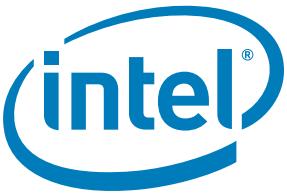

Designing for Energy Efficiency

White Paper

— For the Intel® 3 Series Chipset

June 2007

Document Number: 316970-001

Contents

Revision History

Revision Number	Description	Revision Date
1.0	• Initial release	June 2007

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1 Introduction

Over the last twenty-five years, computers have become pervasively used tools that have increased productivity in the office and enhanced entertainment and utility within the home. Their remarkable growth has been fueled by amazing advancements in performance, capability, and affordability. As the number of computers has grown, so has the need for delivery and deployment in increasingly greater energy-conscious ways. More energy-friendly computers can have an effect on both the available energy capacity as well as on the ecological impacts of generating additional electricity to meet growing demands.

Moving forward, there will continue to be a need for greater levels of computer performance and capability that will also be coupled with the need to manage energy consumption. Intuitively, it would seem that delivering greater performance/capability would be at odds with managing energy consumption. However, innovations by Intel and others in the industry have enabled delivery of technologies that can help offset and, in some cases, even reduce the energy consumed by the computer.

These innovations have typically focused on optimizing the energy efficiency and performance when the computer is actively being used while minimizing the actual energy consumption when the computer is in a state of prolonged inactivity. Today's computers, such as desktops and notebooks, have many power saving capabilities built into them. Examples are the "sleep" and "hibernate" modes that can significantly reduce the amount of energy consumed during inactive states. When these capabilities are turned on during periods of inactivity, it has been estimated to reduce the overall amount of energy consumed by computers by up to 60% (see Appendix).

To help encourage adoption and use of these energy saving technologies, in 1992 the US Environmental Protection Agency (EPA) established its voluntary program, called ENERGY STAR*, to cover first computers and later other categories of office equipment and other products. The ENERGY STAR program for computers has the goal of generating awareness of energy saving capabilities, as well as differentiating the market for more energy-efficient computers and accelerating the market penetration of more energy-efficient technologies. In the middle of 2007, the EPA will update the ENERGY STAR energy usage specification for computers to Version 4.0. The new version is intended to define a set of testing criteria and power limits that could reduce the amount of energy consumed by computers at idle (i.e., when awake but not in active use) by an average of 45%[1]. As this new specification rolls out, it is expected that the cost of ENERGY STAR compliant computers will increase slightly. EPA routinely sets a target goal of about twenty-five percent compliance for each of the platform categories and this will also be the case for the Version 4.0 Specification.

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1. Savings Estimates for the ENERGY STAR® Voluntary Labeling Program (2007). Sanchez, Marla, Carrie Webber, Richard Brown and Gregory Homan. Climate Change Action Plan (CCAP) Model version 061121. Lawrence Berkeley National Laboratory.

2 ENERGY STAR

2.1 ENERGY STAR Version 4.0

Version 4.0 of the ENERGY STAR specification for computers replaces Version 3.0 of the specification that has been in effect since 2000. Version 4.0 of the specification will be deployed in two phases, called tiers.

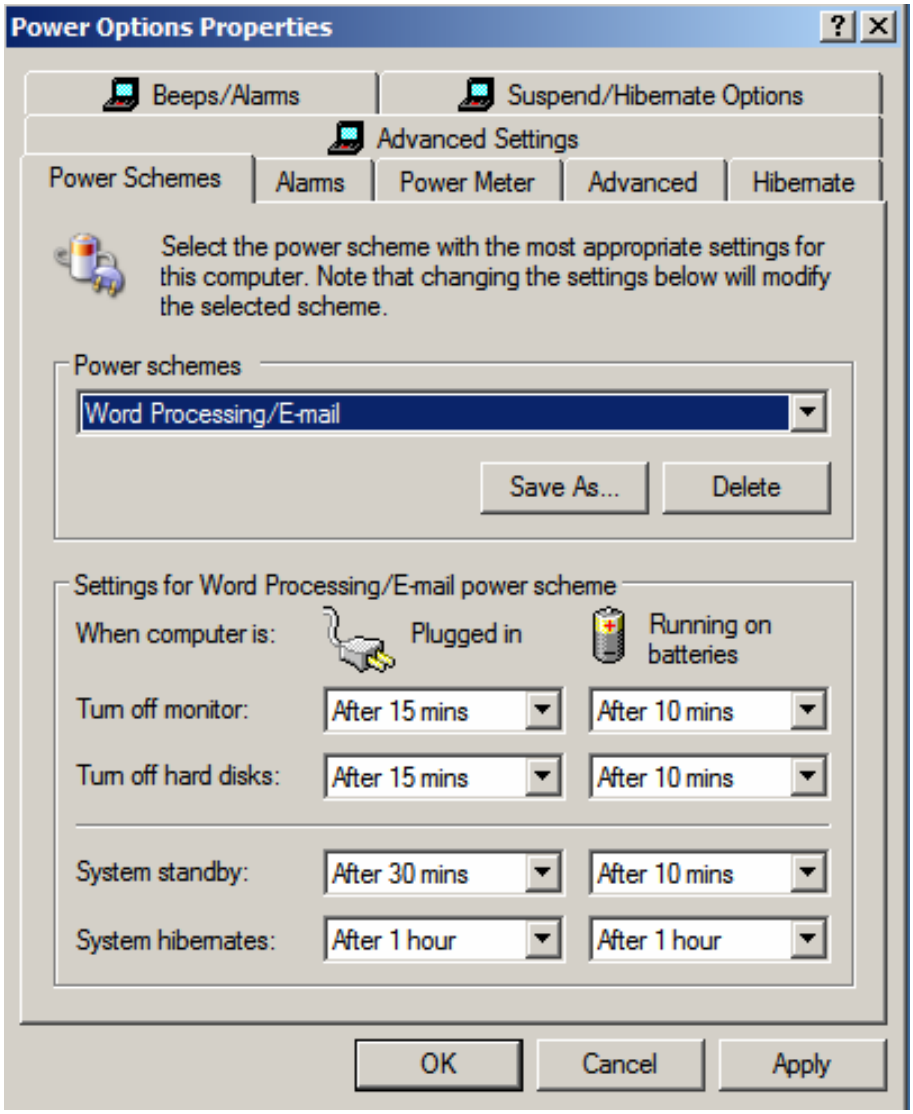
The first phase, Tier 1, will go into effect on July 20, 2007 and will require all systems manufactured on, or after, this date to meet the new requirements in order to ship with the ENERGY STAR logo. As such, there is no grandfathering for existing systems that previously met the Version 3.0 specification. Systems will have to be retested and resubmitted, in their "as-shipped" configuration, in order to continue to carry the logo. In addition, for product models that have multiple configurations, system vendors can qualify the product under a single model that represents the highest power configuration within the ENERGY STAR Desktop and Notebook product categories. For additional information on the logo requirements, refer to the ENERGY STAR specification.

A second phase, Tier 2, is targeted to go into effect in January of 2009. This second phase will define an enhanced test methodology and will be based upon both energy consumed over time and a performance assessment of products as they are expected to be used.

2.2 Taking Advantage of Power Management Settings

Figure 1 shows the power options property sheet for Windows XP* that allows users to control the various power settings. Specific options are: "Turn off monitor", "Turn off hard disks", "System standby" and "System hibernates". ENERGY STAR requirements require that the "Turn off monitor" setting be set (by default) to 15 minutes or less for AC ("Plugged in") operation, and "System Standby" (PC term for "Sleep") to be set for 30 minutes or less, when on AC power.

Figure 1. Windows XP Computer and Monitor Sleep Settings



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3 Intel® 3 Series Chipset

The Intel® 3 Series Chipset supports several features that lower idle power: ACPI processor power state C2, memory power-down, and PCI Express* Active State Power Management (ASPM).

3.1 ACPI Processor State C2

For systems with the right ingredients:

- Intel® Core™2 Duo processor that supports ACPI processor state C2
- Intel® 3 Series Chipset: Intel® 82G33 GMCH or 82P35 MCH
- System BIOS supporting ACPI 2.0 or greater
- Operating systems such as Microsoft* Windows XP SP2 or Windows Vista

System level idle power could be lowered through support of the ACPI processor state C2. When the system is idle, the processor could enter the C2 state. This allows the (G)MCH to also enter a lower power idle state.

3.2 Memory Power-Down

- Using ACPI processor state C2 as clues, the (G)MCH memory controller can put the system memory into the power-down state when the (G)MCH is idle. Power consumed by memory in the power-down state is much lower than the normal operating mode. This (G)MCH feature allows lower system level idle power.

3.3 PCI Express ASPM

For systems with add-in cards, PCI Express Active State Power Management (ASPM) could be used to lower system level idle power. When the card is in the D0 state, the PCI Express link can be in a lower power L1 state - reducing the system level power. The card could also be saving additional power since the PCI Express link is in L1.

3.4 Conclusion

Intel® 3 Series Chipset provides an important component level ingredient to Energy Star platforms.

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4 Appendix

4.1 Estimated Savings with Power Management

Today's computers, such as desktops and notebooks, have many power saving capabilities built into them. Examples are the "sleep" and "hibernate" modes that can significantly reduce the amount of energy consumed during inactive states. When these capabilities are turned on during periods of inactivity, it has been estimated to reduce the overall amount of energy consumed by computers by up to 60%. Increasing the sleep time of a computer can have significant power savings.

A typical baseline configuration consumes about 423 Kilowatt-hours per year without power management:

- the system is in the maximum power state 3% of the time, consuming 118 Watts;
- the system is in the idle state 67% of the time, consuming 65 Watts;
- the system is in the sleep state 27% of the time, consuming 4 Watts;
- the system is in the off state 3% of the time, consuming 3 Watts.

A typical configuration consumes about 173 Kilowatt-hours per year with power management:

- the system is in the maximum power state 3% of the time, consuming 118 Watts;
- the system is in the idle state 20% of the time, consuming 65 Watts;
- the system is in the sleep state 74% of the time, consuming 4 Watts;
- the system is in the off state 3% of the time, consuming 3 Watts.

4.2 Reference Documents

Documents	Location
Advanced Configuration and Power Interface (ACPI) Specification	http://www.acpi.info/spec.htm
PCI Express Architecture Power Management	http://www.intel.com/technology/pciexpress/devnet/docs/pciexpress1archpowermgmt.pdf
ENERGY STAR® Program Requirements for Computers	http://www.energystar.gov/ia/partners/prod_development/revisions/downloads/computer/Computer_Spec_Final.pdf
ENERGY STAR® Program Requirements for Single Voltage External Ac-Dc and Ac-Ac Power Supplies	http://www.energystar.gov/ia/partners/product_specs/program_reqs/EPS%20Eligibility%20Criteria.pdf
Power Supply Design Guide for Desktop Platform Form Factors	http://www.formfactors.org

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