Stop Wasting Money!

How Building Owners and the Design and Construction Industry Can Conserve Energy and Save Money with Low-Cost and No-Cost Fixes – and Improve IEQ at the Same Time

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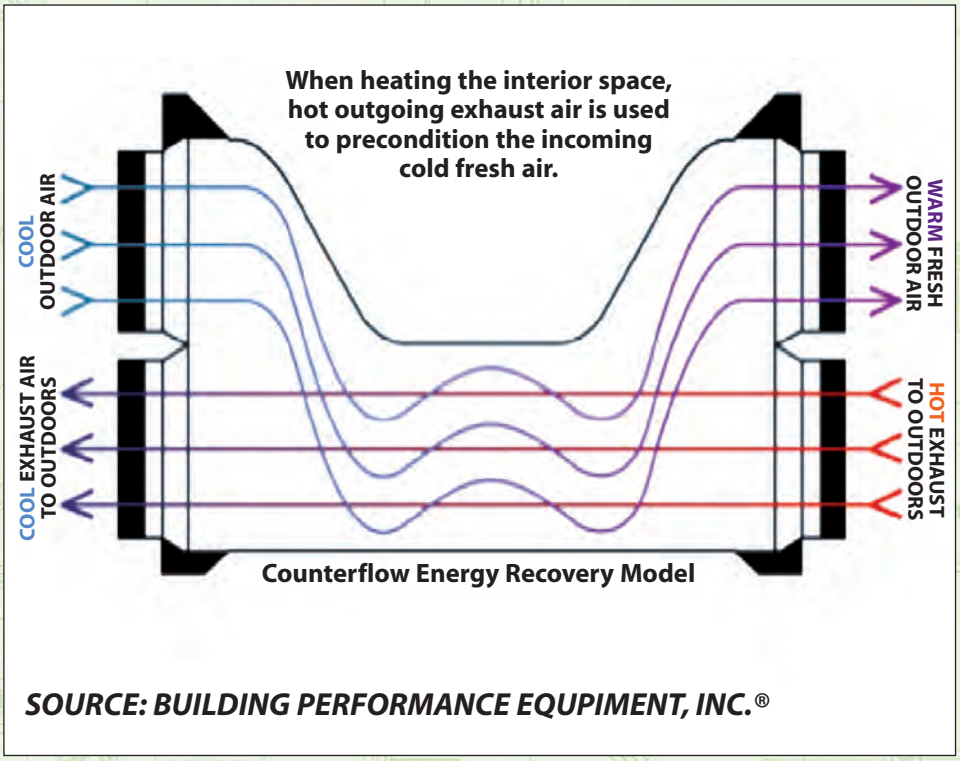
According to the World Business Council for Sustainable Development, 40 percent of the energy used in the U.S. is consumed by buildings. And most building owners know that energy costs are one of the largest expenses of operating a building. They also know that the HVAC systems can go from "green" to "gray" in a very short time after they have been installed or retro-commissioned.

So why do so many building owners and managers avoid energy audits, either performed internally or by an outside professional audit team? Usually it is because they don't want to spend money on what they speculate the recommendations in the audit might cost. Does this sound familiar? But having an energy audit, and implementing some low and no-cost recommendations, can yield a great return.

A well-run building is like a finely tuned vehicle. There's the building envelope - the exterior body and doors. The HVAC systems are the engine, and the duct work is the distribution system. If the exterior is good, but the engine and the exhaust system are in poor shape, the energy usage - and the operating and maintenance costs - will be higher for both the building and the vehicle in this analogy. At the same time, the indoor environmental quality (IEQ) typically will suffer.



SOURCE: BUILDING PERFORMANCE EQUIPMENT, INC.®

Whether the building is large or small,

new or old, urban or suburban, HVAC performance can be improved without spending a lot of money. Often it has more to do with how the building is operated than the HVAC system itself. And if you are thinking about these while the building is under construction, you will be ahead of the game.

Most low-cost and no-cost energy saving steps fall into four primary categories of operations and maintenance:

- Equipment Scheduling
- Sensor Error
- Heating or Cooling When You Shouldn't Be
- Managing Outside Air

EQUIPMENT SCHEDULING

Building Automation Systems (BAS) are becoming more common and should be a part of every new construction project or retrofit. But most BAS systems do not have feedback loops, meaning adjustments must be made to optimize the systems.

When was the last time you checked your BAS? Even though the BAS says the HVAC equipment is off, are you sure the HVAC equipment is not actually operating when it is supposed to be off? Is HVAC operating in vacant offices or stores? Are there other areas of the building that don't require certain HVAC systems to be running during normal operating hours? Does the HVAC system really need to be running on Saturdays?

Making sure the BAS is operating properly should not take an extraordinary amount of time (except perhaps for the first time) but can save an extraordinary amount of money. Evaluations should be scheduled at least annually or even quarterly.

Another often overlooked but easily implemented energy saving technique is to use power strips to turn off plug loads, sometimes called parasitic loads. The EPA estimates that devices plugged into electrical receptacles, such as chargers, task lamps, computers, copiers, and coffee machines are 10 to15 percent of the electrical load in a commercial building, and soon will be 15 to 20 percent of that load. Building tenants can help reduce energy draw by taking these steps:

- Put plug loads on a power strip at each work station.
- Educate employees and tenants to turn off the toggle switch when they leave for any extended time period.
- Alternatively, use power strips that automatically turn off after a period of time when there's been no load. Educate employees to save the work on their computers when they leave their desks.
- Make sure any new purchases are Energy Star-rated.

SENSOR ERROR

Problems with enthalpy (humidity) sensors, sometimes used in air-side economizers in rooftop units and other air handling equipment, can also lead to energy waste. 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 cool weather is higher than that in the return air. This causes the chiller, or the compressors in a rooftop unit, to work harder than they would otherwise. Recalibrating thermostats on a regular basis and placing them correctly is another low-to-no-cost fix.

HEATING OR COOLING WHEN YOU SHOULDN'T BE

Do you really want to both heat and cool your building at the same time? Unfortunately, this happens a lot, and it may be happening in your building right now. Many buildings end up with oversized HVAC systems. This is supposed to help the system compensate when something isn't operating properly. While temperatures may be maintained, energy costs will spike. So wouldn't it be better to have a right-sized system working properly? Here is an example of what happens when the HVAC has to compensate:

- If the issue is overcooling in cold weather, the larger heating system has the added capacity to put additional heat into the space.
- If the problem is overheating in warm weather, the cooling system can deliver more cooling.

Basically, if the airside economizer is bringing in too much outside air, the oversized heating/cooling system will usually have enough extra capacity to overcome the problem. The problem can be difficult to find as no one is complaining about the temperature. But it is a costly way to maintain temperature.

Fortunately, there are two ways to address the issue: sub-metering and/or regular analysis. Any building with tenants should have sub-meters. Period. If the building isn't sub-metered, and there are no funds to install sub-meters, then conduct a monthly, or preferably weekly, analysis of the systems. With a BAS in place, this can — and should — be done on a daily basis.

Look for trends outside of what is normal. For instance, if a large water-cooled chiller is gradually using more energy than it has in the past, you will know there is a problem. Here are a few of the many possible reasons that might happen:

- An additional load has been added, or the weather has warmed.
- The condenser tubes have contaminant in them, decreasing their heat transfer capability.
- The cooling tower is not operating properly.
- The chilled water sensor isn't operating properly or requires recalibration.
- Some of the two- or three-way valves have problems that need to be addressed, e.g., they're not closing or opening properly.

In a new building or a major retrofit, especially one being submitted for LEED® certification, a building, at the minimum, should have sub-meters for lighting, plug loads and HVAC systems, as well as for water usage. Suppose there is a large spike in summer electrical use that raises the demand rate for the rest of the year. Sub-metering will indicate what might have caused the spike so it can be addressed.

While this is not a no-cost solution, it is worth considering. Prices for sub-metering have come down, especially with wireless, and installing them may be relatively low-cost compared with dollars spent on wasted energy. This is referred to as cost-avoidance. Check with your local utility companies as many offer incentives for sub-metering.

MANAGING OUTSIDE AIR

To maintain good indoor air quality you have to bring in the proper amount of outside air. Extensive experience with ASHRAE Level II energy audits has shown that most buildings bring in too much outside air. And most of them have no energy recovery. In some cases, this is out of compliance with current energy codes and/or ASHRAE Ventilation Standard 62.1.

Checking return and outside air 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.

Adding energy recovery to existing HVAC systems is another option. While not usually a simple or inexpensive project, building owners can often realize relatively short paybacks — depending on exhaust temperatures. Of course, if you can include energy recovery in the design of the building, all the better.

Run-around coil energy recovery loops do it hydronically with

coils in the supply and exhaust air streams. Although not as efficient, they are easier to use in retrofit applications than systems that require bringing exhaust and supply air together. There are also counter-flow, high-efficiency energy recovery modules, with efficiencies as high as 80 percent or more, that eliminate the need to purchase 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 is an effective way to conserve energy without reducing the amount of outside air brought into the building, which can lead to IAQ problems and even a "sick" building.

EDUCATION AND EXECUTION

Educating building occupants is a critical part of any successful energy program. All new tenants should be educated about energy saving measures in the building. Without that education and buy-in, most energy reduction programs will fail.

Saving energy in a facility is not always about spending money on the most "energy efficient" equipment. It's about making sure existing equipment is operating as well as it can, and about a well-informed facility staff that knows what's going on in the building.

Don't leave it all to reactive maintenance. Everyone in the field knows this is not the proper, and certainly not the best, way to do it. What's more, reactive maintenance - don't touch it until it breaks - is seemingly the least expensive route, but actually increases maintenance costs. Put some time, effort and money into preventive and predictive maintenance, so you can save money in the long run.

One year after a major building retrofit, the Empire State Building reduced its energy use by five percent. That may not seem like a lot, but it saved them $2.4 million. Ultimately, they expect a 38 percent reduction, saving $4.4 million per year. The project has less than a four-year payback, and attracted new tenants as well.

A newer, highly efficient, well-run system will cost the least to operate. But an older, less efficient HVAC system that is properly maintained and operated often can perform better than a newer, more efficient system operated poorly. Using the methods in this article, you can make significant reductions in energy use and save considerable money in the process – without spending considerable money to accomplish it.

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FOR MORE ADVICE ABOUT ENERGY EFFICIENCY MEASURES FOR THE HVAC SYSTEM AS WELL AS OTHER BUILDING SYSTEMS, CHECK OUT THESE WEBSITES:

- **ashrae.org/aedg** — ASHRAE's Advanced Energy Design Guides, available for free download
- **boma.org/evergreen** — BOMA's Guide to Green and Sustainable Building Operations and Practices
- **energystar.gov/portfoliomanager** — The U.S. Environmental Protection Agency's free online tool for benchmarking building energy use
- **ifmafoundation.org** — IFMA's guides on sustainability and commissioning
- **peci.org** — energy efficiency through proper operations and maintenance, commissioning, etc.
- **usgbc.org/leed/eb** — LEED for Existing Buildings: Operation and Maintenance Guidelines