

## Surviving the Increase: How Rising Energy Costs are Affecting Corporate Data Centers

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### **A NEW ERA IN TECHNOLOGY**

In the information age, devoted Internet users spend countless hours on sites like MySpace, conduct searches on Google, read news stories and get updates on their stocks or favorite sports teams. When we connect to the World Wide Web we are tapping into any one of the many data centers around the globe that house countless servers, (Keefe, Bob. "Putting Data Centers on a Diet," *Austin-American Statesman*, 31 July 2006 ). These machines drive our information as well as our transaction-fueled economy every moment of our lives, (Dunn, Darrell. "Power Surge," *Information Week*, 27 February 2006).

As the Internet use grows in sophistication, an increased supply of electricity will be needed to power these servers. Having the proper amount of power will be just as important to your computer as having the next software upgrade or hardware makeover, (Keefe, "Putting Data Centers on a Diet"). When technology requirements are assessed, the analysis will show an increasing need for power.

Most data centers run 24 hours a day, seven days a week, (Patton, Susannah. "Data Centers Powering Down." *CIO Magazine*, 15 April 2006). The machines are always working. Problems arise when computer servers are required to process increasing work loads to keep up with business demands. When the machines become obsolete, newer, more expensive models that use considerably more power are brought in to replace the old. More than in the past, users of computer technology will find that decisions about technology and the resources needed to operate the technology must be made as a whole and not in isolation. Quite often, a decision made in isolation – an increase in the computing power of a single station, for example – may have an impact on the performance and cost of the entire IT infrastructure.

Companies pay millions of dollars to keep these centers running. The processing power of these machines is substantial. But if their power is something to be respected, their insatiable hunger for energy is something to be feared.

### **THE HEAT IS ON**

The global demand for more energy is due in part to the creation of more powerful computers. Ironically enough, state of the art machines are part of the problem, (Patton, "Powering Down"). New financial models are being studied in order to stay abreast of this dynamic industry. Firms that once based their costs on the use of data center space are finding that the consideration of raw space is giving way to consideration of power used. (Mitchell, Robert. "Power Struggle: How IT Mangers Cope with the Data Center Power Demands." *Computerworld*, 3 April 2006). And with more usage comes escalating costs.

Though high-performance servers consume large quantities of power and generate extensive heat, there are few alternatives to which businesses can turn. (Shankland, Stephen. "Electric Slide for Tech Industry?" *C-Net News.com*. 11 April 2006). More efficient computer and server designs can achieve productivity benefits but may have a large, adverse impact on the costs of cooling, protecting and powering the entire system. In today's computing environment, the computer grows in efficiency per unit of computing but the increase invariably comes with an increased power requirement for operating and cooling. Simply replacing computing equipment will not control a need for electricity; instead, the change can exacerbate the power requirement.

## **THE FACTS**

Nine million computer servers hum in offices, homes and storage facilities across the United States, (Dunn, "Power Surge"). For every watt of power used by IT equipment in data centers today, another watt or more is needed to remove waste heat, (Mitchell, "Power Struggle").

Data centers average at least one serious outage a year according to a recent survey of 200 AFCOM members, (The Organization of Data Center Professionals), (Dunn, "Power Surge"). More than half of these outages are caused by a lack of in-house power required to run these centers.

A typical 10,000-square-foot data center eats up enough electricity to turn on more than 8,000 60-watt light bulbs, (Patton, "Powering Down"). That amount of power is six to 10 times the amount needed to operate a typical office building during peak hours, (Patton, "Powering Down").

At least 12 million additional square feet of data center space will come online by 2009, (Patton, "Powering Down"). To put that in perspective, the Mall of America in Minnesota, the largest shopping center in the world, only covers 2.5 million square feet, (Patton, "Powering Down").

## **CHICAGO IS NO EXCEPTION**

Annual power bills for multimegawatt data centers can easily exceed \$1 million, (Mitchell, "Power Struggle"). Data center electricity costs are already in the neighborhood of \$3.3 billion per year, (Dunn, "Power Surge"). In Illinois, experts forecast that rates will rise as much as 55 percent, (Johnston, David Cay. "Competitive Era Fails to Shrink Electric Bills," The New York Times. 15 October 2006). ComEd, forecast to raise rates 17 – 23 percent for power delivery at the beginning of 2007, told analysts on October 27, 2006 that the company will request regulatory approval of a price hike for delivery in 2008. The company will file the request during the second quarter of 2007, (Daniels, Steve. "ComEd: We want a rate hike – again", Crain's Chicago Business. 30 October 2006.)

Some organizations spend as much as \$50 million a year on the electricity costs required to power a data center, (Keefe, "Putting Data Centers on a Diet"). In some cases, the amount of money needed to pay the utility bill will exceed the amount needed for companies to acquire new computers. The cost of cooling a data center often costs more than the floor space it takes up, (Dunn, "Power Surge").

In Chicago as in other parts of the country, colocation companies are unbundling. Providers that previously charged a fixed price for a cabinet with power, for example, now provide a separate price for the cabinet space and a separate price for the power required.

## **BUSINESS CONCERNS**

IT departments will have to worry about getting as much power as possible, and they will have to make sure the power is used efficiently, (Fogarty, Kevin. "The Greening of the Data Center." EWeek, 21 August 2006). Computer chips consume more electricity now than they did before, which creates a conflict of priorities. Chief Technical Officers (CTO) are now forced to find space, power and cooling systems adequate for multiple servers. The air conditioning needed to keep the machines from overheating eats away at IT budgets considerably.

Chief Information Officers (CIO) are spending more time developing plans to combat energy costs that consume organization dollars. Strategies that utilize more energy-conscious equipment and use servers more efficiently are being developed.

Nearly every large company says the biggest problem its IT shop has is getting enough power to run all the computers the company is buying, (Gomes, Lee. "Some 'Breakthroughs' Deserve That Title -- But Definitely not All." The Wall Street Journal, 27 September 2006).

Many in-house data center managers do not see the staggering electricity costs their systems are generating, (Dunn, "Power Surge"). These employees are doubling as HVAC (heating, ventilating and air conditioning) experts as well as certified IT administrators, (Fogarty, "The Greening of the Data Center").

As companies search for the best machines that use the least amount of energy, CIOs will need to educate themselves on the solutions that will work best for their organizations. The decisions require management of a matrix of options, a complex evaluation that weighs the consequences of one choice on all the others. Favorable equipment pricing will only be one component in the buying decision; operating costs of the equipment will gain in importance. In a company's own environment, including the data center facilities provided by third parties, the combinations of equipment, resources and processes can be unique. CIOs will need to gather an enormous amount of environmental information and should also establish metrics for power consumption, (Patton, "Powering Down"). In-house or third party data centers will have to be adept at recording and interpreting operations data.

Statistics from the Robert Francis Group in Westport, Connecticut state that 41 percent of the 50 Fortune 500 IT executives it surveyed identified power and cooling as the number one and two problems in their data centers, (Mitchell, "Power Struggle").

Individual businesses are facing alarming concerns as well. If an Internet retailer's data center fails, the effects can be disastrous, (Keefe, "Putting Data Centers on a Diet,"). A lack of power can cause a website to go down and a potential customer will look elsewhere, (Keefe, "Putting Data Centers on a Diet,").

## **MANAGING THE COST OF A DATA CENTER**

Apart from any rise in the price of coal, natural gas, oil, uranium and other fuels, electricity prices are expected to rise in the next few years, (Johnston, "Competitive Era Fails to Shrink Electric Bills"). The change in the market has caused companies to focus on power costs, (Daniels, Steve. "Electric Shock for Small Business." Crain's Chicago Business, 18 September 2006). Data center operations are readying for an impact from their own use of power. IDC Global, which provides enterprise scale IT services that include provision of data center space in Chicago, New York, London and other cities, is already experiencing a change in customers' requirements:

Companies are choosing colocation over management and maintenance of a dedicated data center. Placing equipment in the facilities of a specialized firm allows the company to take advantage of the economies of scale of electricity with equipment and services that are unaffordable for a single user. The per unit cost drops and can more than offset the price of the third party service. Rather than increase the power to their buildings or their cooling capacity, companies elect to use the services of a well-equipped data center.

Colocation is being offered to customers at prices that unbundle electric costs so that space and power are separate items. Typically, a data center provides space at an attractive price. Electricity expense varies according to the company's usage.

Companies considering data center location are scrutinizing power management abilities and cooling systems as well as base costs, security, emergency preparedness, and staff resources.

IDC Global and other data center providers manage their facilities for the control of power costs as well as the full range of security and services enterprise level customers require.

Power costs are increasing the importance of good counsel from colocation and data center service providers. No longer viewing colocation or other services as commodities, companies seek out providers who can help them choose efficient equipment and adopt an architecture that protects data while managing costs. They make the decision in order to obtain economies of scale and to gain a provider's expertise with decisions that affect the quality as well as the price of operations. With the provider's insights, they expect to keep their systems scalable, their costs predictable, and their operations safe.

A common problem that is often overlooked and quite ironic is the fact that a surplus of cooling centers can often overheat the very equipment it is meant to cool, (Keefe, "Putting Data Centers on a Diet,"). As servers use more power, they produce more heat. It's a vicious cycle as IT managers are then required to use even more power to cool the data centers to a level where they will not overheat, (Dunn, "Power Surge").

Power consumption is a new concern for companies. Mistakes are often made. For example, data center managers would place an exhaust fan above server racks, (Mitchell, "Power Struggle"). This should be avoided unless the ceiling is very high as those fans can make the racks run hotter. This practice can interfere with the room's air conditioning system, (Mitchell, "Power Struggle").

The placement of equipment has consequences that companies now take very seriously. Some companies space out servers to reduce overheating. Some conserve floor space by packing servers in a dense array, (Shankland, "Electric Slide for Tech Industry"). Many data storage centers have raised floors with holes in them to direct the flow of specially cooled air from below directly into the various server compartments. Other configurations employ ceiling-mounted cooling.

## **MANAGING THE COST - THROUGH EQUIPMENT IMPROVEMENTS**

The demand for data center cooling systems is heating up. American Power Conversion and Hewlett-Packard are both offering new machines designed to cool servers, (Dunn, Darrell. "Uncool Data Centers Need to Chill Out," Information Week, 27 February 2006).

Virtualization and multicore processors currently offer the greatest hope for slowing the rate of increase in the amount of electricity data centers require, (Dunn, "Power Surge"). Virtualization is a recent technological advancement that allows several operating systems to occupy space on the same server, (Patton, "Powering Down"). Virtualization helps data centers to survive by allowing a single machine to do the work of many. However, the attraction of the solution can come with a cost: the increased computing productivity requires an increase in power and cooling requirements.

Hardware makers like Hewlett-Packard, Silicon Graphics and IBM have either offered or are developing liquid cooling options, (Shankland, "Electric Slide for Tech Industry"). This new technology has actually been used before and is making a comeback of sorts as it is more efficient than air-conditioning. It involves cooling air using chilled water.

The newest servers offer more power per unit, per capacity. The technology becomes more efficient as new models are introduced and as advances are made. However, there are some snags to this method. Managers have to figure out how to cool the hot water. The larger problem is whether a data center manager even wants to have water in the same room with millions of dollars in computer and server equipment.

## **POSITIVE SIGNS FOR THE FUTURE**

The EPA gives out "Energy Star" labels to various machines that perform well. This label means that they lose less than 20 percent of the power they draw in waste heat. A 70 to 72 percent operating efficiency is the norm for power supplies, (Shankland, "Electric Slide for Tech Industry").

Computer companies are developing environmental control systems which use water to lower temperatures as an alternative. Liquid cooling is also being examined as a solution to overheating. Egenera, IBM, Silicon Graphics, and Hewlett-Packard are just some of the companies that have added liquid cooling options to their hardware, (Patton, "Powering Down"). Servers could someday have built-in water coolers that would cut heating costs. Semiconductor technology improvements could continue to make the machines more efficient, (Keefe, "Putting Data Centers on a Diet").

These new methods are positive signs. But while they are considered cutting edge for now, the overhead for these practices is significant. Variable speed and infrastructure requirements can send costs skyrocketing. The vents and compressors needed to cool the machines can cost a fortune to a small business owner who may not have an IT department or even a worker on staff who is knowledgeable in IT matters.

Tech vendors are looking more closely at power as well. Efforts are being made to find computer models that are both energy and cost efficient. Models that have superior power efficiency but a sub-par cost efficiency rating are unlikely to be competitive, (Dunn, "Power Surge").

The most recent air conditioners have compressors, pumps and fans that can either slow down or speed up depending on the outside temperature, (Patton, "Powering Down").

For most companies, the goal of achieving an energy-efficient data center will take time. The process of implementing computers that conserve energy will be a gradual one. The problem is sure to grow more acute before efforts to curtail the situation catch up.

New, energy conscious computers are being created, but the situation is far from perfect. John Fruehe, a senior manager at Dell, warns that investing in cooling systems that attach directly to server racks, and describing them as proprietary products, is a method vendors use to lock customers into continuing service, (Dunn, "Uncool Data Centers Need To Chill Out"). There is no simple solution or quick fix, (Dunn, "Power Surge").

## CONCLUSIONS

Those who think that today's energy crunch is simply going to disappear or correct itself are misinformed. One needs only to look at the global energy markets for a glimpse of the growing need and the exceeding cost, (Patton, "Powering Down"). Energy rates increase every year not just in the U.S. but throughout the world.

Measuring the rate at which energy is used is paramount to deciding where IT dollars can be saved. The first step is to measure the problem and institute a framework to measure performance, (Shankland, "Electric Slide for Tech Industry"). Using industry resources, a comparison could be created to measure power consumption as well as to estimate how damaging the problem can be to a company's computer system as well as the success rate for any possible solutions. IT departments will need to make their systems as unique as the companies they serve. The design of their systems, from equipment selection to operating processes, will need to include the efficiencies, knowledge and management capabilities of their third party vendors.

Cable and phone companies have been in a technological arms race since the late 1990s when both began rolling out high-speed Internet connections, (Grant, Peter. "Cable Industry May Need to Spend Heavily on Broadband Upgrades." The Wall Street Journal, 17 August 2006). Microsoft Corp., Google and Yahoo! Inc. are now in the habit of building their data centers in states like Washington and Oregon where the supply of electricity is the key determinant, (Keefe, "Putting Data Centers on a Diet,"). Yahoo! currently uses 27 data centers housing upwards of 200,000 servers. Writing in the October, 2006 issue of Wired, George Gilder says that, according to the lowest estimate, Google's data centers around the globe house 450,000 servers handling a current load of 100 million queries a day, (Gilder, George. "The Information Factories." Wired. 16 October 2006.)

These days, Google, Yahoo!, and IT departments everywhere are thinking about the impact of rising electricity costs.

## ADDITIONAL INFORMATION IS AVAILABLE FROM IDC GLOBAL:

### Contact:

Shelly Greco cell: 312.907.4885  
or Craig Daiker cell: 312.907.4887

### IDC Global

111 North Canal Street  
Chicago, IL 60606  
312.669.7547  
[www.idcglobal.net](http://www.idcglobal.net)

[Colocation Services Brochure \(PDF\)](#)

[Colocation Checklist & Questions \(PDF\)](#)

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