Eco-Friendly IT: Greener Approach to IT

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Abstract

Information Technology is widely considered as a key tool that can help address the frightening energy and environmental challenges facing the world today. Environmental issues are receiving unprecedented attention from businesses and governments around the world. Eco-friendly Information Technology, also known as Green Computing, in particular, is geared towards utilizing Information Technology in creating a more environmentally friendly and cost-effective use of power and production in technology. Eco-friendly Information Technology starts with manufacturers producing environmentally friendly products and encouraging various departments to consider more friendly options like virtualization, power management and proper recycling habits.

Feeling pressure from customers and other stakeholders, organizations have begun to make serious improvements in their environmental performance, recognizing that if they fail to deliver on this, it frequently translates into a negative impact on profit. Many governments are introducing aggressive environmental policy, encompassing everything from greenhouse gas reduction and natural resource protection to clean power initiatives and incentives for energy efficiency.

The main purpose of this research paper is to discover the various issues relating to the harsh environmental impact caused by high energy resource consumption of data centers as well as discuss various eco-friendly solutions to address the issues. Advantages of implementing identified eco-friendly solutions to resolve the highlighted issues are also discussed in this research paper. Moreover, related case studies are presented to support how influential Information Technology companies resolved various issues pertaining to high energy consumption in data centers – companies that were able to utilized eco-friendly technology in resolving the issues facing the modern industry today. This research paper aims to establish and highlight the important link between the environment and Information Technology. This further emphasize that Information Technology can be a vital instrument in saving the environment through various eco-friendly solutions available.

Keywords: Green IT, virtualization, eco-friendly, energy-efficient, environment.

1. Introduction

In recent years, we have seen a great increase in the number of companies joining the green movement bandwagon. As more and more organizations are becoming aware of their responsibilities to the environment, numerous efforts towards saving the environment are being implemented. Some companies see the move as a necessity as regulators consider limits on greenhouse gas emissions and consumers demand environmentally friendly products.

The compounding effect of high gas emission, toxic waste materials, and high energy consumption has put a toll on the environment. Increasingly, more organizations are becoming aware of their responsibility to the environment as numerous efforts towards saving the environment are implemented through utilization of eco-friendly IT. As the name implies, eco-friendly IT refers to environmentally sustainable computing or Information Technology. The main goal of eco-friendly IT is to reduce the use of hazardous materials, maximize energy efficiency during the product's lifetime, and promote the recyclability or biodegradability of obsolete products and factory waste.

In the Information Technology industry, energy consumption is considered to be a critical issue today. As data centers grow, their carbon footprints increases. One would think that a computer does not consumed much energy; however, if you think of it on a bigger scale, such as in the case of data centers, where you have thousands of computers with many processors and numerous memory cards - energy consumption becomes probabilistic for company owners as well as for the environment. The IT industry is not the only one experiencing such issues relating to high energy consumption, various highly developed industries as well has the same dilemma of coping up with the effects of modernization.

The effect of modernization has harsh impact on the environment, as the world becomes more modernized – various products are developed, manufactured, and used to keep abreast with the constant changes brought by the modern world. All aspects that go along with manufacturing a certain product produce unwanted toxic elements and pollutants that can have an adverse effect on the environment and the public health. Issues relating to the effect of production waste disposal, packaging materials discarding, and recycling obsolete products must be addressed by every organization to minimize pollution.

Various companies in the Information Technology industry adopted various eco-friendly IT solutions in support of creating a sustainable environment. Sustainability is an issue that affects organizations of all sizes. With the awareness of "green" issues at an all-time high, it is important that every company make every effort to be as environmentally conscious as possible.

Many businesses have discovered that eco-friendly IT initiatives offer costs savings benefits while reforming the organization, meeting stakeholder demands and complying with laws and regulations. In this study, IBM and Info-Tech Research Group find that businesses who complete eco-friendly IT initiatives realize significant cost savings alongside superior environmental performance.

2. Eco-friendly Adoption Needs

Energy consumption is a critical issue for Information Technologies organizations today, whether the goal is to reduce cost, save the environment or keep data centers running efficiently and cost effectively. Data centers consume so much electricity that United States' data centers alone consume 4.5 kWh annually which is 1.5% of the country's total energy consumption. Industry analysts estimates that over the next 5 years, most enterprise data centers will spend as much on energy (power and cooling) as they do on hardware infrastructure. This number would likely double in the next few years as the demand for data centers increases due to the central computing need to support businesses and lifestyles. Servers basically are driving energy consumption and costs.

Rising energy costs has already had an impact on all businesses, and all businesses have increasingly been judged according to their environmental credentials, by legislators, customers and shareholders. This won't just affect the obvious, traditionally power-hungry 'smoke-belching' manufacturing and heavy engineering industries, and the power generators. The Information Technology industry is more vulnerable than most – it has sometimes been a reckless and profligate consumer of energy. Development and improvements in technology have largely been achieved without regard to energy consumption.

The total amount of electricity used to operate data center servers and related infrastructure equipment in the United States was $2.7 billion in 2005 in comparison to $1.3 billion in 2000. Worldwide the total bill was $7.2 billion in 2005, compared with $3.2 billion in 2000. Looking at it in a different way, U.S. data center power consumption in 2005 was equivalent to about five 1,000- megawatt power plants or five typical nuclear or coal power according to analysts. In the United States, in 2005 Data center servers consumed 0.6 percent of all electricity. When counting with the infrastructure equipment such as network and cooling gear that figure goes up to 1.2 percent, about the same percentage consumed for televisions.

Today's data center design decisions all pivot around maximizing efficiency, while giving companies a path for future growth, says Steve Sams, VP of global site and facilities services for IBM. "We see our customers make very different design decisions than they used to," Sams says. "And the end result is that they are saving 30 percent in operational costs over the lifetime of the data center."

In many companies, there has been a shift away from dedicated data centers, as part of an attempt to provide all IT requirements by using smaller boxes within the office environment. Many have found this solution too expensive, experiencing a higher net spend on staff as well as with higher support costs. Energy consumption of distributed IT environments is difficult to audit, but some have also noted a progressive increase in power consumption with the move from centralized to decentralized, then to distributed architecture, and finally to mobility-based computing. Even where distributed computing remains dominant, the problems of escalating energy prices and environmental concernsnare present, albeit at a lower order of magnitude than in the data center environment, and even though the problems are rather more diffuse and more difficult to solve.

Increase in server demand can be accounted to the huge market demand for Web content, video on demand, music downloads, and Internet telephony. Factors that contribute to excessive energy consumption in data centers are as follows:

- **Underutilized server hardware**

  -Studies proved that a server consumes 80% of the total IT load and 40% of total data center consumption in 2006. Site infrastructure accounts to the 50% of total data center consumption

  -Servers typically house only single application where processors sit idle 85-95% of the time and while sitting idle, these servers uses nearly as much power as they do.

  -The inefficiency caused by running single application on x86 is not only wasteful but expensive due to electricity costs and increase in continuous computing demand.

- **Inefficient and aging data centers**

  -Many organizations have older application (legacy) running on older hardware. These applications and the hardware that they run on are expensive to manage and maintain because power consumption and hardware maintenance for older hardware is generally higher.

  -Companies running out of power and/or capacity to support the increase energy demands on inefficient and aging data centers caused by the following;

  - Utility incapable of providing adequate power
  - High power consuming and dense equipment

- **Inability of IT staff to respond rapidly to changing business needs and computing requirements**

  -Work load in IT varies depending on the day or month and increases over time as the company grow or the demand for application increases. Due to the static nature of IT physical infrastructure, hardware and servers are over-provisioned to work for peak load. This is mainly due to the fact that applications are very difficult to reconfigure to different hardware once it is installed. Consequently, the inability to provision the physical infrastructure dynamically to accommodate these fluctuations leads to wasteful practices in the data centers which results to high energy consumptions.

Businesses in various industries are looking for different ways to relief themselves with the burden of increasing energy demands and costs. Moreover, businesses are seeking to free themselves from the constraints of inflexible and underutilized hardware. Many of these dilemmas are now being resolved through eco-friendly IT solutions that are catered towards creating a sustainable environment. Virtualization is on the top list of solutions which is the fundamental element of the green data centers.

3. Eco-friendly Adoption Methods and Solutions

Modernization has brought increase need to have high-performance servers to meet the increasing demands for new applications. Consequently, energy usage in data centers rises in order to keep up with the trends which are becoming a major dilemma for many IT managers and corporate executives. Thus, the amount of power cooling systems needed for these servers increases as well which attributes to high electricity cost. Industries have noted that companies with data centers attribute 40% of their operating cost to power and cooling-related expenses alone. Furthermore, data centers are accounted for 23% of carbon emissions from global information and communications technology and claim about 1.5 percent of total electricity usage in the U.S. Much of this consumption comes from cooling the space used to house data servers.

The data centers high operating cost has drove big companies like Microsoft, Google, and Yahoo to establish data centers in locations where hydro-electric power and wind energy is abundant. This move has compelling advantages for such companies to address the high operating cost of maintaining its data centers as well as supports its movement towards a greener environment. However, building massive data centers to a well situated location requires huge investments which not all companies could afford. Google and Microsoft alone have spent an estimated $1.15 billion to create their data centers. These companies feel that such effort towards driving down the data center operating cost is much needed to keep abreast with the continuous evolution of the Internet while reducing their corporate carbon footprint to save the environment.

Companies want to reduce power usage these days, both to save cash on energy bills and to reduce their environmental impact. Saving energy is more than saving trees. Not only the environment clearly benefits from power-saving measures, but also the companies benefits from saving energy. That's because solutions to improve energy efficiency is often cost effective.

Various companies have acquired eco-friendly IT solutions to address the pressing environmental problems caused by inefficient usage of high energy consuming servers, aging servers, and the tremendous demand for cooling data centers. Various solutions to address power consumption are server virtualization, cutting data center energy consumption and changing data centers design and architecture. The following further details the eco-friendly IT solutions to address the aforementioned issues discussed in this research paper:

Virtualization and Server Consolidation

Virtualization solutions has successfully reduced corporate carbon footprint and positively impacting the environment all over the world. Virtualization is the creation of a virtual version of hardware platform, operating system, and storage device or network resources. Virtualization provides tremendous energy benefits and lifeline to datacenters that are running low on capacity and high on power and cooling costs. Through virtualization, businesses can create virtualized, dynamic IT environments that are cost and energy efficient as well as support the eco-friendly movement that various companies are aiming to implement in their daily business operation. The ever changing demands on IT infrastructure are challenging the way we implement data storage. Mounting pressures due to capacity, skill shortage and reduction in IT related costs is forcing businesses to optimize available storage assets. This can be done by consolidating the use of geographically dispersed and underutilized servers and storage.

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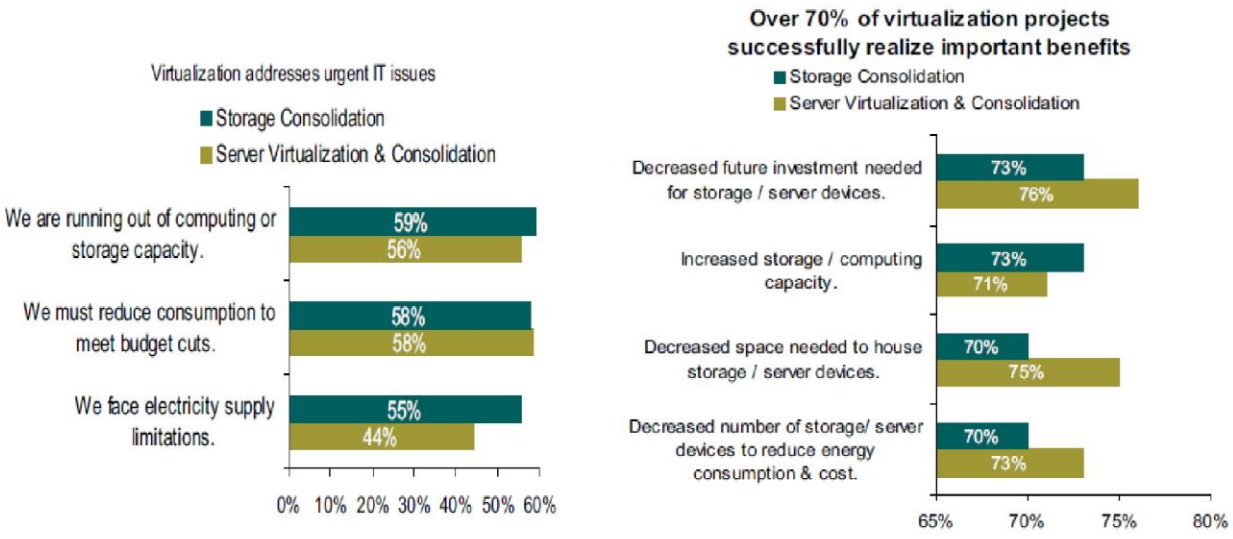


Source: http://www-03.ibm.com/press/attachments/GreenIT-final-Mar.4.pdf

Figure 1: Virtualisation Projets

The following are advantages of virtualization:

- Ability to contain an consolidate the number of servers in a data center

-Allows businesses to run multiple application and Operating System workload on the same server. The typical setup is a 10 server workload running on a single physical server; however, there are companies that consolidate 30 to 40 server workload on one server.

- Dramatic reduction in server count results on lower IT energy consumption. Reducing the number of physical servers through virtualization cuts power and cooling cost and provides more computing power in less space. Virtualization can decrease energy consumption by 80 percent.

- Ability to respond rapidly to changing business needs and computing requirements

  -Various companies providing virtualization services have diverse virtualization technology that allows administrators to move running virtual machines from one server to another with no disruption to the application or end users. They have the technology to monitor the utilization of pool of servers. Moreover, they have the technology to dynamically rebalance virtual machines across an entire resource pool of physical servers on an ongoing basis. Other technologies includes reduction of power consumption by turning off servers when there is unneeded capacity and servers are powered back on when the capacity is required,

- Virtualization technology helps the environment

  -Every server that is virtualized saves 7,000 kWh of electricity and 4 tons of carbon dioxide emission per year. With more than a million workloads running on virtualization technology, the cumulative power savings are about 8 billion kWh.

- Increases existing server and storage utilization and efficiency.
- Helps devise a centrally managed server storage plan.
- Centralizes and Efficiently Managed backup and recovery operations.
- Helps devise a simple disaster recovery and business continuity plan.
- Virtualization is used to consolidate the workloads of several under-utilized servers to fewer machines, perhaps a single machine (server consolidation), bringing your savings on hardware, environmental costs, management, and administration of the server infrastructure.
- Your legacy applications might simply not run on newer hardware and/or operating systems. Even if it does, if may under-utilize the server, so as above, it makes sense to consolidate several applications. Virtualization helps you here, as such applications are usually not written to co-exist within a single execution environment.
- Virtualization can provide the illusion of hardware, or hardware configuration that you do not have (such as SCSI devices, multiple processors etc.). This can also be used to simulate networks of independent computers.
- Virtualization allows for powerful debugging and performance monitoring. You can put such tools in the virtual machine monitor, for example. Operating systems can be debugged without losing productivity, or setting up more complicated debugging scenarios.
- Virtualization makes software easier to migrate, thus aiding application and system mobility.

25% of organizations expect server spending to grow by 5 percent to 10 percent, and 6 percent expect it to grow by 10 percent or more. And to reduce operating and capital costs, companies should consider server virtualization. Masking of server resources, including the number and identity of individual physical servers, processors, and operating systems, from server users is called as Server virtualization. Software application is used to divide one physical server into multiple isolated virtual environments and these virtual environments are sometimes called virtual private servers, but they are also known as guests, instances, containers or emulations. There are various approaches to server virtualization such as the virtual machine model, the paravirtual machine model, and virtualization at the operating system (OS) layer. Reasons for server virtualization are (1) Virtualization reduces the overall energy consumption of the server footprint, and hence it allows the same workload to run on fewer physical servers; (2) Virtualization alleviates out-of-space, power, and cooling constraints; and lastly, (3) Virtualization reduces the overall server footprint and cuts energy-related carbon dioxide emissions also electronic waste is reduced as less server equipment are required.

Even if server virtualization is used, there is still room to improve energy savings. The three process improvements that can help organizations to cut server energy costs are maximize virtual machines, cooling and design, and energy efficient servers.

I. **Maximize virtual machines:** Virtualization is not enough in addition to increasing the overall server virtualization footprint, the main aim is additional energy savings by virtualizing more efficiently. Server virtualization ratios are not keeping pace with modern hardware and virtualization platform capabilities such as three virtual servers need one host server. Virtualizing more efficiently can help in avoiding new server purchases, not to mention the additional power, cooling, and space expenses from this new equipment. According to Doug Washburn, Forrester (Jan11, 2011) a key ratio that administrators use to determine the acceptable number of VMs per physical host is server CPU utilization. The direct relationship between CPU utilization is VMs per physical host, and energy savings. A standalone non virtualized server might run at an average of 10 percent to 15 percent utilization, whereas virtualized servers could theoretically approach 100 percent. If the numbers of VMs are increased per physical host, the total numbers of physical servers are decreased and energy consumption is also reduced. As server teams become more comfortable with higher server virtualization utilization ratios, they can safely add more VMs per physical server without diminishing service levels.

II. **Cooling and design**: Packing all this technology into such a small space generates a large amount of heat, and it is the power used by cooling and air conditioning systems that often makes up the majority of the utility bill in the datacenter.

Some manufacturers have been experimenting with different ways of cooling densely packed server, storage and network components, including server cabinet door designs that feature a variety of liquid cooled tubes to distribute cold air across racks, and direct spray technology that douses CPUs themselves with chemically treated water.

Gartner estimates that improved row- and rack-based cooling techniques can reduce energy consumption by 15 per cent, for example, while redesigning datacenter floor plans and racks to bring colder air in and disperse heat (often called hot aisle, cold aisle design) more effectively can also take the weight off over-worked air conditioning systems.

Energy Efficient Servers and Architecture Management:

Datacenter management software: One of the biggest problems facing datacenter managers under pressure to reduce electricity consumption and utility bills is how to get accurate usage information.

Some manufacturers, such as IBM, have added power metering and monitoring utilities to their servers and racks, and linked management software to the power distribution units that monitor individual and multiple racks of servers, network switches and storage appliances to find out exactly how much power the equipment on each unit is using. Elsewhere, IntelliData Systems provides cabinet and rack-mounted power strips with built-in metering, environmental monitoring and remote shutdown capabilities for any attached equipment, as well as inline devices for individual mainframe computers.

A number of software vendors offer reporting tools that can detail trends and patterns in power usage, total power input, carbon emissions and costs, some for billing and charge-back purposes. Also available is modeling software that predicts how equipment can be re-arranged for optimum temperature control, making it easier for organizations to identify ways to reduce datacenter energy consumption.

Scottish and Southern Energy (SSE) has been using datacenter performance management suite since 2009, for example. The software has helped the utility company to map existing rack, server and network hardware and the relationships between them, and to migrate two datacenters from one provider to another when the existing facilities began to run out of capacity. SSE also uses it to predict and prevent failures, using modeling tools to identify potential problems with the electricity supply.

Steve Wallage, managing director of Broad Group Consulting, a company specializing in giving advice on datacenters, managed services, outsourcing and virtualization, says more organizations are taking a closer interest not just in datacenter hardware, but also the applications and services that run on top of it to identify where potential efficiency improvements could be made.

"There is a lot more effort now to understand datacenters and what goes on inside, not just the power units and chillers, but also the data and applications," he says. "The banks have detailed analysis of every application in use, for example, and use information on different classes of datacenter infrastructure and location to decide whether they could move them into the cloud, and we will see a lot more corporate effort in that direction."

Datacenter pods: In some cases, both enterprises and service providers may not have to spend millions on building or leasing customized datacenter facilities: scaled down,

"containerized" datacenters that fit into the back of a truck can meet permanent or temporary demand for infrastructure resources so long as there is somewhere close to the network point of presence to park it.

Running out of Processing Power:

This feature is completely because of the reason of the huge amount of storage involved and the business reports say the way the technology has been progressing very soon the storage capacity would be exhausted. The traditional methods were adding of additional hard disks and servers that needed to be installed, these days the servers are being installed virtually on the cloud that consume less power than these normal additional servers and hard drives.

Desktop Virtualization and Thin Clients

Moving Desktops to a virtual server than keeping them on the actual server helps us a lot. They consume less power and also the storage problem can be solved to a great extent. Thin clients are generally without a CPU, RAM and are directly connected to the cloud server.

The shared resources model inherent in desktop virtualization offers advantages over the traditional model, in which every computer operates as a completely self-contained unit with its own operating system, peripherals, and application programs. Overall hardware expenses may diminish as users can share resources allocated to them on an as-needed basis. Virtualization potentially improves the data integrity of user information because all data can be maintained and backed-up in the data center. Some of the advantages of Desktop Virtualization can be listed as follows:

- Simpler provisioning of new desktops.
- Reduced downtime in the event of server or client hardware-failures.
- Lower cost of deploying new applications.
- Desktop image-management capabilities
- Increased data security.
- Longer refresh cycle for client desktop infrastructure.
- Secure remote access to an enterprise desktop environment.

Server Room Upgrades & New Server Room Builds

Most of the Mid-size businesses face a preponderance of issues related to a server. There are many reasons that we need to upgrade to a new server.

- Decrease cost and increase the effectiveness of the server as the server is not generally prepared for full capacity conditions.
- Increase the server and the computing capacity of the server. The server rooms need to be increased as they are either too small or not compatible to the virtual

servers they are connected to.

- The reliability of the old servers is questionable as they need to be upgraded after a definite period of time.
- The mounting and maintenance of these old servers are questionable as it is often very expensive to maintain these servers and handle the effective increase in the storage.
- The infrastructure also needs to be sufficient enough to keep up to server expansion and the other aspects related to the new technologies that keep coming up.

Some of the advantages of these server room upgrades would be that the company would be in the competition for being one of the most innovative companies. The market keeps changing with the ever change in the technology. Thus it becomes very important for us the company to come up with new and better ideas that would keep it in competition in the market.

These room upgrades and new servers have become a necessity the company needs to take a further step towards eco-friendly IT and have virtual servers that tend to consume less power and facilitate in smooth running of the company and enables it not to violate with the environment. This is has in turn enabled companies to develop successful projects.

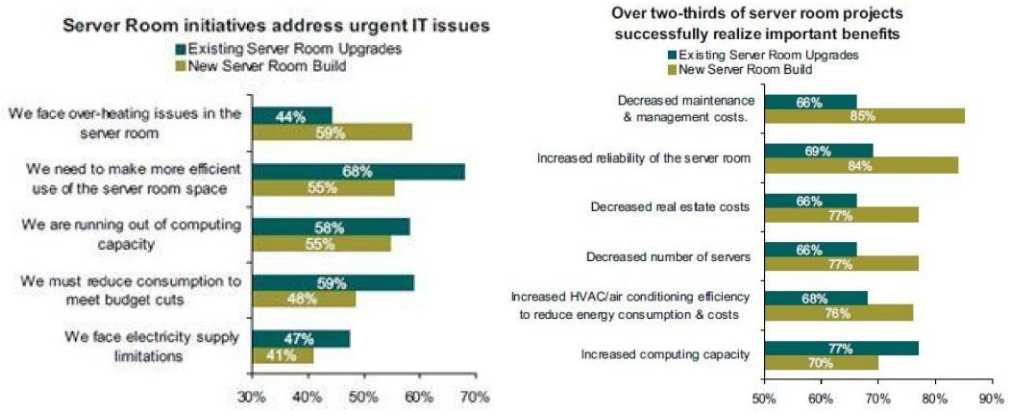


Figure 2: Server Room upgrades

Information Technology Energy Measurement

A recent Info-Tech study found that 28% of mid-sized enterprises are piloting or implementing IT energy measurement, and another 25% plan to implement in the next 12 months. Adoption is driven by rising electricity costs, a need for data and guidance in planning future initiatives involving energy efficiency, and greater awareness of the impact of carbon emissions on energy consumption.

This note demonstrates how to move through a gradual but effective energy measurement implementation, including:

- Adoption drivers for energy measurement solutions.
- Simple, cost-effective metering solutions to estimate Information Technology's total cost of energy.
- Using the total energy estimate to educate stakeholders about the cost and impact of energy.
- Building a solid business case for a formal measurement solution.
- Success factors for moving through each stage of this energy measurement implementation approach.
- A disguised case study of a real company, ABC Foods.

We need to understand how organizations can quantify the total cost of energy for IT, drive interest and attention for this operational cost, and ultimately build a business case for formal tools that allow full reporting, better infrastructure planning, and new quantifiable energy efficiency opportunities.

IT Energy measurement can also be dealt by preventing the unnecessary wastage of the energy within a company like unwanted usage of the computers and use of printers.

Printer Consolidation

Most of the companies across the United States have the best printers in the market and print over 300,000 pages in a fiscal year. As per a survey conducted it was found that more than 60% of the paper used goes in trash and more three forth of the paper that is wasted cannot be recycled. So we can imagine the amount the paper that has been wasted over the last few years with the increase in technology. Along with the printers, the maintenance of the printers, toners, cartridges etc. proves to be very expensive for the company.

So one of the most important aspects within a firm would be to cut down on the use of printers within the firm and avoid the wastage of so much of paper that would help us preserve the energy and not harm the environment. Thus a very unique measure was undertaken by the companies where they only provide printouts where necessary and the rest of the important would be stored on the servers or share across virtually.

Remote Conferencing and Telecommunication Strategies

The fuel prices have reached the skies and on the other hand emitting out so much of waste in the air tends to pollute the air. It tends to pollute the environment and creates an imbalance in the nature. Greenhouse effect comes into picture with the emission of such harmful gases in the environment. Human beings, plants and animals and every living creature are affected by such ways and means of emitting fuel. Thus we need to conserve the fuel for the right time and also save our planet. Thus in this initiative in the paper we would study the ways and means of remote conferencing and telecommunication strategies.

Remote Conferencing and Collaboration involves two major aspects video conferencing and implementing them between two different offices or client sites. It also involves online collaboration environments. This feature helps us to convey our message in a much efficient and better way and also enables us to protect the environment as well. Telecommunication strategies and capabilities also have proven quite worthwhile and also enable us to protect the environment from the different hazards caused. Virtual private networks are the next big thing in these days. It has enabled users to start working from home and thus offices are getting less crowded, people need not travel by cars or other vehicles and consume fuel that would in turn pollute the environment. People prefer working from home as they can multi-task their work. They can take care of their family, chat with friends, watch television and do their work side by side. They need not wear proper office wear and be in their casuals doing their work. It has created employment for those who can work from home. It has enable the physically challenged to work from their own space and lead a life of dignity.

Not surprisingly, businesses adopting travel reduction initiatives seek to decrease the travel and fuel consumption costs associated with driving or flying between office locations and to client sites. Some of these initiatives not only reduce costs of fuel, flights, hotels and related expenses, but also result in higher employee satisfaction.

Another major factor pushing companies to implement these initiatives, particularly telecommuting strategies, is to satisfy employees. This rang true for one CIO of a North American public company who notes that, “Our employees, faced with high gas prices, are coming back to us and saying, ‘I really like working here but I’m driving 30 miles one way, I may have to look at something else. People don’t want to move, especially for the salaries that we can pay. Telework is going to open up some avenues for us to get employees that are, frankly, out of our reach right now.” Organizations are also gaining access to remote talent that they otherwise would not be able to tap. In two-thirds of all travel reduction projects, organizations report their employees are very satisfied with the increased flexibility they are now offered.

Information Technology Equipment Recycling:

The IT industry has taken its share of plaudits for embracing the green agenda over the past few years. This is certainly well-deserved considering the substantial investment in virtual and related technologies that have helped reduce overall energy consumption.

However, many of the measures have rightly been described as "low-hanging fruit" in that they were fairly easy to accomplish and produced relatively quick, quantifiable returns on investment. That may not be the case in the next phase of the green data center movement, however, in which the industry will increasingly be asked to do what's right for the environment even if it does not produce significant benefit, and may in fact be detrimental, to the bottom line.

Out of all initiatives in this study, the success of IT equipment recycling relies not on a business case with cost savings, but on a combination of environmental responsibility and regulatory pressures. The single most important factor in adopting recycling initiatives is to decrease waste sent to landfills. A close secondary consideration is ensuring equipment is responsibly discarded at end of life. Additionally, there appears to be greatly increased customer demand for responsible recycling practices. Space, too, plays an issue: Many IT departments are simply running out of closets and crannies to store old equipment.

A key example is recycling. Enterprises have traditionally left disposal of old equipment to suppliers or distributors, essentially washing their hands of it once depreciation had eroded its value. That approach isn't likely to hold up much longer considering the impact that refuse enterprise hardware is having on both the environment and municipal budgets that have to accommodate the e-waste.

Obsolete computers or other electronics are a valuable source for secondary raw materials, if treated properly; if not treated properly, they are a source of toxins and carcinogens. Rapid technology change, low initial cost, and planned obsolescence have resulted in a fast-growing surplus of computers or other electronic components around the globe. Technical solutions are available, but in most cases a legal framework, a collection system, logistics, and other services need to be implemented before applying a technical solution. The U.S. Environmental Protection Agency, estimates 30 to 40 million surplus PCs, classified as "hazardous household waste" would be ready for end-of-life management in the next few years. The U.S. National Safety Council estimates that 75% of all personal computers ever sold are now surplus electronics.

Computer components contain many toxic substances, like dioxins, polychlorinated biphenyls (PCBs), cadmium, chromium, radioactive isotopes, and mercury. A typical computer monitor may contain more than 6% lead by weight, much of which is in the lead glass of the cathode ray tube (CRT). A typical 15-inch computer monitor may contain 1.5 pounds (1 kg) of lead, but other monitors have been estimated to have up to 8 pounds (4 kg) of lead. Circuit boards contain considerable quantities of lead-tin solders that are more likely to leach into groundwater or create air pollution due to incineration. The processing (e.g. incineration and acid treatments) required to reclaim these precious substances may release, generate, or synthesize toxic byproducts.

Export of waste to countries with lower environmental standards is a major computer or electronic recycling concern. The Basel Convention includes hazardous wastes from computer CRT screens as an item that may not be exported Trans continentally without prior consent of both the country exporting the waste and that receiving the waste. Companies may find it cost-effective in the short term to sell outdated computers to less developed countries with lax regulations. It is commonly believed that a majority of surplus laptops are routed to developing nations as "dumping grounds for e-waste". The high value of working and reusable laptops, computers, and components (e.g. RAM) can help pay the cost of transportation for many worthless "commodities".

We have several recycling methods available and some of them can be listed as follows:

Consumer recycling involves taking the products directly back to the manufacturer or a refurbish firm.

Corporate recycling involves several businesses seeking a cost-effective way to recycle large amounts of computer equipment responsibly face a more complicated process. Businesses also have the options of sale or contacting the Original Equipment Manufacturers (OEMs) and arranging recycling options. Some companies pick up unwanted equipment from businesses, wipe the data clean from the systems, and provide an estimate of the product's remaining value. For unwanted items that still have value, these firms buy the excess IT hardware and sell refurbished products to those seeking more affordable options than buying new.

Sale involves online auction of products and they get a good price in turn for the products that are need to be scrapped.

Donation involves the process of changing the parts that are required within the computer and then the entire computer would be given to a person in need of it.

Take back involves researching computer companies before a computer purchase, consumers can find out if they offer recycling services. Most major computer manufacturers offer some form of recycling. At the user's request they may mail in their old computers, or arrange for pickup from the manufacturer.

Exchange involves offering a free replacement service when purchasing a new PC. Dell Computers and Apple Inc. take back old products when one buys a new one. Both refurbish and resell their own computers with a one-year warranty.

Many companies purchase and recycle all brands of working and broken laptops and notebook computers, from individuals and corporations. Building a market for recycling of desktop computers has proven more difficult than exchange programs for laptops, smartphones, and other smaller electronics.

Scrapping/Recycling has become very essential due the rising price of precious metals — coupled with the high rate of unemployment during the Great Recession — has led to a larger number of amateur "for profit" electronics recyclers. Computer parts, for example, are stripped of their most valuable components and sold for scrap. Metals like copper, aluminum, lead, gold, and palladium are recovered from computers, televisions and more.

PC Power Management:

Many look to managing end-user device power consumption as an easy, effective way to reduce energy costs. These power management initiatives include the following:

-Using software that centrally manages energy settings of PCs and monitors.
-Enforcing standardized power settings on all PCs before distributing to end users.
-Procuring energy-efficient equipment, such as Energy Star certified devices.

Older computers can use up to 300 watts during peak load, but less than eight watts during sleep modes. By maximizing the number of PCs and monitors controlled for hibernate, sleep or shut-down times, companies reduce the amount of energy consumed during lengthy idle times, particularly overnight. Procuring Energy Star-compliant devices or more energy-efficient equipment can also reduce power consumption during equipment use. This includes replacing old desktops with laptops, or refreshing CRT monitors with LCD flat-screens. Altogether, these power management strategies result in significant energy and maintenance cost savings; such benefits are realized by 65% of companies that complete such initiatives.

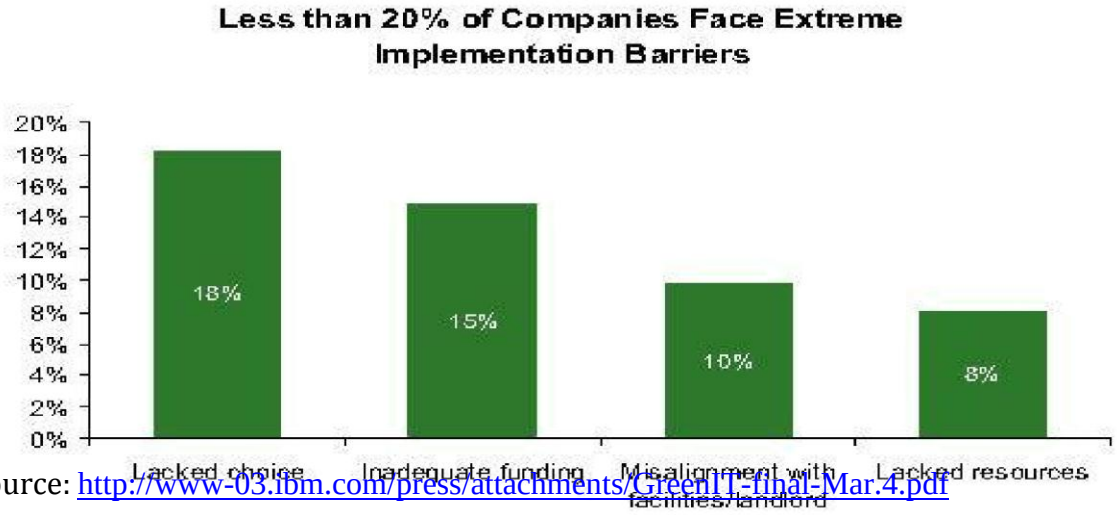
4. Key Success Factors in Eco-friendly IT Projects

The likelihood that companies will successfully implement Eco-friendly initiatives depends on the following factors:

1. Stakeholder Support:

   Any project in a firm has some stakeholder. It is indeed critical to have their support for the success of that particular project, especially as far as eco-friendly use of technology is concerned. Major stakeholders include C-level executives, IT directors, IT staff, employees, and in some cases, property or facilities management. Although gaining buy-in from all levels is important, the likelihood of success is higher when implementations have support of C-level executives – specifically, the CEO. The most successful projects are strongly supported by the CEO in more than three-quarters of implementations. As an IT manager at a finance company said, “One of the reasons we’ve been able to move forward with this is because of sponsorship and support from the CEO and his executive team. Without that, we wouldn’t have the funding to do it. It wouldn’t be pushed.”

2. Lack of Implementation:



Source: http://www-03.ibm.com/press/attachments/GreenIT-final-Mar.4.pdf

Figure 3 : Facing extreme implementation barriers

Companies adopting eco-friendly information technology initiatives may face barriers that inhibit the successful approval and implementation of these projects. A lack of choice due to missed refresh cycles, inadequate funding, misalignment with physical facilities, and a lack of resources, such as IT staff, can all be barriers. However, it is found that less than one-third of respondents cite these as major barriers to implementation; only 7% say they face extreme barriers. The most common barrier for this latter group is a lack of flexibility due to missed refresh cycles.

3. Economic Trade-offs:

In a recent survey a few respondents were asked to anticipate the impact of the downturn on their revenues, IT budget, prioritization of projects, and funding for eco-friendly information technology projects for the next 12 months. Approximately 61% of respondents did not believe that they will be affected by in such areas. These also include more than 50% of respondents who do not think that tat funding for eco-friendly information technology projects will drastically decrease. This is a positive signal for eco-friendly information technology, showing cost-cutting benefits. This is believed by 38% of the companies felt that cost saving would prove a success to their projects.

5. Company Case Analysis

Hewlett Packard

HP's Performance Optimized Datacenter (POD) is one example, with others available from

Sun Microsystems (now Oracle), IBM and APC. The POD, which comes in 20ft and 40ft versions, provides up to 20 standard 19in 50U racks and 600kW of power (34kW per rack), and uses chilled water to keep the servers cool, alongside blower fans and heat exchangers, backed up by dual active power distribution paths for redundancy purposes.

Whichever, if any, of these technologies or datacenter design methodologies individual organizations choose to deploy will depend very much on what they have in place already and the extent of the upgrade budget available to them. But the potential of innovative datacenter design to deliver reduced capital and operational costs means few IT departments can afford to ignore them.

DELL

Dan Traynor, IT infrastructure director, Southern Company, United States

Dell's Challenge was its rapid business growth which created server sprawl, threatening to outstrip the available space in Southern Company's data centers and driving up costs by consuming more energy each year.

Virtualizing and consolidating on Dell PowerEdge servers enable the Southern Company IT team to save data center space reduce costs and increase energy efficiency. Some of the benefits which Dell achieved were the virtual infrastructure that helped speed up new server deployment time by a week. Dell virtual infrastructure enabled IT to accommodate future growth, while slowing down the pace of energy consumption; Dell PowerEdge servers enabled up to 26:1 server consolidation to save data center space; Southern Company avoids over 2 million kilowatt hours of energy use with virtualized Dell servers; consolidating on Dell servers enabled IT to avoid an estimated U.S. $1.3 million in capital expenditures.

Dell's approach is called the Efficient Data Center, and it can help you free up some 50 percent of your IT budget while also lowering your carbon footprint. Built on virtualization, automation and consolidation, this strategy yields open, robust and cost-effective solutions that help optimize the current center virtualize in a time frame that makes sense for the business and leverage cloud technologies where appropriate. In addition, the Efficient Data Center improves business continuity. Downtime costs money, drains resources and can harm a company's reputation. With an infrastructure that's virtual-ready, you can recover from server failure rapidly and without having to rebuild from scratch. Within minutes the functions performed by the failed server — whether it's virtual or physical — can be retargeted to an available spare server so that the applications are back up.

SAMSUNG:

Kim Seungh-ho. October 4th, 2010."Samsung Electronics unveils 'Smart & Green plus'

Strategy" Data Center Electricity Consumption Doubles: A big increased in the number of server accounts for 90% of the extra power consumption, based on a study conducted by Stanford's Jonathan Koomey. The energy consumed by data center servers, cooling equipment, and related infrastructure more than doubled in the United States and worldwide between 2000 and 2005, according to a new study.

An increased in the number of servers accounts for 90% of the additional power consumption, according to a study by author, Jonathan Koomey, a consulting professor at the Stanford University and a staff scientist at Lawrence Berkeley National Laboratory. The study was conducted by Advanced Micro Devices, which is touting its energy-efficient processors. Only 5% to 8% of the increase in data center electricity consumption is attributed to power use per unit. What is driving the server proliferation is the insatiable appetite for Web content, video on demand, music downloads, and Internet telephony. The total amount of electricity used to operate data center servers and related infrastructure equipment in the United States was $2.7 billion in 2005 in comparison to $1.3 billion in 2000. Worldwide the total bill was $7.2 billion in 2005, compared with $3.2 billion in 2000. Looking at it in a different way U.S. data center power consumption in 2005 was equivalent to about five 1,000- megawatt power plants or five typical nuclear or coal power plants says Koomey.

In the United States in 2005 Data center servers consumed 0.6 percent of all electricity. When counting with the infrastructure equipment such as network and cooling gear that figure goes up to 1.2 percent, about the same percentage consumed for televisions. To overcome this big consumption of electricity by data center servers companies such as Samsung have lunched strategies to a more "smart and Green" approach. Samsung Electronics revealed the "smart & green plus" strategy at the 2010 Samsung mobile solution forum held in Taiwan on Sept 7.

"The strategy reflects Samsung's strong will to lead the world's mobile semiconductor industry with high-function, low electric power and environment-friendly semiconductors," said at the forum Kwon Oh-hyun the president of the semiconductor business of Samsung Electronics. "At the same time, we will effectively cope with changes in the new mobile market environment by strengthening the win-win partnership between semiconductor manufacturers and set makers," Kwon Oh-hyun.

"Samsung also plans to expand the "green memory campaign" to three fields - server, PC and mobile. Through updating their green memory campaign website, the company expects to introduce four top green memory products - DDR3, SSD, LPDDR2 and GDDR5," said Kwon. At the forum, Samsung introduced new mobile semiconductor products in keeping with the smart & green plus strategy, including 1GHz dual core application processor designed on low-power process technology, a high-performance 16gigabyte moviNANDTM chip with an eMMC4.41 interface, and an engineering sample of the world's first application processor utilizing 32 nanometer (nm) low-power process technology.

6. Conclusion

The soaring demand for powerful servers and cooling equipment to support the data centers has brought vast effect in the energy consumption requirements of the modern industry today. This has become a problem of majority of the highly industrialized companies – problems with coping up with the demand for higher level technology while keeping the operation cost low has been quite a challenge for many businesses. Moreover, as industries are becoming more aware of the ill effects of globalization to our planet, everyone is doing their part and taking its steps towards contributing to a sustainable environment.

Businesses around the world have discovered that going green isn't just good for the planet; it is good for their bottom lines. The paper highlights how mid-size companies are realizing significant cost savings when they adopt eco-friendly information technology initiatives.

Issues relating to high energy consumption of data centers are mostly attributed on how companies manage their system requirements. Most of the companies purchase a new server whenever there is a need for a new system. The accumulation of servers running in a single system brings so much impact on the high cost of electricity bill to run the machine as well as it has adverse effect to the environment. Servers emit a great amount of heat which can cause damage to the machine. Cooling equipment is needed to control the heat being emitted from the machines which also consume so much energy resources. Consolidating these systems into one server alone does not serve as a solution for this problem.

Virtualization is the most popular eco-friendly solution to address the high energy consumption of data center. This is usually the first step that the IT department takes to consolidate their servers to significantly bring down the cost of maintaining data centers and high energy cost that is associated to it. One significant finding that we learned from this research paper is that virtualization alone is not the entire solution to address the pressing issues – it needs processes, procedures and management to benefit from the advantages that virtualization can bring in solving the aforementioned issues presented in this research paper.

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