HVAC Gains with No Budget Pains

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HVAC Gains with No Budget Pains

*By **James L. Newman**, CEM, LEED AP, FESD, BEAP, OPMP*

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It's hardly news that buildings use 40 percent of the natural resources and more than 70 percent of the electrical energy in the United States. And facility managers know there are plenty of ways to get buildings to use less energy — measures that send savings directly to the bottom line. By now, most facility managers have replaced magnetic ballast T12 lamps with electronic ballast T8s, or even more efficient lamps. Many have installed motion sensors. If the lighting retrofit was good enough, the organization might have received a tax deduction of up to $0.60 per square foot under the Energy Policy Act of 2005 (EPAct 2005).

But what about the "heart and lungs" of a building: the HVAC system? The thermal energy plant and HVAC systems can go from "green" to "gray" in a very short time after they have been installed or retro-commissioned. Nevertheless, implementing HVAC upgrades is far from easy in many organizations. Many companies put off having an energy audit by an outside team because they don't want to spend the money on what the recommendations in the audit might cost.

Fortunately, there are many ways to improve HVAC performance that do not cost a lot of money to implement. Some have more to do with the manner in which the building is operated than the actual HVAC system itself. Most low- and no-cost items fall into four categories:

- **Equipment Scheduling.** HVAC equipment running when not required is a major source of energy waste. HVAC equipment running when it's not needed, along with plug loads for chargers, computers, copiers and printers, task lights and other items that are on when not necessary, can account for as much as 10 percent of electricity

use. Chargers typically use more energy when left plugged in 24/7 than the equipment they charge.

- **Sensor Error.** Sensors are seldom calibrated after installation, yet over time they drift from their setpoints. Or use of the area has changed but location of the sensor or its setpoint has not.
- **Simultaneous Heating and Cooling.** To make working spaces more comfortable, many older HVAC systems use some form of reheat. That in itself is an energy hog, but if the cooling and heating setpoints are incorrect, more energy will be used than is necessary.
- **Outdoor Air.** The amount of outdoor air brought into a building to provide proper indoor air quality (IAQ), usually mandated by code, is a function of the number of people, area of the space and type of work. Issues like outside air dampers that are stuck in the open position or artificially held open (or closed), sensors that aren't working properly — or are incorrectly wired to the return and the outside air damper so that the damper is wide open, instead of being at minimum position during extremes of hot or cold temperatures — contribute probably more than almost anything to increased energy use, as well as potential comfort problems.

There are many ways to reduce energy costs by addressing these four areas without spending a lot of money.

Equipment Scheduling

HVAC equipment often operates during hours it is supposed to be off, even though the building automation system (BAS) says it is off. Checking the BAS to make sure it is operating properly does not take an extraordinary amount of time but can save an extraordinary amount of money.

Don't stop with HVAC if the goal is to find low-cost ways to reduce energy use. Put plug loads on a power strip that sits on people's desks and teaching them to turn off the toggle switch when they leave at night. There are also power strips that automatically turn off after a period of time where there's been no load. Of course, occupants must be taught to save the work on their computers before they leave their desks. Education of occupants is an important part of a successful energy program, as is getting buy-in before the program begins and consulting them throughout the planning process.

Close Attention To Sensors

Problems with sensors are another common source of energy waste. Many "I'm too hot" and "I'm too cold" complaints are because people are reading numbers on thermostats as opposed to how they really feel — and the thermostats are reading incorrectly. Frequent travelers know there are many times when the hotel thermostat has to be set up or down well beyond what it reads to get the HVAC unit in the room to turn on.

Also, look at where the thermostat is placed in the area. Is it now just above a microwave oven or a coffee maker? Or has it been closed in by shelving and boxes so it's sitting in a dead air space where it cannot possibly be sensing correctly?

Being aware of where the thermostats are and recalibrating them on a regular basis is another low-to-no cost fix to conserve wasted energy and save money.

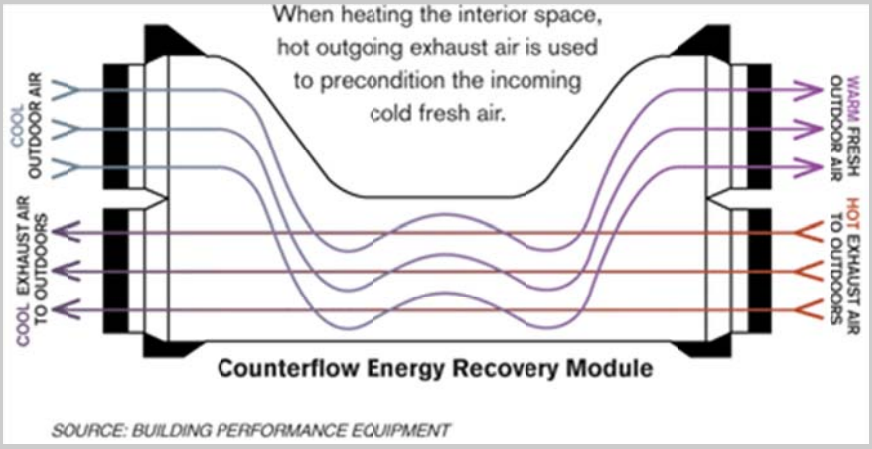
Another area of energy waste lies in enthalpy (humidity) sensors, typically used in air-side economizers. While newer designs maintain sensitivity for longer periods, older ones need to be checked and recalibrated at least once a year; otherwise, they might bring in excess outside air when the outdoor humidity in warm weather is higher than that indoors.

Energy Recovery Is Worth a Close Look

Adding energy recovery to existing HVAC systems is not usually a simple and inexpensive project, yet there are many ways to accomplish this, sometimes with relatively short paybacks — depending on exhaust temperatures. Run-around coil energy recovery loops do it hydronically with coils in the supply and exhaust air streams. They typically are easier to use in retrofit applications than systems that require bringing exhaust and supply air together, although they are not as efficient. There are also counterflow high-efficiency energy recovery modules, with efficiencies as high as 80 percent or more, that eliminate the need to buy complete packaged energy recovery units for retrofit. Many of these systems also provide relatively efficient latent recovery.

Whether the exhaust is only room temperature from bathrooms or is from higher temperature process exhaust systems, energy recovery should be considered. It is a very effective way to conserve energy without reducing the amount of outside air brought into the building, which can lead to IAQ problems and even Sick Building Syndrome.

— *James Newman*



Avoid Simultaneous Heating and Cooling

Most HVAC systems are oversized, as engineers are loathe to get sued for undersizing equipment. Therefore, if something isn't operating properly — for example, the airside economizer is bringing in too much outside air — the system will usually have enough extra capacity to overcome the problem. If the issue is overcooling in the winter, the system has the capacity to put additional heat into the space. If the problem is overheating in warm weather, the system can respond with more cooling where it's needed. This can be a difficult problem to find, as no one is complaining about being too hot or too cold. But it is an extremely costly way to maintain temperature in a space.

If the building isn't sub-metered, and there are no funds to install sub-meters, then a monthly, or preferably weekly, analysis of the systems is something that needs to be done to reduce energy use. With a BAS in place, this can — and should — be done on a daily basis. What you are looking for is a trend away from what is normal. For instance, if a large water-cooled chiller suddenly begins using more energy than it has in the past, it might simply be that an additional load has been added — or it might be that the condenser tubes have contaminant in them, decreasing their heat transfer capability. If that is the case, checking the operation of the cooling tower and its chemical system, if chemicals are being used, or cleaning the condenser tubes would be in order.

Another possible reason might be a sensor problem, e.g., the chilled water sensor isn't operating properly or requires recalibration, or some of the two- or three-way valves have problems.

In a new building or a major retrofit, especially one looking for LEED certification, it is advisable to sub-meter lighting, plug loads and HVAC systems — at the minimum. Suppose there is a large spike in summer electric use that raises the demand rate for the rest of the year. How can anyone tell what caused it if there is no sub-metering? - prices

have come down, especially with wireless. While this is not a no-cost solution to a potential problem, it is definitely one worth considering. Some utilities may offer incentives for sub-metering.

Managing Outside Air

Bringing in the proper amount of outside air is important to maintain good indoor air quality. Extensive experience with ASHRAE Level II energy audits on many different types of buildings has shown that most buildings bring in too much outside air. And most of them have no energy recovery, which in some cases, is not in compliance with energy codes.

Here is an extreme example. The building was an 11 million square foot installation in the Southeast. It was August, when the temperature was 95 F with a relative humidity of 72 percent. The building, which was only 10 months old, had a 200-ton air-cooled screw chiller working at full load. Perfectly reasonable for a late afternoon with that temperature and humidity, right? But there was practically no one inside the building. After a short investigation, it turned out that the dampers on the air handling units were all wired backwards, and the outside air damper was pulling in almost 100 percent outside air rather than being at its minimum position. The building had not been commissioned. The owner had been paying for all that warm, humid outside air to be cooled by the chiller for a sizeable portion of the time that the building had been in use.

Checking dampers on air handling equipment to make sure they're operating properly does not take a lot of time, and can bring large dollar savings.

Industrial plants all too often add processes that require exhaust, without adding the proper volume of makeup air. This unbalanced airflow situation causes cold or hot, humid air, along with dirt, leaves and other particulate, to be brought in through open

overhead doors, cracks in walls and window framing. This can affect both the productivity of the people and the effectiveness of the process.

"Greening" facilities is not always about buying the most efficient equipment, but rather making sure existing equipment is operating as well as it can be and that facility staff knows what's going on in the facility. An older, less efficient HVAC system maintained and operated well can perform better than a newer, more efficient system operated poorly.

Most facility managers have only enough money and time for reactive maintenance. Yet everyone in the field knows this is not the proper, and certainly not the best, way to do it. What's more, reactive maintenance, seemingly the least expensive route, actually increases maintenance costs. Making that argument to top management can help justify funds for preventive or predictive maintenance.

Many times there is no choice but to propose a major retrofit, with a longer payback period than the C-suite folks might find acceptable. Bundling this with shorter payback or no-cost items will show an overall better payback.