



# BEST PRACTICES IN DESKTOP AND NOTEBOOK ENERGY EFFICIENCY.

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## EXECUTIVE SUMMARY

While there are many ways to improve environmental friendliness with regard to client computing devices, one of the easiest ways is to manage electricity consumption. This white paper makes a case for reducing power consumption by recommending best practices. These practices include purchasing energy-efficient hardware, implementing a centralized power management strategy and running ongoing analytics to assess and report results. By following these guidelines, an organization can realize financial and institutional benefits from reduced energy bills and lower carbon emissions—not to mention the tangible and intangible benefits of being a “greener” company.

### SUCCESSFUL POWER MANAGEMENT REQUIRES A THREE-PRONGED STRATEGY:

- 1 Purchasing hardware configurations that consume less electricity
- 2 Implementing company-wide power management policies using industry-recognized best practices and enforcing their uniform use throughout the organization<sup>1</sup>
- 3 Modifying these management policies based on individual business needs, measuring the savings and reporting these results to senior management

## STEP ONE: CHOOSING ENERGY-EFFICIENT HARDWARE

Companies can easily be forgiven for having a fleet of inefficient hardware crowding their employees' desks. At the time they purchased many of these machines, there was no other real option. The Gartner Group, a leading information technology research and advisory company, regularly advocates a four to five-year refresh cycle for desktop PCs and a three-year notebook refresh cycle. This would make the average age of a typical customer's fleet somewhere around two-and-a-half to three years. It is only within the last 12 to 15 months that hardware with integrated power savings capabilities has been widely available at a “reasonable” price, and so many companies have eschewed purchasing efficient configurations in favor of a lower acquisition cost.

Through hundreds of customer bids every year, we've found that many customers tend to “over spec” for peace of mind. Several years from now, these customers want to be the owners of hardware that still has enough performance to run the most current software. Yet trends have been clear. The Gartner Group communicates that architectural changes in 2009 and 2010 will have increased application/system

### KEY FINDINGS

Many existing PC infrastructures are not provisioned with energy conserving hardware.

According to an industry watchdog named The Climate Group, PCs and related peripherals consumed close to 41% of the information and communication technology industry's global footprint in 2007<sup>1</sup>. Whether it is for environmental or financial reasons, or even a combination of the two, there is no denying that going “green” has become a top-of-mind subject for many organizations.

Because power management is a recent interest, many existing PC infrastructures are not provisioned with energy conserving hardware. Additionally, many companies use default power management settings shipped with Microsoft® Windows®. Even worse, some of these companies disable power management altogether for reasons ranging from ease of software patching during off hours to a fear of premature wear and tear on internal electronic components.

demands on hardware for things like virtualization. Yet many of the configurations our customers are purchasing today are more than ready for those changes when they occur. This suggests some very clear recommendations for purchasing energy-efficient hardware:

**1** Choose desktop power supplies that convert 80% or more of their electricity draw into usable system power. Power supplies from as little as two years ago were rated 60—70% efficient, causing a lot of AC power to be wasted in the conversion to usable DC power. Assuming an identical configuration except for the power supply, choosing an 80% efficient power supply over a less efficient power supply can reduce electricity consumption by 25% or more based on the increased conversion efficiency alone.

**2** Choose integrated graphics on both notebooks and desktops unless there is a clear and specific need for discrete graphics solutions. One common reason for choosing a discrete graphics chip is to have enough computing power to run the latest graphics capabilities from Microsoft®. However, nearly any modern integrated graphics chipset on both notebooks and desktops has sufficient power to run Windows Vista® in its most graphically intense “Aero” mode. While hardware requirements for the next generation Windows® 7 operating system have not yet been released as of this writing, they are acknowledged to be similar to Windows Vista®. A typical integrated graphics solution from Intel® will consume 15 to 25 watts in a desktop and around 5 watts in a notebook PC under normal usage modes. In contrast, common dedicated “discrete” graphics solutions consume around 50, but sometimes up to 150, watts of power.

**3** Replace any remaining Cathode Ray Tube (CRT) technology displays with displays based on now standard LCD technology. Power savings per replaced display can save 75 to 100 watts per PC per year.

**4** Less clear is the advantage of choosing slower speed 5400 rpm hard disk drives vs. faster 7200 rpm hard disk drives. There are some power savings of 3 to 4 watts by choosing slower spinning drives because runtime is increased while the notebook PC operates from battery power. Unfortunately, the resultant 10% average real-world performance drop is seldom worth the reduced power draw while on AC power. Solid state disk technology can also save significant amounts of power over any spinning disk technology by requiring less power to operate, but the current high cost of the technology will not offer a payback period within the lifetime of either a notebook or a desktop PC. In conjunction, many customers choose SSD technology for other reasons including performance and reliability considerations.

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Choosing 80% efficient power supplies and integrated graphics capabilities are the easiest power conserving choices that have little effect on the average user's computing experience.

It may be tempting to choose an ENERGY STAR™ system configuration based on the United States Environmental Protection Agency program (or similar local governance designation), but such designation is not the differentiator it once was. Also, care must be taken when customizing a system configuration as it is very easy to make a once ENERGY STAR™ compliant system noncompliant based on hardware configuration changes such as higher power consumption graphic cards.

To lay out the case for choosing power efficient hardware at time of purchase, we compared two machines very reflective of typical customer environments.

System One was a common user desktop configuration from three years ago. It consisted of a tower form factor with a Pentium® D processor running at 3.0GHz with 1GB of system memory, integrated graphics hardware, 40GB hard disk drive, and a 17" CRT display. Its power supply was rated 65% efficient. A typical system setup like this without power management enabled could expect to consume approximately 1667 Kwh of power per year.

System Two, a typical modern system, includes many more power efficient components. While the computing power has increased tenfold, average power consumption has dropped considerably. This machine is a tower PC running an Intel® Core™2 Duo processor, 160GB hard disk drive, 2GB of RAM, integrated graphics, and a 19" LCD flat panel display. It has an 80% efficient power supply.

When power consumption was calculated using the Lenovo Energy Calculator, there was a remarkable difference in power consumption, even under the same usage conditions. An end user can expect this configuration to consume approximately 617 Kwh of power annually. While some organizations might say buying new hardware is a job well done to reducing energy bills, this is only part of the equation to achieving energy efficiency. It is necessary to implement a policy of effective and auditable power management in order to achieve maximum savings. Simply using the "defaults" is not enough.

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Energy Star is not the differentiator it once was.

### STEP TWO: IMPLEMENTING POWER MANAGEMENT

Before the advent of modern power savings improvements, an organization wanting to save power usually had one simple decision: to turn machines off or leave them running 24 hours per day. Prevailing wisdom suggested that the power savings benefit of turning machines off was far outweighed by the disadvantages—namely, increased wear and tear on the hardware. Furthermore, many organizations have a policy to patch and remediate systems overnight while they are not in use. Adding to this, users often did not want to turn off their machines because of lengthy boot up and shutdown times. To put simply, it was just easier to leave everything on.

First, the long-lived myth that PCs wear out faster when they are turned off and on is not true. Modern PCs are designed with power management in mind and are engineered to be shut down and/or placed into a low power mode on a regular basis with no ill effects. Conventional PC wisdom no longer applies and has not been valid for more than ten years.

In many organizations, refreshes are managed on an ongoing basis with lowest acquisition cost being the chief driver of technology choices. As a result, there is a wide disparity of equipment ages which presents problems for IT departments wishing to maintain best practices of standardization. Software "images" are developed using the lowest common denominator of settings that "just work" and minimize support costs without giving



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much thought to power management. This thinking, while reducing immediate support costs, is costing companies money in increased power consumption. As power is not a line item in many IT organizations' budgets, there is no incentive for a CIO to act.

Step two is actively implementing companywide power management policies using industry-recognized best practices and enforcing their uniform use throughout an organization.

To show that simply choosing energy-efficient hardware was still leaving "money on the table," our team used Machine Two as described above and ran benchmarks measuring power consumption with and without power management enabled.

The first scenario, "Maximum Performance," used the included Lenovo Power Management software available on Lenovo desktops and notebooks to set all parameters to "maximum." All sleep timers were disabled, which reflects the common 24/7 usage environment of many of our customers. After running a benchmark suite simulating eight hours of usage followed by 16 hours of inactivity, the system consumed 1379.9 watt-hours of electricity.

The second scenario, which we called "Reasonable Power Management," used Lenovo Power Manager with the setting "Maximum Power Savings." This setting closely reflects best practices surrounding power management from the Climate Savers Computing Initiative. The same benchmark suite simulating eight hours of usage followed by 16 hours of sleep/standby mode only consumed 429.3 watt-hours of electricity with very little drop in apparent performance.<sup>xii</sup>

In summary, power management can result in 69% less power consumption per PC using identical hardware while still providing a reasonable computing resource for the end user. While this suggests "building in" settings for power management with regard to an image, this still leaves a hole in a well-managed infrastructure: there is no enforcement and no provision for after- hours software patching.



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Simply setting power management in a preloaded software image is inadequate for long-term realized savings if users are not trained to regularly use the applied settings. In our experience, more than 85% of all customers allow their end users to log on as "administrators" of their own machines. This policy may be preferred because it makes it easier to minimize end user calls to the help desk. These calls arise when the end user is not able to accomplish a task because he or she is logged on as a "user." However, that same freedom brings additional headaches. As administrators of their own machine, users are given full reign to affect parameters such as power management and will almost certainly, given enough time, change their power settings to minimize hassle for them — namely reverting back to an always-on, full-power state. Clearly, enforcing newly applied power parameters is necessary in a successful power savings strategy. Forrester, a technology and market research company that provides advice to global leaders in business and technology, has recently suggested that your existing client management software may give you all of the control and enforcement capability that you need.

Turning on these capabilities in your management software solutions may or may not be the full answer, especially when you also need the ability to wake PCs up to patch them. As a result, Lenovo designed its Power Manager software with a unique feature available at no additional cost: Power Profiles.

Power Profiles work much like a programmable thermostat for a home heating and air conditioning system. An I.T administrator can program multiple specific power behaviors depending on the time of day. This includes the ability to wake systems up at predetermined times to allow for a normal patch update cycle and then later return to a low power state. Because Lenovo Power Manager has the ability to be "locked down" using commonly available tools like LANDesk® or Microsoft® System Management Server (SMS), I.T administrators can feel free to give their users administrator rights without compromising their power strategy.

## STEP THREE: MODIFY, MEASURE AND REPORT

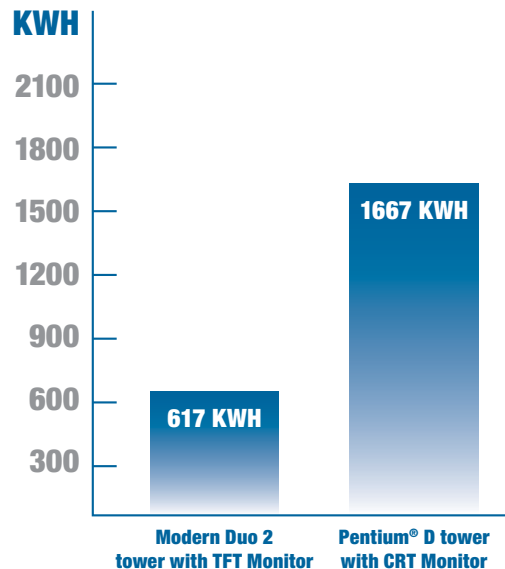
The final step in implementing a successful power management strategy is modifying areas that are not working as expected, measuring the complete strategy carefully, and then reporting the results to senior management.

It is unlikely that you will be able to deploy your new power management settings and then promptly forget about them. Different users will have differing business needs for separate power settings. It is important that any power tool you deploy have the ability to adjust to these needs. Despite all of the monitoring tools, servers and back-end databases that exist, 78% of all issues are detected by end users. By monitoring the end-user experience, I.T. becomes part of a proactive solution instead of a reactive one.

With this in mind, Lenovo partnered with Serden® to offer power analytics data at the end user level with Lenovo Power Manager. Many tools, including those shipped standard with Microsoft® Windows®, may have the capability to set power settings, but do not have a way to report back and audit the benefits of these settings. Lenovo Power Analyzer provides per user data based on actual usage including percentage of time at keyboard, daily and yearly power consumption, and inactivity periods. Based on this, the tool provides dashboard reporting that allows for modifications to policy based on data, rather than intuition. In such a manner, there is accountability, allowing for greater long-term savings compared to a “spray and pray” type of implementation.

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### CONCLUSION

The PC industry has moved into a new era of electricity consumption awareness. Purchasing ENERGY STAR™ rated PC hardware is not enough, as it still leaves low-hanging fruit for reducing power consumption. Unlike a refrigerator or washing machine, a PC must be set in order to realize maximum energy savings. Implementing centralized power management can save significant amounts of electricity without impacting end user productivity. Analytics and forensics complete a successful enterprise power management solution and provide auditability. A successful enterprise will implement all three phases and realize financial and institutional benefits from reduced energy bills and lower carbon emissions—not to mention the tangible and intangible benefits of being a “greener” company.

- i Smart 2020: Enabling the Low Carbon Economy in the Information Age, The Climate Group, June 2008
- ii How Long Should Organizations Keep their PCs?, The Gartner Group, March 2006
- iii How Long Should Organizations Keep their PCs?, The Gartner Group, March 2006
- iv <http://support.microsoft.com/kb/919183>, <http://www.intel.com/support/graphics/sb/cs-023606.htm#8>
- v <http://www.intel.com/Assets/PDF/datasheet/319970.pdf>
- vi <http://www.intel.com/Assets/PDF/datasheet/320122.pdf>
- vii [http://download.micron.com/pdf/whitepapers/reducing\\_power\\_consumption\\_ssds.pdf](http://download.micron.com/pdf/whitepapers/reducing_power_consumption_ssds.pdf)
- viii The SysMark2007 results for the two test cases were 66 for MaxPerf and 52 for MaxSave. However, since this test suite is complex and tests many different aspects of system performance, conclusions about the performance of the system in the two power modes
- ix <http://www.lenovo.com/save>
- x Logging was started using a WattsUp Power Meter with logging intervals set to ten seconds. All power consumption represents the combined power consumption of the computer and display. SysMark2007 Preview edition was installed on both machines with all required settings and run in the three-iteration mode to simulate a daily workload on the machine. This test typically run takes from four to five hours to run. Logging was started and a three-iteration run of SysMark was started and completed. The system ran in Max Performance power state for 24 hours. Logging ended 24 hours after the test was started.
- xi Monitor off after 15 minutes of idle time, hard drive off at 15 minutes of idle time, and entering standby/sleep mode after 30 minutes of inactivity. <http://www.climatesaverscomputing.org/learn/energy-saver-guide>
- xii “How Much Money are Your Idle PCs Wasting,” Forrester, December 2008

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