ENERGY FACTS

Are There Ghosts in Your Closet? Saving Wasted Energy in Computer Server Rooms

Computer servers and the facilities that house them, from the server closet in your office to the warehouse-scale data center in a business park, are the hidden side of your digital life. When you talk on your cell phone, tweet or chat on social networking sites, shop and bank online, email at work or at home, you are using a web of servers located all over the internet. This fast growing army of servers is powering the digital economy, enriching people's lives, creating jobs, and supporting economic growth. It is also responsible for wasting massive amounts of energy. All U.S. data centers together are estimated to consume over 75 billion kWh annually,[1] equivalent to the output of 26 medium sized coal-fired power plants. NRDC estimates that half of this energy—equivalent to the output of 13 power plants—is going to waste. By taking steps to lower and optimize energy use in server rooms, companies can reduce carbon pollution while saving money.

MUCH DATA CENTER ENERGY IS WASTED POWERING SERVERS DOING NO USEFUL WORK

Typical servers in the U.S. only use 5 to 15 percent of their maximum capability on average, while consuming 60 to 90 percent of their peak power.[2] Servers draw a lot of power simply by being on. People could get the same amount of work done with many fewer servers, just by increasing the load on each server.

Most of the energy used to power the nation's servers is wasted doing no useful work. NRDC estimates that this wasted energy represents the equivalent output of 13 power plants.[3] This waste not only costs consumers money by raising the cost of products and services, but it also generates unnecessary atmospheric pollution, makes our economy less competitive, and impacts jobs.

Optimizing server energy use is already the subject of intense focus by the Information Technology (IT) industry and utility companies in large data centers. However, the

NRDC
THE EARTH'S BEST DEFENSE

13 POWER PLANTS	Energy wasted to power and cool servers doing no useful work
13 POWER PLANTS	Energy used to power and cool servers doing useful work
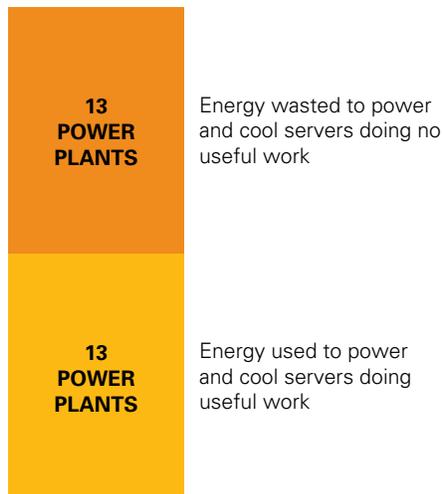
opportunities for savings in smaller server rooms and closets are often overlooked. Together, small server rooms and closets account for over 50 percent of data center energy use in the U.S.[2] Small server rooms can be found in organizations such as small- and medium-sized private businesses, local government agencies, hospitals, schools and universities, etc. Even large organizations may still have small server rooms and closets scattered about in addition to their corporate data centers. These organizations, both small and large, are often unaware of how much of their electricity bill is due to their server rooms. NRDC's research indicates that for many office-based organizations, 30 to 70 percent of electricity use comes from powering and cooling servers running 24 hours a day.

Low server utilization levels are typically due to the common but outdated practice of deploying each new application on its own server. This provides plenty of margin for growth and peak load performance, though in practice this margin for growth is rarely utilized, as most businesses find it easier to buy new servers. As a result, computing resources in many smaller organizations are vastly over-provisioned relative to needs. These common practices mean that the nation's server fleet is used very inefficiently and wastes a lot of energy.

HOW TO OPTIMIZE THE ENERGY FOOTPRINT OF YOUR SERVER ROOM

Fortunately, there are many proven, cost-effective solutions to reduce the energy footprint of your servers:

1. Measure or Estimate the Energy Consumption of Your Server Room

As a first step, determine your current electricity usage to serve as a baseline. You can use this electricity usage baseline to evaluate the cost-effectiveness of energy efficiency improvements, and to track your progress. The baseline will also help raise awareness of the problem of wasteful server energy use, and garner internal support for action.

2. Switch Off Unused Servers

Server rooms of all sizes often contain servers doing absolutely nothing. Sometimes the application they hosted was decommissioned or no longer used, but these ghost servers continue to run around the clock. In large data centers, keeping track of hundreds or thousands of servers can be difficult, and many servers fall through the cracks of asset management processes. Even in small server rooms, NRDC researchers have found unused or very infrequently used servers that could be switched off without impacting anyone.

3. Set Servers to Go Into Low Power Mode When Inactive

Some servers run all the time even though they are used for short periods of time only. For example, a backup server might run just a few hours per day. During the hours when they are not needed, servers can be set to go into a low-power mode, which uses a fraction of the power, while still being ready to respond to service requests.

4. Optimize Server Use Through Consolidation and Virtualization

Once you have taken care of the basic measures, turn your focus to the utilization level of your server assets. "What gets measured gets managed" goes the saying, so start by measuring your server utilization. Server hardware vendors offer software solutions that allow server room operators to track utilization over time. This will provide you with a second baseline. You can use this server utilization baseline to plan and evaluate your optimization efforts.

How to estimate the energy consumption of a server room

There are many ways to estimate the energy use of a server room in an office building, but here is a simple approach that will work in most cases:

1. Most Uninterruptible Power Supplies (UPS) have a load indicator. Multiply your UPS load factor by the UPS power rating you can find online. This will give you a rough estimate of the IT load for that UPS.

2. Have a professional electrician install a logging meter on the circuit breakers for the server room air conditioning on the electrical panel. Add the IT load and server room cooling load to estimate your server's overall energy use.

3. If you cannot measure your air conditioning use, you can assume that 1 Watt of cooling is necessary for every Watt of IT load, and simply multiply your IT load by 2.

CONSUMER ELECTRONICS

TABLET

COMPUTER

PHONE

TV

DATA SERVICES

SERVER ROOMS AND CLOSETS

DATA CENTERS

26 COAL-FIRED POWER PLANTS
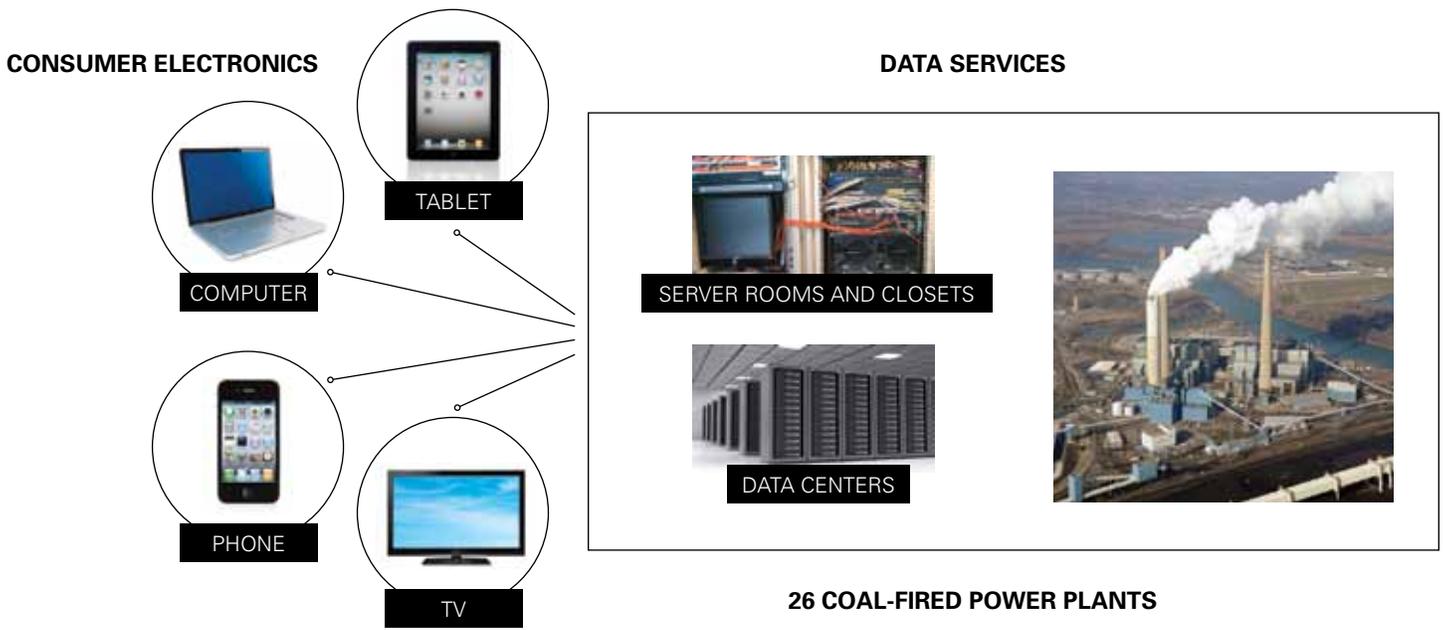
U.S. data centers, which process the data needed to run our televisions, cell phones, computers and mobile devices, consume over 75 billion kWh of electricity annually, equivalent to the output of 26 medium-sized coal-fired power plants. Half of this energy simply goes to waste.

Perhaps the single most important opportunity to save energy and money is to consolidate multiple applications from several underutilized servers onto a single, right-sized server. This is known as virtualization.

A virtualized server runs applications in virtual machines, that can be housed together in a single server or moved from one physical server to another depending on load conditions. A single virtualized server, even heavily loaded, uses far less energy than multiple, lightly loaded servers.

As of August 2010, only 16 percent of data center loads were virtualized.[4] Virtualization commonly enables consolidation ratios of 10:1 or even 15:1, meaning 10 to 15 servers can be consolidated down to a single one. While virtualized host servers are more powerful and use more energy than a standard single server, the consolidation can yield overall energy savings of 50 percent or higher.

Consolidating servers not only saves server energy, it also reduces cooling needs, therefore saving on cooling energy use and costs as well. Virtualization also provides significant benefits in terms of operational and capital costs savings. It is a highly cost-effective project even in small server rooms.

5. Move Some Applications to the Cloud

Every IT trade magazine talks of cloud computing these days, due to its many cost and flexibility benefits. Yet few organizations look at cloud computing as an opportunity to reduce their energy and carbon footprint. Cloud computing can be defined as internet-based computing whereby shared servers provide computing resources to multiple customers. Email, office applications, data backup, and customer relationship management, to name but a few, all have significant cloud-based offerings.

Moving an application to the cloud does not just outsource your server footprint to an external service provider. In most cases it also significantly reduces the overall energy and carbon footprint of your computing. Cloud computing is generally greener than in-house computing thanks to better sharing of server resources, and a natural market incentive for cloud service providers to invest in efficiency. A recent Microsoft-Accenture-WSP[5] report estimates that using cloud computing can reduce the carbon footprint of applications by 30 percent of more. However, some cloud service providers are greener than others, and most can become even greener. Be sure to ask vendors about the environmental attributes of their cloud services before making a decision.

6. Consider Facilities and Hardware Efficiency

While server utilization is often the largest opportunity for energy savings in server rooms, significant opportunities also exist to reduce energy use through power distribution, cooling, and hardware energy efficiency:

■ Facilities efficiency: You can save energy by optimizing the efficiency of cooling, power distribution, lighting and other electrical loads that are necessary to run the data center on top of the IT load itself. For example, adjust the cooling temperature of your server room per the American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) recommendations. Most server rooms are overcooled, which wastes energy.[6]

- Hardware efficiency: increasing the efficiency of the IT hardware itself also reduces energy use. Over the past few years hardware manufacturers have developed servers that are much more energy efficient than their predecessors. Customers can save significant energy by purchasing the most energy efficient servers in their class.

SAVE MONEY AND ENERGY

Businesses that implement virtualization today do it not just to save energy, but also to save money on electric bills and IT costs, as well as to increase the reliability and performance of their IT environment. NRDC estimates that an organization with 10 underutilized servers can save more than $100,000 over 5 years in energy, hardware, software, and consulting costs by implementing a fully virtualized environment.

Unfortunately, a number of barriers prevent this opportunity from being fully realized in many cases. Most businesses are not aware that wasteful server use represents such a large portion of their organization's energy use, nor that solutions exist to cut that energy use in half or more. Even when aware of the opportunity, small and medium businesses may not prioritize this type of project, even if it pays back in less than 2 years. They may be held back by misaligned incentives, such as full-service leases in which the building owner does not pass any energy savings back to the tenant.

How Green is the Cloud?

- While most cloud service providers optimize the efficiency of their data centers, some are better than others. Unfortunately most cloud service providers do not report their emissions factor, making it difficult for customers to compare their carbon footprint.
- An efficient data center does not mean a low-carbon data center: cloud services powered by coal-generated electricity have a much higher carbon footprint than those that use clean energy.
- Ask your cloud service provider for transparent reporting of the carbon footprint of their services.

UTILITY INCENTIVE PROGRAMS NEEDED

Energy efficiency programs run by local utility companies can be key to raising awareness and motivating server room operators with incentives to perform IT efficiency assessments and to implement server consolidation projects that will save energy and money.

The server rooms and closets of both small and large organizations represent a significant and often overlooked energy savings opportunity. There are many opportunities to reduce server room energy use, from power management to virtualization, facilities retrofit, and hardware efficiency improvements. Investing in server room energy savings is very cost-effective, saving businesses and consumers money, reducing pollution, and making the U.S. economy more competitive. Utility incentive programs are needed to overcome market barriers and fully realize this opportunity.

[1] Koomey, Jonathan G. "Worldwide Electricity Used in Data Centers"(Environmental Research Letters, vol. 3, no. 034008, September, 2011), Page 14, doi:10.1088/1748-9326/3/3/034008

[2] EPA, Report to Congress on Server and Data Center Energy Efficiency, 2007.

[3] 35% of current server stock already virtualized. Rest of servers consolidated 1:7 on average (1:10 for servers that are virtualized, but factoring in that not all servers can be virtualized). This yields a 55% reduction in total server stock after virtualization, and with an energy proportionality of 50% (servers idling at 50% of maximum power), total energy use of US server stock after virtualization is 50% of current.

[4] Information Week, August 23, 2010

[5] http://www.microsoft.com/environment/cloud.aspx

[6] http://www1.eere.energy.gov/femp/pdfs/eedatacenterbestpractices.pdf