Saving Costs and Energy with Windows Vista®

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Microsoft

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Executive Summary

Businesses are rapidly responding to the growing requirement for greater environmental stewardship by defining goals that will improve corporate environmental practices. Sustainable IT, also known as "green IT," is one goal that is often at the top of the list. As evidence of the importance of sustainable IT, the market growth for related consulting services is rapidly accelerating. From a standing start of around $500 million in 2008, Forrester Research, Inc. predicts that "enterprise user spending for green IT services will grow by 60% annually to reach $4.8 billion in 2013."[1] Furthermore, "as of October 2007, 38% of IT professionals said that their companies were using environmental criteria in their evaluation and selection of IT equipment.[2]

For leaders tasked with creating sustainable IT, Windows Vista® can be a strong foundation to help create cost savings and help to achieve corporate environmental goals for an organization. By deploying Windows Vista, businesses can take significant steps forward in achieving specific sustainable IT goals such as:

- Reducing the organization's energy costs and carbon footprint
- Implementing an environmentally sustainable PC life cycle
- Complying with industry, corporate, or government regulations

This paper details the specific features of Windows Vista that make it more energy efficient, helping to reduce power consumption and costs, including:

- Intelligent idling of hardware to conserve power
- Customizable power plans to refine power settings
- Centralized management of power settings

This paper also illustrates how Windows Vista can help save costs by providing an analysis of having a managed PC power policy enabled with Windows Vista compared to a PC power policy deployment without Windows Vista. This analysis is based on data provided by the United States Environmental Protection Agency (EPA). The publicly available EPA data provides a common baseline for the comparison in our model.

The objective of our analysis is to provide an understanding of the potential savings that implementing Windows Vista with enforced power management policies can generate. For the model, a high power-consuming 5,000 seat company using Windows Vista can reduce power costs by up to $262,000 annually. To put this savings into an environmental context, the $262,000 is the equivalent of removing over 1,877 tons of CO_2 from the environment – which is the same as taking nearly 323 cars off the road. The savings may be different for your company due to variations in user work patterns.

Microsoft has partnered with Alinean to build an online power savings calculator, which you can access at http://www.microsoft.com/greenit, and with Wipro to deliver guidance on implementing power savings with Windows Vista (see the paper entitled "An IT Administrator's Guide to Using Windows Vista for Sustainable IT Success"). The section, "Understanding the Sustainable IT Benefits of Windows Vista" later in this paper provides

[1] "The Dawn of Green IT Services", Forrester Research, Inc., March 2008.

[2] "Five Green IT Trends that Will Impact the IT Infrastructure and Operations Professional", Forrester Research, Inc., March 2008.

an overview of the EPA data and the potential power and cost savings that Windows Vista can generate.

Achieve Sustainable IT Goals

Sustainable IT is an important piece in the overall corporate focus to improve the environment. But sustainable IT is not just a benefit to the environment; it can also potentially generate cost savings for the business. To create cost savings and improve the environment, IT leaders should focus on achieving specific sustainable IT goals such as:

- Reducing the organization's energy costs and carbon footprint
- Implementing an environmentally sustainable PC life cycle
- Complying with industry, corporate, or government regulations

Reducing the organization's energy costs and carbon footprint

Power generation is a leading producer of CO_2 in the world.[3] Many organizations are exploring ways to reduce the impact of their power consumption and thus create a positive effect on the environment. Using the centrally managed power settings in Windows Vista is one way organizations can help lower power consumption, and as a result, reduce energy costs and emissions.

Implementing an environmentally sustainable PC life cycle

According to a report from 2007, the U.S. Environmental Protection Agency stated that 700,000 tons of computer equipment is thrown into landfills in the United States each year.[4] Toxic chemicals, such as lead and mercury, contained in the computer components pose a potential health threat when left in landfills. To reduce the impact of technology on the environment, IT managers can reduce the amount of PC hardware their company contributes to landfills.

PC hardware refresh cycles are required as businesses seek to maintain operating efficiencies by using the latest hardware and software technology, but the environmental implications for disposal are high. Organizations need efficient and ecologically friendly ways of disposing retired hardware.

Comply with industry, corporate, or government regulations

Many industries, corporations, and governments have enacted or may soon enact regulations pertaining to the impact IT services have on the environment. With new regulations comes the potential for disruption of IT service levels and budgets, unless organizations take a proactive approach to prepare and mitigate such risks. This paper discusses how the power saving technology of Windows Vista can help mitigate the risk of disruption to your IT service brought about by new regulations. Please check with your government or environmental agency for information on current and future regulations.

As a result of taking these actions that create more sustainable IT, organizations can enhance their corporate image and follow through on public commitments to help improve the environment. A 2005 survey of 2,000 adults by the Natural Marketing Institute found that 88% agreed that "it is important for companies to not just be profitable, but to be mindful of their impact on the environment and society." More than 70% of those surveyed said that knowing a company is mindful of its impact on the environment and society makes them more likely to buy its products or services.[5] An

[3] http://www.eia.doe.gov/iea/overview.html

[4] http://www.epa.gov/osw/conserve/materials/ecycling/docs/app-2.pdf

[5] http://www.nmisolutions.com/press080205.html

investment today in sustainable IT can not only help you in the present, but it may also provide a strong foundation for the future.

What Features Make Windows Vista More Energy Efficient?

Windows Vista has a broad set of centrally managed features that help reduce the power consumption of PCs and monitors. Microsoft developed these features with the input of the U.S. Environmental Protection Agency (EPA) and its extensive energy studies to create power settings that would have the greatest impact on reducing power, while maintaining the flexibility to be applicable across many different organizations. The following features are the most effective at reducing power costs:

- Intelligent idling of hardware to conserve power
- Customizable power plans to refine power settings
- Centralized management of power settings

IT Administrators can use these Windows Vista features right out-of-the box to gain power savings across their organization. Power management settings that reduce power consumption are enabled by default on Windows Vista, and IT managers can further customize these settings to fit the needs of different organizations, preserve user productivity, and maintain a positive user experience.

Intelligent Idling of Hardware to Conserve Power

Intelligent hardware idling can be one of the easiest and effective ways to reduce energy consumption in an organization. This is because PCs and monitors are often idling at full power for long periods of time when they could be switched to a lower power state.

System Sleep

A survey conducted in 2007 revealed startling news about PC energy habits in the United States. Among employed adults who regularly use a PC at work:[6]

- 49 percent “never,” “rarely,” or “sometimes” shut down their PCs at end of the day
- 11 percent “often” do
- 40 percent “always” do

With nearly fifty percent of the employed adults never turning off their PCs, organizations are consuming far more energy than necessary to run the business. This creates a cost burden on the company and a burden on the environment. Eliminating this waste can result in cost savings and environmental improvement.

One of the most important energy savings features in Windows Vista is Sleep. Sleep is a low power state that stores documents and programs running on the desktop in memory. It enables users to resume work quickly, often within a few seconds, without having to go through a lengthy boot process. The default sleep state in Windows Vista for desktop PCs, Hybrid Sleep, is a low power state which saves open programs and documents both

[6] http://www.climatesaverscomputing.org/docs/Energy_Report_US.pdf

to memory and the hard disk. In the event of power loss during idle, the system can restore the session directly from the hard disk – thus helping to prevent any data loss.

Both Sleep and hybrid sleep has additional advantages at the organizational level. IT Administrators can customize sleep settings based on the patterns of PC usage within their company's user community. Desktop management tools like Microsoft® System Center Configuration Manager enables IT administrators to "wake" a networked PC from sleep, providing the ability to deploy software, install updates, and conduct overnight maintenance.

Monitor Blanking

The attached display is one of the largest power consuming components on the modern PC, and can account for up to 40 percent of the total system power consumption.[7] Therefore, one of the easiest ways to reduce energy consumption in an organization is to use the Windows Vista display idle time out to power down the monitors after a period of user inactivity.

With the display in a low power state, a monitor will typically consume 1 to 3 watts of power. Contrast that to the monitor left in an active state: an LCD monitor consumes 15 to 60 watts of power, and a CRT display consumes 50 to 125 watts of power.[8]

Due to the major power saving benefits, Windows Vista configures the display idle time-out for a moderately short amount of time by default. For desktop PCs, the display idle time out will occur after 20 minutes of inactivity, while a mobile PC running on battery will idle the display after 5 minutes of inactivity to help extend battery life. The user may see different settings on their version of Windows Vista because these settings are subject to change according to the IT settings of the user's organization.

Hard Disk Drive Spin Down

Energy savings may also be realized by spinning down the hard disk during periods of inactivity. The Hard Disk Drive (HDD) idle time out setting in Windows Vista allows a PC to automatically spin-down the hard disk after a period without disk read and write activity. Energy savings will vary depending on the make and model of your PCs, with multiple hard drive models enjoying most benefits. greater power reduction benefits.

Customizable Power Plans to Refine Power Settings

A power plan is a set of hardware and system settings that manage how much power is used by the computer. Power plans are accessible to all users of a PC, unless IT administrators dictate otherwise. Three power plans are standard in Windows Vista:

- **Balanced:** Provides full performance when the users need it but saves power during inactivity. This is the default Windows Vista setting.
- **Power Saver:** Reduces the system performance and helps mobile PC users to get the most power from a single battery charge.
- **High Performance:** Maximizes system performance and responsiveness but uses more power.

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[7] http://www.microsoft.com/whdc/system/pnppwr/powermgmt/Optimize_Power.mspx

[8] http://www.microsoft.com/whdc/system/pnppwr/powermgmt/Optimize_Power.mspx

Because of the versatility and flexibility of the power settings in Windows Vista, IT Administrators or users (if authorized) can set up custom power plans that fit the work patterns of various user groups in the company. For example, IT Administrators can create a unique plan to fit highly mobile, information workers who are concerned about battery life and create a different plan for stationary task workers. Each organization can determine the optimal plan for their users' needs.

Centralized Management of Power Settings

Windows Vista provides the IT manager with more flexibility and control over how to define and enforce power management policies for PCs and monitors throughout the organization.

Group Policy enables IT managers to easily define organization- or business unit-wide policies to control many power-specific settings and put those policies into effect quickly. While the default power settings will be appropriate for many organizations, IT administrators can enforce their usage or customize any of the 35 power management settings offered in Windows Vista to establish individual power reduction plans and enforce power reduction settings. The settings apply to a variety of components in a PC, such as idle hard disk timeout and system hibernate timeout, and also to various components of a monitor such as idle display timeout and screen brightness. IT administrators can manage Group Policy power management settings from a central location, rather than configuring individual settings for each PC.

Because of Group Policy, Windows Vista can help ensure that the PCs comply with the power management policies, driving a reduction of energy usage and, by extension, cost. While an IT Administrator may allow users to switch between the power plans described above, Group Policy can be used to enforce specific settings within those power plans. IT Administrators can effectively disable a user's access to the PC's power settings, which stops the user from overriding the Group Policy. The centralized control enables IT Administrators to enforce policies, allowing organizations to realize energy and cost savings.

Understanding the Sustainable IT Benefits of Windows Vista

To demonstrate the benefits of using intelligent idling, customized power policies and centralized management in Windows Vista, we compare the power consumption of two scenarios:

- Desktop PCs in idle without an enforced power policy using Windows® XP
- Desktop PCs in idle with an enforced power policy using Windows Vista

The idle state without an enforced power policy is a worst case scenario, and thus acts as a baseline for determining the potential power savings when using an enforced power policy.

The model uses publicly available power consumption data from ENERGY STAR, a joint program between the U.S. Environmental Protection Agency and the U.S. Department of Energy.

Using the difference in power consumption between the two scenarios, we calculate four different results:

1. Annual power cost savings
2. Reductions in CO_2 production from lower power use
3. The equivalent acres of trees freed from carbon processing
4. The equivalent number of cars removed from the road

We performed the scenario comparison on three models of PCs, each with different power consumption characteristics. Each model has a different level of capability, with the highest capability PC best suited for running more resource-intensive applications. Also, the "Low Capability" PC consumes less power than the "Medium Capability" PC, which consumes less power than the "High Capability" PC. By using three PCs with different capability characteristics, Microsoft can showcase a range of potential power savings, which increases the likelihood that your organization will find a scenario that resembles your specific situation. The table below shows the hardware specifications for each of the three PCs used in this model.

Table 1:

		PC Hardware Specifications
PC Model	PC Type	Processor Speed
Low Capability PC	Desktop	2.2 GHz
Medium Capability PC	Desktop	2.8 GHz
High Capability PC	Desktop	3.0 GHz

All three PCs are from a single vendor. All models, however, include a monitor, keyboard, and mouse and share these additional attributes:

- Widespread use in small, medium, and large businesses
- Similarity to other computers currently on the market
- Released into the market in April and May of 2008
- All capable of running Windows Vista and Windows XP

The capability to run both Windows Vista and Windows XP permits a hardware agnostic comparison to showcase the energy savings of Windows Vista compared to Windows XP.

ENERGY STAR Data Definitions

Before presenting our findings, we would like give a brief explanation of some key terms used by ENERGY STAR and assumptions that we use to generate our model.

The U.S. EPA encourages computer manufacturers to submit power consumption ratings regularly to ENERGY STAR as products are improved and new products are released.[9]

[9] www.energystar.gov/index.cfm?fuseaction=find_a_product.ShowProductGroup&pgw_code=CO

PCs that meet ENERGY STAR's qualifications for power consumption get the ENERGY STAR label, which denotes an energy efficient product.

The ENERGY STAR program collects the power consumption ratings according to three operational modes: Standby, Sleep, and Idle. ENERGY STAR defines these modes as follows:[10]

- **Idle State:** This is the state in which the operating system has completed loading, the machine is not asleep, and activity is limited to those basic applications that the system starts by default.
- **Sleep Mode:** A low power state that the computer is capable of entering automatically after a period of inactivity or by manual selection. A computer with sleep capability can quickly "wake" in response to network connections or user interface devices.
- **Standby Mode:** The power consumption level in the lowest power mode that may persist for an indefinite time when the appliance is connected to the main electricity supply. [11]

The table below shows the power consumption data for each of the three PCs used in this model.

Table 2:

Power Consumption in Watts[12]			
PC Model	Idle state	Sleep mode	Standby mode
Low Capability PC	32.21	2.64	1.23
Medium Capability PC	66.59	3.86	1.95
High Capability PC	91.00	3.18	0.93

[10] www.energystar.gov/ia/partners/product_specs/program_reqs/Computer_Spec_Final.pdf

[11] The emphasis in this paper has been on sleep/hybrid sleep because of the advantages these settings have over hibernate. While Hibernate is the lowest power state in Windows Vista, sleep/hybrid sleep are more versatile tools. Sleep/hybrid sleep provide low power consumption during inactivity and a user can resume work more quickly from a sleep/hybrid sleep state. Sleep/hybrid sleep allows the user to resume work more quickly than hibernate due to a quick start time. PCs in sleep/hybrid sleep can be awakened for maintenance during non-business hours.

[12] Watt is a unit of power used to measure power consumption of a device. Energy is defined as power over time. The most recognized unit of energy is the kilowatt hour (kWh) which is 1000 watt hours.

Analysis of Windows Vista Power Savings Using ENERGY STAR Data

For the comparison, scenario one is a 5,000 seat organization without an enforced power policy, using Windows XP. 100 percent of the PCs are considered to be in "Idle" state during inactive hours because Windows XP cannot enforce power policy. Scenario two is the same organization, except 100 percent of the PCs are now considered to be in "Sleep" state during inactive hours because they use Window Vista to enforce the power policy.

Monitors

The power consumption data in Table 2 does not break down the power usage for the monitor and the PC separately. Below is power consumption data of some typical monitors.

With the CRT's power consumption being markedly higher than an LCD's, using sleep mode in CRT environments will have a dramatic impact on power consumption.

Power Consumption of Monitors in Watts

	Off mode	Sleep mode	Active Mode
LCD, 15 inch	0.39	0.59	15.81
CRT, 15 inch	5	15	90.00
LCD, 24 inch	0.70	1.26	54.20

This scenario comparison was repeated three times, once for each of the three PC models mentioned above. The comparison assumes that 100 percent of the PC population is of a single PC model; for example, in the first iteration all PCs are the low capability model and so forth.

In this model, the PCs were considered "on" 24 hours a day 7 days a week, being actively used 10 hours a day, Monday through Friday. Outside of the 10 hour active period each work day, the PCs were inactive. This inactive time totaled 118 hours per week or 6,160 hours per year.[13] In the model, we focus on calculating the power consumption when the PCs are inactive. Inactive behavior is more likely to have commonalities across many industries and companies, enabling many different companies to glean useful information from this model. A model attempting to calculate the power consumption of active periods would have to include the wide variability of power demands between different users, different roles and different applications, generating a model too complex for the purposes of this paper.

[13] 24 hours x 365 days per year = 8,760 hours per year; 10 workday hours x 5 working days per week x 52 weeks = 2, 600 operating hours; 8,760 hours per year – 2,600 operating hours = 6,160 non-use hours per year

Other assumptions include

- The cost of 1 kWh in USD: 0.0973, the average cost in the US for 2008 through August.[14]
- 1 kWh of power generation produces 1.39 lbs of CO_2[15]
- One acre of trees can absorb 1,178 lbs of CO_2 in one year[16]
- One car (mid-sized sedan) produces 11,640 lbs of CO_2 in one year[17]

Having stated the assumptions, the results are as follows:

Table 3: The benefits of reducing power consumption

PC Model	Savings: Acres of Trees freed from Carbon Processing	Savings: Equivalent number of cars off the road	Power Cost Savings: US Dollars
Low Capability PC	1,075	109	$88,617
Medium Capability PC	2,280	231	$187,992
High Capability PC	3,192	323	$262,371

For the formulas used to generate this table, please see the Appendix.

The reduction in CO_2 emissions are further illustrated in the chart below (Chart 1). This chart describes the CO_2 production, due to power consumption, of a moderate power consuming 5,000 seat organization described in the calculations above that uses the Windows Vista enforced power policies, compared to the same organization not using Windows Vista nor enforcing its power policies. Chart 2 shows the energy cost savings in dollar amounts for the range of power consuming PCs mentioned in Table 3.

[14] http://www.eia.doe.gov/cneaf/electricity/epm/epm_sum.html

[15] http://www.epa.gov/greenpower/pubs/calcmeth.htm

[16] http://www.epa.gov/sequestration/rates.html

[17] http://www.epa.gov/OMS/climate/420f05004.htm 19.4 lbs of CO_2 per gallon of gasoline, 15,000 miles driven on average per year, 25 mpg = 11,640 lbs of CO_2 per car in one year

Chart 1: CO_2 production over one year, based on the power consumption of the medium power consuming PC detailed above deployed across a 5,000 seat organization. The red line represents the organization using Windows Vista enforced power policy while the blue line represents the same organization not using Windows Vista and unable to enforce their power policy.

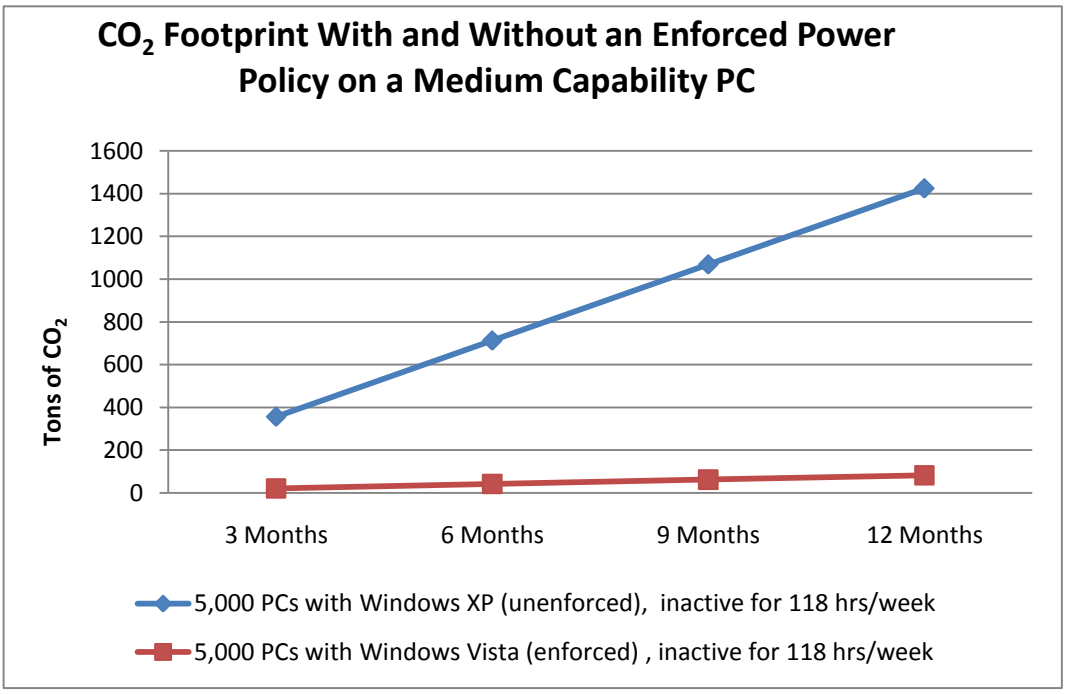
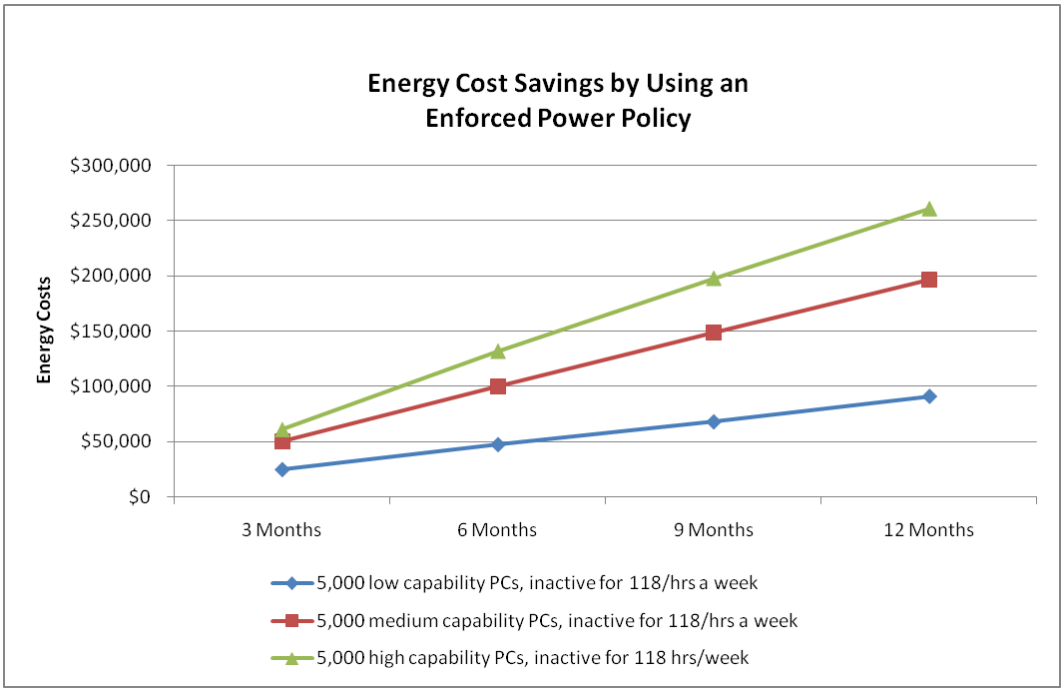


Chart 2: Energy cost savings by using an enforced power policy over one year, based on the power consumption of the three types of organizational usage patterns detailed above deployed across a 5,000 seat organization.



Implementing an Environmentally Sustainable PC Life Cycle

An environmentally sustainable PC life cycle takes into account both ends of the PC life cycle, the beginning and the end. Organizations with an environmentally sustainable PC life cycle will purchase PC equipment that will promote the company's environmental initiatives. Energy Star compliant PCs can be purchased to assure energy efficiency of the new equipment. LCD monitors can also be purchased because of their lower rates of power consumption compared to CRT monitors. The organization can also consider refurbished PC equipment, if the needs of the users and applications do not require the latest hardware.

At the other end of the PC life cycle, extending the life of older PCs for use in specific scenarios is a good option for companies looking for alternatives to recycling or refurbishing PCs. Windows Fundamentals for Legacy PCs allows organizations to convert older PCs into a "thin client," accessing applications via Windows Terminal Services or a full Windows Vista virtual machine instance running on a Windows Server® 2008 Hyper-V™ server. Windows Fundamentals for Legacy PCs is based on Windows XP Embedded, provides a small footprint, and has minimal system requirements. Task workers, who typically run only one or two applications from a central server, can use older PCs and access a Windows Terminal Server for those applications. Likewise, contract workers or offshore developers, who may need access to a rich desktop running Windows Vista, can be given an older PC running Windows Fundamentals for Legacy PCs and have complete access to Windows Vista running on a central server. These scenarios provide the user with access to the applications they need, enable IT to preserve its control, and continue to use older PCs which would normally end up in the landfill.

Computer recycling has advanced markedly over the past decade, enabling safer and more efficient methods of recycling computer components. In addition to capturing and safely eliminating the toxins such as lead, mercury, and cadmium in PCs and monitors, recyclers reclaim valuable metals such as copper, gold, palladium, and others. This effort greatly reduces the impact on the environment. Depending on the specific refresh cycle (typically 3-4 years) of your organization's PC fleet, there will always be a portion of PCs that are unsuitable for production use due to age, performance limitations, or because of the high cost required to upgrade the PC for refurbishment. Those retired PCs could be designated for recycling. For each retired PC, the asset tag should be removed and the hard drive should be wiped clean to prepare for recycling. IT should work with their OEM PC supplier to learn if it provides a recycling option. If not, IT can contract with local, trusted recycling organizations, which will take over the task of recycling the PC, disposing of the toxins properly, and salvaging the valuable metals and components. For those PCs that are not designated for recycling, IT has more options.

Customer Examples

Windows Vista is already yielding power savings benefits for many customers, including:

Continental Airlines

Continental Airlines has a long history of responsible corporate citizenship and is committed to promoting environmental responsibility within its corporate culture through initiatives such as its Carbon Offset Program. The company is always striving to increase the impact of its "green" initiatives through technology and reduce its carbon footprint.

By choosing Windows Vista, Continental Airlines has more granular control of the desktop experience through added group policies, including the ability to configure power management settings, which helps reduce its electrical use and carbon footprint.

In July 2008, Continental's Utah office saved a total of 58,200 kilowatt (KW) hours of electricity—U.S. $2,368. "We estimate our annual energy savings from deploying 18,500 PCs will be 33,264 megawatts," says Eric Craig, IT Manager, Continental Airlines. Taking into consideration variables such as energy prices in different regions, that energy savings translates to U.S. $1.5 million to U.S. $2 million each year.

Source: www.microsoft.com/casestudies/casestudy.aspx?casestudyid=4000002271

City of Miami

The City of Miami plans to take advantage of the improved power management capabilities provided by Windows Vista, as a way to reduce electricity usage and costs. "The new power and performance options and Group Policy settings to manage power consumption in Windows Vista will give us the tools that we need to significantly reduce power usage," says Marco Sanchez, Network Administrator at the City of Miami. "For example, we'll be able to take advantage of the operating system's new Sleep power state, and can centrally define and push out power plan settings through Group Policy." Adds Jim Osteen, Assistant Director of IT for the City of Miami, "With the new PC hardware that's available, Windows Vista will enable us to wake up computers to deploy updates and applications or take remote control of user PCs, even if they're in Sleep mode. That capability will allow the City of Miami to keep computers in Sleep mode for more than 75 percent of the time."

"The new and improved power management features in Windows Vista will give us the tools that we need to reduce power usage by 70-plus percent," says Sanchez. "We expect to save $80,000 in power costs in the first year, with that number increasing to $190,000 by year four. Not only will this save us money, but it also will enable the city to do its part to reduce the impact on the environment—with the resulting power savings equivalent to a 355-ton reduction in carbon dioxide emissions in the first year alone."

Source: www.microsoft.com/casestudies/casestudy.aspx?casestudyid=4000002825

Conclusion

Fulfilling green strategies by implementing sustainable IT policies can lead to a reduction of the organization's energy costs and carbon footprint, an environmentally sustainable PC life cycle, and compliance with government regulations. Windows Vista makes achieving sustainable IT goals easier through features such as:

- Intelligent idling of hardware to conserve power
- Customizable power plans to refine power settings
- Centralized management of power settings

These features give IT Administrators the flexibility to deploy, customize, and enforce the power policies, according to the goals of the company. The potential savings with Windows Vista are significant in terms of dollar savings and carbon reduction.

According to the analysis included in this paper, Windows Vista can generate up to $262,000 of power savings for a high power consuming 5,000 seat organization annually. The reduction in power use is the equivalent of removing over 1,877 tons of CO_2 from the environment, which would be the equivalent of removing nearly 323 cars off the road each year.

Microsoft encourages corporations focused on implementing these strategies to understand their respective organizational power usage and use Windows Vista to help achieve their goals.

For More Information:

Microsoft's Environmental Sustainability website: www.microsoft.com/environment.

Microsoft Desktop Energy Savings Calculator: http://www.microsoft.com/greenIT

Technical Guidance: An IT Administrator's Guide to Using Windows Vista for Sustainable IT Success

Appendix

Calculations from Table 2:

These are the formulas used to calculate the results shown in the "Medium" row of the table:

Without enforced power policy using Windows XP:

*(Idle power consumption)*hours/year * Number of seats* .USD per kWh =*

*(.067 kw) * 6160 * 5,000 * .097 =*

$199,560 power cost per year

With Windows Vista enforced power policy:

*(Sleep power consumption)*hours/year* number of seats * USD per kWh =*

*(.004 kw) *6160 * 5,000 * .097 =*

$11,568 power cost per year

Take the difference to generate the cost savings:

$199,560 - $11,568 = 187,992 power cost savings

To calculate the lbs of CO_2 saved, along with the acres of trees released from CO_2 processing and the number of cars taken off the road:

Calculate the lbs of $C0_2$ by replacing the kWh cost factor with the "1 kWh of power generation produces 1.39 lbs of CO_2" from the assumptions list above, in the first and second equations

Without enforced power policy using Windows XP:

*(Idle power consumption)*hours/year * Number of seats* Tons of $C0_2$ generate/ kWh =*

*(.067 kw) * 6160 * 5,000 * .000691 =*

1,435 Tons of $C0_2$ per year

With Windows Vista enforced power policy:

*(Sleep power consumption)*hours/year* number of seats * Tons of $C0_2$ generate/ kWh =*

*(.004 kw) *6160 * 5,000 * .000691 =*

83 Tons of $C0_2$ per year

Take the difference to calculate CO2 saved:

1,435 - 83 = 1,343 Tons of $C0_2$ saved

With each acre of trees processing 1,178 lbs of CO_2 each year, this CO_2 savings frees 2,280 acres of trees from carbon processing

With one car generating 11,640 lbs of CO_2 per year, this CO_2 savings removes 231 cars off the road