WHITE PAPER

# How VMware Virtualization Right-sizes IT Infrastructure to Reduce Power Consumption

vmware®

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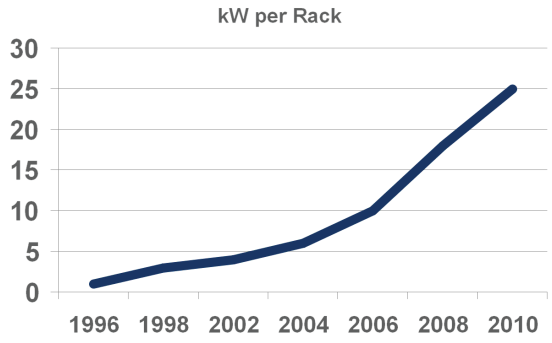
Rising energy costs and consumption in datacenters is a hot topic, whether you care about saving money, deploying new IT services, keeping the datacenter running or sparing the environment. As energy climbs the list of corporate priorities, "Green IT" solutions are proliferating. Prioritizing potential fixes is not easy amidst this flood of information. There is no silver bullet, but virtualization often tops the list because it right-sizes the largest culprits of energy over-consumption – underutilized x86 desktops and servers. In typical environments these machines sit idle almost all of the time, consuming significant amounts of power. VMware solutions help customers safely consolidate these machines onto much less hardware, both through initial consolidation efforts and dynamically as computing requirements change. This white paper explains how innovations in virtualization technology from VMware provide a foundation for a dramatically more efficient and greener IT environment

## Servers Are Driving Energy Consumption and Costs

Today's datacenters consume a lot of electricity. A recent report by the Environmental Protection Agency claims datacenters in the U.S. consume 4.5 billion kWh annually, 1.5 percent of the country's total.[i] Perhaps more importantly, this figure has doubled from 2000 to 2006, and is likely to double again in the next few years. This trend is affecting datacenters around the world and is likely to continue, given how central computing is to our businesses and lifestyles.

**Figure 1. Rising Energy Consumption in the Datacenter**




There are many factors contributing to excessive energy consumption in datacenters, but underutilized x86 hardware is the most significant. According to the EPA, servers consumed 80 percent of the total IT load and 40% of total datacenter power consumption in 2006.[ii] Site infrastructure—including cooling of equipment—accounts for another 50 percent of total datacenter power consumption. Yet because x86 servers typically house only a single application, their processors sit idle 85-95 percent of the time. While sitting idle, these servers use nearly as much power as they do when they are active. According to analysts, companies maintain roughly three years of excess hardware capacity due to this vast underutilization. With more than seven million servers sold annually, this represents more than 20 million servers sitting idle and wasting energy. This inefficiency is not only wasteful but expensive, especially as electricity costs and computing demand continue to rise.

As a result of increasing energy demands on inefficient and aging datacenters, many companies are simply running out of power and/or capacity. Either the utility cannot provide adequate power, or the equipment is so power-hungry and dense that the datacenter runs out of capacity even though the datacenter is not physically full; energy costs preclude investments in additional physical hardware.Analyst firms and industry research suggest that most datacenters will feel the crunch soon, if they don't already.

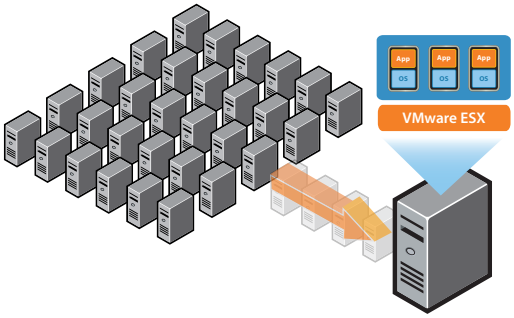
Another challenge is the inability of IT staff to respond rapidly to changing business needs and computing requirements. IT loads can vary depending on the time of day or month, and often grow over time as companies grow or the demand for applications increases. The static nature of a physical IT infrastructure makes it difficult to respond. Hardware is typically over-provisioned for peak load, because applications are very difficult to reconfigure to different hardware, once installed. For example, if a server is running an ERP application that has a spike in usage at the end of every month, the server must be sized to accommodate that peak in usage. In preparation for increased capacity requirements, businesses also maintain excess IT capacity. The inability to provision the physical infrastructure dynamically to accommodate these fluctuations leads to wasteful practices in the datacenter that increase energy consumption.

Businesses of all sizes are looking for relief from increasing energy demands and costs, as well as freedom from the constraints of inflexible and underutilized hardware. Many are turning to virtualization—a fundamental element of the green datacenter.

## Server Consolidation

A key benefit of virtualization technology is the ability to contain and consolidate the number of servers in a datacenter. This allows businesses to run multiple application and OS workloads on the same server. Ten server workloads running on a single physical server is typical, but some companies are consolidating as many as 30 or 40 workloads onto one server. As you might expect, dramatically reducing server count has a transformational impact on IT energy consumption. Utilization of x86 servers increases from the typical 8-15 percent to 70-80 percent. Reducing the number of physical servers through virtualization cuts power and cooling costs and provides more computing power in less space. As a result, energy consumption typically decreases by 80 percent.

**Figure 2. Server Consolidation with VMware ESX**



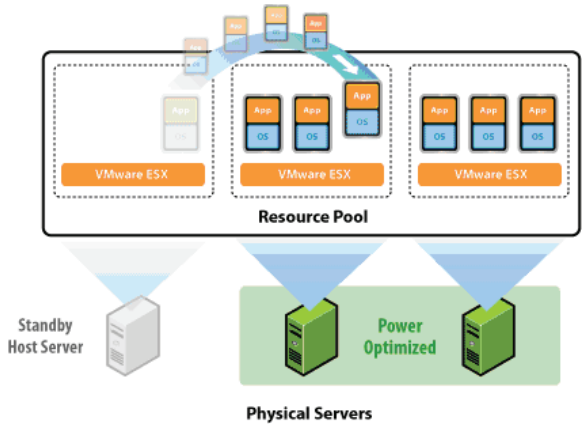

The impact of virtualization on energy consumption is so significant that utilities in North America such as PG&E, Southern California Edison, SDG&E, BC Hydro and Austin Energy are paying customers for removing servers through consolidation.[iii] These programs compare the energy use of existing equipment to that of remaining equipment in service after consolidation. Incentives are based on the net reduction in kilowatt-hours from direct energy savings from the project (cooling costs are excluded), which can be as high as $300 USD per server and $4 million per physical site. Incentive programs are more cost-effective than creating new power plants, and better for the environment.

## Dynamic "Right-Sizing" of Virtual Infrastructure

Another advantage of virtualization is the ability to respond rapidly to changing business needs and computing requirements. Through VMware virtualization technology, IT infrastructure becomes dynamic and responsive to fluctuating capacity requirements. VMware® VMotion™, allows administrators to move running virtual machines from one server to another with no disruption to the application or end users. VMware® Distributed Resource Scheduler (DRS) monitors the utilization of a pool of servers and uses VMotion to dynamically rebalance virtual machines across an entire resource pool of physical servers on an ongoing basis.

VMware DRS uses a feature called VMware Distributed Power Management (DPM) to reduce power consumption by turning off servers when there is unneeded capacity. Servers are powered back on when the capacity is required. Because virtual machines are unaffected by live migration, this feature automatically shrinks or expands the pool of servers running at any given time without reducing service levels. This capacity on demand eliminates the need to maintain "excess capacity" while ensuring resources are available if more capacity is needed. VMware DRS also reserves capacity for automatic failover.

**Figure 3. Distributed Power Management with VMware DRS**




VMware Infrastructure intelligently right-sizes physical hardware in the datacenter, reducing energy consumption in real time while maintaining high reliability and availability. These innovative technologies enable an infrastructure that is infinitely more flexible than traditional physical infrastructure and allow businesses to adapt rapidly to changing requirements, without wasting energy.

## The Environmental Impact of Right-Sizing IT

In addition to reducing costs and improving flexibility, the ability of businesses to right-size their IT infrastructure using VMware virtualization technology helps the environment. Every server that is virtualized saves 7,000 kWh of electricity and four tons of carbon dioxide emissions per year. With more than a million workloads running on VMware Infrastructure, the aggregate power savings are about 8 billion kWh, which is more than the heating, ventilation and cooling electricity consumed in New England in a year.[1] If companies have an average of three years

excess capacity as analysts suggest, this represents a reduction of 80 million tons of carbon dioxide emissions per year, which is equal to the emissions of half of all countries in Latin America.

Industry forecasts suggest that although only about five percent of physical servers have been consolidated to date, a majority of servers will be consolidated using virtualization in the next few years, now that virtualization has become mainstream. Widespread server consolidation and dynamic right-sizing of IT capacity will have a huge economic and environmental impact.

## A Revolution in the Datacenter

Virtualization provides tremendous energy benefits and a lifeline to datacenters that are running low on capacity and high on power and cooling costs. Leveraging innovations in virtualization technology, VMware Infrastructure provides increased IT flexibility, reliability and availability and frees datacenters from the shortcomings of a static, physical IT infrastructure. Now businesses can create virtualized, dynamic IT environments are cost and energy efficient and support the green movement in a significant way.

[1] http://www.eia.doe.gov/emeu/reps/enduse/er01_new-eng_tab1.html

[i] EPA Report to U.S. Congress on Data Center Energy Efficiency, July 2007

[ii] EPA Report to U.S. Congress on Data Center Energy Efficiency, July 2007.

[iii] http://www.vmware.com/solutions/consolidation/green/pge.html

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