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sustainable information technology

Greening The Data Center

A Five-Step Method for CIO's and Data Center Managers

Professionals who manage Data Centers know what is expected from them for performance and uptime. What many are only just beginning to realize is that they will also be expected to address the environmental issues associated with Data Centers.

Why? …..

From 2000 to 2005 consumption of electricity by servers in Data Centers doubled.

During those same years -----

- The price of oil went from $25 to $60 a barrel.
- The Governor of California ordered the State Government to reduce electricity use 20% (or more) below the amount used in 2003.
- 144 nations signed and began implementing the Kyoto Accords, committing to reduce Greenhouse Gas (GHG) emissions by 29%.
- The European Union (EU) approved the RoHS and WEEE directives that ban the use of Hazardous Substances in electronics and mandates recycling of all electronic equipment.
- California and 23 other U.S. states enacted or proposed restrictions on the disposal of "e-waste".

In 2006 the U.S. Congress directed the EPA to study how much power is consumed by corporate and federal Data Centers, and what to do about it; Gartner Group said that half of the world's Data Centers will experience power shortages in the next two years.

In the near future many U.S states will have mandatory GHG reduction programs, the EU will implement its Electricity Using Products (EuP) directive, governments and industry will launch major energy efficiency programs, and e-waste restrictions will be tightened …

> ***… while Data Centers will continue to get bigger and see ever higher expectations for performance.***

It's clear that the future will bring increasing pressure for Data Center managers to ---

- use less electricity,
- buy "greener" equipment,
- take increased responsibility for the responsible management of "e-waste",
- and participate in meeting GHG emission reduction goals.

The real question for Data Center managers is not "Why" but …How?

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How to Green Your Data Center in Five Not-So-Easy Steps

Step 1 – Know Your Stuff

The first step in greening your Data Center is understanding, in detail, what you have, what you use, and why. This is the tedious, but essential, initial step that everyone wants to skip over. Who wants to "waste" time and money gathering data and analyzing it when you could be doing something to make things better?

But, you can't manage what you can't measure. You can't measure progress unless you know where you started. You can't respond to data requests from management, regulators, or colleagues unless you have data … good data on what you are doing and why. You can't make informed decisions about how to spend scarce dollars for the biggest impact, or ask for more money, unless you can show on paper what you have, what you use, and what it costs.

In this first step you need to address ***Power Consumption***, in total and broken down to the lowest equipment level possible. Power tracking products are available that enable accurate measurement over time. Consumption data needs to be translated into ***Power Costs*** associated with every element of Data Center operations. To make sense of power use and costs, a complete and accurate ***Hardware Inventory*** for equipment and an ***Application Inventory*** of the software and services is required. Once accurate data has been collected, new ***Performance Metrics*** need to be set, or old ones updated, for all of the equipment and applications.

Another essential element of Step 1 is ***Benchmarking*** your performance against other Data Centers and other types of Facilities. Studies and data are available from internal resources, personal contacts, and private external organizations. In the near future, public benchmarking resources will likely be developed by government agencies to provide a forum for anonymous information sharing and standards of comparison.

Step 2 – Clean Up, Power Down, and Get Smaller

Step 2 is about good housekeeping, management attention, and readily-available technology solutions. The first task is to eliminate unnecessary equipment. Most people are familiar with the three R's of environmental responsibility: Reduce, Reuse, Recycle. GreenIT has developed the ***ER^3 Principle***: first Eliminate, then go after the other three R's. The quickest way to lower electrical load, minimize space needs, and reduce cooling requirements is to get rid of equipment you don't need, including "abandoned" data cable, unused servers, and other equipment that accumulates over time.

Once clean-up is complete, develop ***Power Management Procedures*** for minimizing power consumption by all of the systems in the Data Center. The ***Cooling and Power Supply Efficiency*** for the Data Center facility should be evaluated, and investments made in tune-ups, re-design, or replacement for inefficient infrastructure.

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Racks can be re-stacked with more ***Energy Efficient Equipment***. Based on the data collected in Step 1, Data Center managers can identify equipment consuming the most power and evaluate options for replacement or modification. In some parts of the U.S., utility companies offer cash rebates for the purchase of more energy-efficient servers.

Beyond simply shutting down old boxes, ***Virtualization*** of servers and storage is a technology being widely deployed to reduce the quantity of equipment needed in the Data Center. Reducing power bills by cutting heat load and power consumption through consolidation can produce savings to off-set investment costs for more efficient technologies (even though the savings may go to someone else's budget!).

Step 3 – Make New Friends

In the average Data Center today the biggest power draw is for cooling, and demands for additional space are constantly growing. Design and management of cooling systems, building power supply, back-up power systems, and management of building space is assigned to Facilities Management in most organizations. They are also usually the people whose budget pays the rent, the utility bills, the waste management bills, operating permits, and fines.

Many Facilities Managers (FM's) don't know much about IT and Data Center operations. But, they are learning fast. FM's are under increasing pressure to reduce costs and increase financial returns on those big-ticket Balance Sheet assets. They have mandates to reign in energy consumption growth and reduce carbon-emissions to meet corporate and government climate protection goals. They face new limits and restrictions on solid and hazardous waste management. And, IT systems or IT system infrastructure (power, wiring, wireless networks) are increasingly an integrated part of the building environment they must manage. Data Centers are a highly visible source of problems in all of these areas.

Data Center managers should engage with colleagues in Facilities Management to develop protocols for ***Coordinated Operations*** and ***Integrated Planning.*** Architects, Engineers, Consultants, and Researchers who help design and construct Data Centers are others that Data Center managers should connect with to understand their disciplines and ideas, and to explain the realities of Data Center operations. Data Center Managers should also get involved with planning ***On-Site Power Production***, particularly from renewable, low-carbon sources.

Another part of the typical Enterprise that Data Center managers need to engage with is the Purchasing Department. Creating ***Green Specifications*** for equipment, material, and service purchases is not something Purchasing can do properly without assistance from IT professionals.

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Step 4 – Think Green, Be Green

Reducing the environmental impacts of Data Center operations requires integrating "green thinking" into everything you do – measurement and data collection, budgeting design and engineering, operations, and purchasing. Integrating all of these elements into a ***Design for the Environment*** program is something a few IT product manufacturers have been doing for some time. Data Center managers need to create their own ongoing programs for continual improvement.

The cycle of continuous improvement starts with financial planning and budgeting. In a time where the purchase cost of a low-end server may be less than the cost of the electricity that device uses in its lifetime, organizations need to develop methodologies for assessing ***Total Cost of Ownership*** for equipment, even though those costs appear in different budgets in different parts of the organization. Energy costs for operations, (and the associated GHG emissions) and end of life management costs for equipment need to be factored into financial analysis and forecasts before designs and specifications are set. Many organizations are beginning to develop methodologies for ***Life Cycle Assessments*** across the Enterprise that include financial, environmental, and operational factors.

Many organizations, particularly in government, have ***Environmentally Preferable Purchasing*** policies that specify requirements and guidelines for all procurement decisions, including IT equipment. The specifications and guidelines frequently reference public certification standards such as Energy Star and EPEAT, which don't yet apply to Data Center equipment. However, those standards are in the process of being extended to servers. Truly committed purchasers can apply the same criteria to products without certifications and seek out products that exceed current standards. Going ***Beyond Compliance*** can only happen if IT professionals seek out the best solutions, drive the purchasing requirements, and incorporate environmental issues into all decision-making processes.

Data Center Managers also must work with Purchasing and Facilities on ***Product Life-Cycle Management***, ***E-Waste Waste Management***, and the reduction of solid waste streams. Many product manufacturers now offer ***Product Takeback*** services. Takeback clauses need to be written into purchase contracts and procedures developed to ensure implementation at the end of product life. Some manufacturers also offer "green" or reduced packaging waste options for new equipment, another requirement buyers should include in purchase specs. Buyers should also inquire about suppliers' ***Environmental Management Systems (EMS)*** and ***ISO14001*** Certification for their operations and product supply chain.

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Step 5 – Imagine a Greener Future

Data Center design practices haven't changed much in decades. Today new, more energy-efficient, greener technologies are available or in development. However, taking advantage of these new developments challenges many existing concepts and practices in the construction and management of Data Centers.

Blade Servers are available now, but can lead to densities for power and heat that existing facilities infrastructure can't handle. ***Virtual PC's*** and other ***Thin-Client Architectures*** are also available, and can have significant environmental advantages in system power consumption, reduced quantities of desktop equipment, and extended product lives. But, deployment requires a re-thinking of overall IT system architecture for most Enterprises. Virtualization and new ***Multi-Core Processors*** may also significantly effect the type and quantity of equipment to be installed in a Data Center.

For facilities design, new technologies for ***Liquid Cooling*** at the rack level have been developed to address the heat removal requirements for high-power, high density computing environments. Adoption of these designs can run counter to the practice of Data Centers as raised floor environments, creating a need for new cabling design and management practices. The use of ***Industrial Cooling Technologies*** adapted from other industries is another area of innovation being offered for energy efficient cooling at the facility level.

For power efficiency, more efficient server power supplies are available today, as are new engineering approaches to eliminating inefficiencies in traditional systems with multiple AC/DC power conversions. Innovative designs for ***DC-Powered Data Centers*** that could radically increase power efficiency are being researched and tested.

Ultimately, the evolution of IT network technologies and management systems, changing ideas of how to provide for reliability and redundancy in networks, and the need to be environmentally responsible will challenge existing paradigms of what a "Data Center" is. Electrical utility companies are already planning for a future that includes far more distributed power generation, with a variety of renewable, non-polluting power sources located close to the loads they serve. Pre-fab Data Centers on wheels are available today, as are mobile, liquid-cooled enclosures that can go most anywhere there is space, a power source, and a robust network connection. In the future, for many Enterprises, the "Data Center" may be more of a concept than a place.

Greening your Data Center and building an environmentally sustainable future for IT will require imagination, new skills, and new thinking. It's a challenge but, it can be done …. just start with Step 1.

*…**The difficult I'll do right now***
The impossible will take a little while.
Billie Holliday – Crazy He Calls Me

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