How to Reduce Data Center Energy Use

By David Lewellen

PUE, LEED drive Data Center Energy Efficiency

Given all the power that data centers use, it's no surprise that energy efficiency is a hot topic in the industry. "Interest in energy efficient data centers has grown as companies realize they can lower the cost of operating a data center by reducing fees for power consumption," says Robert Cassiliano, CEO at Business Information Services and chairman of **7x24 Exchange**.

The good news for facility managers is that a range of proven measures — including some relatively low cost steps — can be taken to cut energy use significantly.

Energy efficiency is far more than talk for many data centers today. One tangible sign of progress on data center energy efficiency is that typical power usage effectiveness (PUE) numbers have been falling. PUE, the main measure of data center energy efficiency, is defined as total power use divided by IT power use.

In general, says Paul Schlattman, senior vice president at ESD Consulting, a design PUE of 1.4 with an operating PUE goal of 1.2 annualized has become the basis of design. He says that seven or eight years ago, a PUE of 1.8 or higher was acceptable.

Cassiliano says he sees a slightly higher PUE value in the design of new corporate data centers. "New data centers typically are targeting PUEs of 1.6 or better," says Cassiliano.

The move to energy-efficient data centers got a boost when the U.S. Green Building Council released its LEED for Data Centers rating system in 2013. Corey Enck, vice president of LEED technical development, says that the

USGBC worked with the industry to quantify how data centers are different from other buildings and rate them accordingly. Of course, energy use is “orders of magnitude different from a typical site,” Enck says. Beyond that, commissioning a data center requires a specific skill set, Enck says, and the standards for indoor environmental quality are actually lower. That’s because so few employees typically work there.

Water use, too, is far different from a typical office building, in which LEED standards reflect sinks and toilets. A data center’s water use has to be evaluated using industrial standards. Enck says it’s “just a different output, data instead of widgets.”

The new LEED certification applies only to buildings solely devoted to data centers. Developing criteria for an office building that might have one floor of data storage is a longer-term project, Enck says.

Basic Steps

Whether a data center is standalone or part of a larger building, or new construction or legacy space, a set of fundamental best practices can go a long way to achieving energy efficiency.

A good place to start is with air flow.

“It’s important for customers to maintain discipline around their own equipment,” Rinard says. “Air is like water. It seeks the path of least resistance.” To help control that flow, Equinix uses blanking plates in server cabinets with unused slots; if a customer’s cabinet has 10 empty spots, a metal and foam block can plug those spaces. To reduce overall energy use, Equinix also builds its facilities with variable-speed drives in its HVAC equipment and installs smart control systems.

Along with effective air flow management, the use of hot-aisle or cold-aisle containment is a proven way to trim energy use.

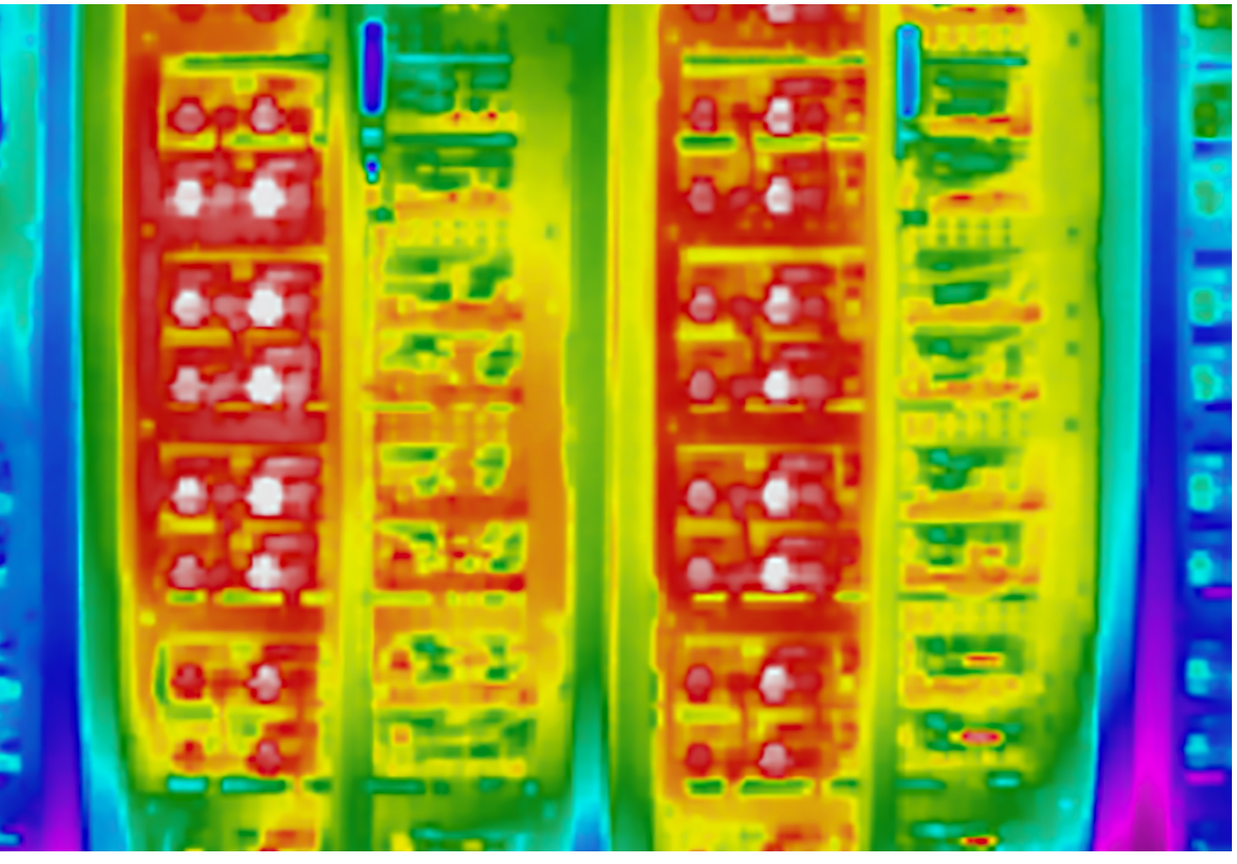
A standard practice at new facilities is to install servers in double rows, with back sides (hot) facing each other. Building partitions to keep the hot aisles and cold aisles separate lowers overall cooling costs; cooled air feeds into the servers’ intakes before it can mix with hot air being sucked out. Containment can also be implemented in existing data centers.

Perhaps the simplest energy-saving technique of all is probably to let the building get warmer. That’s because ASHRAE and the IT industry have agreed that servers can handle higher temperatures than they used to. Years ago, 68 to 72 degrees was considered the standard, according to David Rinard, senior director of global sustainability for Equinix, which runs 146 colocation data centers totaling 6 million square feet.

However, today’s IT equipment can handle temperatures of 78 degrees or more, meaning less cooling is needed.

Data Centers Get More Sophisticated About Air Flow, Higher Temperatures

While the concept of allowing data centers to operate at higher temperatures is easy to understand, implementation can be harder. “Believe it or not, some technology executives still think data centers need to be run like an ice box,” Cassiliano says.



The challenge for a colocation provider, Rinard says, is that if one customer wants the servers kept at a colder temperature, the request basically has to be honored.

In some settings, waste heat from the data center can be used to warm the rest of the building (or an adjacent building, in some cities). Enck says the same strategy can be used in some other settings, such as laboratories.

“We’re getting fairly sophisticated at getting the right amount of air at the right temperature,” Rinard says.

And air at the right temperature, or at a close enough temperature, can come from outside the building. “Fifteen years ago, outside air was a bad thing,” Rinard says, but technology has progressed for filtering out dust and dirt. And that approach uses less energy than re-circulating and re-cooling the air within the building. Outside air, in most places and most seasons, “keeps the environment clean as well as utilizing free cooling,” Rinard says, and “moves the heat to where it doesn’t matter.”

That envelope is rapidly being pushed to new borders; even in the challenging environment of Arizona, which com-

bines extreme heat and sandstorms, eBay is building data centers with no compressor-based cooling. Dale Sartor, a staff engineer at the Lawrence Berkeley National Laboratory, said that when a chip runs at 180 degrees, “if done well, even 120 degrees is cool.” Sartor explains that eBay’s state-of-the-art modular containers are built “with the entire cold aisle wall exposed to the outside. Air passes through louvers, filters, an evaporative air wash (for cooling and cleaning when needed), and then through the servers and out the hot aisle back to the outside.”

Location Can Improve Energy Performance

For a new data center, one basic energy-saving strategy is simply location: a data center in Minnesota will have lower cooling costs than an equivalent data center in Arizona. “If the shell of the building stays cooler, everything stays cooler,” says Kelly Sullivan, Vice President of Global Data Center Operations for Century Link.

Choosing a location is easier for huge firms that can fill an entire data center with their own servers. However, companies in the colocation business “have to be where our customers want us to be,” Rinard says. Many companies that rent server space will send employees to check on them. Rinard says that someone is in Equinix facilities 24 hours a day, so they contain “a few meeting rooms and break rooms for the human beings.”

In some locations, nature helps with energy costs above and beyond a cool climate. Rinard says that Equinix’s Toronto data center pulls cold water from the bottom of Lake Ontario for cooling, so that the site doesn’t need a chiller at all; pumps and fans are sufficient.

Schlattman points out that another factor to consider in siting a new facility is how often the area experiences blackouts — and unfortunately, California, Texas and the East Coast all rate poorly in that respect. Even though data centers have generators and UPS, using them will hurt sustainability ratings. A compromise that Google and some other large companies are using, he says, is to build large data centers in states like North Dakota or Nebraska, which can offer few blackouts and plenty of free cooling, and smaller facilities near population centers.

The life cycle of a UPS system at a colocation provider is 12 to 15 years, Schlattman says, which means that now and in the near future, many data centers will need upgrades. New tenants, he says, tend to want their data stored at newer, more efficient sites, which is another reason why the industry will be seeing retrofits and consolidation.

Sullivan says that in addition to designing hot and cold aisles, some straightforward steps to save energy include installing LED lighting (often getting a local rebate in the process), installing variable-speed drives in HVAC upgrades, and turning off lighting, because “in our business, after normal business hours, not a lot of people come in.” (Customers who want to check their servers at odd hours should be able to override the controls, however.)

Advanced data center energy efficiency measures include replacing inefficient cooling plants with more efficient chiller units. Also, Sullivan says, older UPS units are very inefficient at low loads, so CenturyLink will shut down some of the older boxes to make sure that the remainder run at least 50 percent of capacity.

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Of course, not every data center is a large building with new equipment. Many servers are housed in converted closets or spare rooms, which were not designed for energy efficiency. A report from the **Lawrence Berkeley National Laboratory** points out that in such cases, the data owner rarely pays the utility bill or sees a submetered bill, which reduces both the urgency to improve efficiency and the means to measure it. However, consolidation of servers

and turning off unneeded machines can save energy; so can raising the setpoints for temperature and humidity in the small data room. Another technique is the use of blanking plates and other basic steps to regulate air flow.

Other steps that facility managers can take include setting up a schedule to replace equipment; getting training in energy efficiency for IT and facility operations staff; and installing a dedicated cooling system for the data room (preferably with variable-speed drives) instead of letting the entire building's system run around the clock.

Sullivan says that although reliability and redundancy will always be first for data center customers, energy efficiency is definitely on their minds now. But are they willing to pay more for data stored in a green center? "Never," he says flatly.

Even so, interest is growing, and the new LEED standards have been well received by the market. "The changes have really resonated with this industry," Enck says. "They're set up to benefit from LEED certification."

Renewable Energy Gaining Ground In Data Centers

No matter how energy efficient they become, data centers will always be energy hogs. That's one reason more and more data centers are looking at renewable energy.

"Utilizing renewable energy sources aligns with the corporate social responsibility policy for many firms," says Robert Cassiliano, CEO at Business Information Services and chairman of 7x24 Exchange. "In many instances, it is a matter of image and reputation."

Equinix plans to use 50 percent renewable energy in 2017, with a long-term goal of 100 percent, says David Rinard, senior director of global sustainability for Equinix, and in discussions with customers, "renewable energy is starting to become table stakes. We're seeing it in our RFPs; we're getting lots of questions and lots of interest."

A creative solution that involves renewable energy, Schlattman says, is happening in Phoenix, where methane gas from a landfill is helping to power a new data center, and water harvested from the chiller is being used for cooling. The expense of installing the system is expected to pay for itself in about six years, he says.

The interest is industry-wide. Cassiliano says that 7x24 Exchange conference attendees have expressed interest in topics related to renewable energy and energy efficiency. "To address this interest 7x24 Exchange has had speakers from the U.S. Department of Energy present the president's Better Buildings Challenge, The Green Grid and ASHRAE deliver talks on efficiency, and companies such as Google speak about how they utilize renewable energy sources. In Google's presentation they discussed the use of sea water to cool their data center in Finland.

"So, yes, there is interest in renewable energy," Cassiliano concludes. ■

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