Healthcare and Energy Savings: An HVAC Approach

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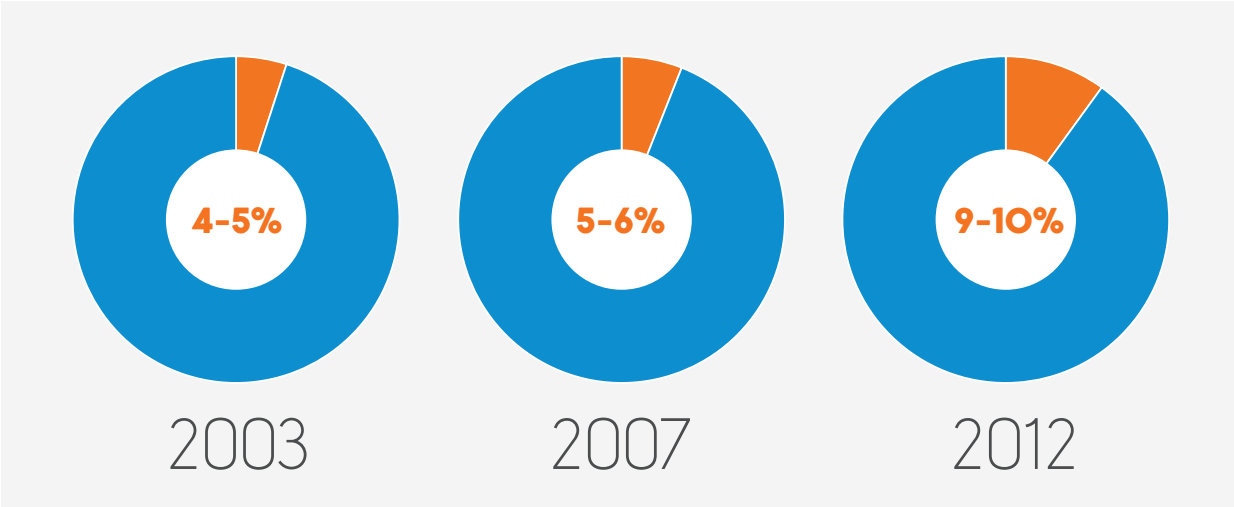
ENERGY—THE LIFEBLOOD OF HEALTHCARE

For hospitals and other healthcare facilities, power systems can never be allowed to flatline. It is this "always on" setting that keeps patients alive, provides reliable access to vital electronic health records, and ensures that medical staff can perform life-sustaining work 24/7. But all that energy expenditure comes at a steep price.

QUICK FACT

Healthcare facilities spend more than **$8 BILLION** per year on energy.

Although U.S. healthcare facilities account for only 2% of the total commercial floorspace, they use an outsized — and growing — share of the total energy consumed.



HEALTHCARE FACILITIES' SHARE OF TOTAL ENERGY USED IN THE U.S.

How Are Hospitals Using All This Energy?

A high-traffic facility may host thousands of employees, patients, and visitors in a single 24-hour period. But energy is spent on far more than just keeping the lights on and the elevators running.

Common uses include:

- UV lights for disease control to reduce hospital-acquired infections
- Sophisticated HVAC to tightly manage temperature, humidity, air flow, and pressure
- Domestic water treatment (heating water to 130°F to kill legionella bacteria and then cooling it to 105°F for safe use)
- Energy-intensive processes (sterilization, food service, refrigeration, laundry)
- High-tech equipment (medical imaging, life support, lab equipment, computers and servers)

QUICK FACT

Hospitals with the highest energy usage are those with:

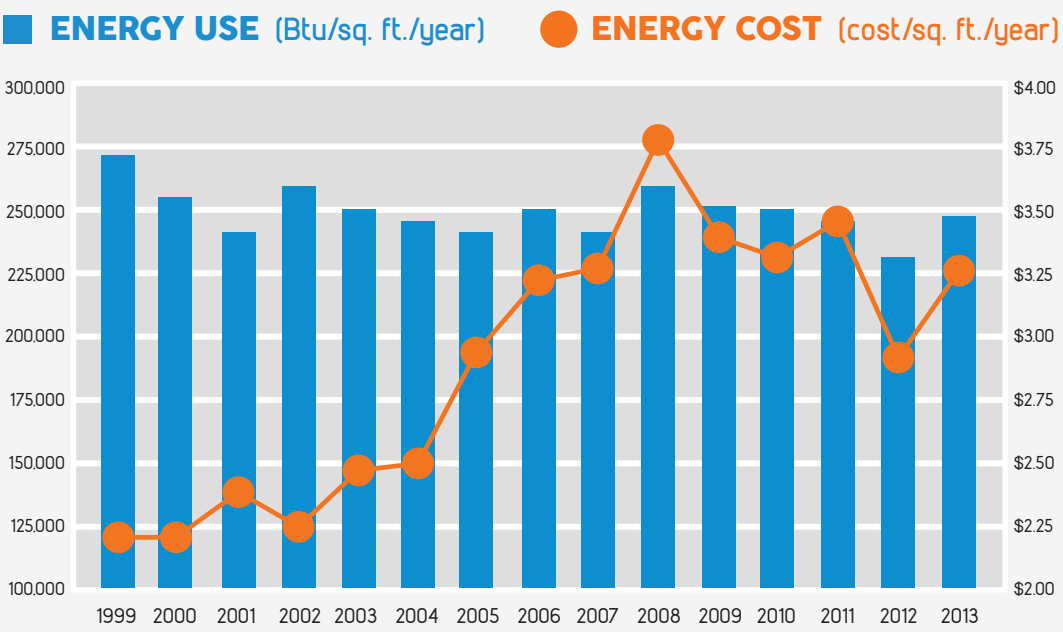
THE MOST FULL-TIME EMPLOYEES AND STAFFED BEDS PER SQUARE FOOT

THE MOST COOLING DEGREE DAYS PER YEAR

Hospitals Are Experiencing High "Energy Pressure"

Even though hospitals are trying to become more efficient, power usage is still high. At the same time, the cost of energy — electricity and natural gas — has risen dramatically

since the turn of the century. Aging infrastructure, deregulation of energy markets, and increasing demand across all sectors is likely to continue to drive prices upward.



ENERGY USE AND COST IN THE HEALTHCARE SECTOR

Other Issues Putting Healthcare on the Critical List

What about the broader regulatory and economic landscape? A variety of factors are forcing healthcare organizations to cut costs if they want their facilities to remain profitable.

- Employers are negotiating lower prices for healthcare plans and contracting with fewer providers as a result.
- ACOs along with Medicare and commercial insurers are tying reimbursement to treatment strategies that keep patients well (and out of the hospital).
- Under the ACA, an influx of previously uninsured patients who are very ill means a higher percentage of patients require energy-intensive interventions with medical equipment.
- Cost-sharing places more of the burden of medical bills on patients and reduces utilization.

QUICK FACTS

Inpatient admissions per 1,000 are projected to drop from **103** in 2011 to **88** in 2021.

As much as **30%** of the energy consumed is used unnecessarily.

With all these factors at play, hospitals are in dire need of some big wins in energy conservation to help them run lean and efficient facilities. Fortunately, the potential for cost-savings in energy is very high.

CURE FOR UNHEALTHY ENERGY CONSUMPTION HABITS

Hospitals are struggling to manage energy consumption more effectively. And it's as true as ever that the largest room in the world is room for improvement.

Although hundreds of healthcare facilities participate in energy-savings programs such as Energy Star, USGBC, and LEED, there's still a long way to go. The average hospital Energy Star Rating is still only 50.

Six-Figure Savings Are Common

The impact of energy retrofits can be immediate and dramatic. Greenwich Hospital in Connecticut implemented a deep energy retrofit and saved $303,000 in electricity per year, doubling its Energy Star rating to 88. Thirty Chicago-area hospitals were retro-commissioned and averaged $120,000 in energy savings the first year. In both these examples, the payback period was only **six months**. The potential for savings in new construction are even more dramatic. A newly constructed, code-compliant hospital saves between $500,000 and $800,000 a year in energy costs.

Hospitals Are Hemorrhaging Money on Energy	Energy Efficiency Yields a Healthier Profit Margin
Hospitals spend about **2-5%** of their operating budget on energy	Every **$100,000** a non-profit hospital saves on energy is equivalent to **$2,000,000** in new revenue.
Energy represents about **50%** of a healthcare facility manager's budget, or **15%** of the profit margin.	For-profit healthcare facilities can boost earnings per share by one penny by reducing energy costs **5%**.
78% of hospitals say high operating costs are the primary reason for implementing energy improvements.	**30%** savings in energy costs can improve profitability by as much as **1%**. That might not seem like much, but for a typical hospital generating only a **4%** net profit, it's a huge leap of nearly **25%**.

WHAT'S THE PROGNOSIS FOR HEALTHCARE ENERGY SAVINGS?

With so much potential for energy savings, shouldn't there be a consortium dedicated to making healthcare organizations more efficient? In fact, there are several.

TARGETING 100

SPONSORS: UW IDL, Northwest Energy Efficiency Alliance and The US Department of Energy

GOALS: Reduce energy consumption by 60%, eventually achieve 100 kBtu/ft^2. Carbon neutrality by 2030.

STRATEGY: Aggressively reducing external climate-dependent loads and internal loads as a first step of an integrated approach to significantly decrease annual energy use and costs.

SUSTAINABILITY ROADMAP FOR HOSPITALS

SPONSORS: ASHE, AHE, AHRMM

GOALS: Improving energy and water efficiency, reducing waste and chemical usage, prioritizing sustainability in supply-chain decisions.

STRATEGY: Providing a roadmap for quick reductions in efficiency and long-term strategic sustainability initiatives and creating a platform for sharing information and best practices across the healthcare sector.

AIA 2030 CHALLENGE

SPONSORS: AIA, ASHRAE, the U.S. Conference of Mayors, federal government

GOALS: Drop energy consumed from fossil fuels to 40% below current levels by 2020 and 80% by 2050. Carbon neutrality by 2030.

STRATEGY: Implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy.

NET-ZERO CBI

SPONSORS: U.S. Department of Energy and Hospital Energy Alliance

GOALS: The DOE's Net-Zero Energy Commercial Building Initiative (CBI) aims to achieve market-ready, zero-energy commercial buildings by 2025.

STRATEGY: Promoting the integration of advanced energy efficiency and renewable technologies in hospital design, construction, retrofit, operations, and maintenance.

Funding Is Available for Energy Upgrades

Fortunately for healthcare facilities, there is financial assistance available to help them reach their energy efficiency goals. Many hospitals qualify for hundreds of thousands of dollars in incentives from a variety of sources.

UTILITY REBATES • LEED INCENTIVES • LOANS • GRANTS • FEDERAL AND STATE TAX CREDITS

MANY CURES AVAILABLE FOR ENERGY OVERCONSUMPTION

Hospitals have many options for reducing their energy usage both in the short term and over the lifetime of a given facility. The Sustainability Roadmap provides a list of Green Light projects or "low hanging fruit" that gives hospitals a quick way to capture energy savings with relatively modest up-front cost. Examples include:

HVAC: Retro-commission controls, re-evaluate equipment scheduling, practice preventive maintenance, replace AHU filters regularly • **BOILERS:** Insulate equipment and piping, evaluate steam traps for repair/replacement • **BUILDING:** Check and repair thermal envelope • **LIGHTING:** Use energy-efficient lighting and fixtures, upgrade surgical task lighting to LED • **SUPPLEMENTAL LOAD REDUCTION:** Upgrade to Energy Star equipment to reduce the heat burden on cooling systems

QUICK FACT

Up to **50%** of energy costs in U.S. healthcare facilities is devoted to HVAC.

No Single Solution

There's no single answer to rising energy costs in healthcare. Solutions range from simply teaching people to turn things off when not directly in use to building healthcare facilities and systems based on strict energy-conservation and sustainability principles.

At the national level, laws such as the National Energy Act (1978) and the Energy Security Act (1980) were passed to provide incentives and disincentives, energy-efficiency programs, etc. Many of these government measures were designed to maintain a healthy energy strategy. Towards the end of the century, though, focus began to shift to the environment as a whole and to sustainability, with energy conservation and cost saving as a byproduct of these broader initiatives.

A Shift in Focus

Towards the end of the 1990s, more attention turned to sustainability and to the use of the latest technology to provide smarter solutions.

In 1993, three private individuals registered a non-profit organization, the U.S. Green Building Council (USGBC) with the aim of promoting sustainability in building design, construction, and operation. This body developed a program called Leadership in Energy and Environmental Design (LEED), which has become the most popular rating system for environmentally sustainable building. LEED buildings are more "green" and cost less to operate. Architects, engineers, contractors, and others qualify for LEED accreditation by passing set examinations, and are then recognized as experts in the field.

LEED principles have become important in the healthcare sector, and thousands of healthcare construction projects have received some level of LEED certification.

Supply and Demand

In 2013, the Sustainability Roadmap for Hospitals initiative began. Collaborating organizations are: **AMERICAN HOSPITAL ASSOCIATION (AHA), AMERICAN SOCIETY FOR HEALTHCARE ENGINEERING (ASHE), ASSOCIATION FOR THE HEALTHCARE ENVIRONMENT (AHE), ASSOCIATION FOR HEALTHCARE RESOURCE & MATERIALS MANAGEMENT (AHRMM)**.

The Roadmap is devoted to providing the tools and expertise needed to integrate sustainable practices into the healthcare environment. As previously noted, sustainability almost always means energy efficiency and a reduction in operating costs.

QUICK FACT

Energy management can be approached in two ways:

SUPPLY-SIDE & DEMAND-SIDE

Supply-side energy management is primarily concerned with the efficient, cost-effective production of power, selecting and organizing production resources. Supply-side energy considerations may include choosing the best energy source, migrating from fossil fuel to more sustainable energy sources, such as wind or solar power.

While these are hugely important issues, they're not the focus of this paper. Instead, we're concerning ourselves with demand-side energy management, or lowering costs by reducing the amount of energy required. Because its focus is on facilities and on conservation, demand-side energy management is closely associated with a variety of sustainable energy initiatives, including efficient building practices, the use of energy-efficient equipment — for example, Energy Star® products — and installing systems that reduce energy consumption.

So our focus is on the role of HVAC in a demand-side approach to energy management in the healthcare sector. Because hospitals and similar healthcare facilities are the biggest consumers of energy, we'll concentrate on these.

BIG PICTURE, SMALL PICTURE

There are really two ways to approach demand-side HVAC energy management in the healthcare sector: whole systems and components, or big-picture solutions and small-picture solutions. Big-picture solutions are whole-system solutions, building energy efficiency from the ground up to provide dramatic savings.

These big-picture, ground-up solutions include smart sun and daylight shading, outdoor air supply with heat recovery, thermal energy systems, better insulation of walls and windows, on-demand ventilation of rooms and other spaces, smart sensors to control ventilation, and more.

QUICK FACT

It is estimated that these and similar ground-up measures can mean energy consumption savings of **MORE THAN 60%**.

There are other big-picture solutions, too:

Displacement Ventilation

A study undertaken by the Healthcare Ventilation Research Collaborative (*Displacement Ventilation Research, Phase II Summary Report*, Arash Ghity, PE, Bob Gulick, PE, Paul Marmion, PEng, 2009) found that a displacement ventilation (DV) system could be superior to an overhead ventilation (OHV) system in some cases. While tests showed this improvement at 4 ACH vs 6 ACH, ASHRAE Standard 170 only approved 6 ACH for DV systems, based on the volume of a room from floor to six feet in height instead of full room height. An addendum later reduced total air changes for rooms to 4 ACH, but kept the 6 ACH requirement for DV. This resulted in the average air savings from a 33% reduction to a 10% reduction.

DOAS Systems

A Dedicated Outside Air System (DOAS) delivers dehumidified outside air that meets a portion of the overall air distribution needs. Another complementary system of some kind is needed, such as Variable Air Volume (VAV) system, additional fan coil units, a heat pump system, or chilled beam.

Chilled Beam

These heating or cooling systems are more efficient than traditional systems. Some studies show that operating costs can be twenty-five to fifty percent lower. They are quieter, since there are no fans either in or near the room. They require less fan energy or fan brake horsepower.

A chilled beam solution is ideal for use in any space where room recirculating units are allowed, as well in administrative areas, office spaces, and other spaces that are not regulated by ASHRAE Standard 170.

- **BETTER COMFORT THAN WITH OTHER AIR-CONDITIONING**
- **SMALLER DUCT SYSTEM REQUIRED BECAUSE OF REDUCED AIR QUANTITIES**
- **ELIMINATES WET-SURFACE COOLING COILS AND LOWERS SEPTIC CONTAMINATION RISK**

Titus manufactures a broad range of both active and passive chilled beam solutions for installation in any appropriate space.

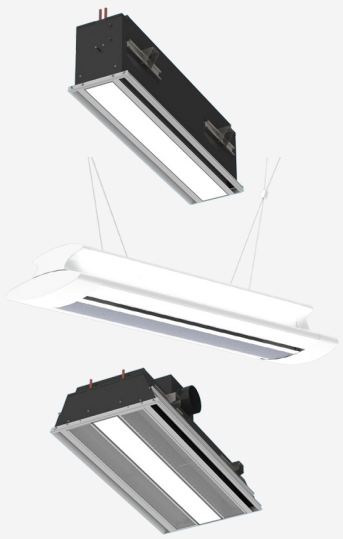
Units are available with a number of different throw patterns to accommodate a variety of user requirements.

One of the important advantages of chilled beam is that the amount of outside air needed can be controlled using smart technology. Units are generally ceiling-mounted, but there are also floor-mounted units for use with DV systems.

The introduction of chilled beam solutions in a new build or a retrofit situation is one way that healthcare facilities can reduce operating costs while increasing indoor comfort for both patients and staff.

Chilled Beam and Light

Working with the international product design firm HOK and Mark Lighting, we developed and introduced a new concept in ventilation called VENTUS LUX. We think of it as bringing the smartness of chilled beam together with low-energy lighting. The result is a system that can **save up to 40% in energy costs** when compared to traditional systems. The VENTUS LUX system reduces ductwork and delivers energy-efficient heating, cooling and lighting to areas such as offices, treatment rooms, and public areas.



VENTUS LUX

Active chilled beam for up to 40% lower energy costs

Less ductwork saves installation costs

Fewer fans means quieter operation

Bright integrated LED lighting

Suitable for new builds or retrofit

SMALL-PICTURE SOLUTIONS

In addition to the big-picture solutions, there are smart solutions that can be introduced right away, as part of a retrofit:

Smart controls

These go beyond programmable thermostats or sensor-activated lighting and may include:

- **ZONE SCHEDULING**
- **NIGHT/UNOCCUPIED SETBACK**
- **AFTER-HOURS OVERRIDE**
- **OCCUPANCY SENSORS**
- **HOLIDAY SCHEDULING**
- **FOLLOW SUNRISE & SUNSET**
- **DAYLIGHT HARVESTING**
- **OPTIMUM START**

Retrofitting Can Involve Rightsizing

Another way to achieve energy savings is to upgrading to smarter, leaner equipment. HVAC and air distributions systems may be outdated or oversized for the job they are required to perform. An EPA study found that about six out of ten building fan systems were oversized by at least 10%, with an average oversizing of 60%.

According to Practice GreenHealth: "When replacing system components, it is extremely important to size the equipment properly to meet current loads. Besides saving energy, proper sizing will likely reduce noise, lower first costs for equipment, and optimize equipment operation."

Smaller equipment, used more efficiently, can save significantly on operating costs.

Sources and Resources:

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