating, and cooling equipment. The site also offers an energy benchmarking tool and a financial analysis calculator customized for the healthcare industry.

U.S. Department of Energy, EnergySmart Hospitals, www1.eere.energy.gov/buildings/energysmarthospitals. Here you can find a guide for creating an energy management plan, among other resources. Creating an energy team to design and implement a comprehensive energy management program will streamline the process of making your facility more energy efficient and will help you to lock in long-term savings.

Practice Greenhealth, www.practicegreenhealth.org. This membership-based organization offers web conferences, best practices guides, sample policies and brochures, forums, and other resources for healthcare professionals working on sustainability issues.

Green Guide for Health Care, www.gghc.org. The Green Guide for Health Care is a best practices guide for healthy and sustainable building design, construction, and operations for the healthcare industry.

ASHRAE Advanced Energy Design Guide for Small Hospitals and Healthcare Facilities, http://aedg.ashrae.org/index.php. Published in 2009, this is a detailed guide for achieving a 30 percent reduction in energy consumption in small hospitals as a first step toward zero net energy healthcare buildings. The focus is primarily on new construction; however, many recommendations are also applicable to renovations.

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