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Overview

Today's organizations face an urgent need to develop energy-efficient and environmentally responsible data centers. Data centers are growing at a tremendous rate, but energy costs are becoming a proportionally higher part of their operational budget. Analysts estimate that within a few years, the cost of powering and cooling a server will equal its purchase price¹. Unfortunately, IT management often lacks sufficient visibility into the details of energy costs and inefficiencies, so it is unable to take proper steps to lower consumption, streamline operations, make better use of assets it already has and resolve other energy-related requirements.

To address these critical issues, today's IT organizations need a comprehensive yet tightly integrated energy management solution that encompasses both IT and physical facilities. A properly designed and implemented energy management solution delivers the ability to view system utilization rates, generate energy alerts, monitor energy trends, measure energy use data and cap system power use. It should also manage data center facility assets such as air conditioning, electricity and floor space in conjunction with IT to optimize the entire data center environment for energy efficiency. The result can be a significant savings in energy costs, as well as the opportunity to show leadership in promoting innovative ways to increase energy efficiency.

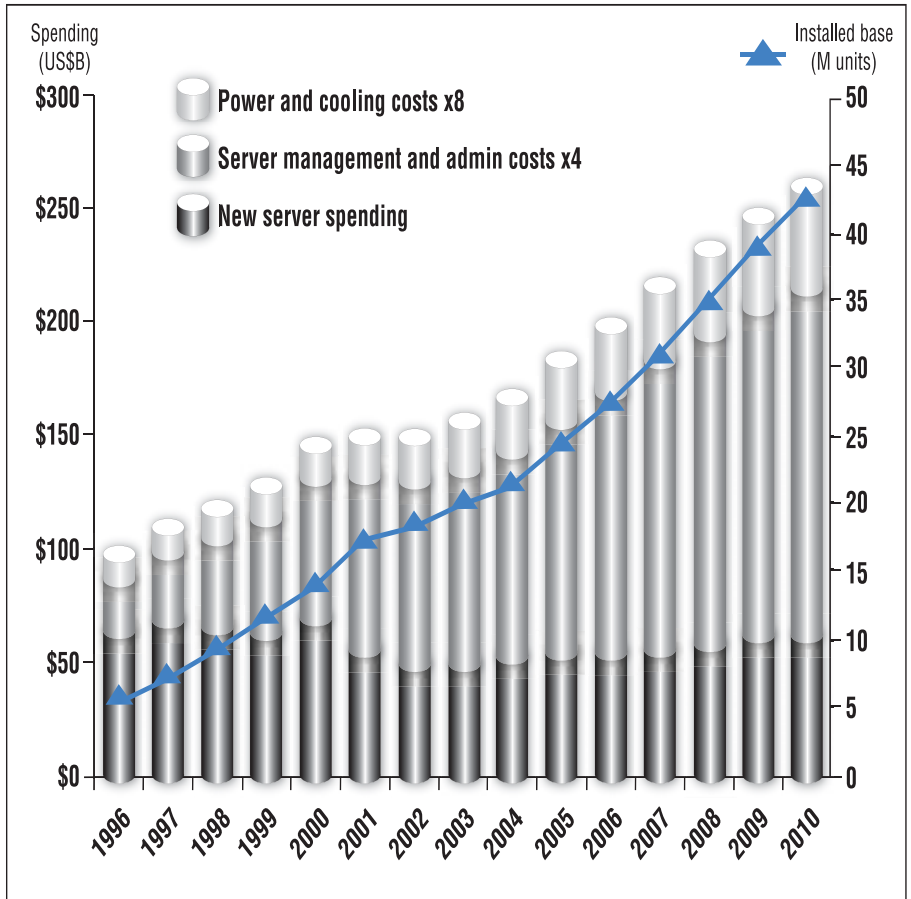
Along with an in-depth discussion of energy measurement and management, this white paper provides a brief overview of IBM solutions that can help organizations support their initiatives for developing energy-efficient and environmentally responsible data centers.



Estimated savings from improvements in energy efficiency

The EPA Report to Congress on Server and Data Center Efficiency estimates that “the improved operational management [of IT equipment] offers potential electricity savings of more than 20%³.” Based on this scenario, a typical 25,000-square-foot data center that spends \$2.6 million in power annually has potential savings of more than 4 million kWh. This reduction would have the equivalency results of:

- *An abatement of 3,714 metric tons of CO₂ annually.*
- *Annual greenhouse gas emissions of 617 passenger vehicles.*
- *Carbon sequestered by 86,325 tree seedlings grown for 10 years.*
- *A potential savings of \$1.2M in energy costs over four years (assuming a 5% per year improvement over that period).*



From 1996 to 2008, the costs to power, cool and manage data centers have more than doubled. Analysts expect this trend to continue in the future².



Recognize the critical need for energy-efficient data centers

Today's data centers are at a tipping point. Data center floor space capacity is growing by approximately 10 percent per year for large enterprises, and the amount of energy that these data centers consume continues to soar. Typically, a data center consumes 10 to 100 times more energy per square foot than the average office building. At current rates, these power requirements could double in five years⁴.


In fact, IT is becoming the largest single component of many firms' energy costs—often 30 to 40 percent of the entire energy budget⁵. Current trends suggest that within a few years, the cost to power and cool servers will actually equal new server acquisition costs. Even now, each dollar of new servers results in a cost of \$0.52 for power and cooling. This cost is expected to increase 37 percent over the next four years to \$0.71⁶.



Understand the requirements of an effective measurement and management solution

Energy efficiency in the data center depends on being able to clearly measure, monitor and manage energy consumption. This includes having hardware and software work hand-in-hand to address power surges, “hot spots” in facilities, wasted energy, overheating and overuse of power by applications, air conditioning and other categories. Monitoring solutions should also collect energy data from across the enterprise and work closely with solutions that track facilities, business priorities and policies. In addition, data center space is saved if IT assets such as servers are used more efficiently, thereby reducing the need to add more servers while making better use of those already in place.

Equally important, this energy data must be integrated across the enterprise and at multiple levels, on both the IT and the business sides of the organization, thereby managing energy in the context of business requirements. This way, IT managers can reduce system power but not business performance. In fact, organizations need an integrated system that enables users to set up policies that will automatically increase or decrease power consumption while still guaranteeing fulfillment of the business’ service level agreements (SLAs).

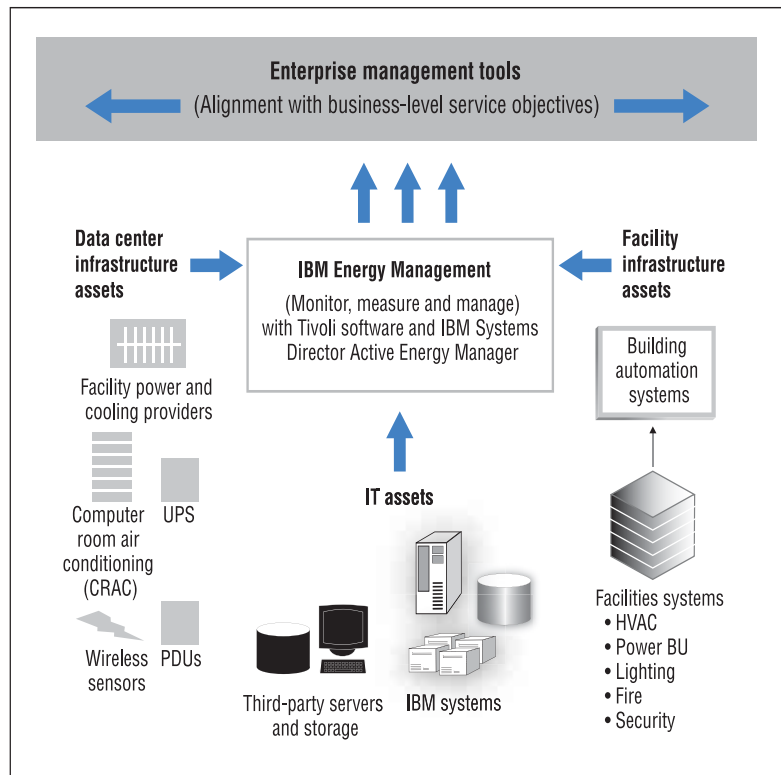


Accordingly, an effective energy measurement and management solution should be able to:

- *Integrate information across the infrastructure, including IT and physical facilities.* System administrators should have a consolidated view of power, temperature and application performance metrics in the data center.
- *Flexibly manage power* on servers or groups of servers either manually or automatically according to a defined policy. Administrators need to monitor and manage facilities (such as air conditioning, power and equipment) in conjunction with IT to increase energy efficiency and reduce power use and cost.
- *Enable administrators to view system utilization rates* to make sure that IT assets are being used efficiently before new systems are added to the data center, thereby making the best use of existing systems, space, power and air conditioning.
- *Manage processor resources and power consumption* to achieve application-response times and SLAs with minimum energy use and cost.
- *Determine the proper power allocation* for each server and help reallocate power to additional servers without additional power or cooling equipment. Care should be taken that limiting power consumption does not degrade performance.
- *Provide operational management tools* to incorporate a business and financial perspective. This includes the management of the IT asset life cycle to manage server assets so that older, less energy-efficient servers are replaced with newer, more energy-efficient ones when the time is right.



- *Capture, analyze and display assets, locations and work orders* through geographic information system (GIS) modeling and mapping software.
- *Feed energy-use information into chargeback applications*, enabling business units to accurately understand “who is using what” and hold users accountable. They can also see which organizations are causing large amounts of power to be consumed while at the same time generating reports that show where opportunities for energy savings exist.



IBM provides an integrated approach across the entire energy spectrum to address client concerns.

Free 60-day trial

A no-charge, 60-day trial version of IBM Systems Director Active Energy Manager™ is available online. Visit ibm.com/systems/greendatacenter to download this offer and test-drive IBM Systems Director Active Energy Manager today.

Explore integrated solutions to support the energy-efficient data center

Although “going green” will remain an important challenge for IT in the years ahead, the good news is that green strategies and technologies exist today to help data centers optimize space, power, cooling and resiliency—all while improving operational management, reducing costs and supporting business growth.

IBM Systems Director Active Energy Manager measures, monitors and manages the energy management components built into IBM systems while enabling a cross-platform management solution. Active Energy Manager offers a single view of actual power use across multiple platforms in the infrastructure, as opposed to published system-energy-label specifications for power consumption.

In addition, Active Energy Manager enables IT managers to cap power use at a system level. This is an important capability for organizations that have signed agreements with their utility companies to restrict their utilization of power to certain thresholds. If they exceed those thresholds, then they have to pay a premium. With Active Energy Manager, these organizations can choose to trade-off power consumption for performance in a controlled way, according to service level policies, so they can stabilize power use. In an outage, Active Energy Manager can “throttle back” systems to reduce consumption and better maintain power costs.



Active Energy Manager is an application that runs as an extension to IBM Systems Director and employs agent-less technology to communicate directly (natively) with systems that are being managed and monitored by the application. IBM Systems Director is not required on every system that is managed by Active Energy Manager since agents do not need be installed on the end-point systems. Active Energy Manager does not require an additional management server because it can run on the server that it is managing while also serving as a single control point for other systems that are being managed.

In addition, Active Energy Manager supports energy monitoring of devices that are connected to select Power Distribution Units (PDU), or “smart” power strips used to provide power to multiple devices. By plugging systems into a PDU, Active Energy Manager can collect energy information from equipment in the rack that is plugged into the PDU, including I/O drawers, storage devices and servers. Using PDUs, Active Energy Manager can monitor both IBM and non-IBM servers that do not have native support, thus providing a broader view of energy use within the IT data center. In the event that PDUs are not a viable alternative, Active Energy Manager can retrieve temperature and power information using the facility provider’s wireless sensors, which can be located virtually anywhere in the data center. This allows monitoring of older IBM servers and non-IBM servers without installing new PDUs.

IBM services for the data center

IBM provides a range of integrated, proven service solutions for the data center to help IT organizations reduce energy consumption, contain costs, maintain performance and support business objectives:

- ***IBM Systems Director Active Energy Manager Implementation Jumpstart*** *is an implementation and hands-on training service that assists organizations in exploiting the capabilities of IBM Systems Director Active Energy Manager and IBM Systems Director on IBM systems, IBM BladeCenter® and IBM System Storage™ environments. This service can optionally include discussions and guidance on how to integrate Active Energy Manager Extensions with Tivoli Enterprise Management software using IBM Tivoli Monitoring Power Agent and/or OEM equipment such as building and facility automation systems.*

The scope of the Active Energy Manager also extends beyond systems because it can receive alerts and events related to power and cooling equipment. Interaction with facility providers reveals these events. As one example, alerts can notify IT administrators about issues with facilities equipment. Administrators can then use this information to determine if servers are in danger of overheating, if an uninterruptible power supply (UPS) battery is running low or if any other conditions may keep IT equipment in a data center from running properly.

As an integrated part of the IBM Systems Director family, Active Energy Manager provides a source of energy management data that can be fully exploited by IBM Tivoli® enterprise solutions for large-scale, enterprise-wide power management, facilities management, asset management and usage reporting.

Tivoli software delivers a complete solution for managing energy efficiency. Monitoring capabilities from Tivoli software allow an administrator to view and manage application response times to minimize power consumption while still achieving SLAs. IT managers can set policies in monitoring solutions that indicate when a server's power consumption should be reduced and when it should be increased. These policies can be as simple as reducing power on weekends or automating adjustments based on response-time requirements.



IBM services for the data center

- **IBM Data Center and Facilities Strategy Services** are designed to streamline the data center planning and management process, helping organizations determine their data center facility capacity, availability and security requirements. These services also help organizations identify suitable locations for facilities and evaluate the best way to acquire, operate and manage the data center.

For example, if an SLA requires a response time of two seconds or less, an IT manager can set a policy indicating that if the response time is less than one second, power consumption is reduced for the server. When the response time reaches 1.5 seconds, power consumption is increased for the server. Once defined and integrated into power operations, these policies require no manual intervention to execute. Monitoring capabilities from Tivoli software can also be used to set thresholds and drive automated actions based on events such as overheating of a system. This data can be shared through power and thermal information reports.

Tivoli solutions for facilities management allow asset managers to visualize the spatial relationships among managed assets and other mapped features across IT, data center infrastructure and building automation systems such as fire alarms, lighting, heating, ventilation, air conditioning (HVAC) and so forth. This capability can help bring energy data together from multiple systems instead of being distributed across different environments, thereby helping to improve work planning and analysis, eliminate the need for data duplication, create efficiencies in business processes and enhance communication. Embedded GIS functionality provides seamless access to dynamic GIS functionality, instead of just views of a static map.

IBM services for the data center

- **IBM Global Asset Recovery Services** provide IT asset disposal options to help organizations safely and securely dispose retired IT hardware in an environmentally friendly way and invest in refurbished, warranty-backed equipment.
- **IBM Global Financing Services** provide hardware, software and services financing to help stretch budgets and make investments in measuring and managing energy even more affordable.

Tivoli asset management solutions help customers manage their IT assets from a financial standpoint, using a single solution that tracks and manages hardware, software and related information throughout their life cycles. Designed to support both IT and enterprise assets, these solutions can significantly reduce IT asset cost by helping customers decide when a mature, energy-inefficient IT asset should be replaced with a new, more energy-efficient model. Underutilized assets can be redeployed and software overlicensing can be avoided.

Tivoli usage and accounting solutions can be used to feed energy-use information into reporting and chargeback (financial accounting) applications, encouraging additional energy efficiencies through a better understanding by corporate users of actual energy consumption, including who caused that energy to be consumed. IT managers can accurately track, allocate and invoice by a number of criteria such as department, business unit or even by customer in situations where an application has been outsourced. Designed for ease of use and efficient management, the solutions deliver detailed information and reports while masking the underlying complexity of shared resource use.

Tivoli also has additional offerings in its portfolio to increase energy efficiency throughout an enterprise. The capabilities mentioned above represent only an example of the benefits that Tivoli software offers to clients who want to measure and manage energy more efficiently and effectively today.




Conclusion

Data centers with the tools to measure and manage energy consumption are well positioned to use less energy, generate less CO₂, make better use of existing IT assets, take up less space and provide significant cost savings.

Based on more than 50 years of success in developing data centers around the world, IBM solutions for energy-efficient data centers can help organizations:

- Monitor server utilization rates and energy consumption for greater energy efficiency:
 - Enable IT to use less energy while still supporting business priorities and achieving application response-time targets and SLAs.
 - Track “who used what,” and obtain reports showing which internal users are responsible for the greatest use of IT assets and power consumption.
 - Bill either to internal users or to external customers, encouraging reduced IT and energy use.
 - Measure power draw by actual use, not published system-energy-label specifications.

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- Manage IT assets from a financial perspective:
 - Decide when to replace older, less energy-efficient systems with newer, more energy-efficient ones to help save costs.
 - Understand the exact power and cooling costs in a data center from a facilities perspective, as well as the breakdown of costs per component.
 - Cap power at the server levels, helping to remain within corporate use policies or negotiated rates from energy providers.
 - Save energy costs in periods of low utilization by “throttling down” servers and balancing server loads.
 - Combine hardware, system logic and group management tools.
 - Ensure data center robustness within a fixed power envelope.
 - Increase performance without increasing infrastructure.
 - Strike the optimal balance between business needs and environmental concerns.

IBM also provides a powerful range of integrated service solutions (see sidebar) to help organizations with their data center initiatives. IBM services include financing, planning, designing, building and testing for new data centers, as well as training for IT staff about how to best maintain the new environment.



For more information

To learn more about IBM solutions for developing an energy-efficient and environmentally responsible data center, contact your IBM representative or IBM Business Partner, or visit ibm.com/systems/greendatacenter

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- ¹ IDC, "Worldwide Server Power and Cooling Expense 2006-2010," Document #203598, September 2006.
 - ² "Worldwide Server Power and Cooling Expense 2006-2010."
 - ³ U.S. Environmental Protection Agency, *Report to Congress on Server and Data Center Efficiency*, August 2, 2007, page 10. www.energystar.gov/ia/partners/prod_development/downloads/EPA_Datacenter_Report_Congress_Final1.PDF
 - ⁴ U.S. Department of Energy, "Creating Energy-Efficient Data Centers," May 18, 2007.
 - ⁵ IBM study, "IT energy efficiency for small and midsize businesses: Good for business and the environment," November 2007.
 - ⁶ "Worldwide Server Power and Cooling Expense 2006-2010."

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