COMPUTING ENERGY CONSERVATION RECOMMENDATIONS

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These days with power consumption and costs on the rise, saving energy is becoming a larger issue. Whether the goal is to protect the bottom line or to be environmentally conscience, there are a multitude of ways to save energy by adjusting settings on PCs, printers, and peripherals.

The chart below contains data collected using a Dent Instruments PlugLogger configured to display usage in watts. We looked at a number of devices typically found in most offices. It will be used throughout this document and may be useful in evaluating your own energy usage.

Devise	Off/Standby	On-PowerSave	On-Idle	On-Loaded
Laser Printer - HP 4050N	0 Watts	17 Watts	19 Watts	460 Watts
Monitor - Dell 17" LCD	1 Watts	2 Watts	31 Watts	31 Watts
Monitor - Dell 17" CRT	0 Watts	1 Watts	50 Watts	50 Watts
Desktop - Dell GX 280	1 Watts	73 Watts	85 Watts	144 Watts
Dekstop - Dell GX 240	3 Watts	41 Watts	46 Watts	82 Watts
Desktop - Dell GX 110	4 Watts	22 Watts	30 Watts	47 Watts
Laptop - Dell D610 w/ Dock	1 Watts	15 Watts	25 Watts	47 Watts
Laptop - Dell C640 w/ Dock	3 Watts	18 Watts	27 Watts	50 Watts
HP 3970 Scanner	0 Watts	9 Watts	9 Watts	18 Watts
Speakers w/ Subwoofer	0 Watts	6 Watts	6 Watts	13 Watts

- *Table: Power usage of various computer equipment.*
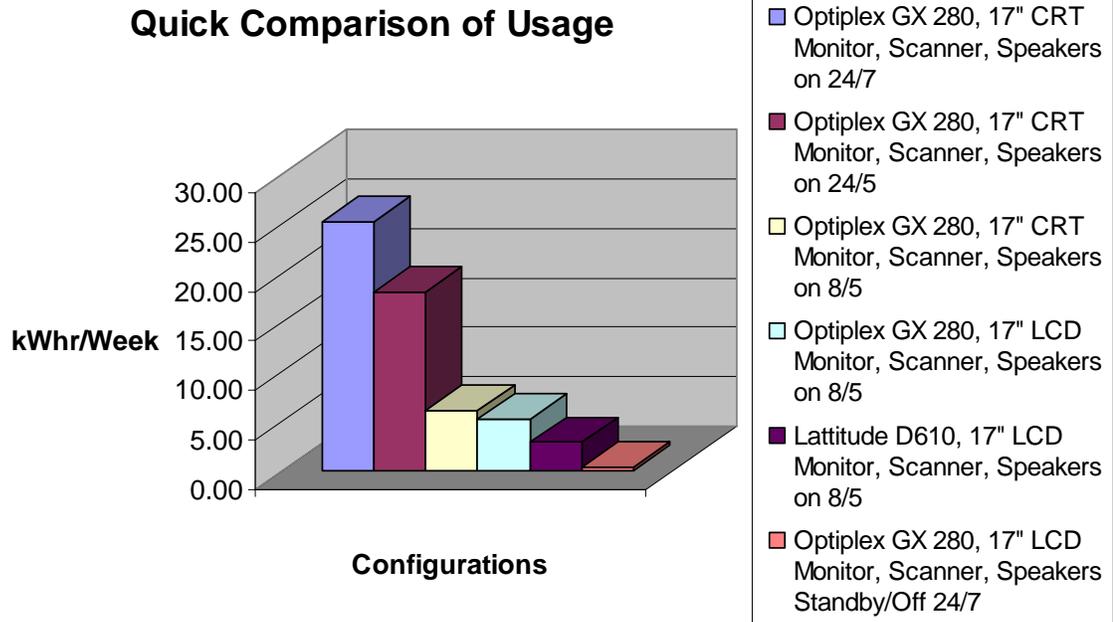- *Data collected using a Dent Instruments PlugLogger.*

There are a few things you can learn just by glancing over the chart above:
- Laser printers use a significant amount of energy while printing
- LCD monitors use 40% less energy than equivalent-sized CRTs
- Desktop power usage appears to increase by 35 to 45% every two years
- Peripherals can account for 10% or more of a desk's energy usage

A typical workstation consists of energy eating devices such as a computer, monitor, and any number of peripherals. For example, a Dell Optiplex GX280 desktop, Dell 17" CRT monitor, keyboard, mouse, speakers and a scanner. Such a configuration when left turned on and idle, would consume 150 watts or 3.6kWhrs every day. The cost to power 100 of these workstations all day at $0.087 per kWhr is $11,432.00 a year.

However, there are methods that can be employed to reduce this daily consumption by up to 88% depending on how strictly a power management policy is enforced.

Quick Comparison of Usage

kWhr/Week

30.00
25.00
20.00
15.00
10.00
5.00
0.00

Configurations

Legend:
- ■ Optiplex GX 280, 17" CRT Monitor, Scanner, Speakers on 24/7
- ■ Optiplex GX 280, 17" CRT Monitor, Scanner, Speakers on 24/5
- □ Optiplex GX 280, 17" CRT Monitor, Scanner, Speakers on 8/5
- □ Optiplex GX 280, 17" LCD Monitor, Scanner, Speakers on 8/5
- ■ Lattitude D610, 17" LCD Monitor, Scanner, Speakers on 8/5
- ■ Optiplex GX 280, 17" LCD Monitor, Scanner, Speakers Standby/Off 24/7

Turn off peripherals when not in use

Peripherals in the example system make up 10% of the total energy usage. Assuming an eight-hour work day, turning the peripherals off for the remaining 16 hours in the day would reduce the daily energy usage in the example by 6.7%.

Turn off monitors when not in use

Most monitors manufactured in the past 10 years come with a number of energy saving options. Almost all monitors can be placed into PowerSave mode, which typically involves shutting off the display while the logic circuits continue to function. Monitors typically enter this mode in one of two ways: either they detect that there is no input from the computer (ie: the computer is off) or they are directed to enter that mode by the computer in which they are attached through a feature which has been set.

In a Microsoft Windows environment, power saving features are available to place a monitor into PowerSave mode after a predetermined number of minutes of inactivity. These power saving settings are most commonly accessed through the display settings panel under the screen saver tab. They can also be configured in bulk across a windows domain using the EZ GPO Tool (an ADM template) available at:

 http://www.terranovum.com/projects/energystar/ez_gpo.html

Assuming that a typical user is only at their desk 8 hours during the work day, this leaves 16 hours in which the monitor is not in use. If the example workstation were configured to place the monitor into PowerSave mode during unused time, there could be a 24.5% reduction in daily energy usage.

Turn off computers when not in use
Powering down or placing a computer in standby mode will result in the largest drop in energy usage. Turning off the example computer for 16 of the 24 hours in a day would reduce the daily energy usage of that workstation by 62.3%.

Computers, like monitors, have power saving features which will allow place them in standby mode after they have been inactive for a predetermined number of minutes. These settings are located with the monitor PowerSave features on the screensaver tab in the display settings panel. They can also be configured in bulk across a Windows domain using the EZ GPO Tool (an ADM template) available at:

> http://www.terranovum.com/projects/energystar/ez_gpo.html

Powering down a computer does have some draw backs. Many desktops are configured to perform updates, nightly maintenance, and backups while their users are not there. These tasks are typically performed during business hours to avoid inconveniencing the user. However, there are methods of running typical nightly maintenance without interrupting users during regular business hours.

COMPUTER POLICY AND CONFIGURATION RECOMMENDATIONS

### Symantec Anti-Virus Configuration
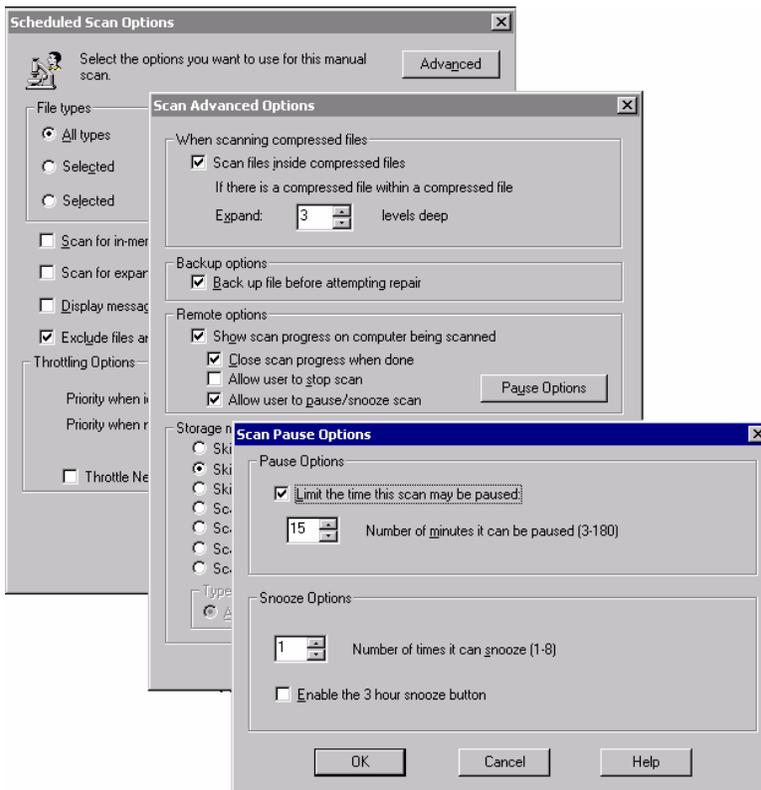
We recommend the use of a Managed Symantec Anti-Virus system. This allows centralized administration of the service to ensure up-to-date virus definitions and prevents users from accidentally turning off their virus protection. Symantec Anti-virus can be configured to allow users to pause a virus scan for a customizable amount of time, like a snooze button on an alarm clock. This setting is configured from the Symantec server and requires that the clients operate in Symantec's 'managed mode.' The idea is that if a user needs to work while the scan is running, they can *pause* the scan. Symantec will automatically resume the scan after the time specified. This scan can typically be configured to run at noon while the majority of the users are out to lunch and yet provide flexibility to those who have a deadline to meet.

Disk Defragmentation Recommendation

Disk maintenance such a defragmentation can be handled mid-day by using third party tools such as WinInternals Defrag Manager. DefragManager allows schedules defragmentation to occur, as well as, monitoring each workstation's progress. It can be configured to allow a user to cancel the process should it affect system performance. There is also a timeout setting so highly fragmented drives are not processed all day.

This process can typically be configured to run at noon while the majority of the users are out to lunch and yet provide flexibility to those who have a deadline to meet.
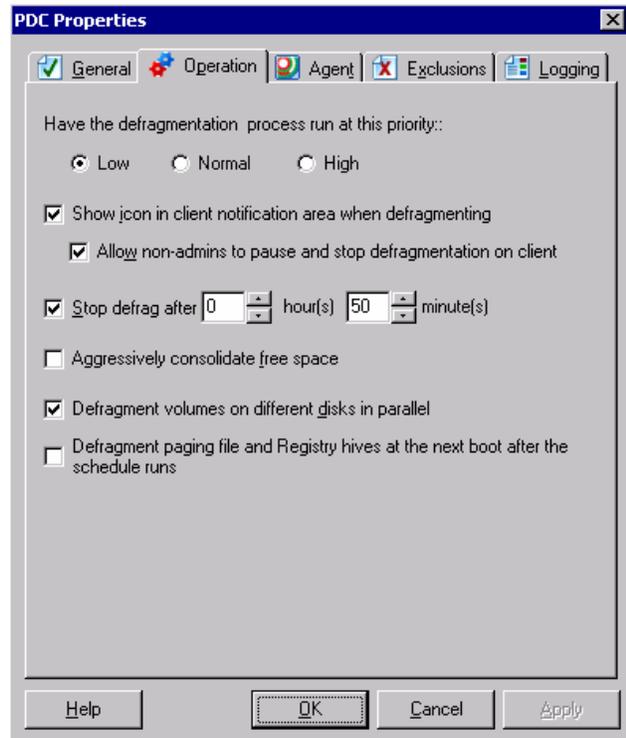
Backup Configuration Recommendation

In the past, the biggest requirement for workstations to remain turned on at night was backups. Backups typically require a large amount of resources and time. It is possible avoid backing up workstations at all by using three features found in Windows 2000, XP and 2003 server: Offline File Caching, Folder Redirection, and Roaming Profiles.

These three features allow a workstation to synchronize specific portions of their data with the server. Using these features to synchronize a user's "Homes" folder and profile when they login and logout can help to eliminate the need for backups all together.

Roaming Profiles is the easiest to configure, and more or less works out of the box. You simply edit the user account in Active Directory and select a path on the network where you would like the roaming profile to be stored.

The workstation this user logs into will then replicate the following portions of the

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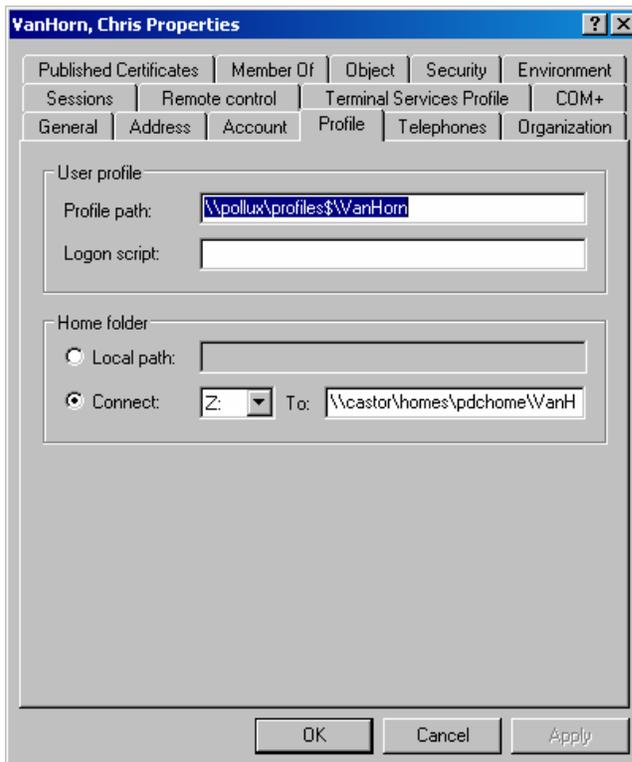
user's profile to the server whenever the user logs off:

- My Documents
- Application Data
- HKEY_Current_User keys
- Desktop
- Start Menu
- Favorites

The workstation will also download these same settings regardless of which machine the user logs into. The result is a backup system which functions during logoff and it allows a user to have the same desktop experience throughout the domain.

One problem you may run into with Roaming Profiles is that they are not very quick when it comes to large amounts of data. Users with large amounts of data in their My Documents folder or on their Desktop will experience slow login and logout times. This can be solved using Folder Redirection and Offline File Caching together.

Folders such as My Documents, Start Menu, and the Desktop can be redirected to a network share using Group Policy. However, this presents a problem should the server hosting the data be slow or unavailable. By also using Offline File Caching, you can make that data available when the server is down and it is available at about the same rate as if the data were stored locally.
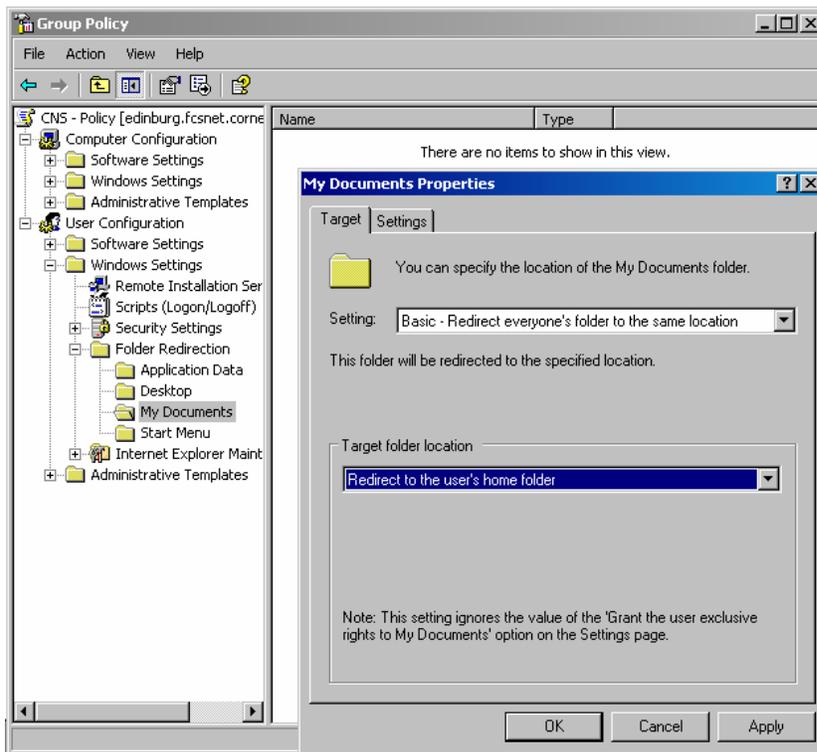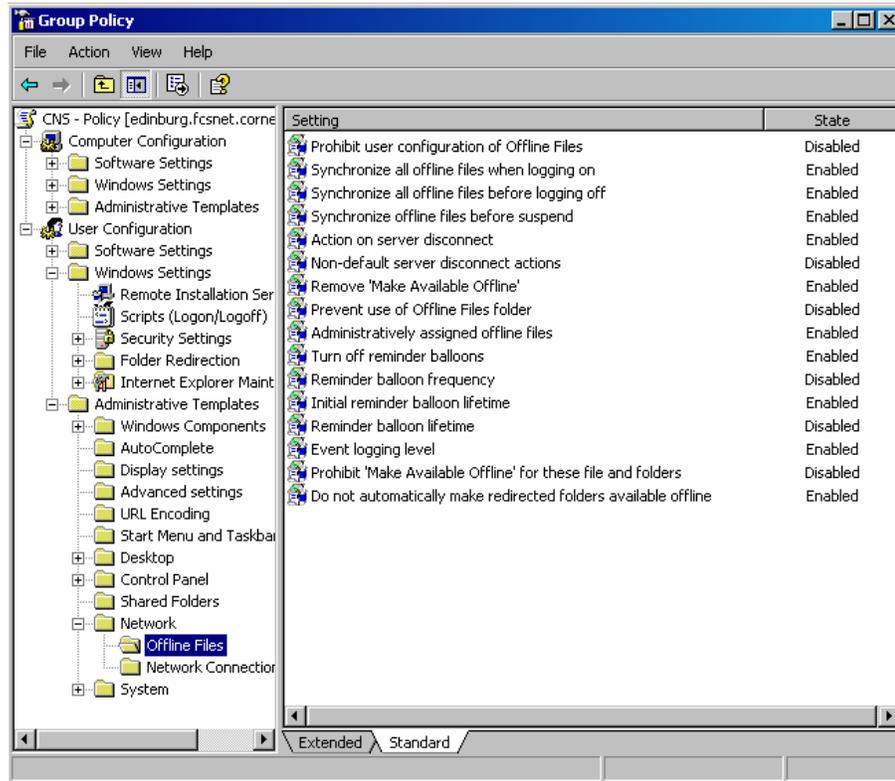

First you will want to configure folder redirection. The settings are located in the User section of Group Policy at User Configuration\Windows Settings\Folder Redirection. Set each folder which you want to redirect to the location you have chosen. There are a number of options including a specific path.

Second, you will need to turn on Offline File Caching.   This also is located in the User section of Group Policy: User Config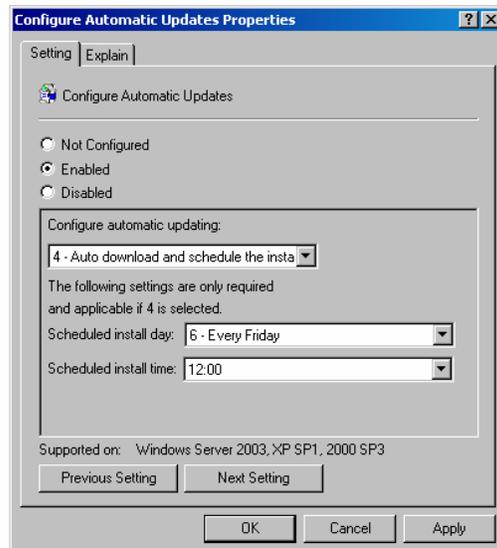uration\Administrative Templates\Network\Offline Files. These settings may need to be adjusted to fit your needs. Shown to the right are settings which I have found to work quite well.

These settings will take affect following the restart of the machine. Be sure to test the configuration before deploying it out to your users.

Windows Patching Recommendation

We recommend the use of a centralized patching system, such as Microsoft's Windows Software Update Server. This enables all workstations in the domain to receive necessary security patches at a predetermined, managed time. During the period of time after the patch is approved in the WSUS and the managed time configured, users will have the option on shutdown to install the patches. Users who do not perform the patch installation before the managed time is reached, will have the patch automatically installed at that time. Once the system is patched, the user can choose to reboot their system then or at a time that is more convenient. If a computer is not in the office or is turned off during the patch time,

the WSUS service will recognize the next time the computer is on and push the patch out to it then.

These settings can be found in Group Policy:\Computer Configuration\Administrative Templates\Windows Components\Windows Update.

Summary
While there are readily available third party software solutions to address power usage and conservation for PC systems, we do not recommend them. These software packages mask poor domain and system administration. If sound computing policies are put into place and enforced, the same, or increased, cost savings are realized. In addition, this solution also provides for secure and reliable networks and access to data.

This configuration which allows us to backup only the servers instead of all PC's saved our department $12,000 in backup costs the first year alone. For every 100 of our example workstations that are powered down for 12 hours a day and 24 hours a day on weekends, an energy savings of $7,345.00 per year can be realized.

GENERAL RECOMMENDATIONS

Replace CRT monitors with LCD models
There are benefits which make CRT's more attractive than LCD's such as true color and faster refresh rates. However, if you do not need such features, planning an upgrade to LCD monitors would reduce your energy usage in the long run. In addition, LCD monitors reduce eye strain for people looking at a monitor all day.

Use laptops instead of desktops
Laptops require significantly less energy than desktops. There are some disadvantages to going this route, however. Laptops often cost twice as much as a similarly configured desktop. Laptops also lag behind a similarly configured desktop in terms of performance. If performance is not a concern and neither is price, you can see a savings of 100%.

Configure printers and copiers for Power Save mode
Laser printers while idle still maintain the temperature of the fuser. This is done so that documents print almost instantly after the printer receives the request. A printer in PowerSave mode will not maintain the temperature of the fuser and will increase the delay before the first page is out of the printer. This increase/decrease of extreme temperatures can actually shorten the life of the fuser in some environments. I suggest you determine a power save setting which prevents the printer from entering PowerSave mode during regular business hours.

Educate your users
The last and most important step is to educate your users.

For more information

For more information, please contact Chris VanHorn, Senior Systems Administrator, in Facilities Services Computer & Network Support via email at ctv2@cornell.edu or by phone at 607-254-8947 or Debra Howell, Manager, in Facilities Services Computer & Network Support via email at dlh19@cornell.edu or by phone at 607-255-4986.   This document can also be found on our web site at http://computing.fs.cornell.edu.

You may also find the following websites useful:

- Microsoft – Using Offline Files
  http://www.microsoft.com/resources/documentation/Windows/XP/all/reskit/en-us/prde_ffs_qoxy.asp

- Microsoft – Combining Roaming Profiles and Folder Redirection
  http://www.microsoft.com/resources/documentation/Windows/XP/all/reskit/en-us/prdc_mcc_yboj.asp

- Microsoft – Supporting Mobile Users
  http://www.microsoft.com/resources/documentation/Windows/XP/all/reskit/en-us/prdc_mcc_gnml.asp

- Microsoft – Windows Software Update Services deployment guide
  http://www.microsoft.com/windowsserversystem/updateservices/techinfo/previous/susdeployment.mspx

- Symantec – Symantec Antivirus Corporate Edition 9.0 Manual
  ftp://ftp.symantec.com/public/english_us_canada/products/symantec_antivirus/symantec_antivirus_corp/9.0/manuals/savcadmn.pdf

- Defrag Manager
  http://www.winternals.com/Products/DefragManager/

- Easy GPO Energy Management tool
  http://www.terranovum.com/projects/energystar/ez_gpo.html

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Data capture notes:
- Powersave settings: Hard Drive and Monitor Off, Standby disabled
- Printers loaded was measure while printing a test page
- Loaded computers were measured while defragmenting and running Geiss
- All printers had network capabilities
- All monitors had their brightness turned up full
- All desktops and laptops had a USB keyboard and mouse attached
- Laptops were measured in their docking stations with the built in screen open and on, battery removed
- Speakers were measure while playing at 30% volume
- All measurements were taken with a Dent Instruments PlugLogger in Watts mode
- All devices where attached to 120Volt AC lines