HVAC

6 tips for higher performing HVAC systems

By James Newman

Owner's role: focus on long term.

What does it matter if filters are bent?

Learn from zero net energy designs.

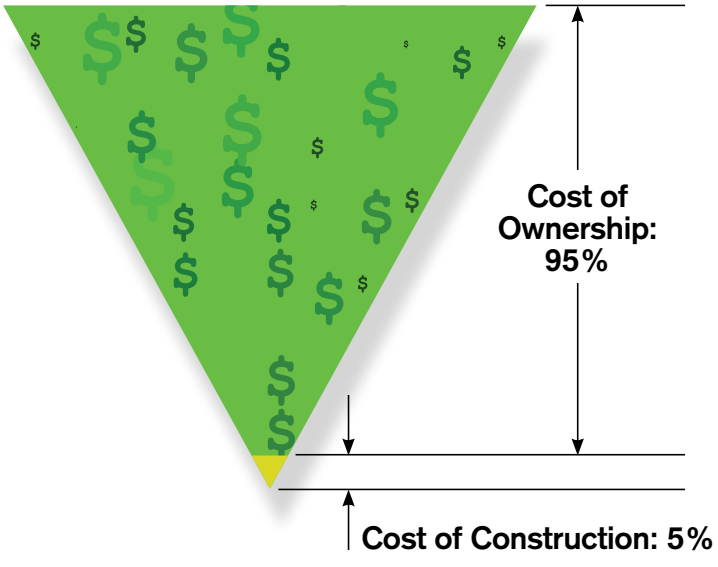
Many building owners don't give proper thought to how much impact a higher performing HVAC system can have on a building and its ability to be profitable. More often they focus on what other people say is important. For example, real estate developers and brokers have long purported that the three most important qualities in a building are location, location, and location. Architects believe buildings must be both stylish and functional, including easy access in and out, natural light, and lots of amenities like outdoor seating, fitness centers, and convenient access to food and fun.

All of these are important. But more and more, building owners and potential tenants look for an environment that is all those things — as well as one that is cost-effective to operate, supports the productivity of the people working in the space, and stands up to increasing weather and security threats. The design of the HVAC system goes a long way to shaping a building's long-term operating costs, its ability to deliver the comfortable indoor environment that can support productivity, and its capacity to sustain operations through potentially catastrophic events. Studies show that economy of operation, productivity, and resiliency can be achieved if the building is energy efficient, has a lower environmental impact, incorporates emergency preparedness principles, and offers good comfort and indoor air quality. A good way to reach those sometimes conflicting goals is with a high performing HVAC system.

What are the keys to designing and maintaining a higher performing HVAC system? The best systems take into consideration how the building is used and managed and are customized to the building.

Experience shows that keeping six things in mind can help owners reach the goal of a higher performing HVAC system.

HVAC: Total cost of ownership



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While higher efficiency HVAC equipment may cost more, the reduction in operating costs can make that greater initial investment a very cost effective decision.

1 Understand costs

Cost is always a major consideration. Building owners work with architects and engineers to stay within budget for the initial cost of the system, the cost to run it (the energy it uses), and the cost to properly maintain it. Good quality engineering — i.e., effective design along with proper maintenance — reduces cost and increases the life of the building equipment.

Let's consider how to reduce initial cost. It's often true that higher efficiency equipment costs more, but you may not be comparing apples to apples. With a higher efficiency system, you may be able to reduce the size of the unit. A smaller, more efficient unit may even cost less than a larger, less efficient one — and that's a win-win.

For example, in the design of an HVAC

system for a casino several years ago, the original plan called for a 4,000-ton capacity system. It is still often typical for casinos to use 100 percent outside air so this made sense. A filtration enhancement system allowed the amount of outside air needed to be reduced. This reduced the tonnage by 25 percent from 4,000 to 3,000 tons. That meant the size of the pumps could be reduced, along with the piping and the electrical switch gear — a huge savings in equipment as well as labor. What's more the downsized system cost less to run. And code officials were shown that this filtration system could provide better IAQ than using the greater amount of outside air normally used for casinos. The moral of the story is that spending more on high performance equipment — in the case of the casino, high-performance filtration — can be a very cost-effective strategy.

2 Design in room for maintenance

A second serious problem is providing inadequate space for maintenance of HVAC equipment. Some mechanical rooms are so tight you cannot get the dirty filters out of the filter box to exchange them for clean ones. Either there is not enough room between the side of the filter box and the wall next to it, or another piece of equipment is in the way. Filters have to be bent to get them out.

So what? You're done with them, what does it matter if they are bent? It matters because the new ones will have to be bent to get them in. Bent filters do not work optimally; air bypass will cause the cooling or heating coil to become a filter thus making the coil less efficient and subsequently reducing the capacity and effectiveness of the entire system.

When planning the mechanical room, prepare for the worst. Remember that, someday, that large, heavy motor will have to be replaced. If you don't have enough room, how do you get it out of the air handling unit? How do you get the new one in?

And if you are in or near a flood plain, don't put equipment in the basement where it's more likely to take on water. These are points that everyone involved in the design needs to think about.

The best design teams typically include the architects, the mechanical and electrical designers, the building owner and the owner's facilities staff including the building engineers. And if contractors are already involved, the contractors and perhaps even manufacturers or their representatives should be on the team too.

Mechanical engineers are often expected to help the lead design engineer figure out how to shoehorn the mechanical equipment into a room that is really too small for it. And ductwork is supposed to be designed with a decent aspect ratio, even when there isn't enough room to do that. One project ended up with a duct that was 4 inches high and 4 feet long. It fit, but was not the best outcome for the building. Ductwork that is not sized properly, or installed properly, can be noisy as well as consume additional energy. Another option is placing the equipment outside if possible, and above ground level — and, of course, properly protected from the elements and from people.

3 Consider hybrid systems

There is a growing movement toward net-zero energy buildings. Those building to net-zero standards typically use renewable energy, co-generation, and passive heating and cooling. Some eliminate standard HVAC systems by using better building envelopes, siting, and design.

For building owners not yet ready to adopt a net-zero energy goal, hybrid HVAC systems are worth considering — not only for conserving energy, and thus saving money, but also for the reduced impact on the environment compared to a traditional system. The other benefit of a hybrid system is the built-in redundancy, so that in case of emergency, it can be less likely the building will lose all means of heating and cooling.

There are many forms of hybrid systems. Here are a few:

• Gas-, hot-water-, or steam-driven chillers can conserve energy and reduce cost of electricity during time-of-day pricing, and may be able to produce heat for reheat, preheating water, or other uses.

• A hybrid geothermal system — i.e., one combined with a small boiler and cooling tower or closed-circuit cooler — requires less space and is less expensive to install than a full geothermal field. The cost savings would more than offset the additional maintenance and the potentially higher utility operating cost required for the boiler and chiller.

• If there can be a use for the heat output, a combined heat and power system can not only conserve energy but also supplement utility power during times of sustained grid problems.

4 Get useful data

Today it's all about the data. Data rule everything. So you would think that the more information you can collect about a building's operations the better. Right? Not so fast. True, there are wonderful systems that help the building engineer, facility manager and owner see what's going on with their systems. But there's a danger of overdesigning control systems and providing so much information that it overwhelms the people who are looking at it.

All buildings should have some form of energy information system (EIS) rather than simply a building energy management system (EMS). An EIS doesn't control equipment the way an EMS does. Rather, it gathers, organizes, and often analyzes data to make it easier for the operating staff to take actions that reduce energy waste. EIS are easier to use and less costly to install today than only a few years ago.

5 Test and balance the system

How do you know what's really going on with the building HVAC system? A testing and balancing contractor can help create that picture and answer important questions:

• Is the air handling unit delivering the right amount of air?

• Is the right amount of air getting through all the grilles, registers, and diffusers into the space — and returning from the space?

• How much leakage is there in the duct system, both supply and return?

The best-designed HVAC systems are not going to function properly if the proper amount of air is not delivered.

6 Don't stop with design

When designing HVAC systems for long-term optimal performance, don't just look at the initial cost of the system. To begin with, determine if you can reduce first cost, or at least break even with first cost — and reduce operating costs — by creating a better building envelope, using daylighting properly, optimizing water use, reducing the amount of outside air, etc. Factor in the lifelong expense of keeping it running optimally (and having it shut down if it's damaged due to weather or other unforeseen events), but do not treat the maintenance department as an expense. Treat good maintenance as an asset, because that's what it really is.

If you want the same optimal performance year after year — along with the energy and cost savings that come with it — you may need to think about increasing your initial budget and your ongoing maintenance budget. The savings will come in continued energy efficiency (read: lower utility bills), less need for emergency (reactive) fixes, and improved air quality.

Thoughtful planning is key for new buildings or renovations. Whatever stage you're in — designing, installing, commissioning, operating, re- or retrocommissioning — there's a common thread: Effective maintenance and proper planning for resiliency may be the most important factors in the long-term success of an HVAC system. ■

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