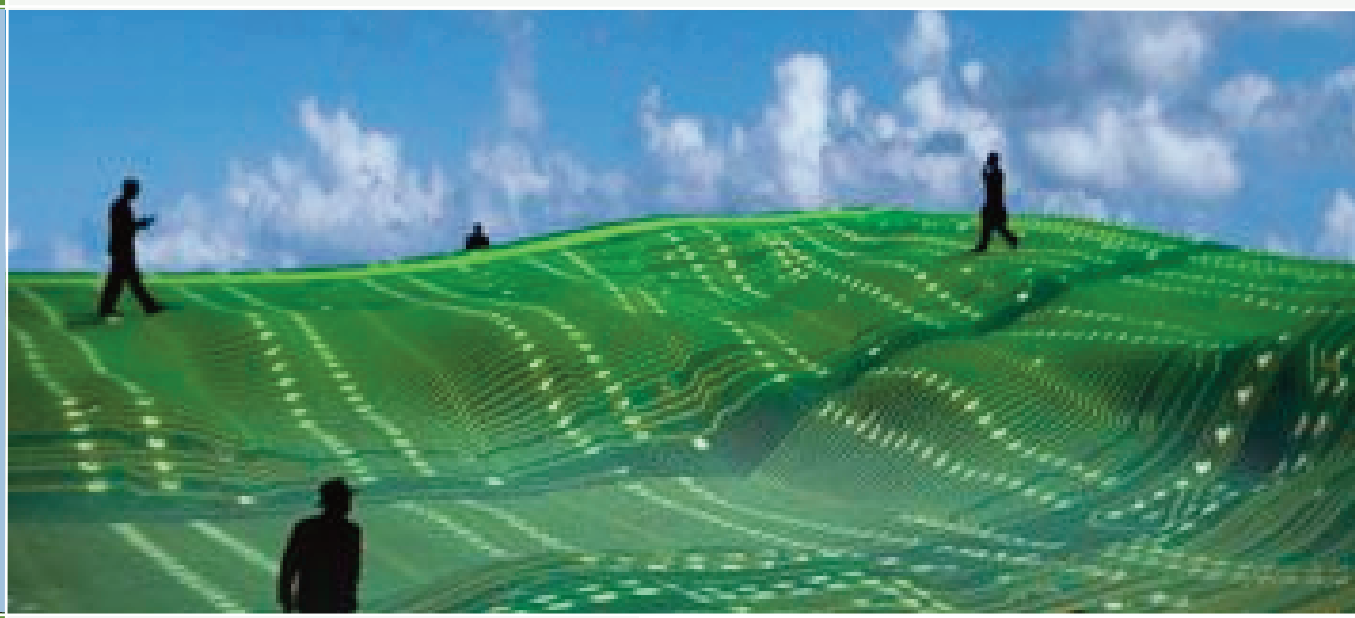
THE

State of Power

for the Adaptable, Resilient Data Center



The Quest to be Green

Few data centers fully capitalize on the opportunities

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An exclusive TechWeb Research survey

IT teams grapple with some harsh realities. The cost of powering and cooling the data center is outpacing the cost of IT resources themselves. High-density equipment pushes power and cooling systems to maximum capacity. Moves, adds and changes can put the power infrastructure at risk of overloads, tripped circuits and unplanned shutdowns.

It doesn't have to be that way. There are practical and affordable ways to ease these concerns without making major changes in the power delivery system.

Executive Summary

The Quest to be Green

"Data center energy efficiency is a priority, but the results of a TechWeb survey show that lots of work remains to truly go green."

High-efficiency power quality systems, greater visibility into power conditions at all levels, flexible options to power all those dual- and triple-corded power supplies, servers, modularity for flexible growth… New approaches and technologies such as these are redefining the economics and environmental impact of running the modern data center.

Why are so few organizations taking advantage?

The results of a new survey conducted by TechWeb for Eaton® show that companies have lots of work to do when it comes to ensuring that they are optimizing their energy usage for IT. Among the key findings of the research:

- A large number of organizations have no formal program underway to reduce energy consumption related to IT.
- Few are using readily available solutions such as energy-efficient UPS (uninterruptible power supply), energy-efficient storage and process changes to reduce energy consumption in the data center.

Energy efficiency is a priority, but a neglected one

TechWeb's survey of 265 data center decision-makers in the U.S. shows that energy efficiency in the data center remains a priority. About three-quarters of the survey respondents say data center energy efficiency is a priority, and 56 percent say it is either somewhat more of a priority or a much higher priority at their organization compared with two years ago (see Figure 1).

But in spite of the growing focus on energy efficiency, fully 40 percent of respondents say their organization has no formal program in place to reduce energy consumption related to the IT infrastructure or data center—and they have no plans for such a program. About one-quarter of the organizations don't currently have a program but plan to adopt one within 12 months (see Figure 2).

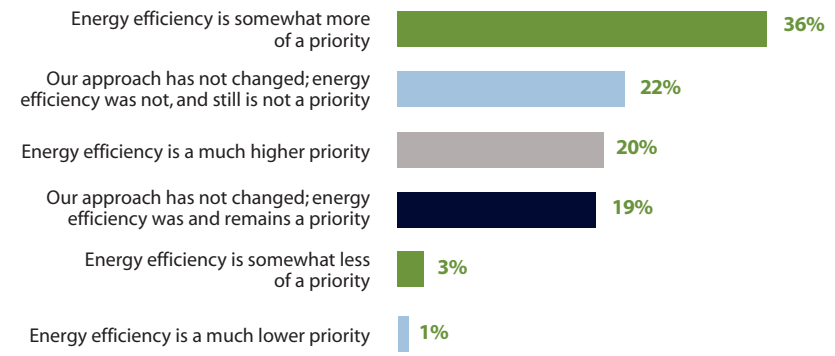
In short, we see a situation where 75 percent of respondents acknowledge an urgent problem to be addressed, and 67 percent have done little or nothing about it so far.

In fact, in some areas of data center operations, energy efficiency doesn't even seem to be a major factor in decision-making. For example, when asked to identify their top concern regarding backup power in their data center, only 19 percent named operating cost/energy efficiency—which ranked well below capacity concerns. Similarly, when asked to identify their top

Methodology

TechWeb surveyed 267 InformationWeek readers in November 2008 in an online survey examining data center power and reliability. Survey participants primarily hailed from IT management and staff (74 percent), followed by project management (6 percent) and executive management (4 percent). They represented a cross-section of industries, with the greatest number of participants representing the fields of education, manufacturing and healthcare/medical. Fifty-one percent of respondents came from companies with 100 to 1,000 employees and 39 percent came from companies with more than 1,000 employees.

Figure 1: How would you describe your organization's approach to energy-efficiency in the data center, compared with two years ago?
Three-quarters of respondents say data center energy efficiency is a priority—slightly more than half say it's more pressing than it was two years ago.



Source: The State of Power, TechWeb Research, November 2008

concern related to cooling systems, 46 percent of respondents pointed to capacity, while operating costs and energy efficiency ranked a distant second.

Reducing energy consumption

Data centers and servers consume a considerable amount of the nation's total supply of electricity—some 61 billion kilowatt-hours (kWh) as of 2006, about 1.5 percent of total U.S. electricity, according to the *Environmental Protection Agency Report to Congress on Server and Data Center Energy Efficiency.* That's about the same as the energy consumption of the entire U.S. transportation industry (including the manufacture of cars, planes, trucks and ships). Data centers consume more power than all the color televisions in the country put together—double the demand of only six years ago.

Furthermore, the cost for each of those kilowatt-hours keeps going up. For many IT organizations, energy costs now represent the largest component of total cost of ownership—and the most stifling influence on IT expansion.

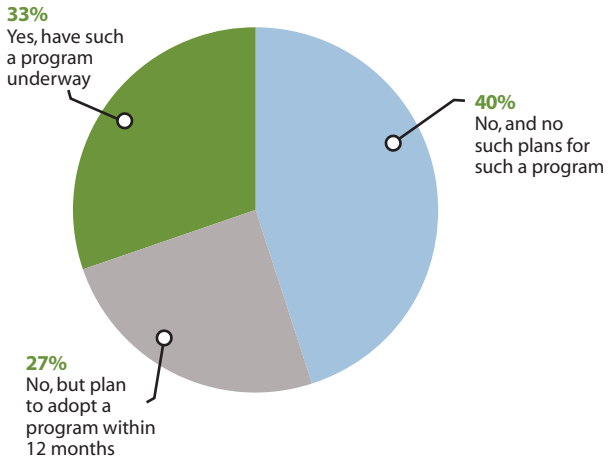
If IT leaders are not aggressively seeking to reduce energy consumption, they should be. Our survey showed some positive trends—many organizations do apply energy-saving practices—but they could more fully exploit the possibilities.

To date, efforts to reduce energy consumption have focused largely on server consolidation, server virtualization and blade servers (see Figure 3). Few organizations capitalize on other energy-saving practices, such as using outside air to reduce cooling costs, shifting batch processes to utility off-peak hours, and matching storage drives to the tasks required of them.

All of these practices can help cut energy bills and make the data center more environmentally friendly, so it makes sense to explore and combine all feasible options.

For example, advances in UPS technologies have greatly improved the efficiency of these systems. In the 1980s, most UPSs used silicon-controlled rectifier (SCR) technology that operated at a low switching frequency and were 75 to 80 percent efficient at best. With the advent of new isolated gate bipolar transistor (IGBT) switching devices in the 1990s, switching frequency increased, power conversion

Figure 2: Is there a formal program underway at your company to reduce energy consumption related to the IT infrastructure/data center?
One-third of respondents have a program in place to reduce data center energy consumption, and 27 percent say their organizations plan to adopt such a program in the coming 12 months.



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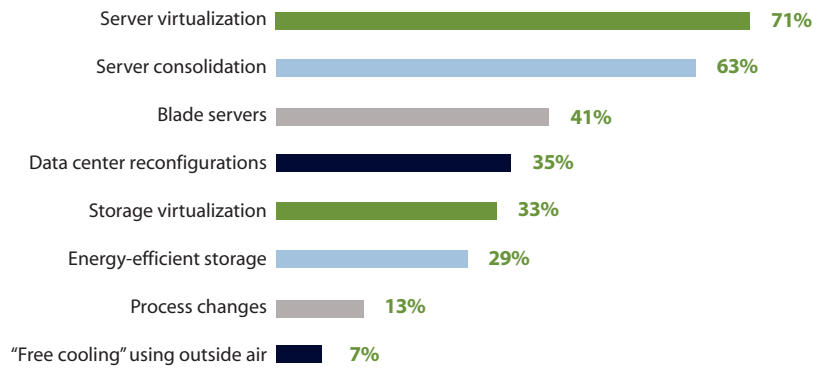
losses decreased accordingly and UPSs could run at 85 to 90 percent efficiency.

When even higher-speed switches became available, there was no need for UPS solutions to include transformers, which helped boost efficiency to 90 to 94 percent. The Eaton BladeUPS®—optimized for today's IT equipment power supplies—operates at a remarkable 97 percent efficiency.

Even small increases in UPS efficiency can quickly translate into thousands of dollars, in more real power and lower cooling costs. In a one megawatt data center, a 10-year-old UPS is probably wasting about 150 kW of power and dissipating a lot of heat. Replacing that vintage equipment with new, high-efficiency UPSs can free up about 120 kW of that power to support new IT equipment and reduce the burden on cooling systems. Assuming a utility rate of 10 cents per kWh, a 60 kW N+1 redundant configuration would save more than $30,000 in five years. The savings compound with data center size.

Figure 3: Which of the following is your organization using to try to reduce energy consumption in the data center?
Most survey respondents are relying on server virtualization and server consolidation to reduce data center energy consumption.



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You cannot manage what you don't measure

Ask any data center manager about server utilization, available CPU capacity and network latency and throughput, and you will get specific, accurate figures. This information is known; it is considered fundamental to running the data center. But ask how much power capacity is available for new IT equipment, how much battery runtime to cover outages, and how much surplus cooling capacity is available, and you're likely to get a blank look.

Our survey confirmed that awareness is low in these critical aspects of data center operations—traditionally viewed as facilities responsibilities, not IT concerns. When asked to quantify the average power consumption per rack in their organization's data center, nearly half of the respondents said they did not know (see Figure 4). If they were to build out new racks and cooling systems, more than half the respondents said they did not know what power density figures they would use to plan for that growth.

Of those who claimed to have a handle on power consumption, 19 percent conservatively estimated 2 to 5 kW per rack. Another 15 percent estimated 5 to 7.5 kW per rack, 10 percent thought they used 7.5 to 10 kW per rack, and only 3 percent thought their racks consumed 10 to 11 kW apiece.

Those figures are likely to be quite different in the future. With the continued adoption of high-density IT systems, a single rack could soon consume 15 to 20 kW. That means less margin for error as new equipment and processes are added.

If you add a new piece of equipment, will you overload that branch circuit? Which rack has enough power to accommodate a new piece of equipment? How can you optimize the available power distribution in your data center without more capital investment? The greater the overall power consumption, the more critical these questions become.

These questions are answered with 7x24 power quality metering, which can now be conducted at several points in the power distribution chain:

- At the PDU or RPP level, a meter can monitor hundreds of branch circuits feeding tens of racks, with one IP address.
- At the sub-distribution level, a meter can monitor tens of power strips in a mulitple racks or a com-

plete row with one IP address.
- At the rack power strip, a meter can monitor a few branch circuits with one IP address.

The right strategy for any given data center will be a trade-off between the number of IP addresses the organization is willing to allocate, the number of devices to monitor, and degree of detail required.

Constant change is the norm

Nearly 40 percent of survey respondents said they need to manage moves/adds/changes (MACs) in the data center once a month. About one-quarter said it is at least once a week.

Is the power infrastructure up to these realities? How and where power components are implemented in a data center dictates how flexible and scalable the power chain will be, especially as the data center changes and grows. The good news is that there are more options than ever to tailor the power system for your unique data center requirements—and for the velocity of change.

For example, the conventional approach to power distribution is to bring power in from the utility or a large, centralized UPS to a transformer that "steps down" power to the desired voltage. Power then goes through the main breaker to a panel board, then to power strips in racks. The complexity of this arrangement—particularly multiple connections from panel board to power strips—makes it expensive, difficult to install, hard to monitor and prone to failure.

New power distribution units (PDUs) provide a more reliable and streamlined solution. A PDU eliminates the need for separate transformer, main breaker and panel boards. You have one factory-tested, pre-packaged solution, with options for integrated metering and monitoring.

PDU benefits extend even to distribution within the rack. New enclosure-based PDUs provide an effective way to manage the tangle of power cords, deliver plug-and-play power without taking up valuable rack space and offer visibility into current draw at any time.

Are you managing change or fighting fires?

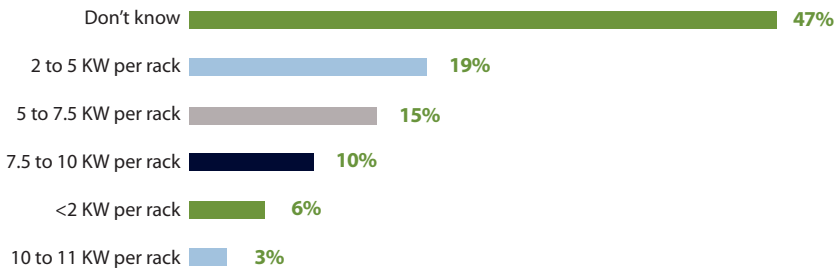
Even though MACs are commonplace, planning for them is not. One-third of our survey respondents said their organization has no set process for identifying and managing moves, adds and changes in the data center. Another 45 percent said they map out a process as each change is required. Only about 20 percent said they have a detailed process that is always followed.

That last 20 percent is operating at an advantage when it comes to enhancing reliability and reducing costs. "On a high level, our mission statement is really predicated on provisioning power and reducing consumption as much as possible," said John Martin, data center facilities infrastructure specialist at Independence Blue Cross, a health insurance provider. "My team hosts a weekly data center change management meeting to go over current and projected moves, adds and changes to the environment. We provide weekly metrics on power consumption relative to our overall capacity to senior management and the IT teams."

You can imagine the operational efficiencies that can be discovered and exploited, when change is managed systematically with power consumption metrics in plain view.

Figure 4: What is the average power consumption per rack in your data center?

IT awareness of data center power consumption is low, since it's traditionally viewed as Facilities responsibilities, not IT concerns. When asked to quantify the average power consumption per rack in their organization's data center, nearly half of the respondents said they did not know.

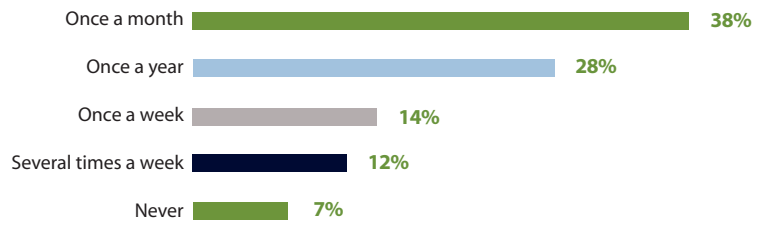


Source: The State of Power, TechWeb Research, November 2008

Is power the weakest link in your data center?

Slightly more than one-third of respondents said they have

Figure 5: How often do you need to manage changes, additions and moves in the data center?
Nearly 40 percent of survey respondents said they manage moves, adds and changes in the data center once a month, and about one-quarter manage moves at least once a week.



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experienced power reliability issues with their data centers over the last two years—most of them suffering more than one power outage in that timeframe.

If you think the risk of loss or downtime from a disaster such as a hurricane or fire is slight, you're right. Only a tiny number of data loss incidents are caused by site disasters (water damage, 3 percent; fire/smoke, 4 percent). Computer viruses also account for only a small percent of data loss incidents.The most destructive influences on data centers actually come from much more mundane causes: human error (19 percent), network equipment failure (13 percent), IT or cooling equipment malfunctions (27 percent), insufficient backup power provisioning and power outages (20 percent).

The majority of time, the culprit was a utility power outage, coupled with insufficient backup power systems (see Figure 5). That is actually good news, because it means your greatest risks of data center disruption are preventable—or at least can be greatly mitigated—with intelligent power protection strategies.

Savvy IT leaders will take advantage of new power protection systems—backup capacity with appropriate redundancy—to take those top two risk factors off the table to the extent possible.

Provision sufficient backup capacity. Realistically assess how much battery runtime you need. During an outage, you need enough runtime to gracefully shut down systems or switch to backup generators. New, modular UPS designs enable you to add internal and external batteries to increase runtime as more equipment is added to the load.

When the outage hits, selectively shed loads.When power outages extend beyond the limits of backup systems, power management software can orchestrate the selective, sequential shutdown of loads. For instance, the system could shut down power to non-critical devices, thereby extending battery backup time available for critical devices.

Establish redundant power protection systems. Separate UPSs can be set up to provide serial redundancy; even if the primary UPS is offline, its bypass path is protected by another UPS. Or a data center could be divided into separate zones served by separate UPSs, thereby minimizing the impact of taking a UPS out of service. Separate UPSs could serve either side of dual-corded loads—even source their power from different substations.Any of these options can be set up for duplicate redundancy.

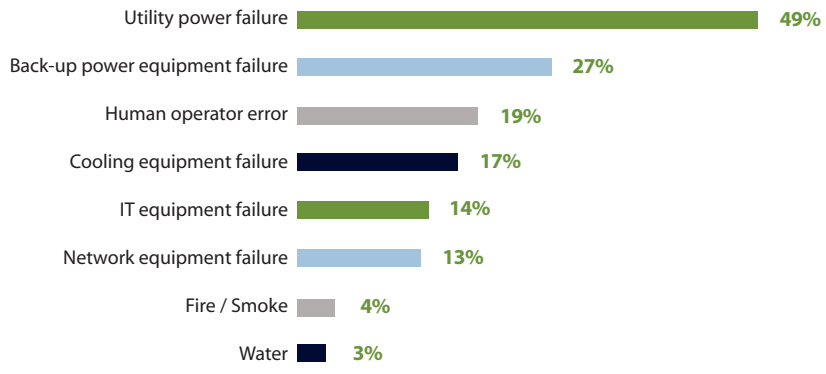
Where premium reliability and availability are required, but without costly and cumbersome "redundant-redundancy," the right choice is a parallel UPS configuration. In paralleling, two or more UPSs are electrically and mechanically connected to form a unified system with one output. In an N+1 redundant configuration, you would have at least one more UPS module than needed to support the load. As a conjoined system, each UPS stands ready to take over the load from another UPS whenever necessary, without disrupting protected loads.

Who should drive the data center to "green?"

Whose job is it to reduce energy consumption in the data center? There seems to be some disconnect between *involvement and responsibility*—which usually implies a parallel disconnect between ideals and incentives.

Data center managers and IT executives were seen as adopting a larger role in efforts to reduce energy consumption and costs. However, when it comes to overseeing energy consumption and costs, the most common designee was an operations or facilities manager, then perhaps a data center manager. In most organizations, the CEO or president, CFO or other finance executive and heads of business lines are not involved, even though their application demands are driving up the

Figure 6: How much of an impact have the following factors been on the interruptions to your data center operations? (Very high or high impact)
The most common causes of data center downtime are issues that can be resolved—or at least greatly mitigated—with appropriate power protection strategies.



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costs and environmental impact of the data center.

As a result of these disconnects, most organizations are missing opportunities to optimize their operations around energy efficiency and cost savings. They're missing opportunities for IT and facilities to work in tandem on energy-saving efforts, and they generally lack the executive-level endorsement that could make these efforts more accepted and successful.

"Many organizations are waking up to the concept of a gatekeeper function straddling the line between the two areas," said Martin of Independence Blue Cross. For example, Martin's facilities group participates in selecting servers, mainframes and storage devices, with an eye toward lifetime cost of ownership. As a result, facilities helps the IT team create a greener data center—one that the installed infrastructure can safely support.

Closing thoughts

Get IT leaders together, and the topic will quickly turn to the biggest potential bottleneck in data center expansion: power. Although data centers can now pack more processing power into less real estate, high-density computing environments can be a huge drain on operating budgets.

High-density 1U/2U and blade servers that are required to satisfy business users' demands are consuming three to five times as much power as previous-generation equipment in the same footprint. This equipment generates a lot of heat. For example, at 30 kW of power consumption per rack, you would need the equivalent of two five-ton household AC units for cooling. On top of these pressures, utility rates have risen three times in the last year alone, now accounting for 20 to 30 percent of data center operating costs.

The good news is that even a small data center can save tens of thousands of dollars simply through wise choices in management practices, IT hardware, power and cooling options. For example, the three-year utility savings from an energy-efficient server can nearly equal the cost of the server itself. Couple this strategy with energy-efficient power and cooling systems, and a mid-sized data center with 1,500 servers could save millions of dollars—while reducing the organization's carbon footprint.

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