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Get Up to Speed on Green IT

Whether it's in the front office or the server room, green thinking can save energy, trees and money.
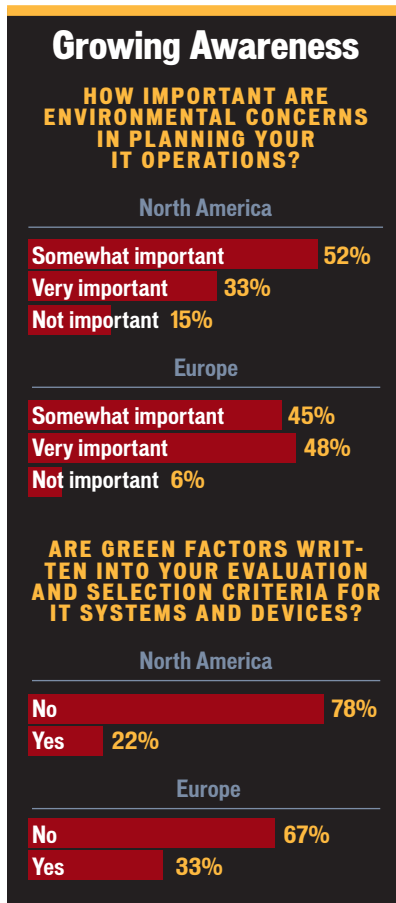
Green by Default

BY ROBERT L. MITCHELL

DON'T PANIC: You may be more green than you think you are. Leading IT industry vendors are trying to out-green one another by spending hundreds of millions of dollars on new, state-of-the-art showcase data centers, but practical, workaday IT operations are going green almost by default.

In the data center, going green is about energy efficiency first and foremost. Fortunately, efficiency is a natural by-product of solving the cooling, power and space challenges that today's data centers face.

An audit that weeds out unused servers not only opens up rack space but typically saves about $1,200 annually for every server decommissioned. Server virtualization projects may consolidate 20 physical servers into 20 virtual machines running on just one new physical box. That hardware may offer more than twice the performance of your old equipment while consuming less than half the energy of just one of those 20 servers you'll be retiring.

Simply replacing old hardware with new equipment moves your organization up the green curve. But you'll want to do more than that. Better power management can cut 20% off your load, saving energy while freeing up available power for other tasks in the data center. And choosing more energy-efficient components can help too.

Growing Awareness

HOW IMPORTANT ARE ENVIRONMENTAL CONCERNS IN PLANNING YOUR IT OPERATIONS?

North America

Somewhat important	52%
Very important	33%
Not important	15%

Europe

Somewhat important	45%
Very important	48%
Not important	6%

ARE GREEN FACTORS WRITTEN INTO YOUR EVALUATION AND SELECTION CRITERIA FOR IT SYSTEMS AND DEVICES?

North America

No	78%
Yes	22%

Europe

No	67%
Yes	33%

SOURCE: FORRESTER RESEARCH INC. SURVEY OF 91 NORTH AMERICAN AND 33 EUROPEAN IT PROCUREMENT PROFESSIONALS; FEBRUARY TO APRIL 2007

In the front office, simply sticking to your regular equipment refreshes will make your operation greener. Refreshing desktops with Energy Star 4.0-certified equipment can cut energy costs by 50% or more, while phasing out aging CRTs cuts power consumption by as much as two-thirds. Changing the type of printers you use and how you manage them can cut both power and consumable costs.

But IT also has an opportunity to be proactive. When you use tools that rein in desktop management costs, efficiency gains come for free. Just ask Verizon Wireless CIO Jeff Waghray, who cut help desk calls by 50% — and reduced energy costs 30% — by moving to thin clients. At Jenny Craig, thin clients cut power costs by 90%.

Smart management tools can enforce power management settings across all desktops and can deliver scheduled updates to PCs without requiring that they be left turned on after-hours.

Going green means more than simply conserving energy, but many of the steps you can take make good business sense. Better use of natural lighting is socially responsible and also improves the work environment. Proper disposal of old IT assets helps the environment and also helps you avoid the embarrassment and legal headaches of having your equipment show up in an illegal dump.

At the end of the day, being green usually makes good business sense. As Waghray says, green done right is "pretty much part and parcel of what you're doing anyway." Or, at least, what you should be doing anyway. Read on to be sure you've crossed your t's and dotted your i's. ∎

Seven Steps to a Green Data Center

ROBERT L. MITCHELL

HOW GREEN is your data center? If you don't care now, you will soon. Most data center managers haven't noticed the steady rise in electricity costs, since they don't usually see those bills. But they do see the symptoms of surging power demands.

High-density servers are creating hot spots in data centers that have surpassed 30 kilowatts per rack for some high-end systems. As a result, some data center managers are finding that they can't get enough power distributed out to those racks on the floor. Still others are finding that they can't get more power to the building: They've maxed out the power utility's ability to deliver additional capacity to that location.

The problem already has Mallory Forbes' attention. "Every year, as we revise our standards, the power requirements seem to go up," says Forbes, senior vice president and manager of mainframe technology at Regions Financial Corp. in Birmingham, Ala. "It creates a big challenge in managing the data center because you continually have to add power."

Energy efficiency savings can add up. A watt saved in data center power consumption saves at least a watt in cooling. IT managers who take the long view are already paying attention to the return on investment associated with acquiring more energy-efficient equipment.

"Energy becomes important in making a business case that goes out five years," says Robert Yale, principal of technical operations at The Vanguard Group Inc. in Valley

> **"If they spent $20 on [an energy-efficient] power supply, you would save $100 on the capital cost of cooling and infrastructure equipment.**
>
> **AMORY LOVINS**
> CHAIRMAN AND CHIEF SCIENTIST
> ROCKY MOUNTAIN INSTITUTE

Forge, Pa. His 60,000-square-foot data center caters mostly to Web-based transactions. While security and availability come first, he says Vanguard is "focusing more on the energy issue than we have in the past."

Green data centers don't just save energy, they also reduce the need for expensive infrastructure upgrades to deal with increased power and cooling demands. Some organizations are also starting to take the next step and are looking at the entire data center from an environmental perspective. (See "*Building to Be Green All Over*" on page 11.)

Following these steps will keep astute data center managers ahead of the game.

1 CONSOLIDATE SERVERS, THEN CONSOLIDATE SOME MORE

Existing data centers can achieve substantial savings by making just a few basic changes, and consolidating servers is a good place to start, says Ken Brill, founder and executive director of The Uptime Institute, a consultancy in Santa Fe, N.M., that has studied this issue for several years. In many data centers, he says, "between 10% and 30% of servers are dead and could be turned off."

Cost savings from removing physical servers can add up quickly — up to $1,200 in energy costs per server per year, according to one estimate. "For a server, you'll save $300 to $600 each year in direct energy costs. You'll save another $300 to $600 a year in cooling costs," says Mark Bramfitt, senior program manager in customer energy management at PG&E Corp. The San Francisco-based utility offers a "virtualization incentive" program that pays $150 to $300 per server removed from service as a result of a server consolidation project.

Once idle servers have been removed, data center managers should consider moving as many server-based applications as feasible into virtual machines. That allows IT to substantially reduce the number of physical servers required while increasing the utilization levels of remaining servers.

Most physical servers today run at about 10% to 15% utilization. Since an idle server can consume as much as 30% of the energy it con-

sumes at peak utilization, you get more bang for your energy dollar by increasing utilization levels, says Bogomil Balkansky, senior director, product marketing at VMware Inc.

To that end, VMware is working on a new feature associated with its Distributed Resource Scheduler that will dynamically allocate workloads between physical servers that are treated as a single resource pool. Distributed Power Management will "squeeze virtual machines on as few physical machines as possible," Balkansky says, and then automatically power down servers that are not being used. The system makes adjustments dynamically as workloads change. In this way, workloads might be consolidated in the evening during off-hours and then reallocated across more physical machines in the morning, as activity increases.

2 TURN ON POWER MANAGEMENT

Although power management tools are available, administrators today don't always make use of them. "In a typical data center, the electricity usage hardly varies at all, but the IT load varies by a factor of three or more. That tells you that we're not properly implementing power management," says Amory Lovins, chairman and chief scientist at Rocky Mountain Institute, an energy and sustainability research firm in Snowmass, Colo.

Just taking full advantage of power management features and turning off unused servers can cut data center energy requirements by about 20%, he adds.

That's not happening in many data centers today because administrators focus almost exclusively on uptime and performance, and IT staffers aren't comfortable yet with available power-management tools, says Christian Belady, distinguished technologist at Hewlett-Packard Co. He argues that turning on power management can actually increase reliability and uptime by reducing stresses on data center power and cooling systems.

Vendors could also do more to

facilitate the use of power management capabilities, says Brent Kerby, Opteron product manager on Advanced Micro Devices Inc.'s server team. While AMD and other chip makers are implementing new power management features, "in Microsoft Windows, support is inherent, but you have to adjust the power scheme to take advantage of it," he says. Kerby says that should be turned on by default. "Power management technology is not leveraged as much as it should be," he adds.

The potential savings of leveraging power management with the latest processors are significant. AMD's newest designs will scale back voltage and clock frequency on a per-core basis and will reduce the power to memory, another rapidly rising power hog. "At 50% CPU utilization, you'll see a 65% savings in power. Even at 80% utilization, you'll see a 25% savings in power," just by turning on power management, says Kerby. Other chip makers are working on similar technologies.

In some cases, power management may cause more problems than it cures, says Jason Williams, chief technology officer at DigiTar, a messaging logistics service provider in Boise, Idaho. He runs Linux on AMD64 servers. "We use a lot of Linux, and [power management] can cause some very screwy behaviors in the operating system," he says. "We've seen random kernel crashes primarily. Some systems seem to run Linux fine with ACPI turned on, and others don't. It's really hard to predict, so we generally turn it and any other power management off."

ACPI, short for Advanced Configuration and Power Interface, is a specification co-developed by HP, Intel Corp., Microsoft Corp. and other industry players.

3 UPGRADE TO ENERGY-EFFICIENT SERVERS

The first generation of multicore chip designs showed a marked decrease in overall power consumption. "Intel's Xeon 5100 delivered twice the performance with 40% less

power," says Lori Wigle, director of server technology and initiatives marketing at Intel. Moving to servers based on these designs should increase energy efficiency.

Future gains, however, are likely to be more limited. Sun Microsystems Inc., Intel and AMD all say they expect their servers' power consumption to remain flat in the near term. AMD's current processor offerings range from 89 W to 120 W. "That's where we're holding," says AMD's Kerby.

For her part, Wigle also doesn't expect Intel's next-generation products to repeat the efficiency gains of the 5100. "We'll be seeing something slightly more modest in the transition to 45-nanometer products," she says.

Chip makers are also consolidating functions such as I/O and memory controllers onto the processor platform. Sun's Niagra II includes a PCI Express bridge, 10 Gigabit Ethernet and floating-point functions on a single chip. "We've created a true server on a chip," says Rick Hetherington, chief architect and distinguished engineer at Sun.

But that consolidation doesn't necessarily mean lower overall server power consumption at the chip level, says an engineer in IBM's System x platform group who asked not to be identified. Overall, he says, net power consumption will not change. "The gains from integration . . . are offset by the newer, faster interconnects, such as PCIe Gen2, CSI or HT3, FB-DIMM or DDR3," he says.

4 GO WITH HIGH-EFFICIENCY POWER SUPPLIES

Power supplies are a prime example of the lack of focus on total cost of ownership in the server market, because inefficient units that ship with many servers today waste more energy than any other component in the data center, says John Koomey, a consulting professor at Stanford University and staff scientist at Lawrence Berkeley National Laboratory. He led an industry effort to develop a server energy management protocol.

Progress in improving designs has been slow. "Power-supply efficiencies have increased at about one half percent a year," says Intel's Wigle. Newer designs are much more efficient, but in the volume server market, they're not universally implemented because they're more expensive.

With the less-efficient power supplies found in many commodity servers, efficiency peaks at 70% to 75% at 100% utilization but drops into the 65% range at 20% utilization — and the average server load is in the 10% to 15% range. That means that inefficient power supplies can waste nearly half of the power before the power even gets to the IT equipment.

The problem is compounded by the fact that every watt of energy wasted by the power supply requires another watt of cooling system power just to remove the resulting waste heat from the data center.

Power supplies are available today that attain 80% or higher efficiency — even at 20% load — but they cost significantly more. High-efficiency power supplies carry a 15% to 20% premium, says Lakshmi Mandyam, director of marketing at power supply vendor ColdWatt Inc. in Austin.

Still, moving to these more energy-efficient power supplies reduces both operating costs and capital costs. "If they spent $20 on [an energy-efficient] power supply, you would save $100 on the capital cost of cooling and infrastructure equipment," says Rocky Mountain Institute's Lovins. Any power supply that doesn't deliver 80% efficiency across a range of low load levels should be considered unacceptable, he says.

Compounding the problem, Sun's Hetherington says, is the fact that server manufacturers have traditionally overspecified power needs, opting for a 600 W power supply for a server that really should only need 300 W.

"If you're designing a server, you don't want to be close to threaten-

> ## "Power management technology is not leveraged as much as it should be.
>
> **BRENT KERBY**
> PRODUCT MANAGER
> ADVANCED MICRO DEVICES INC.

ing peak [power] levels. So you find your comfort level above that to specify the supply," he says. "At that level, it may only be consuming 300 W, but you have a 650 W power supply taxed at half output, and it's at its most inefficient operating point. The loss of conversion is huge. That's one of the biggest sinners in terms of energy waste."

All of the major server vendors say they already offer or are phasing in more efficient power supplies in their server offerings.

HP is in the process of standardizing on a single power supply design for its servers. Paul Perez, vice president of storage, network and infrastructure, speaking at an Uptime Institute conference last year, predicted that future shipments of power supplies would have much higher efficiency. He added that HP is trying to increase efficiency percentages into the "mid-90s."

HP's Belady says all of his employer's servers use power supplies that are at least 85% efficient.

Smart power management can also increase power supply utilization levels. For example, HP's PowerSaver technology turns off some of the six power supplies in a C-class blade server enclosure when total load drops; this saves energy

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and increases efficiency.

One resource IT can use when determining power-supply efficiency are the results at 80Plus.org. This certification program, initiated by electric utilities, lists power supplies that consistently attain an 80% efficiency rating at 20%, 50% and 100% loads.

Stanford University's Koomey says that Google Inc. took an innovative approach to improving power-supply efficiency in its server farms. Part of the expense of power-supply designs lies in the fact that you need multiple outputs at different DC voltages.

"In doing their custom motherboards . . . they went to the power supply people and said, 'We don't need all of those DC outputs. We just need 12 volts,' " Koomey notes. By specifying a single, 12-volt output, Google saved money in the design that then went toward delivering a higher-efficiency power supply. "That is kind of thinking that's needed," he adds.

5 BREAK DOWN INTERNAL BUSINESS BARRIERS

While IT has carefully tracked performance and uptime, most IT organizations aren't held accountable for energy efficiency, due to the separation of IT functions from the facilities group. The former generates the load, while the latter usually gets the power bill, says Uptime Institute's Brill.

Breaking down those barriers is critical to understanding the challenge — and providing a financial incentive for change. Better communication among groups is also essential as cooling moves from simple room-level air conditioning to targeted cooling systems that move heat exchangers up to — or even inside — the server rack.

The line between facilities and IT responsibilities in the data center is blurring. "The solutions won't happen without coordination by people who hardly talk to each other because they're in different offices or different tribes," says Lovins.

The stovepiping problem has also afflicted IT equipment vendors, says Lovins. Engineers are now specialized, often designing components in a vacuum without looking at the overall system — in this case, the data center — in which their component will operate.

What used to be a holistic design process that optimized an entire system for multiple benefits got "sliced into pieces," Lovins says, with one specialist "designing one component or optimizing a component for single benefits."

6 FOLLOW THE STANDARDS
Several initiatives are under way that may help users identify and buy the most energy-efficient IT equipment. These include the 80 Plus program for power supplies, as well as a planned Energy Star certification program for servers. Under a congressional mandate, the U.S. Environmental Protection Agency is working with Lawrence Berkeley National Laboratory to study ways to promote the use of energy-efficient servers.

Standard Performance Evaluation Corp. (SPEC) announced a performance-per-watt benchmark for servers that should help provide a baseline for energy efficiency comparisons. The specification, SPECpower_ssj2008, will be useful for making comparisons across platforms, says Klaus-Dieter Lange, chairman of the SPEC Power and Performance Committee. The benchmark will measure energy efficiency at different load levels, he says.

7 ADVOCATE FOR CHANGE
IT equipment manufacturers won't design for energy efficiency unless users demand it. Joseph Hedgecock, senior vice president and head of platform and data centers at Lehman Brothers Holdings Inc., says his company is lobbying vendors for more efficient server designs. "We're trying to push for more efficient power supplies and ultimately . . . systems themselves," he says.

The Vanguard Group's Yale says his company is involved with The Green Grid and other industry organizations to push for greater energy efficiency. "We're becoming members of that, and I'm involved in different informational organizations," he says. "This is a topic that, industrywide, we're discussing, and [we're] trying to work with manufacturers." ∎

For more information about green IT practices, see the following Computerworld stories:

■ **GREENING UP IS ABOUT MORE THAN JUST ENERGY**
Data center managers talk about the coveted LEED green-building certification, how they earned it and why it matters to their businesses.

■ **OPINION: WHY ENVIRONMENTAL GROUPS ARE WRONG ABOUT E-WASTE**
'Reupgrading' works better than recycling.

■ **COOL YOUR CHIPS: WHAT'S AHEAD IN ENERGY MANAGEMENT**
One technique works like crisping produce in the supermarket; add-on modules spray water on hot chips at predefined intervals.

■ **BUSH SIGNS LAW TO STUDY DATA CENTER ENERGY USAGE**
The president has authorized the EPA to study energy consumption in servers and processors.

■ **WHEN IT COMES TO IT ENERGY COSTS, LITTLE STEPS CAN SAVE A LOT**
IT managers are turning more attention to the cost of power.

■ **CONGRESS BEGINS PUSH FOR ENERGY-EFFICIENT SERVERS**
But don't look for Energy Star ratings on your servers anytime soon.

Five Steps to a Leaner, Greener Desktop

BY ROBERT L. MITCHELL

FIRST, the data center dialed back its power consumption. Now it's the front office's turn. Concerned about soaring energy costs, IT organizations have begun to make significant changes to the way their data centers are powered and cooled. But many IT departments haven't yet looked at saving energy by targeting the rest of the company's IT equipment.

That's short-sighted, say IT organizations that have been down this road. The reason — data centers may use more power per square foot, but as a percentage of total power consumption, it's office equipment that's the big kahuna.

"Office equipment has become more highly featured and powerful than ever before, but there's an energy cost to that," says Katherine Kaplan, who manages the Environmental Protection Agency's Energy Star consumer electronics and IT initiatives.

"If you look at overall power consumption, you're seeing almost double for computers and monitors than for data centers," says Jon Weisblatt, senior product manager for power and cooling initiatives at Dell Inc.

Verizon Wireless is one company that is saving plenty of green by going green. Earlier this year, the wireless carrier deployed Night-Watchman power management software from 1E Ltd. that puts desktop computers and monitors in offices, stores and call centers into power-saving mode after a period of inactivity, overriding any personal settings. Another 1E product, SMSWakeUp, automatically "wakes up" those machines after-hours to deliver patches and updates, shutting them down again when the process is complete. "It saved us [money] just turning computers on and off on demand," says CIO Ajay Waghray.

But Waghray didn't stop there. He also replaced 7,000 PCs with power-sipping Sun Ray thin clients from Sun Microsystems Inc. in Verizon's call centers and migrated to LCD monitors companywide (a process that's still ongoing). Replacing nonmanaged PCs in 10 call centers with 7,000 managed thin clients cut energy use for that equipment by 30%, says Waghray. He estimates that the two initiatives combined have cut front-office power consumption by $900,000 a year.

To Waghray, going green is good business. The projects were good for customer service — off-hours patching and the more-reliable thin clients improved uptime and reduced trouble-ticket volumes by 50%. "Just do business to make things more efficient, simple and customer-focused, and green becomes a very important factor," he says.

There were an estimated 900 million desktops in use worldwide in 2006, according to IDC. Even if all of those units were Energy Star 2006-compliant, they would still consume 426 billion kilowatt-hours of power annually.

If all of that equipment met the 2007 Energy Star 4.0 specification, it would cut power consumption by 27% over 2006 Energy Star levels, according to Marla Sanchez, principal research associate at the Lawrence Berkeley National Laboratory in Berkeley, Calif. That would save 115 billion kilowatt-hours — enough to power all of Switzerland for nearly two years — and cut greenhouse gas emissions by about 178 billion pounds.

Do your part to reduce some of those emissions — and save your own company some dough — by following our five tips on saving resources and increasing the efficiency of front-office equipment.

1 DO AN ENERGY AUDIT

It's hard to know where you stand if you don't first measure the efficiency of the equipment you have.

Fortunately, doing a power audit of ordinary office equipment is less complicated than auditing your data center. A simple, inexpensive meter that fits between the target device plug and the outlet can measure both current loads and cumulative power consumption over time.

If you select a device with a typical usage pattern — say, a laser printer that gets an average-for-your-office workout each day — you can multiply the results across the total population of similar equipment to quickly estimate total power consumption. From there, all you need to do is multiply use in kilowatt-hours by your local electricity rates, and you've got a baseline for savings.

Meters range from the simple to the advanced. P3 International Corp.'s Kill A Watt or Sea Sonic Electronics Co.'s Power Angel are both simple to use and inexpensive.

More advanced units, such as the Watts Up Pro from Electronic

Educational Devices Inc., store data and include software for downloading and graphing that data to show watts, volts and kilowatt-hour consumption over time, giving a more accurate picture of power use.

When the facilities staff at Farmer's Almanac publisher Gieger Brothers in Lewiston, Maine, did an initial power audit, it became "a driving force behind initiatives to get power consumption down," says Joe Marshall, business systems analyst and software specialist at the firm. The audit revealed that computer equipment was consuming nearly as much power after-hours as it was during the day.

After you've audited energy use, the next step is to audit your internal processes to ensure that equipment is being used in the most energy-efficient manner, says Robert Aldrich, a senior manager specializing in energy efficiency at Cisco Systems Inc. And once you have that process audit — in other words, once you know how well you are doing human-behavior-wise — the next step is to "kick the tires on technology" by taking a look at utilities such as power management tools, he says.

2 ADOPT AND ENFORCE POWER MANAGEMENT

"The biggest impact you're going to make in your overall computing environment is to get systems to go to sleep," says Dell's Weisblatt. For example, a laptop that uses 14 to 90 watts in full operation uses less than 1 watt in standby mode. Desktops consume even more, and a single CRT monitor may use upward of 90 watts.

Most companies, however, aren't managing power settings in a coordinated way, and many desktops don't have power management turned on at all.

Enhanced power-management tools provided by system vendors aren't even installed in the baseline system image of many corporate PCs. "We do all this work to make [computers] optimized for power management, and we find big corporations go and make changes and de-

> **"If you look at overall power consumption, you're seeing almost double for computers and monitors than for data centers.**

JON WEISBLATT
SENIOR ÐPRODUCT MANAGER
DELL INC.

optimize it," says Howard Locker, director of new technology at Lenovo.

The issue is that it takes IT extra work to integrate and test Lenovo's bundled software with the company's standard image, he says. Often, organizations don't want to take the time to do that.

Some corporations, however, are starting to get the message. Network administrator Keith Brown deployed LANDesk Software's LANDesk to manage — and lock down — power settings on all laptops, desktops and attached monitors at Gwinnett Hospital System in Lawrenceville, Ga.

Like 1E's SMSWakeUp, LANDesk takes advantage of Intel Corp.'s vPro Active Management Technology (AMT), a feature built into the vPro series processors that supports remote management. It enables LANDesk and similar tools to remotely turn on PCs, upload updates, and turn the machines off again. "It allows you to do 'out-of-band' management on desktops," enabling control even when machines are turned off, explains Brown.

For times when laptops are turned on — that is, when they're being used by employees — Lenovo recommends configuring the disk drive to spin down after five minutes of inactivity, the monitor to go blank at 10 minutes,

and the machine to go into standby, or suspend, mode after 20 minutes.

Others, such as Amory Lovins, chairman and chief scientist at energy efficiency think tank Rocky Mountain Institute, recommend even more aggressive settings. He suggests turning off monitors and spinning down the disk drive after just two or three minutes of inactivity.

Verizon's Waghray says he had no trouble enforcing power-saving settings. Machines power off at 12:30 a.m. and back on at 5:30 a.m. Desktop monitors and hard drives go into power-saving mode after two hours, while on thin clients the monitors and processors go into low-power mode after 20 minutes of inactivity.

At Gieger, things have worked out differently. While the company does centrally control power management settings, it has had to back off a bit. "There's been a little bit of pushback on that, so we're taking baby steps," Marshall says, noting that current monitor timeouts are set for one hour.

The problem for users is that recovery times vary. Getting back online from hibernate mode, where the system turns off and the system's state is saved to disk, can take up to 30 seconds. It takes just a few seconds, though, to recover from low-power suspend mode or for the monitor or disk drive to come back to life. Still, some users don't like to wait at all, says Marshall.

Every organization needs to find the right balance, managers say. "A few seconds of [wait] time for the average person is not going to be invasive," says Jorge Bandin, vice president of information systems and technology at hosted services provider Terremark Worldwide Inc. His company forces all PCs to go into sleep mode after 30 minutes of inactivity.

In a call center, where computers are in use all the time, sleep mode is less of an issue, but even so, people aren't given a choice, says Waghray. When users step away from a console for more than a couple of minutes, the system is powered down and locked.

3 DUMP THOSE CRTs

Replacing older computers and peripherals with Energy Star-rated equipment can save both energy and space — and the lower power consumption can significantly reduce cooling loads in office areas, further extending savings.

The place to start is with CRT displays.

"The biggest offenders are the monitors," says Brown. Most businesses have already begun phasing out CRTs in favor of more efficient LCDs, which use about one-third less power, but they still have plenty of CRTs waiting to go. Verizon Wireless accelerated its refresh cycle because doing so not only saved energy but freed up valuable desk space in its call centers, says Waghray.

Energy savings can add up. Brown estimates that Gwinnett Hospital System is already saving between $30,000 and $60,000 a year in electricity costs after replacing about 70% of its CRTs with LCD monitors and using automated power-management tools.

4 SLIM DOWN THE CLIENT

As for the desktop, look for equipment that is Energy Star 4.0 compliant. Previous Energy Star ratings looked only at low-power modes, but "with this new version, we're comparing energy use while working," the EPA's Kaplan says. Computers that meet the standard consume 20% to 50% less energy than those that meet previous Energy Star standards, says Kaplan.

Compact PC models, such as Lenovo's ThinkCentre A61e desktop or Dell's Inspiron 531, are more efficient than standard desktops and save space as well as power (the A61e is about the size of a 3-inch-thick notebook binder). Compact PCs may use as little as half the power of a standard desktop, include Energy Star 4.0-mandated high-efficiency power supplies that are at least 80% efficient, and include a low-speed fan that reduces noise levels.

Many businesses, including Jenny Craig, are moving to a Terminal Services or Citrix Presentation Server setup, which enables them to use easily managed thin-client PCs on the desktop. Thin clients use less power and space, since they have no disk drive or fan, and the Windows session and applications run on the server.

For Jenny Craig, the noise factor was as important as energy savings when choosing Wyse Technology's thin clients. "When you throw 10 or 12 PCs into a front desk, you can't hear your customers anymore," says Alessandra Nicoletti, director of IT operations. So she moved the stores onto a Citrix Presentation Server back end and Java applications, and populated 484 Jenny Craig weight loss centers with thin clients from Wyse, which don't need a fan. Operating power consumption ranges from 6 to 35 watts, and power management settings can be locked and remotely managed.

While replacing PCs with thin clients does require adding servers on the back end that boost power requirements, the savings on the desktop more than make up for that, says Jeff McNaught, chief marketing officer at Wyse. With the 64-bit edition of Presentation Server running on the back end, 1,000 PCs can be accommodated on three 800-watt servers. That amounts to about 3 watts per client, he says.

Jenny Craig's system uses 90% less energy than the PCs it replaced. "We see it on the bills [for the centers]," Nicoletti says.

Waghray says thin clients had other benefits in Verizon Wireless' call centers, where equipment density is high and space is at a premium. "We have seen a reduction in cooling needs for the whole building," he says.

For all their energy-saving benefits, thin clients won't work in every case, such as for some graphics or compute-intensive applications. Northrup Grumman Corp.'s space technology sector is rolling out 3,000 thin clients and has tested 39 engineering applications. While most ran just fine, a few graphics-intensive ones didn't

work, says Clayton Kau, vice president of engineering.

And other companies have encountered user resistance. Gwinnett Hospital System has dabbled in thin clients but has stalled at around 100 terminals. "It hasn't always worked out as we had hoped," says Brown, noting that most employees pushed back, preferring to have a fully equipped desktop that runs their applications locally.

POWER SAVINGS AT THE NETWORK LEVEL

WHEN IT COMES TO NETWORKING, power savings are more difficult to come by. In other words, sleep mode doesn't help much when the network never sleeps.

"If you want [your] YouTube video to come up in three seconds or less," quips Robert Aldrich, a senior manager specializing in energy efficiency at Cisco Systems, "the switches moving those packets have to be in always-on ready mode."

But he sees that changing. "By this time next year, any end devices we sell will have some sort of power-efficiency mode. That's a big initiative for us," he says.

Voice over IP and power over Ethernet (PoE) have also increased upfront office power demands by pushing power consumption from a central PBX out onto the desktop. An IP phone adds about 15 watts of power to each cubicle – which adds up when you have 1,000 or more users. The PoE-enabled switches in the wiring closet also use more power than non-PoE models do.

Overall, however, a native VoIP system typically consumes less power than the digital PBX system it replaces, Aldrich says.

5 PRINT MORE EFFICIENTLY

Desktops and laptops aren't the only area where IT can improve efficiency. Printers tend to be kept longer than PCs, but each year new models bring greater efficiencies.

With each generation of Hewlett-Packard Co.'s printers, for example, energy efficiency has increased by 7% to 15%, according to the vendor's statistics. Therefore, replacing units a few generations old with new, Energy Star-labeled models can cut energy costs by as much as 25%. Also, consumables packaging may be smaller with new machines, which means less waste to throw away.

New technologies are also improving efficiency. Last spring, for example, HP began replacing the fluorescent tubes used for photocopying with LEDs in some products. The technology uses 1.4 times less energy during copying and four times less power when idle, according to the company.

Printers are also getting smarter about when to go into low-power mode. Multifunction printers from Xerox Corp., for example, monitor printer usage patterns over time to decide when to power down and to bring the machines online.

Both Jenny Craig and Terremark Worldwide have configured printers to print double-sided by default. While using duplex mode doesn't save energy, it does avoid unnecessary utilization of paper, says Jorge Bandin, vice president of information systems and technology at Terremark. Duplex mode can cut paper consumption by up to 25%, says Dave Lombato, environmental lead for HP's LaserJet business.

While that won't cut the company's energy bill, it does cut down on paper costs as well as the energy and carbon emissions required to produce paper. According to Forrester Research Inc., pulp and paper manufacturing is the third-biggest consumer of energy in North America, behind steel and chemicals.

Administrators can configure duplex printing across all printers, invoke power-saving modes or configure machines to shut down during specific evening or weekend hours using automation tools available from various printer vendors.

Consolidating and better managing printers, scanners and other peripherals also saves energy and money. According to Forrester, individual copier, printer and fax machines can consume 1,400 kWh of power annually, while a single, multifunction printer (MFP) consumes half that amount.

Multifunction printer devices, which combine copying, printing, scanning and fax, offer additional efficiencies, making consumables management easier and saving space as well as energy. Consolidating just two devices into a single machine, for example, cuts energy consumption by about 40%, according to HP. Terremark uses MFPs in conjunction with j2 Global Communications Inc.'s eFax service, which routes incoming faxes to an e-mail in-box instead of to a printer.

But while MFP sales are growing at double-digit rates, many businesses still have an array of printers, copiers, scanners and fax machines that remain largely unmanaged. "For every MFP out there, there are [still] six or seven printers," says IDC analyst Keith Kmetz. By 2011, however, IDC expects the ratio to be closer to one to three.

While there's no one-size-fits-all solution for energy-efficient computing, the best options will be those that complement the business by simplifying processes, making staff more efficient and serving the customer better, says Verizon Wireless' Waghray.

While green isn't necessarily the goal, he says, it is a means to those ends. The best way to begin, he says, is to "start to think about [green computing] as something that's pretty much part and parcel of what you're doing anyway." ∎

TO SAVE ENERGY, MOVE DATA, NOT PEOPLE

ENERGY-EFFICIENT COMPUTERS are good; energy-efficient people are even better. A green office is about more than using energy-efficient equipment: The application of information technology to support teleconferencing and telework can make both people and businesses more efficient.

Several hundred people employed with Cox Communications Inc.'s call center this year began working from home four days a week. Using a browser and their own home computers, remote staff access a suite of applications hosted on a Citrix Presentation Server back end.

To access the system, call center workers download a browser plug-in and then authenticate to the system. "We can present the entire environment to any computer anywhere. We even stream content to employees for staff meetings," says Josh Nelson, vice president of information and network technology.

By rotating different teleworkers into the office on different days of the week, Cox has cut computer equipment and cubicle space needs, and avoided a building expansion.

Employees benefit, too: In an era of $3 a gallon gasoline, they have taken to the voluntary program because it saves four commuting trips to the office each week and takes several hundred cars – and the emissions they produce – off the roads each day. "It's been quite impressive from a cost perspective [and] what it does for the environment," Nelson says.

Terremark Worldwide's hosting business requires employees to travel both globally and locally between facilities for everyday meetings. It recently deployed videoconferencing systems from Tandberg to tie together conference rooms at its facilities. Before, staff made regular trips between the main offices and the company's hosted data center facilities two hours away.

"It helped us avoid about 20% of the travel we were doing before," says George Bandin, vice president of information system and technology. "Just within our own facilities, it's a huge savings in fuel and time."

Building to Be Green All Over

BY DARRELL DUNN

MANY BUSINESSES have at least begun to take stabs at the cooling and heating problems in their data centers, even if only in the planning stage. But few are looking holistically at the data center's entire sphere of operation to reduce the impact on the environment and the use of natural resources.

Some 800 buildings have been given the stamp of Leadership in Energy and Environmental Design (LEED), a certification given by the U.S. Green Building Council (USGBC) for the past decade to encourage the development of environmentally friendly construction.

Only two data centers have made the LEED grade thus far, and another six have applications pending. Already LEED-certified are health insurance provider Highmark Inc.'s 28,000-square-foot data center in Harrisburg, Pa., and mortgage provider Fannie Mae's 130,000-square-foot data center in Urbana, Md.

Jack Pouchet, director of green initiatives at Emerson Network Power, said businesses are just beginning to understand what embracing green practices means and the benefits that can be generated through environmentally friendly designs.

"You can have the most efficient data center in the world and not be green," Pouchet said. "Green requires an end-to-end understanding and holistic view of the data center, including site, surroundings, community, physical building, infrastructure, staff, building operations and maintenance." (For tips, read "*Seven Steps to a Green Data Center*" on page 3.)

> " **You can have the most efficient data center in the world and not be green.**
>
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> DIRECTOR OF GREEN INITIATIVES
> EMERSON NETWORK POWER

THERE IS A COST

The cost to build a green data center versus a "conventional" data center is difficult to gauge. Estimates for the increased upfront cost of a green project range between 3% and 15%. But many green practices, such as more efficient servers, consolidation, virtualization and enhanced cooling equipment, are quickly becoming standard in data center design, so the difference between "green" and "traditional" costs isn't always clear.

Brian Cobb, senior vice president of IT at Fannie Mae, believes that the cost to go green is minimal. "Technology has evolved to the point where you don't have to trade off environmental friendliness with costs," Cobb said. "At the end of the day, we run the facility cheaper than if we had gone with a nongreen design, and we believe the more efficient we build, the longer the usable life of the building."

Cobb estimates that the data center saves 13,000 gallons a day through the use of a rainwater collection system that also creates a stored supply adequate for three days' operation in the event that the public utility system is unable to provide water.

"We really didn't engage in this as a 'feel-good' project," he said. "It makes business sense and helps us fit into the community."

Fannie Mae and Highmark will have company very soon, experts say. "This is not a passing phase," said Rakesh Kumar, an analyst at Gartner Inc. CIOs who do not invest "at least some effort" in green design and operations, particularly in new data centers, risk "seriously compromising" their positions, he said.

Unfortunately, many data centers still don't see the problem coming. While 38% of 194 IT professionals *Computerworld* surveyed in February and March of 2007 said that energy costs are becoming a bigger part of equipment life-cycle costs, 41% said they don't know how much energy their data centers use — either because it's not metered separately from the rest of the facility or because it's not part of the IT budget.

"The IT industry is where the oil industry was 25 years ago," Kumar said. "We are the nasty players here. Much of what the industry has done in the past has served us well and provided a fantastic increase in productivity. The downside is, we haven't paid any regard to efficiency and a balanced approach to environmental design."

DATA CENTERS ARE DUE

Kath Williams, a principal at Kath Williams Associates, an architectural firm engaged in green data center proj-

ects, is a board member of USGBC and has served as vice chair for six years. She has seen a maturing of the LEED certification effort and believes that data centers are the next logical step for green design and operation.

"Design teams can now look at complex buildings like data centers and laboratories and use LEED to really attack issues such as energy and water use," Williams said. "Society has become a lot more socially conscious about the environment. You don't have to be a tree-hugger, but corporations want to step up and say they are green. A finger has been pointed at big data centers, and businesses don't want to waste resources and pay more for utilities. There is plenty of motivation."

LEED certification comes by accumulating points through the implementation of green designs and operational procedures. The Fannie Mae facility received points for being located within a half-mile of public transportation, and by providing bicycle storage areas, changing rooms, preferred parking for carpoolers and refueling stations for alternative-fuel vehicles.

GETTING LEED-CERTIFIED
Mark Wood, director of data center infrastructure at Highmark, said upfront investment in gaining LEED certification for its data center added about 3% to the development cost, but operational efficiencies will offset the investment.

"Everyone knows that data centers are power hogs, and one of our corporate strategies is to reduce energy use," Wood said.

Highmark has a 100,000-gallon tank that collects rainwater that is used to flush the building's toilets and serves as a backup water supply. Alternative transportation is encouraged, with bike racks and parking for carpoolers and alternative-fuel vehicles. The site was selected to ensure that the building would not harm environmentally protected lands.

Microprocessor manufacturer Advanced Micro Devices Inc. is seeking LEED certification for an 870,000-square-foot complex that will be

used primarily by design engineers. Its Lone Star campus in Austin is expected to be completed this year and is located on a 57-acre site that incorporates the Lady Bird Johnson Wildflower Center objectives for conservation of native wildflowers, plants and landscapes. The layout of the buildings, garages and roads were made to minimize the impact on existing plants and water sources, and it uses 100% native plants to reduce watering requirements.

The campus incorporates a 1.1 million-gallon rainwater collection system that is used in the facility's cooling towers, where an average of 150,000 gallons of water is evaporated each day. By supplementing the water supply with rainwater, the campus will save about 12% on its water requirements, or about 6.5 million gallons annually.

THE AIR FORCE'S OFFUTT DATA CENTER
Williams, through her architectural company, has been engaged in LEED data center projects at the Offutt Air Force Base in Omaha and for Taiwan Semiconductor Manufacturing Co.

The Offutt facility, which opened in March, is 188,000 square feet, making it one of the 25 largest data centers in the world. The Air Force requires LEED certification for all new buildings. In addition to handling compute requirements for the Air Force, the center will serve as the primary military weather agency in the country, supplying data for NASA.

Part of the Offutt LEED effort began with site selection. The new data center was placed adjacent to a closed runway, allowing the project to place parking on land that had already been paved, reducing additional landscape impact. If not used for parking, the old runway would have been torn up and likely buried in a landfill.

One of the center's goals is to reduce conventional water requirements by 30%, or as much as half a million gallons annually.

Williams noted that accommodations that improve the worker experience, such as employee lounges, showers, should also be part of a

green building project.

"Working in a data center can be incredibly boring, or incredibly high-pressure," she said. "Either way, the employees need a break, and paying attention to the needs of the occupants and giving them some control over their environment, as well as a connection to the outdoors, are all important green concerns."

TAKING OUT THE TRASH
Some technologists have decided that they can no longer turn a blind eye to the disposal of electronic equipment.

"The majority of electronic scrap generated in the United States is exported to developing countries, where materials of value are extracted in conditions that are extremely poor in worker safety, and the balance is simply dumped where toxic materials leech into the environment. That is not environmentally sustainable, or sustainable in social responsibility," said Bob Houghton, president of Redemtech Inc., an asset recovery company that guarantees that none of the equipment or materials it receives will be sent overseas for "harvesting."

Two groups trying to stop the practice of electronics scrap harvesting are the Silicon Valley Toxics Coalition and Health Care Without Harm. Catholic Healthcare West (CHW), a system of 42 hospitals, worked with the organizations to increase recycling and ensure that none of its products are shipped overseas, said Mary Ellen Leciejewski, ecology program coordinator at the hospital.

"When we became aware of what was going on, we didn't want to be a part of that and began looking at alternatives," she said.

Enterprises should first see if they can reuse old computer gear somewhere within a company and then resell what they don't want; they should try to recycle systems or parts that cannot be reused or sold only a last resort, Houghton said.

Since beginning to work with Redemtech in November 2005, CHW has recycled 9,200 computers, resold 2,000 computers and recycled nearly 200,000 pounds of equipment. ∎