How to Cut Data Center Energy Consumption

Paul W. Taylor | May 21, 2008

Gartner predicts energy costs could soon consume as much as half of an organization's IT budget, so running cleaner, cooler and cheaper - from the data center to the farthest reaches of an organization - may make "green" the last best chance to stay out of the red.

"Data centers are the energy hogs of the 21st century," said Aneesh Chopra, Virginia's secretary of technology, "and if we all believe we need to have renewable energy and energy independence in this country, those of us in the IT community must step up and acknowledge that we are net consumers in a significant way."

Indeed the hogs have a huge appetite. Data centers consumed 61 billion kilowatt- hours of power in 2006, according to a U.S. Environmental Protection Agency (EPA) report last year to Congress. That's 1.5 percent of all power consumed in the United States - at a cost of $4.5 billion. The EPA offered no approximation of how much of that is attributable to state and local government, but it estimated federal data centers were on the hook for 10 percent of that total.

If there is an imperative, it is over energy waste. "The information technology function is responsible for a major portion of an organization's power consumption - often needlessly so," said Mike Mittleman, deputy CIO of New York state.

The remedy begins with a "focus on improving power efficiency for those business aspects unquestionably under CIO control, [which] should have a salubrious impact on the organization's carbon footprint," Mittleman said, referring to emissions of man-made carbon dioxide, which is a greenhouse gas. "Given the spiraling cost of power, the CIO is obligated to implement strategies that will reduce consumption; responsible organization citizenship demands nothing less."

California CIO Teri Takai is less confident about the prospects: "We are the main power consumers in the state and our costs are rising. Replacing our old equipment with energy-efficient equipment sounds great but is very hard to justify. Replacing old facilities is even harder. And while virtualization sounds great, we are still fighting to consolidate physical data centers. How are we going to consolidate across servers that we can't get into the same room? I am a great believer that CIOs need to get the IT shop in order before they branch out to take over the world."

These are very real challenges, but government agencies can overcome them. There's tremendous opportunity for energy reduction and increased performance.

In a meeting with technology firms in Silicon Valley, Andrew Karsner, an assistant secretary for the U.S. Department of Energy, characterized computer systems as "an absolute juggernaut" of energy consumption. He argued that industry and government share a moral obligation to ensure the country's energy security.

As energy consumption and related costs have increased for data center facilities, so too has the workload. In 2006, data centers around the world managed 161 exabytes, which equates to 161 billion GB. The information created, captured and replicated is on track to grow sixfold by 2010 to 988 exabytes.

But there is apparently no correlation between workload and energy consumption.

"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," said Amory Lovins, chief scientist of the sustainability-focused Rocky Mountain Institute, in Seven Steps to a Green Data Center, published in Computerworld UK last year.

In addition, the Robert Frances Group estimates that power and cooling costs for data centers consume as much as 40 percent of the operating costs of the buildings in which they are housed. Moreover, Gartner estimates that 60 percent of a data center's energy consumption is wasted.

Always On vs. Turn It Off

The chief performance attributes

of data centers - availability, reliability and sheer horsepower (performance) - are at odds with the conservation-based assumptions of sustainability. Through experimentation with available tools, and the promise of new functionality in subsequent "greener" releases, data center operators and their providers (as well as analysts and other observers) are working on a number of emerging practices that may result in an honorable compromise between performance and sustainability. In broad strokes, the emerging set of greener practices suggests organizations should build on long-established data center disciplines. Here are nine steps to start:

1. Take a broad, holistic view of the organization and its operations in assessing energy use, and factor energy and cooling cost reduction into life cycle management.

2. Consider power efficiency as a key placement attribute in scheduling server workloads.

3. Balance energy consumption and utilization when picking platforms. CPU utilization averages 90 percent on a mainframe but only 5 percent to 15 percent on servers. At the processer level, activate "throttle down" features to reduce energy consumption and consider migration to multicore processors which provide better performance at lower clock speeds.

4. Compare blade servers and rack servers on the basis of computing capacity and power and cooling requirements - not on space. The calculations, not to mention operational considerations, are complex and deserve disciplined analyses. For example, blade and virtualization technologies result in denser data centers that require more power and more cooling, but server consolidation through virtualization can result in significant energy savings.

5. Measure and monitor the energy consumption of servers at least annually. Choose more efficient power supplies for servers and recognize that redundancy and load sharing strategies raise both uptime rates and energy use. Many rack servers ship with supplies that are 60 percent to 70 percent efficient - but the Energy Star 80 Plus requirement, which requires power supplies in computers and servers to be at least 80 percent energy efficient, can save an estimated 301 kilowatt-hours per server annually.

6. Use the operating system to ration the voltage going to the processor, particularly as new power management features in new operating system releases provide granular controls.

7. Take advantage of metrics and models developed by industry initiatives such as The Green Grid to improve the energy efficiency of existing data centers and plan more effectively for new facilities.

8. Adapt performance dashboards to reflect sustainability measures, including metrics such as energy efficiency, emission and waste reduction, and supply chain and staff management.

9. Remember the classically simple (but often overlooked) answer: When not in use, turn it off.

Clearly data center optimization is a much larger undertaking than even the most refined list can capture.

Enter The Green Grid, a not-for-profit industry consortium focused on "advancing energy efficiency in data centers and computing ecosystems." It has completed the key elements of its technology road map, and the first priority is developing metrics for benchmarking, measuring and optimizing data center power consumption.

The consortium was welcomed as an aggregation point as the industry and data center operators struggled to come to terms with green IT. Even at that, some analysts worried that the consortium's ties to industry might hold it back from the kind of innovation needed to re-imagine the data center as part of a sustainable ecosystem.

It is worth noting that The Green Grid aspires not only to help tune up existing data centers, but also to help planners make smarter decisions when and if they are able to rethink data centers and build them from scratch.

Lean and Green

Chopra looks to the private sector for the needed innovation to fundamentally reform data centers. "We need to encourage our vendor community to build green-friendly data centers and

server farms," he said, "so we can be proper stewards of our resources."

One example of industry-led innovation is found at the intersection of modularization and sustainability. In late 2007, a computer manufacturer unveiled a full data center in a box - and delivered it on a truck. The big digital prefab is "a pre-configured, fully

contained data center in a shipping container." The manufacturer says the data center module "is optimized for maximum density, performance and energy efficiency." What's more, it is built with recyclable parts and components.

The modular approach - particularly if it's available as a leased product, or better yet under a software-as-a-service offering - fits with the dual but conflicting demands for greater capacity amid oversubscribed budgets. A new modular infrastructure, with or without a new business model, comes with added sustainability benefits too.

Conventional public-sector data centers tend to be on elongated amortization schedules, and new or replacement facilities have very long gestation periods. "It's a capital construction project, and it can take many years to get it approved," said Doug Robinson, executive director of the National Association of State Chief Information Officers.

Timing may not be everything in a political environment, but it is important. Washington state's timing could not have been better. With careful planning and sophisticated stewardship through the state planning and budgeting processes, the Washington State Department of Information Services (DIS) is expected to break ground on an all-new and very green data center this spring.

The new 166,000-square-foot data center is the defining feature of a 456,000-square-foot, $260 million office complex that will be built on one of the last available spaces on Olympia's Capitol campus. The DIS complex - to be completed in 2010 - will provide new offices for the host agency as well as the Washington State Patrol, Department of General Administration and other smaller agencies. Those departments need a new building because their existing home - a nondescript, 1950s-era cinder brick building with spectacular views of Capitol Lake and downtown Olympia - is slated for demolition to make way for a politically prized Heritage Center, described as "the most important construction project in Olympia since the Capitol was finished in 1928." The operational need to replace the existing 32-year-old DIS data center certainly factored into the decision, but it benefited from being seen in the context of the larger Capitol campus transformation.

Sustainability and efficiency were integrated into the bid for the new DIS complex, as they have been since 2005 under an executive order. The order requires, in part, that major construction projects "be built and certified to the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) silver standard."

DIS Director Gary Robinson said the return-on-investment considerations related to silver certification were addressed at the predesign stage. The project has moved successfully to the design stage, with the Seattle-based firm Wright Runstad & Company under contract to develop and build the complex.

In some pubic installations, LEED silver compliance produced operational savings of up to 35 percent. Gartner suggests that such savings do not come for free, estimating that "going green may add 10 percent to 15 percent [to] capital equipment and operational costs."

Nevertheless Gartner estimates that by 2011 a quarter of new data centers will be strikingly different than those operating today, with "mechanical, electrical, thermal and hosted computer systems designed for maximum energy efficiency."

The new Washington state facility may be prototypical of the new green breed of data centers. It is scheduled to come online in 2010. The transformation will be televised - DIS plans to maintain a live Web stream from the construction site.

http://www.govtech.com/magazines/gt/How-to-Cut-Data-Center-Energy.html