ENERGY STAR® Program Requirements for Computers

Version 5.0
DRAFT 1

Note: EPA has changed the reference from Tier 2 to Version 5.0 to reflect the structural changes in desktop/notebook evaluation, in consideration of Thin Clients for the first time, and to align with EPA's past versioning conventions regarding tiered specifications.

Table of Contents

ENERGY STAR® Program Requirements for Computers

Partner Commitments
Version 5.0
DRAFT 1

Commitments

The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the manufacturing of ENERGY STAR qualified computers. The ENERGY STAR Partner must adhere to the following program requirements:

- comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be met for use of the ENERGY STAR certification mark on computers and specifying the testing criteria for computers. EPA may, at its discretion, conduct tests on products that are referred to as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily supplied by Partner at EPA's request;

- comply with current ENERGY STAR Identity Guidelines, describing how the ENERGY STAR marks and name may be used. Partner is responsible for adhering to these guidelines and for ensuring that its authorized representatives, such as advertising agencies, dealers, and distributors, are also in compliance;

- work with resellers of Partner's products to help ensure that these products remain in compliance with ENERGY STAR requirements. Any party within the distribution channel of an ENERGY STAR qualified computer product that alters the power profile of a product after its date of manufacture through hardware or software modifications must ensure that the product continues to meet the ENERGY STAR requirements before delivering this product to the end customer. If the product no longer meets the requirements, it may not bear the ENERGY STAR mark;

- qualify at least one ENERGY STAR computer model within one year of activating the computers portion of the agreement. When Partner qualifies the product, it must meet the specification (e.g., Tier 1 or 2) in effect at that time;

- provide clear and consistent labeling of ENERGY STAR qualified computers. The ENERGY STAR mark must be clearly displayed:

  1. On the top or front of the product. Labeling on the top or front of the product may be permanent or temporary. All temporary labeling must be affixed to the top or front of the product with an adhesive or cling-type application;

     Electronic Labeling Option: Manufacturers have the option of using an alternative electronic labeling approach in place of this product labeling requirement, as long it meets the following requirements:

     - The ENERGY STAR mark in cyan, black, or white (as described in "The ENERGY STAR Identity Guidelines" available at www.energystar.gov/logos) appears at system start-up. The electronic mark must display for a minimum of 5 seconds;
     - The ENERGY STAR mark must be at least 10% of the screen by area, may not be smaller than 76 pixels x 78 pixels, and must be legible.

     EPA will consider alternative proposals regarding approach, duration, or size for electronic

labeling on a case-by-case basis.

2. In product literature (i.e., user manuals, spec sheets, etc.);
3. On product packaging for products sold at retail; and
4. On the manufacturer's Internet site where information about ENERGY STAR qualified models is displayed:
   - If information concerning ENERGY STAR is provided on the Partner Web site, as specified by the ENERGY STAR Web Linking Policy (this document can be found in the Partner Resources section on the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where appropriate to the Partner Web site;

- agree to complete steps to educate users of their products about the benefits of power management by including the following information, in addition to that described in the User Information Requirements found in the ENERGY STAR Eligibility Criteria (Section 3.C), with each computer (i.e., in the user manual or on a box insert):

1. Energy saving potential;
2. Financial saving potential;
3. Environmental benefits
4. Information on ENERGY STAR and a link to www.energystar.gov; and
5. ENERGY STAR logo (used in accordance with "The ENERGY STAR Identity Guidelines" available at www.energystar.gov/logos).

In addition, a link should be made available to www.energystar.gov/powermanagement from computer product pages, product specifications, and related content pages.

At the manufacturer's request, EPA will supply suggested facts and figures related to the above criteria, template elements, or a complete template suitable for use in user guides or box inserts.

Note: The two paragraphs above have been reworded to clearly note Partner commitments related to power management user information. There are no further proposed changes to the partner commitments section (pages 2-4) in this draft.

- provide to EPA, on an annual basis, an updated list of ENERGY STAR qualified computer models. Once the Partner submits its first list of ENERGY STAR qualified computer models, the Partner will be listed as an ENERGY STAR Partner. Partner must provide annual updates in order to remain on the list of participating product manufacturers;

- provide to EPA, on an annual basis, unit shipment data or other market indicators to assist in determining the market penetration of ENERGY STAR. Specifically, Partner must submit the total number of ENERGY STAR qualified computers shipped (in units by model) or an equivalent measurement as agreed to in advance by EPA and Partner. Partner is also encouraged to provide ENERGY STAR qualified unit shipment data segmented by meaningful product characteristics (e.g., capacity, size, speed, or other as relevant), total unit shipments for each model in its product line, and percent of total unit shipments that qualify as ENERGY STAR. The data for each calendar year should be submitted to EPA, preferably in electronic format, no later than the following March and may be provided directly from the Partner or through a third party. The data will be used by EPA only for program evaluation purposes and will be closely controlled. Any information used will be masked by EPA so as to protect the confidentiality of the Partner;

- notify EPA of a change in the designated responsible party or contacts for computers within 30 days.

Performance for Special Distinction

In order to receive additional recognition and/or support from EPA for its efforts within the Partnership, the ENERGY STAR Partner may consider the following voluntary measures and should keep EPA informed on the progress of these efforts:

- consider energy efficiency improvements in company facilities and pursue the ENERGY STAR mark for buildings;

- purchase ENERGY STAR qualified products. Revise the company purchasing or procurement specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for periodic updates and coordination. Circulate general ENERGY STAR qualified product information to employees for use when purchasing products for their homes;

- ensure the power management feature is enabled on all ENERGY STAR qualified monitors and computers in use in company facilities, particularly upon installation and after service is performed;

- provide general information about the ENERGY STAR program to employees whose jobs are relevant to the development, marketing, sales, and service of current ENERGY STAR qualified product models;

- provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may be as simple as providing a list of planned activities or planned milestones that Partner would like EPA to be aware of. For example, activities may include: (1) increase the availability of ENERGY STAR qualified products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrate the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) provide information to users (via the Web site and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products: and (4) build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event;

- provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.

ENERGY STAR® Program Requirements for Computers

Eligibility Criteria (Version 5.0)
DRAFT 1

Below is the Version 5.0 product specification for ENERGY STAR qualified computers. A product must meet all of the identified criteria to earn the ENERGY STAR.

1) Definitions: Below are the definitions of the relevant terms in this document.

A. Computer: A device which performs logical operations and processes data. Computers are composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user input devices such as a keyboard, mouse, digitizer or game controller; and (3) a display screen to output information. For the purposes of this specification, computers include both stationary and portable units, including desktop computers, gaming consoles, integrated computers, notebook computers, tablet PCs, desktop-derived servers, thin clients, and workstations. Although computers must be capable of using input devices and displays, as noted in numbers 2 and 3 above, computer systems do not need to include these devices on shipment to meet this definition.

Components

B. Display: A display screen and its associated electronics encased in a single housing, or within the computer housing (e.g., notebook or integrated computer), that is capable of displaying output information from a computer via one or more inputs, such as a VGA, DVI, and/or IEEE 1394. Examples of display technologies are the cathode-ray tube (CRT) and liquid crystal display (LCD).

Note: The Version 4.1 ENERGY STAR computer monitor specification is currently under revision. If applicable, EPA intends to align the 'display' definition provided in the final Version 5.0 computer specification with the definition provided in the revised computer monitor specification.

C. External Power Supply: A component contained in a separate physical enclosure external to the computer casing and designed to convert line voltage ac input from the mains to lower dc voltage(s) for the purpose of powering the computer. An external power supply must connect to the computer via a removable or hard-wired male/female electrical connection, cable, cord or other wiring.

D. Internal Power Supply: A component internal to the computer casing and designed to convert ac voltage from the mains to dc voltage(s) for the purpose of powering the computer components. For the purposes of this specification, an internal power supply must be contained within the computer casing but be separate from the main computer board. The power supply must connect to the mains through a single cable with no intermediate circuitry between the power supply and the mains power. In addition, all power connections from the power supply to the computer components must be internal to the computer casing (i.e., no external cables running from the power supply to the computer or individual components). Internal dc-to-dc converters used to convert a single dc voltage from an external power supply into multiple voltages for use by the computer are not considered internal power supplies.

Computer Types

E. Desktop Computer: A computer where the main unit is intended to be located in a permanent location, often on a desk or on the floor. Desktops are not designed for portability and utilize an external monitor, keyboard, and mouse. Desktops are designed for a broad range of home and office applications.

F. Desktop-Derived Server: A desktop-derived server is a computer that typically uses desktop components in a tower form factor, but is designed explicitly to be a host for other computers or applications. For the purposes of this specification, a computer must be marketed as a server and have the following characteristics to be considered a desktop-derived server:

- Designed and placed on the market as a Class B product per the appropriate national RF Emissions requirements to the country of operation and has no more than single processor capability (1 socket on board);
- Designed in a pedestal, tower, or other form factor similar to those of desktop computers such that all data processing, storage, and network interfacing is contained within one box/product;
- Designed to operate in a high-reliability, high-availability application environment where the computer must be operational 24 hours/day and 7 days/week, and unscheduled downtime is extremely low (on the order of hours/year);
- Capable of operating in a simultaneous multi-user environment serving several users through networked client units; and
- Shipped with an industry accepted operating system for standard server applications (e.g., Windows NT, Windows 2003 Server, Mac OS X Server, OS/400, OS/390, Linux, UNIX and Solaris).

Desktop-derived servers are designed to perform functions such as processing information for other systems, providing network infrastructure services (e.g., archiving), data hosting and running web servers.

This specification does not cover server computers as defined in the ENERGY STAR Version 1.0 computer server specification.

Note: The definition for Desktop-Derived Servers is updated to clarify the relationship between EPA's current work on a draft Computer Server Specification and reflect a stakeholder comment regarding updates to EuroNorm EN55022:1998 and the EMC Directive 89/336/EEC.

EPA and the EC are considering further revisions to the Desktop-Derived Server Definition in Version 5.0. To date there have not been any Desktop-Derived Servers qualified under Version 4.0. EPA and the EC intend to investigate possible barriers to qualification that might be addressed under Version 5.0.

EPA and the EC intend to begin data collection for this product category prior to the release of Draft 2. Stakeholders are encouraged to provide comments on the viability of this product area and definition, barriers to qualification under Version 4.0, and data supporting revisions to operational mode power levels (if applicable).

G. Game Console: A stand-alone computer whose primary use is to play video games. For the purposes of this specification, game consoles must use a hardware architecture based on typical computer components (e.g., processors, system memory, video architecture, optical and/or hard drives, etc.). The primary input for game consoles are special hand held controllers rather than the mouse and keyboard used by more conventional computer types. Game consoles are also equipped with audio visual outputs for use with televisions as the primary display, rather than an external monitor or integrated display. These devices do not typically use a conventional operating system, but often perform a variety of multimedia functions such as: DVD/CD playback,

digital picture viewing, and digital music playback.

H. Integrated Computer: A desktop system in which the computer and display function as a single unit which receives its ac power through a single cable. Integrated computers come in one of two possible forms: (1) a system where the display and computer are physically combined into a single unit; or (2) a system packaged as a single system where the display is separate but is connected to the main chassis by a dc power cord and both the computer and display are powered from a single power supply. As a subset of desktop computers, integrated computers are typically designed to provide similar functionality as desktop systems.

I. Thin Client: An independently-powered computer that relies on a connection to a server to obtain primary functionality. Main computing (i.e. program execution, data storage, interaction with other Internet resources, etc.) takes place using centralized server resources.

Note: EPA noted in the Version 4.0 Specification that Thin Clients would be investigated for inclusion under a future tier of the program. Accordingly, and based on stakeholder interest in this product area, EPA has added Thin Clients for consideration as a separate product category under Version 5.0. Further details on this proposal are included in Section 3.d of this draft. EPA and the EC intend to begin data collection for this product category prior to the release of Draft 2.

The definition above is intended to describe thin clients on the market and adequately separate thin clients from the traditional desktop and notebook product categories. EPA welcomes stakeholder feedback on the effectiveness of this definition in meeting these goals and if applicable, component characteristic information supporting suggested modifications to this definition.

J. Notebook and Tablet Computers: A computer designed specifically for portability and to be operated for extended periods of time without a direct connection to an ac power source. Notebooks and tablets must utilize an integrated monitor and be capable of operation off an integrated battery or other portable power source. In addition, most notebooks and tablets use an external power supply and have an integrated keyboard and pointing device, though tablets use touch-sensitive screens. Notebook and tablet computers are typically designed to provide similar functionality to desktops except within a portable device. For the purposes of this specification, docking stations are considered accessories and therefore, the performance levels associated with notebooks presented in Section 3, below, do not include them.

K. Workstation: For the purposes of this specification, to qualify as a workstation, a computer must:

- Be marketed as a workstation;
- Have a mean time between failures (MTBF) of at least 15,000 hours based on either Bellcore TR-NWT-000332, issue 6, 12/97 or field collected data; and
- Support error-correcting code (ECC) and/or buffered memory.

In addition, a workstation must meet three of the following six optional characteristics:

- Have supplemental power support for high-end graphics (i.e., PCI-E 6-pin 12V supplemental power feed);
- System is wired for greater than x4 PCI-E on the motherboard in addition to the graphics slot(s) and/or PCI-X support;
- Does not support Uniform Memory Access (UMA) graphics;
- Includes 5 or more PCI, PCIe or PCI-X slots;
- Capable of multi-processor support for two or more processors (must support physically separate processor packages/sockets, i.e., not met with support for a single multi core processor); and/or
- Be qualified by at least 2 Independent Software Vendor (ISV) product certifications; these certifications can be in process, but must be completed within 3 months of qualification.

Note: EPA welcomes comments on the above definition for workstations. In particular EPA seeks input on any revisions to the noted characteristics that will help ensure continued applicability through the timeframe of this Version 5.0 specification.

Operational Modes

L. Off Mode: The power consumption level in the lowest power mode which cannot be switched off (influenced) by the user and that may persist for an indefinite time when the appliance is connected to the main electricity supply and used in accordance with the manufacturer's instructions. For purposes of this specification, Off Mode correlates to ACPI System Level S4 or S5 states, where applicable.

M. 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. For the purposes of this specification, Sleep mode correlates to ACPI System Level S3 (suspend to RAM) state, where applicable.

N. Idle State: For purposes of testing and qualifying computers under this specification, this is the state in which the operating system and other software have completed loading, the machine is not asleep, and activity is limited to those basic applications that the system starts by default.

O. Active State: The state in which the computer is carrying out useful work in response to a) prior or concurrent user input or b) prior or current instruction over the network. This state includes active processing, seeking data from storage, memory, or cache, not precluding idle state time while awaiting further user input and before entering low power modes. For the purposes of testing and qualifying computers under this specification, this is the state in which the EEPA workload is running, thereby automating the state as described above.

Note: This Version 5.0 specification extends assessment of active efficiency from the solely the idle state to a holistic view that includes energy consumed while the computer is delivering functionality to the user. The definition above has been added accordingly and EPA encourages comments and suggestions on this proposal.

Networking and Power Management

P. Network Interface: The components (hardware and software) whose primary function is to make the computer capable of communicating over one or more network technologies. For purposes of testing to this specification, Network Interface refers to the IEEE 802.3 wired Ethernet interface.

Q. Wake Event: A user, programmed, or external event or stimulus that causes the computer to transition from Sleep or Off to active mode of operation. Examples of wake events include, but are not limited to: movement of the mouse, keyboard activity, or a button press on the chassis, and in the case of external events, stimulus conveyed via a remote control, network, modem, etc.

R. Wake On LAN (WOL): Functionality which allows a computer to wake from Sleep or Off when directed by a network request.

Energy Efficiency Performance Assessment

Note: The following definitions have been added to Version 5.0 to address concepts related to implementation of the Energy Efficiency Performance Assessment.

S. Energy Efficiency Performance Assessment (EEPA): An evaluation of a computer's effectiveness in translating energy into desired work output based on the following test elements: performance data/score, power required to achieve this performance, and system characteristics.

T. EEPA Tool: Benchmark software that automates processes required for a computer to complete a workload and collect data on how the computer performs in addressing this workload. The EEPA tool has the following outputs required for evaluation under this specification: workload energy

use, workload duration, modal power levels, and capability enumerations.

U. Workload: a defined set of computational activities to be performed over a period of time.

Shipment Channels

V. Enterprise Channels: Sales channels normally used by large and medium-sized business, government organizations, and educational institutions, with the intent of identifying machines that will be used in managed client/server environments

Note: This definition was included in Version 4.0 under the Power Management section. The definition remains consistent with Version 4.0 and was moved for better organization.

2) Qualifying Products: Computers must meet the computer definition as well as one of the product type definitions provided in Section 1, above, to qualify as ENERGY STAR. The following table provides a list of the types of computers that are (and are not) eligible for ENERGY STAR.

Products Covered by Version 5.0 Specification	Products Not Covered by Version 5.0 Specification
• Desktop Computers • Integrated Computer Systems • Notebook Computers/Tablet PCs • Workstations • Game Consoles • Desktop-Derived Servers • Thin Clients	• Computer Servers (as defined in Version 1.0 computer server specification) • Handhelds and PDAs

Note: As referenced in Section 1), EPA has added thin clients as a product category with a proposed initial approach for Thin Clients in section 3.B.5, below. In addition, the scope of servers not covered by this Version 5.0 Specification has been revised to reference the Computer Server Specification currently under development.

3) Energy Efficiency and Power Management Criteria: Computers must meet the requirements below to qualify as ENERGY STAR. The Version 5.0 effective date is covered in Section 5 of this specification.

(A) Power Supply Efficiency Requirements

Computers Using an Internal Power Supply: 85% minimum efficiency at 50% of rated output and 82% minimum efficiency at 20% and 100% of rated output, with Power Factor $\geq$ 0.9 at 100% of rated output.

Note: EPA received stakeholder comments after the December meeting requesting alignment with the Climate Savers Computing Initiative (CSCI). EPA supports continuing improvements in power supply efficiency but maintains the goal of maximizing energy savings along with cost effectiveness of the program's specifications.

CSCI has posted internal power supply efficiency tiers for desktop PCs, the first of which is equal to the ENERGY STAR Tier 1 levels. The proposed levels in this draft align with the second tier of CSCI requirements, with a 0.9 power factor requirement maintained from the ENERGY STAR Version 4.0 specification. Stakeholders are encouraged to comment on these levels and relations to the overall goal of maximizing energy savings.

Computers Using an External Power Supply: Must be ENERGY STAR qualified or meet the no-

load and active mode efficiency levels provided in the ENERGY STAR Program Requirements for Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0. The ENERGY STAR specification and qualified product list can be found at www.energystar.gov/powersupplies. Note: This performance requirement also applies to multiple voltage output external power supplies as tested in accordance to the Internal Power Supply test method referenced in Section 4, below.

Note: External Power Supply (EPS) requirements in this draft have been updated to directly reference ENERGY STAR Version 2.0 EPS requirements; a Final Draft of this Specification was released on February 19, 2008. The version 2.0 EPS requirements will take effect in 2008 and EPA believes that appropriate supplies will be available in the market in advance of the July 1, 2009 effective date of this Version 5.0 Specification for Computers.

(B) Efficiency and Performance Requirements:

1) Desktop, Integrated Computer, Notebook, and Tablet PC Levels:

Note: The Energy Efficiency Performance Assessment is intended to evaluate computers holistically across modes of operation. Two other active initiatives, the EU's EuP Directive preparatory studies and Federal Energy Management Program (FEMP) each call for Off Mode power limits. EPA, the EC, and FEMP will consult on modal requirements for computers and the next draft of this specification will include a proposal based on these discussions.

Energy Efficiency Performance Assessment and Associated Levels: Table 1 below lists annual energy consumption requirements for Version 5.0. Annual energy consumption will be determined using the formula below:

$$E_{annual} = 8760 * (P_{off} * T_{off} + P_{sleep} * T_{sleep} + P_{idle} * T_{idle}) + E_{active} * N_{active}$$

where all P_x are power values in watts, all T_x are Time values in % of year, E_{active} is the energy above Idle measured when a computer runs the benchmark workload once (in kWh), and $N_{workload}$ is the number of times each year the workload is assumed to typically run.

Table 1: Annual Energy Consumption

Product Category	Maximum Annual Energy Consumption (kWh)
Desktops and Integrated Computers	TBD
Notebook and Tablet Computers	TBD

Table 2: Capability Adders

Type	Desktops and Integrated Computers (kWh)	Notebook and Tablet Computers (kWh)
Memory (each GB above a base value)	TBD	TBD
Network Interfaces (Ethernet, WiFi, etc.)	TBD	TBD

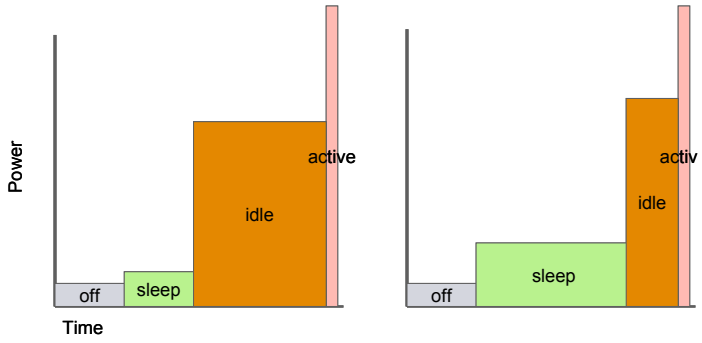
Note: Draft 1 Version 5.0 incorporates an Energy Efficiency Performance Assessment (EEPA) approach to evaluating Desktop, Integrated Computer, Notebook, and Tablet PC product categories. This approach was introduced in the Version 4.0 Specification as and "Energy Efficiency Performance Software" evaluation.

Under this approach, a software tool automates and standardizes the process for computers to run a consensus "workload" of real-world applications and computing tasks. Upon completion of these tasks, information about energy required to run the workload, static operational mode power measurements, workload performance score, and system characteristics are used in combination to evaluate a computer's effectiveness in translating energy consumed into performance. At a minimum, the EEPA tool would output the following: power measured in Off Mode, Sleep Mode, and Idle State, Energy, Performance Rating, and Time to run the workload, and system characteristics/capability enumerations. EPA distributed a usage scenario data collection effort in conjunction with this draft to aid development of a realistic workload.

(*Continued on next page*)

Note: (*Continued from previous page*)

Draft 1 presents the structure of this EEPA approach including EEPA tool measurement outputs and formulas to calculate estimated annual energy consumption based on these outputs. The graphic below represents the goals of this approach – reduction of the total energy consumption of computers through better use of low power modes, reduction of idle power, or other methods to reduce the total energy consumption. Levels for qualification are to be determined. EPA intends to refine definitions and structural elements of the specification prior to EEcoMark availability in June, then focus on testing, data collection, and qualification level development once the tool is ready for EPA's use.



In addition to allowing evaluation of computers as they actively complete tasks, EPA believes that the EEPA approach has the benefits of allowing the Computer Specification to more effectively scale its efficiency metrics to the performance and functionality of a given product, simplify testing, and provide greater longevity and stability to the ENERGY STAR Computer Specification.

EPA is working with BAPCo (Business Applications Performance Corporation) as they develop EEcoMark, a software tool designed to meet both EPA's requirements for use in Version 5.0 and an energy benchmark standard being developed by the TC38-TG2 working group of Ecma International. Both BAPCo and the aforementioned Ecma working group are composed of representatives from the Computer Industry. THE EPA AND EC technical team is also significantly involved in this effort. EEcoMark is scheduled to be finalized for use with Windows and MacOS systems in June 2008. Should it meet EPA and the EC's requirements for use in Version 5.0, EPA and the EC intend to commence data collection using the finalized tool immediately upon its availability.

As referenced in the Version 4.0 specification, EPA will pursue a provisional Idle State requirement as an interim or alternative measure should EPA, the EC, and industry not be able to finalize a specification based on a completed EEPA tool by October 2008, such that the specification can go into effect in July 2009. However, EPA and the EC continue to expect to be able to make use of the Ecma standard and EEcoMark software tool based on current progress of these projects.

2) Workstation Levels: TBD

Note: In a December Stakeholder call to review the Tier 2 Discussion Guide, it was brought up that the EEcoMark EEPA tool would not be applicable to Workstations along with Desktop and Notebook related product categories, largely due to a workload based on applications not applicable to Workstations.

Related to this discussion, EPA has been in discussions with the Standard Performance Evaluation Corporation SPEC Graphics & Workstation Performance Group (SPEC GWPG) to use a simplified version of BAPCo's EEcoMark in which the workloads will be more appropriate to workstations. EPA and SPEC have agreed that such an approach is viable for Version 5.0 and this currently unnamed benchmark is in development. EPA intends to include further details on this benchmark progress as well as invite use of the benchmark and sharing of the resulting data with EPA in the near future.

3) Game Console Levels: TBD

Note: EPA introduced game consoles in Tier 1 to encourage greater energy efficiency as consoles become increasingly present in home entertainment configurations. EPA has discussed the feasibility of developing console-specific ENERGY STAR requirements with leading console manufacturers that reflect the market and system capabilities.

EPA intends to evaluate Game Consoles as a separate product from computers based on initial discussions and feedback from these manufacturers, differing usage patterns between the two product areas, and the realities of the game console market. Potential areas for evaluation include Auto-Power Down, TV/Display Auto-Off, and power supply efficiency. Power supply efficiency overlaps with current ENERGY STAR Computer requirements for external power supplies; to this point, Version 4.0 included provisions for testing both single and multiple output external power supplies.

EPA is continuing to work with these manufacturers to collect power consumption data and prospective areas for energy savings both in the short term (Version 5.0) and in future generations of game consoles. EPA intends to include proposed structure and levels in future drafts of this Specification.

4) Desktop-Derived Server Levels:

Table 3: Desktop-Derived Server Efficiency Requirements

Desktop-Derived Server Operational Mode Power Requirements	
Off: ≤ X W **(TBD)** **Idle State**: ≤ X W **(TBD)**	
Capability	**Additional Power Allowance**
Wake On LAN (WOL)	+ 0.7 W for Sleep + 0.7 W for Off

Note: To date, there have not been any Desktop-Derived Servers qualified with ENERGY STAR. In the absence of further data, EPA proposes to maintain a Tier 1 Operational Mode approach, but is open to stakeholder comments and supporting data on possible barriers the Version 4.0 levels and requirements provided to qualification of Desktop-Derived Servers for ENERGY STAR.

5) Thin Client Levels

Table 4: Thin Client Efficiency Requirements

Thin Client Operational Mode Power Requirements
Off Mode: ≤ 1 W **Sleep Mode:** ≤ X W **(TBD)** **Idle State:** ≤ X W **(TBD)**

Note: Stakeholders have suggested to EPA that the market share for thin clients may be increasing and that these products represent an energy savings due to low per-client consumption. EPA stated in the Tier 1 Specification that Thin Clients would be investigated for possible inclusion in Tier 2. Accordingly, Thin Clients were included in the Tier 2 Discussion Guide presented during the online stakeholder meeting on December 6, 2007, and numerous comments were received by EPA in response. Responses were mixed regarding evaluation of these products against products in the Desktop and Notebook categories.

(*Continued on next page*)

Note: (*Continued from previous page*)

EPA proposes inclusion of Thin Clients as a unique product category in Version 5.0 as well as a separate Thin Client evaluation based on Tier 1 Operational Mode efficiency requirements due to the following factors: 1) Thin Client reliance on server resources to complete EEPA tasks which might vary significantly between testing and real-world implementations, 2) Thin Clients' existence in the market as a separate solution from traditional desktops and notebooks that is dependant on remote servers to run applicable workloads, and 3) presence of proprietary or non-standard operating systems that will not function with initial iterations of EEcoMark, the EEPA tool under discussion. EPA believes that the Version 4.0 Test Procedure, included in Appendix A of this Draft, will be appropriate to evaluate Thin Clients and welcomes stakeholder comment on this approach or others worth consideration.

(C) Power Management Requirements: Products must meet the power management requirements detailed in Table 5, below, and be tested as shipped.

Table 5: Power Management Requirements

Note: Power Management for Game Consoles is under discussion as part of the effort listed in Section 3.B.3. The table below will be updated as appropriate to account for Consoles in future drafts.

Specification Requirement		Applicable to
Shipment Requirements		
Sleep Mode	Shipped with a Sleep mode which is set to activate within 30 minutes of user inactivity	Desktop Computers, Integrated Computers, Notebook Computers/Tablet PCs, Workstations, and Thin Clients
Display Sleep Mode	Shipped with the display's Sleep mode set to activate within 15 minutes of user inactivity	All Computers
Network Requirements for Power Management		
Ethernet	All Ethernet network interfaces shall comply with IEEE 802.3az – "Energy Efficient Ethernet"	All Computers
Wake on LAN (WOL)	Computers shall have the ability to enable and disable WOL for Sleep mode	Desktop Computers, Integrated Computers, Notebook Computers/Tablet PCs, Workstations, Desktop-Derived Servers, and Thin Clients
	Computers must be shipped with Wake On LAN (WOL) enabled from the Sleep mode when operating on ac power (i.e. notebooks may automatically disable WOL when disconnected from the mains)	Computers *shipped through enterprise channels* of the following types: Desktop Computers, Integrated Computers, Notebook Computers/Tablet PCs, Workstations, Desktop-Derived Servers, and Thin Clients
Network Connectivity	Computers must maintain full network connectivity while in Sleep mode, according to a platform-independent industry standard.	Desktop Computers, Integrated Computers, Notebook Computers/Tablet PCs, and Thin Clients. Applies only to systems in the categories above that are shipped through Enterprise Channels.

Wake Management	Computers shall be capable of both remote and scheduled wake events from Sleep mode. Manufacturers shall ensure, where the manufacturer has control (i.e., configured through hardware settings rather than software settings), that these settings can be managed centrally, as the client wishes, with tools provided by the manufacturer.	All Computers *shipped to Enterprise Channels*

For all computers with WOL enabled, any directed packet filters shall be enabled and set to an industry standard default configuration. Until one (or more) standards are agreed upon, partners are asked to provide their direct packet filter configurations to EPA for publication on the Website to stimulate discussion and development of standard configurations.

Qualifying Computers with Power Management Capabilities: The following requirements should be followed when determining whether models should be qualified with or without WOL:

Off: Computers should be tested and reported as shipped for Off. Models that will be shipped with WOL enabled for Off should be tested with WOL enabled. Likewise, products shipped with WOL disabled for Off must be tested with WOL disabled.

Sleep: Computers should be tested and reported as shipped for Sleep. Models sold through enterprise channels, as defined in Section 1V, shall be tested, qualified, and shipped WOL enabled. Products going directly to consumers through normal retail channels only are not required to be shipped with WOL enabled from Sleep, and may be tested, qualified, and shipped with WOL either enabled or disabled.

Customer Software and Management Service Pre-Provisioning: TBD

Note: EPA included the following language related to pre-provisioning of customer-requested additional management services late in the specification development process for Version 4.0 to account for service processors and management controllers:

Systems where any additional management services are, at the customer's request, pre-provisioned by the manufacturer, do not need to test the systems with these functions in an active state providing the function is not actually activated until there is specific action by the end user (i.e., manufacturer should test in pre-provisioned state and does not have to consider the power use after full provisioning occurs on site).

EPA has not been made aware of the prevalence of such components in qualified products and thus intends to remove this allowance for Version 5.0. Stakeholders may provide comments and supporting data on savings potential, energy/functionality information, market prevalence, and applicability to targeted product types for EPA consideration.

User Information Requirement: In order to ensure that purchasers/users are properly informed on the benefits of power management, the manufacturer will include with each computer, one of the following:

- Information on ENERGY STAR and the benefits of power management in either a hard copy or electronic copy of the user manual. This information should be near the front of the user guide; or
- A package or box insert on ENERGY STAR and the benefits of power management.

Either option must at least include the following information:

- Notice that the computer has been shipped enabled for power management and what the time settings are; and
- How to properly wake the computer from Sleep mode.

Note: The first draft of the ENERGY STAR Computer Server specification, available at http://www.energystar.gov/index.cfm?c=new_specs.enterprise_servers, introduces the idea of a standardized information datasheet for customer use in differentiating products. The Version 4.0 user information requirement focuses on power management only; EPA encourages comments if stakeholders believe that a standardized datasheet with additional information would be beneficial for ENERGY STAR computers and if so, what should be included (i.e. EEPA score, component details, etc.).

Note: EPA has received significant interest related to the ENERGY STAR program considering a broader mix energy and safety-related impacts. As such, EPA is evaluating means of addressing this interest in a way that aligns with our guiding principles and fully expects to provide for significant stakeholder engagement during the process.

(D) Voluntary Requirements

User Interface: Although not mandatory, manufacturers are strongly recommended to design products in accordance with the Power Control User Interface Standard — IEEE 1621 (formally known as "Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments"). Compliance with IEEE 1621 will make power controls more consistent and intuitive across all electronic devices. For more information on the standard see http://eetd.LBL.gov/Controls.

4) Test Procedures: Manufacturers are required to perform tests and self-certify those models that meet the ENERGY STAR guidelines.

- In performing these tests, partner agrees to use the test procedures provided in Table 6, below.
- The test results must be reported to EPA or the European Commission, as appropriate.

Additional testing and reporting requirements are provided below.

A. Models Capable of Operating at Multiple Voltage/Frequency Combinations: Manufacturers shall test their products based on the market(s) in which the models will be sold and promoted as ENERGY STAR qualified.

For products that are sold as ENERGY STAR in multiple international markets and, therefore, rated at multiple input voltages, the manufacturer must test at and report the required power consumption or efficiency values at all relevant voltage/frequency combinations. For example, a manufacturer that is shipping the same model to the United States and Europe must measure, meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as ENERGY STAR at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may only be qualified and promoted as ENERGY STAR in those regions that support the tested voltage/frequency combination (e.g., North America and Taiwan).

Table 6: Test Procedures

Product Category	Specification Requirement	Test Protocol	Source
Desktop, Integrated, Notebook, and Tablet PCs	Annual Energy Consumption	ENERGY STAR Energy Efficiency Performance Assessment for Computers	TBD
	Power Supply Efficiency	IPS: Internal Power Supply Efficiency Protocol EPS: ENERGY STAR Test Method for External Power Supplies	IPS: www.efficientpowersupplies.org EPS: www.energystar.gov/powersupplies
Workstations	TBD	TBD	TBD
Game Consoles	TBD	TBD	TBD
Desktop-Derived Servers	Off Mode and Idle State	ENERGY STAR Computer Test Method (Version 5.0)	Appendix A
Thin Clients	Off Mode, Sleep Mode, and Idle State	ENERGY STAR Computer Test Method (Version 5.0)	Appendix A

Note: As referenced in Section 3.B.2, EPA intends to work with SPEC to develop a SPEC benchmark for workstation testing for use with Version 5.0.

B. Qualifying Families of Products: Models that are unchanged or that differ only in finish from those sold in a previous year may remain qualified without the submission of new test data assuming the specification remains unchanged. If a product model is offered in the market in multiple configurations or styles, as a product "family" or series, the partner may report and qualify the product under a single model number, as long as all of the models within that family or series meet either of the following requirements:

- Computers that are built on the same platform and are identical in every respect except for housing and color may be qualified through submission of test data for a single, representative model.

- If a product model is offered in the market in multiple configurations, the partner may report and qualify the product under a single model number that represents the highest power configuration available in the family, rather than reporting each and every individual model in the family; there must not be higher consuming configurations of the same product model than the representative configuration. In this case, the highest configuration would consist of: the highest power processor, the maximum memory configuration, the highest power GPU, etc. For desktop systems which meet the definition for multiple desktop categories (as defined in

section 3.A.2) depending on the specific configuration, manufacturers will have to submit the highest power configuration for each category under which they would like the system to qualify. For example, a system that could be configured either as a Category A or a Category B desktop would require a submittal of the highest power configuration for both categories in order to qualify as ENERGY STAR. If a product could be configured to meet all three categories, it would then have to submit data for the highest power configuration in all categories. Manufacturers will be held accountable for any efficiency claims made about all other models in the family, including those not tested or for which data was not reported.

Note: As mentioned in a clarification memorandum for the Version 4.0 released on November 20, 2007, configurations submitted as the highest-consuming configuration of a particular model must represent the highest possible consuming configuration of the model, not only the highest-consuming configuration that meets ENERGY STAR. The language above has been modified to clarify this point.

5) **Effective Date:** The date that manufacturers may begin to qualify products as ENERGY STAR will be defined as the *effective date* of the agreement. The ENERGY STAR Version 5.0 Computers Specification effective date is July 1, 2009. All products, including models originally qualified under Version 4.0, with a **date of manufacture** on or after **July 1, 2009**, must meet the Version 5.0 requirements in order to qualify for ENERGY STAR. Any previously executed agreement on the subject of ENERGY STAR qualified computers shall be terminated effective June 30, 2009.

6) **Future Specification Revisions:** EPA reserves the right to revise the specification should technological and/or market changes affect its usefulness to consumers or industry or its impact on the environment. In keeping with current policy, revisions to the specification will be discussed with stakeholders. In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model. To qualify as ENERGY STAR, a product model must meet the ENERGY STAR specification in effect on the model's date of manufacture.

Note: EPA anticipates updating Version 5.0 as the EEPA tool is updated as well as to consider the appropriateness of levels, definitions, and other aspects of the specification as the market evolves. Unless called for, EPA intends to retain the overall structure of 5.0 in future iterations of this specification. As is the case for all ENERGY STAR specification revision efforts, EPA will work with stakeholders throughout the revision process. The first revision to the Version 5.0 Specification is expected to occur two years after the effective date of Version 5.0 (2011), in conjunction with an anticipated update to the EEPA tool.

APPENDIX A
ENERGY STAR Test Procedure for Determining the Power Use of Computers in Off, Sleep, Idle and Maximum Power

The following protocol should be followed when measuring power consumption levels of computers for compliance with the Off, Sleep, and Idle levels provided in the ENERGY STAR Version 5.0 Computer Specification. Partners must measure a representative sample of the configuration as shipped to the customer. However, the Partner does not need to consider power consumption changes that may result from component additions, BIOS and/or software settings made by the computer user after sale of product. *This procedure is intended to be followed in order and the mode being tested is labeled where appropriate.*

I. Definitions

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the Version 5.0 ENERGY STAR Eligibility Criteria for Computers.

UUT
UUT is an acronym for "unit under test," which in this case refers to the computer being tested.

UPS
UPS is an acronym for "Uninterruptible Power Supply," which refers to a combination of converters, switches and energy storage means, for example batteries, constituting a power supply for maintaining continuity of load power in case of input power failure.

II. Testing Requirements

Approved Meter
Approved meters will include the following attributes[1]:

- Power resolution of 1 mW or better;
- An available current crest factor of 3 or more at its rated range value; and
- Lower bound on the current range of 10mA or less.

The following attributes in addition to those above are suggested:

- Frequency response of at least 3 kHz; and
- Calibration with a standard that is traceable to the U.S. National Institute of Standards and Technology (NIST).

It is also desirable for measurement instruments to be able to average power accurately over any user selected time interval (this is usually done with an internal math's calculation dividing accumulated energy by time within the meter, which is the most accurate approach). As an alternative, the measurement instrument would have to be capable of integrating energy over any user selected time interval with an energy resolution of less than or equal to 0.1 mWh and integrating time displayed with a resolution of 1 second or less.

Accuracy
Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level. Measurements of power of less than 0.5 W shall be made with an

[1] *Characteristics of approved meters taken from IEC 62301 Ed 1.0: Measurement of Standby Power*

uncertainty of less than or equal to 0.01 W at the 95% confidence level. The power measurement instrument shall have a resolution of:

- 0.01 W or better for power measurements of 10 W or less;
- 0.1 W or better for power measurements of greater than 10 W up to 100 W; and
- 1 W or better for power measurements of greater than 100 W.

All power figures should be in watts and rounded to the second decimal place. For loads greater than or equal to 10 W, three significant figures shall be reported.

Test Conditions

Supply Voltage:	North America/Taiwan:	115 (± 1%) Volts AC, 60 Hz (± 1%)
	Europe/Australia/New Zealand:	230 (± 1%) Volts AC, 50 Hz (± 1%)
	Japan:	100 (± 1%) Volts AC, 50 Hz (± 1%)/60 Hz (± 1%)
		Note: For products rated for > 1.5 kW maximum power, the voltage range is ± 4%
Total Harmonic Distortion (THD) (Voltage):	< 2% THD (< 5% for products which are rated for > 1.5 kW maximum power)	
Ambient Temperature:	23°C ± 5°C	
Relative Humidity:	10 – 80 %	

(Reference IEC 62301: Household Electrical Appliances – Measurement of Standby Power, Sections 3.2, 3.3)

Test Configuration
Power consumption of a computer shall be measured and tested from an ac source to the UUT.

The UUT must be connected to an Ethernet network switch capable of the UUT's highest and lowest network speeds. The network connection must be live during all tests.

III. Test Procedure for Off, Sleep and Idle for All Products

Measurement of ac power consumption of a computer should be conducted as follows:

UUT Preparation

1. Record the manufacturer and model name of the UUT.
2. Ensure that the UUT is connected to a live Ethernet (IEEE 802.3) network switch as specified in Section II., "Test Configuration," above, and that the connection is live. The computer must maintain this live connection to the switch for the duration of testing, disregarding brief lapses when transitioning between link speeds.
3. Connect an approved meter capable of measuring true power to an ac line voltage source set to the appropriate voltage/frequency combination for the test.
4. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units should be connected between the meter and the UUT. For a valid test to take place the meter should remain in place until all Off, Sleep, and Idle power data is recorded.
5. Record the ac voltage.
6. Boot computer and wait until the operating system has fully loaded.
7. If necessary, run the initial operating system setup and allow all preliminary file indexing and other one-time/periodic processes to complete.

8. Record basic information about the computer's configuration – computer type, operating system name and version, processor type and speed, and total and available physical memory, etc.[2]
9. Record basic information about the video card - video card name, resolution, amount of onboard memory, and bits per pixel.[3]
10. Ensure that the UUT is configured as shipped including all accessories, power management settings, WOL enabling and software shipped by default. UUT should also be configured using the following requirements for all tests:
    a. Desktop systems (including workstations and desktop-derived servers) and thin clients shipped without accessories should be configured with a standard mouse, keyboard and external monitor.
    b. Notebooks and tablets should include all accessories shipped with the system, and need not include a separate keyboard or mouse when equipped with an integrated pointing device or digitizer.
    c. Notebooks and tablets should have the battery pack(s) removed for all tests. For systems where operation without a battery pack is not a supported configuration, the test may be performed with fully charged battery pack(s) installed, making sure to report this configuration in the test results.
    d. Power to wireless radios should be turned off for all tests. This applies to wireless network adapters (e.g., 802.11) or device-to-device wireless protocols.
11. The following guidelines should be followed to configure power settings for displays (adjusting no other power management settings):
    a. For computers with external displays (most desktops): use the monitor power management settings to prevent the monitor from powering down to ensure it stays on for the full length of the Idle test as described below.
    b. For computers with integrated monitors (notebooks, tablets and integrated systems): use the power management settings to set the monitor to power down after 1 minute.
12. Shut down the computer.

Off Mode Testing

13. With the UUT shut down and in Off, set the meter to begin accumulating true power values at an interval of 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.[4]

Idle Mode Testing

14. Switch on the computer and begin recording elapsed time, starting either when the computer is initially switched on, or immediately after completing any log in activity necessary to fully boot the system. Once logged in with the operating system fully loaded and ready, close any open windows so that the standard operational desktop screen or equivalent ready screen is displayed. Exactly 15 minutes after the initial boot or log in, set the meter to begin accumulating true power values at an interval of 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

Sleep Mode Testing

15. After completing the Idle measurements, place the computer in Sleep mode. Reset the meter (if necessary) and begin accumulating true power values at an interval of 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

[2] On Windows-based machines, much of this information can be found by selecting the following window: Start / Programs / Accessories / System Tools / System Information.

[3] On Windows-based machines, this can be found by selecting the following window: Start / Programs / Accessories / System Tools / Components / Display.

[4] Laboratory-grade, full-function meters can integrate values over time and report the average value automatically. Other meters would require the user to capture a series of changing values every 5 seconds for a five minute period and then compute the average manually.

16. If testing both WOL enabled and WOL disabled for Sleep, wake the computer and change the WOL from Sleep setting through the operating system settings or by other means. Place the computer back in Sleep mode and repeat step 14, recording Sleep power necessary for this alternate configuration.

Reporting Test Results

17. The test results must be reported to EPA or the European Commission, as appropriate, taking care to ensure that all required information has been included.

IV. Continuing Verification

This testing procedure describes the method by which a single unit may be tested for compliance. An ongoing testing process is highly recommended to ensure that products from different production runs are in compliance with ENERGY STAR.