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Site-Recovered Energy Reduces HVAC Costs

Building owners are turning to site-recovered energy technologies such as ERV.

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Building owners are caught between two powerful forces — the need to lower energy costs and the need to meet or exceed outdoor air ventilation regulations for occupant health and comfort.

Large amounts of energy are wasted each day from commercial, institutional and government building sites as heating, ventilation and air conditioning (HVAC) systems replace indoor air with fresh outdoor air multiple times per day. Heating or cooling energy is continually wasted in the exhaust air stream while new energy must be generated and used to condition entering outdoor air. Building owners who fail to capture this wasted energy will continue to incur high energy costs, negatively impacting property values, profitability, and the ability to attract tenants with corporate or federally directed energy-efficiency mandates

To address this challenge, many building owners are turning to site-recovered energy[1] technologies such as Energy Recovery Ventilation (ERV). Designed to operate with new or existing HVAC units, ERV technology provides an affordable means to simultaneously cut HVAC energy costs without compromising outdoor air ventilation requirements.

Important Energy Efficiency and HVAC Energy Trends

The commercial building energy sector represents 20 percent of all U.S. energy costs and is growing more rapidly than the residential energy sector. With HVAC systems consuming an average of 40-60 percent of commercial building energy, owners are searching for ways to reduce these expenses.[2]

As for government buildings, various local, state and federal policies encourage, and in many cases mandate, “greener” construction and renovation. For example, the Energy Independence & Security Act of 2007 (EISA 2007) established energy management goals and requirements for federal buildings. Section 431 adopts the energy intensity reduction goals of Executive Order 13423, which calls for energy consumption to be reduced by 30 percent by fiscal year 2015

(relative to a 2003 baseline). Section 434 requires every federal agency to ensure that major replacements of installed equipment (such as HVAC systems) or renovations or expansions of existing space employ the most energy-efficient equipment that is life-cycle cost effective. And, with certain exceptions, Section 435 (effective Dec.19, 2010) prohibits federal agencies from leasing buildings that have not earned an ENERGY STAR label.

As the nation's largest energy user, the federal government is leading by example, through the Federal Energy Management Program (FEMP). This program promotes energy efficiency through recommendations and incentives for the private sector as well as through guidelines and mandates for federal agencies. The FEMP mandates ERV systems for federal buildings and recommends these systems be considered for schools and businesses.

To help federal agencies comply with all pertinent mandates, the 2010 Facilities Standards for the Public Buildings Service (known collectively as the P100) establish design standards and criteria for the construction, repair, alteration and modernization of federal buildings.

Administered by the U.S. General Services Administration (GSA), these standards state that heat recovery equipment must operate at a minimum of 70 percent efficiency at winter and summer outdoor design conditions.

Many private organizations are also aggressively working to increase building efficiency. The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) — the organization that established the benchmark national energy standard 90.1 — recently raised energy efficiency levels in its 2010 standard by 30 percent[3] and proposed the first "green building" standard in 2009.[4] When formally adopted by building codes, these increased efficiency standards will significantly impact HVAC equipment selection and design.

In addition, many corporations are recognizing the financial and marketing advantages of green building design, prompting many owners to pursue LEED Certification or the U.S. Environmental Protection Agency's ENERGY STAR rating. With increased focus on energy and the environment, building owners are constantly challenged to improve HVAC efficiency without compromising indoor air quality or the company's bottom line.

HVAC Challenges

Building owners seeking to maximize the profitability of their investments face several HVAC-related challenges and opportunities including: minimizing wasted energy, replacing existing HVAC equipment and cost effectively meeting or exceeding outdoor air ventilation requirements.

1. Minimizing Wasted Energy: A large portion of HVAC energy can be attributed to conditioning outdoor air ventilation. As fresh air is drawn into the building, stale air is expelled along with site-generated energy used to condition it. This energy-rich exhaust air represents the

largest source of wasted energy in most commercial buildings. By failing to recapture this site energy, owners will continue to face rising energy costs, lower profitability, and missed opportunities to reduce greenhouse gas emissions.

2. Existing HVAC Equipment: Upgrading HVAC equipment provides an opportunity to lower building energy use, however many energy efficient technologies are perceived to be expensive. Fortunately, proven technologies are available to improve HVAC system efficiency and provide attractive returns. Building owners willing to apply these technologies can successfully reduce energy consumption and greenhouse gas emissions in existing buildings, often with local utility support.

3. Outdoor Air Ventilation versus Energy Cost: Studies have proven that outdoor air ventilation creates a healthier work environment. According to the EPA, "Indoor air can be 2-5 times more polluted than outdoor air … [and] that increased amounts of outdoor air supply is generally better for indoor air quality."[5]

However, as outdoor air rates increase, so does the size, cost and operating expense of HVAC systems. Attempts to reduce these costs by lowering ventilation rates in the 1980s led to Sick Building Syndrome and multiple indoor air quality complaints and law suits, resulting in building codes to protect the health and comfort of occupants. Recognizing that more ventilation is beneficial, building owners must find a solution to provide for the health of its building occupants while also controlling energy costs.

The Solution: Energy Recovery Wheel Technology

Energy recovery wheels, also known as enthalpy wheels, resolve the conflict between indoor air quality and energy conservation by recovering site energy contained in building exhaust air. Up to 80 percent of this energy is recycled to precondition outdoor air, resulting in reduced HVAC load and operating cost.

For new and replacement projects, energy recovery costs are typically offset by lower HVAC system first costs while up to 80 percent reductions in outdoor air fuel consumption provide healthy returns for the life of the HVAC system.

Energy recovery wheels may also be used to improve the efficiency of relatively new HVAC systems by up to 40 percent providing 1-3 year paybacks when supported by the local utility.

Finally, energy recovery wheels enable building owners interested in marketing green, healthy buildings to increase outdoor air levels above minimum code, earning LEED points and reducing the risk of indoor air quality complaints.

How Energy Recovery Wheels Work

Enthalpy wheels transfer energy by rotating between outdoor air and exhaust airstreams to transfer heat and moisture from one airstream to the other. AHRI certification verifies the effectiveness of this energy transfer.

Total energy saved depends on the wheel's effectiveness and the difference in temperature and humidity between the two air streams. A bigger differential drives larger energy savings.

Benefits of Energy Recovery Wheels

Energy recovery wheels offer many benefits, including:

- Reduce outdoor air energy costs 60-80 percent

- Reduce capital equipment cost by minimizing HVAC design loads

- Increase outdoor air levels 2-3 times without adding load to existing HVAC system

- Cost effectively improve HVAC system's control over indoor humidity to prevent mold and mildew

- Maintain building values by maximizing outdoor air ventilation and building health, thus creating positive public relation opportunities

- Enable building owners to participate in energy programs such as ENERGY STAR

- Provide instant to two year paybacks in most North American climate zones

Case Study: School District Triples Ventilation and Saves Energy

The Port St. Lucie, Fla., school district was faced with having to upgrade HVAC systems in five school buildings to meet changing air quality regulations. Upgrading to the revised code would require adding 479 tons of air conditioning to accommodate increased levels of outdoor air.

The district considered installing additional chillers and air handling systems, however, this method was determined to be impractical and costly due to space constraints and the complexity of the retrofit, which meant the project could not be completed during school break.

Instead, the district chose a simpler, more energy efficient and less costly approach: standalone ERVs with energy recovery wheels. The use of ERVs minimized installation costs by utilizing existing ductwork and eliminating the need for additional chillers saving 335kw in peak demand. A 70 percent reduction in outdoor air energy load saved the district an estimated $700,000 over 10 years.

Energy Recovery Ventilation System Options

Energy recovery wheels are available from most HVAC OEMs and distributors in a variety of configurations, including:

- *Energy Recovery Ventilators*: Mounted indoors or outdoors. May include heating or cooling to provide neutral air. Ducted separately or tied into existing ductwork.

- *Rooftop Accessories*: Bolt to rooftop units, no roof penetration required.

- *Integrated Rooftop Packages*: ERV wheel, fans, filters, and controls integrated into a standard packaged rooftop unit.

- *Air Handler Options*: Energy Wheel modules for custom, semi-custom, and standard air handler designs enabling a reduction in chiller and boilers size.

- *Wall Mounted Packaged Units*: Vertically mounted indoor or outdoor units with integrated ERV components.

What to Look for in Energy Recovery Ventilation

1. *AHRI-certified***:** Products that are rated and certified by the Air-Conditioning, Heating and Refrigeration Institute (AHRI) ensure that building owners and engineers design HVAC solutions based on verified performance data.

2. *Temperature and humidity transfer capability***:** Look for ERV solutions that efficiently transfer both heat and humidity, as this maximizes energy and capital equipment savings for the highest ROI.

3. *Easy cleaning and low maintenance***:** Seek a solution that is easily accessible for cleaning and maintenance. Energy wheels that cannot be cleaned are less effective over time, resulting in shorter life spans and unrealized energy savings.

4. *Performance Modeling***:** Look for a solution with computerized modeling software that predicts performance and savings. The most accurate programs incorporate weather trends and regional differences.

5. *Trusted provider***:** Choose AHRI 1060 performance certified providers to ensure the highest-quality equipment and strong customer service.

Conclusion

The high energy cost of outdoor air ventilation is a pressing issue among building owners eager to save money while providing a clean, healthy building. Energy recovery wheels offer an

environmentally friendly solution to cut energy costs, provide fresh outdoor air ventilation, and guarantee a high return on investment.

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[1] *Site-recovered energy* is any energy recovered on site and re-used to reduce the demand for new energy.

[2] (2011). FlexYourPower. HVAC system.

[3] Scott, J. (July 7, 2010). ASHRAE. Standard 90.1: Setting the energy foundation in buildings for 35 years. News release.

[4] (November 30, 2009). ASHRAE Standard Project Committee 189.1. Standard for the design of high-performance, green buildings except low-rise residential buildings.

[5] EPA, IAQ Design Tools for Schools

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