



Greening the data center with IBM Tivoli software: an integrated approach to managing energy.



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Data center and facilities managers – along with entire enterprises – have started taking a close look at how they can reduce their energy consumption. And it’s easy to see why: the need for computing resources has exploded, stretching the limits of space, power and temperature in the data center. The high capital costs of new or expanded data centers, exponential growth in power costs and the desire to minimize environmental impact are all driving the recognition that managing energy is of critical importance in today’s data center. As an analyst from The Robert Frances Group notes, “Power will be the number one issue for most large company IT executives to address in the next 2–4 years. Ignoring this issue will not be an option. Power consideration must be incorporated into data center planning.”*

As critical as it is to reduce energy consumption, energy management measures should also be approached intelligently. No organization wants to take drastic measures to reduce energy costs only to pay in the end with poor response times and compromised service level agreements (SLAs). To successfully address the challenges of managing energy, organizations should understand the impact of energy policy changes on the services that the energy supports. And to make intelligent policy decisions, organizations should know the risk that is introduced with each proposed energy-related action in real time.

This paper describes the critical importance of managing energy consumption in data centers and provides an overview of the problems and issues associated with “greening” today’s data centers. It then shares insights and solutions that organizations can use to optimize their data center and facility energy requirements while maintaining service levels. Specifically, it describes how IBM Tivoli® solutions offer an integrated approach for managing energy in the context of risk by providing an end-to-end view of IT resources, services, IT and facilities assets, energy costs and response time.

Data centers today face an energy crisis:

- Computing demand continues to rise, driving massive growth in servers and storage.
- Energy costs are rising rapidly around the world.
- Many data centers are literally out of power, space or cooling capacity.
- Executives are under increased pressure to act on green initiatives.

Key considerations for the green data center

Energy management has not always been a major consideration in the design and operation of data centers. For many years, most data centers consumed power and space as if prices would always be low, the supply of energy endless and more space always available. Data centers ignored energy factors as serious impediments to the availability and performance of IT services, and the dollar and environmental costs of providing energy were not tremendously high.

Now, however, organizations are taking a closer look at the environmental impact and their current energy usage. At the same time, the demand for energy is becoming so great that it is outpacing supply and driving up costs – not just energy cost factors, but the cost of data center and office space.

Cost-cutting measures such as consolidating on blade servers have enabled organizations to pack more computing power into a smaller footprint. When energy costs were low, this was a reasonable solution. However, the use of high-density servers caused power consumption and heat generation to be concentrated within the data center. This results in a new issue of determining how to optimize these high-density servers to provide the necessary computational resources into the compact footprint of the current data center space. And as servers become ever more powerful – delivering more and more computational strength per square foot – the challenge will become even greater.

Managing energy and risk in the data center

Solving the energy crisis in the data center could theoretically be quite simple: unplug servers, shut down cooling units or even turn off circuit breakers in the data center. Taking this course would dramatically reduce energy use, of course, but unfortunately it would also destroy the ability to deliver the IT services demanded by applications. While data center managers are not likely to go that far, they are likely to pursue policies such as capping server power usage, raising the temperature in the data center, physically moving servers to balance cooling, aligning energy-intensive applications with efficient servers or virtualizing underutilized servers.

Highlights

Data center operations must manage energy by discovering how energy is directed throughout the enterprise and optimizing its usage – not just by reducing equipment

However, in the absence of a clear view of the resulting impact from energy management decisions, some of these less-drastic actions might still have a major impact on the ability to deliver services. For example, if you cap server power consumption, you need to consider what happens to the response time of applications and SLAs. Are they being put at risk? Are you losing redundancies so that if usage of applications or services spikes suddenly you won't be able to meet demand? And while virtualization provides a great start in optimizing energy costs by helping reduce the total number of servers in the data center, the ability to track usage and monitor service availability can become more complex in the process.

Data center operations must manage energy not just by equipment reduction but also by discovering how energy is directed throughout the enterprise and optimizing its usage. This may mean:

- Capping the number of processors in use at any particular time or even shutting down parts of the data center during off-peak periods.
- Obtaining accurate metrics about how much power is being used to provide services.
- Tuning data center operations to match power consumption against performance requirements.
- Connecting changes in IT energy policy with risk to business services.
- Providing management of energy across both IT and facilities resources.
- Monitoring the data center for power consumption, thermal conditions, and energy-related events and situations.
- Shifting workloads within or between data centers in order to save costs or respond to energy events.
- Maintaining IT and facilities assets for energy efficiency.

Continual monitoring and adjustments are needed to help ensure that no more power is used than is required to meet service level requirements at acceptable levels of risk. The right energy management tools can enable you to monitor, control and administer the infrastructure and facilities

in the data center. You can then coordinate the management of energy-consuming resources so specific services can be matched with specific resources as they demand more, less or no energy. With the right solution, this type of coordination of resources might be available autonomously, providing automatic lights-out coordination of resources against service level requirements. With this level of management, only the energy required to maintain desired service levels is used – no more, no less.

Managing energy consumption with Tivoli service management solutions

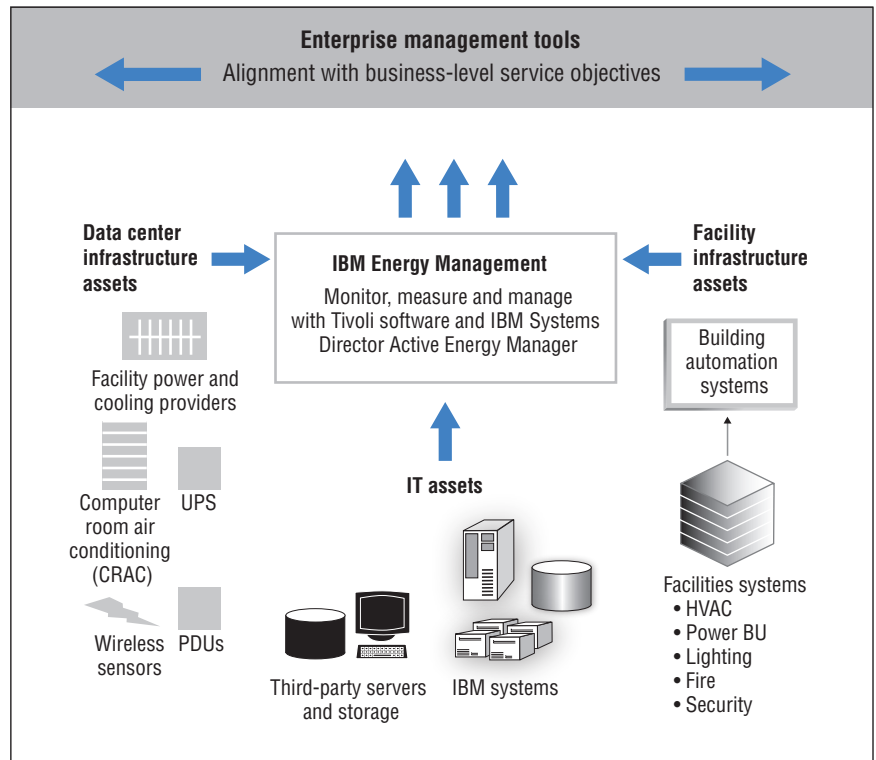
Organizations have long relied on Tivoli software and its broad range of proven monitoring, event health, performance and automation capabilities. When applied to energy consumption, these capabilities can help data centers adapt application usage to power constraints, and maintain service levels and workload throughput.

Greening the data center with Tivoli software starts with monitoring, controlling and integrating energy with IT assets, the data center infrastructure and facilities assets. The connection to these three key dimensions enables a comprehensive view of energy use in the data center. It also allows energy data to be viewed in the context of service management. This connection to Tivoli service management brings an energy dimension to existing processes and gives organizations increased:

- **Visibility.** Gain an overall view of IT resources, services, IT and facilities assets, energy costs and response time in the context of energy.
- **Control.** Provide recommendations for reducing energy use while maintaining service levels.
- **Automation.** Build agility into operations through the ability to use automated policies for energy efficiency.

The next few sections describe how Tivoli energy efficiency solutions can help you better understand your current energy, application and facility power usage and demand.

Highlights



To be truly effective at reducing energy costs and carbon emissions, energy initiatives should be established and integrated throughout the organization

Integrating power and IT

Going green offers the potential to reduce both energy costs and carbon emissions, but to be truly effective, energy initiatives should be established and integrated throughout the organization. In this way, bringing energy and IT together offers the potential for greater oversight and control of data center workload and more efficient use of available energy.

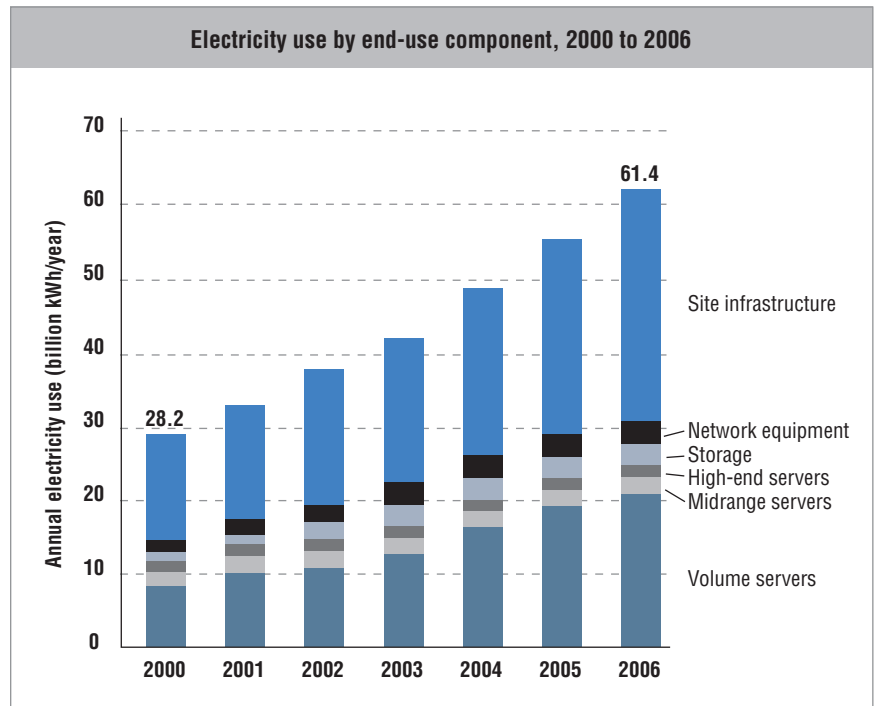
Tivoli monitoring solutions allow you to collect both traditional IT measurements and environmental measurements into a common dashboard that displays an integrated view of power usage, thermal data and application performance metrics. From there, you can feed the temperature data into data warehouses to share with other applications for real-time and historical trending analysis. For example, you might home in on a particular asset that consistently uses more energy than the others. By correlating this information with service level targets, you can take immediate action to slow the system down without impacting SLAs.

You can also set policies to autonomously respond to certain preset thresholds or events to decrease heat generation. As workload increases and decreases, these automated power management policies can continually adjust the power by metering, controlling or capping consumption to save energy while maintaining response times.

In addition, a consolidated view enables you to better assess usage data and financial cost reporting on who is using what resources and to what extent. This allows decisions to be made for chargeback, and provides the basis for decision making about procurement and assignment of additional assets.

Integrating IT and facilities assets

When considering data center energy use, it is natural to first consider the racks of servers or the large storage units. Yet the actual IT equipment uses less than half of the total energy in a typical data center. The majority of the energy used typically is consumed by infrastructure and facilities assets – chillers, UPS systems, air conditioners, power distribution units, humidifiers, lighting and other non-IT equipment.



Enabling cost savings and efficiencies requires integrating all of the information of the entire environment – both IT assets and facilities assets. Not only should data center and facilities managers have access to a common view of energy in the data center, but facilities, IT and finance should use the same data with customized views according to their roles. Visualization promotes quick identification of hot spots and cooling effectiveness – along with the affected assets and by extension, the services most likely to be impacted. Facilities alerts can be integrated with IT events to provide greater awareness of “cause and effects” for IT incidents, such as what failed first – facilities or IT equipment.

Highlights

By integrating Tivoli solutions with IT assets and facility building systems, assets can be monitored and managed for comprehensive energy, risk and service management

Tivoli solutions can extend the business partner ecosystem to gather data and direct changes within the data center facility, including:

- Moving servers among racks.
- Installing new racks in a different location within the data center.
- Installing supplementary fans and heating and air conditioning equipment to help improve air handling in data centers.

Bringing it all together with Tivoli service management

Collecting and integrating IT and environmental information is a critical element of managing energy. By integrating Tivoli solutions with IT assets and facility building systems, assets can be monitored and managed for comprehensive energy, risk and service management. Service management provides the foundation for integration and policy decisions of energy and risk management, addressing the following questions:

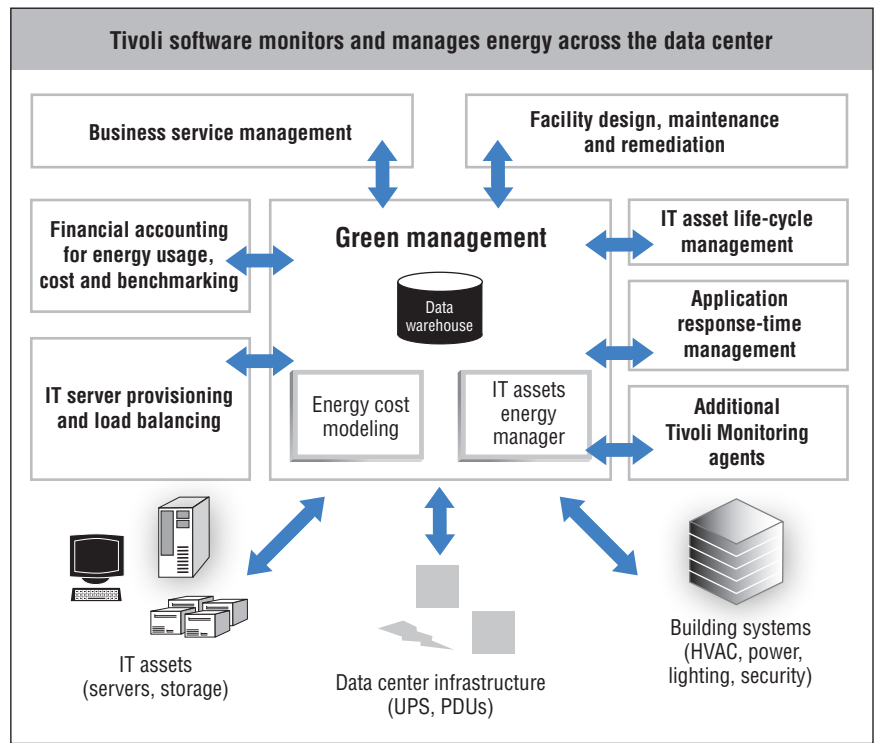
- What SLAs must be met?
- How will the services perform if action is taken to reduce power?
- By saving power how much money are we saving?

Highlights

Based on ITIL, Tivoli service management solutions work together to help reduce energy demand

A service management context – or rather, green service management – helps identify the minimum amount of power needed to maintain response times and SLAs. Based on IT Infrastructure Library® (ITIL®), Tivoli service management solutions work together to help reduce energy demand. As an example, after completing a trend analysis on power usage and temperature using Tivoli monitoring solutions, you discover a server that is consistently warmer or uses more energy than the others. You could then utilize IBM Maximo® asset management solutions to identify other servers of the same configuration, and manufacture and initiate a workflow for approval that defines relocation of all such servers for preventive intervention of service performance.

The solutions described on the next page address a range of energy management entry points. Utilizing the established Tivoli infrastructure, proactive energy, capacity, performance and facility management enable the control of IT resources to efficiently match the resources to performance demands by parameters you set and control. This management paradigm extends to coordinate how the facility assets can optimally match application performance and response-time requirements while providing chargeback information for usage of the data center resources.



Tivoli software monitors and manages energy across the data center with:

- *Business service management* — illuminates the impact of energy issues on business services.
- *Facility design, maintenance and remediation* — supports processes for facilities management of assets and allows for visualization of data center facilities.
- *Financial accounting for energy usage, cost and benchmarking* — determines and manages power usage and cost to establish benchmarks for savings.
- *IT server provisioning and load balancing* — provides provisioning of systems and redistribution of loads to higher-efficiency areas.
- *Green management* — provides monitoring and management of power usage and thermal data from data center resources.
- *Data warehouse* — stores energy information for use in a variety of energy scenarios.
- *Energy cost modeling* — establishes baselines for energy usage, reports on the amount of power consumed and supports “what-if” analysis.
- *IT assets energy manager* — allows for control over energy characteristics of servers, such as cutting power to processors.
- *IT asset life-cycle management* — enables management of IT asset life cycle to procure efficient assets, maintain them for efficiency and ultimately dispose of them properly.
- *Application response-time management* — provides a view into response time of applications so that the impact of energy measures on application performance can be assessed.
- *Additional IBM Tivoli Monitoring agents* — provide additional information on the IT environment, such as utilization rates, so that they can be a part of energy decisions.



Summary

Drawing on a deep understanding of today's energy challenges, IBM provides the breadth and depth of solutions and services that enable organizations to help measurably reduce power consumption and environmental impact without compromising service levels. With its comprehensive range of green service management solutions, IBM delivers the technologies and expertise needed to bring the proper focus and emphasis to energy management.

Although "going green" will remain a race without a finish line, Tivoli software offers solutions and services – and perhaps more important, strategies – to help optimize data center space, power, cooling, facility management and flexibility to exceed customer expectations, reduce costs and support business growth.

For more information

To learn more about how Tivoli solutions can help you manage energy more efficiently – or to find the entry point that is right for your organization – contact your IBM representative or IBM Business Partner, or visit ibm.com/itsolutions/servicemanagement

About IBM Service Management

IBM Service Management helps organizations deliver quality service that is effectively managed, continuous and secure for users, customers and partners. Organizations of every size can leverage IBM services, software and hardware to plan, execute and manage initiatives for service and asset management, security and business resilience. Flexible, modular offerings span business management, IT development and IT operations and draw on extensive customer experience, best practices and open standards-based technology. IBM acts as a strategic partner to help customers implement the right solutions to achieve rapid business results and accelerate business growth.

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*Jonathan Koomey, Ph.D., Lawrence Berkeley National Laboratory, Dec. 2007; (2) US EPA, August 2007.