



ENERGY STAR® Program Requirements for Computers

Version 5.0
DRAFT 2

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Partner Commitments

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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:

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- 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;

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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;

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Note: Stakeholders commented that the 5 second boot time requirement might inhibit desired improvements in boot time. As iterated in a comment response document this summer, it is not EPA's intent to delay boot time with this requirement and stakeholders are welcome to provide other options that result in a balance of adequate communication of ENERGY STAR qualification status to the user and low impact on boot times.

Stakeholders are reminded that the first option presented above as an alternative to the electronic labeling is physical product labeling, which if carried out removes the need to electronically label.

- 91 – The ENERGY STAR mark must be at least 10% of the screen by area, may not be smaller
92 than 76 pixels x 78 pixels, and must be legible.
93
- 94 EPA will consider alternative proposals regarding approach, duration, or size for electronic
95 labeling on a case-by-case basis.
96
- 97 2. In product literature (i.e., user manuals, spec sheets, etc.);
98 3. On product packaging for products sold at retail; and
99 4. On the manufacturer's Internet site where information about ENERGY STAR qualified models is
100 displayed:
- 101 – If information concerning ENERGY STAR is provided on the Partner Web site, as specified by
102 the ENERGY STAR Web Linking Policy (this document can be found in the Partner
103 Resources section on the ENERGY STAR Web site at www.energystar.gov), EPA may
104 provide links where appropriate to the Partner Web site;
- 105
- 106 • agree to complete steps to educate users of their products about the benefits of power management
107 by including the following information, in addition to that described in the User Information
108 Requirements found in the ENERGY STAR Eligibility Criteria (Section 3.C), with each computer (i.e.,
109 in the user manual or on a box insert):
110
- 111 1. Energy saving potential;
112 2. Financial saving potential;
113 3. Environmental benefits;
114 4. Information on ENERGY STAR and a link to www.energystar.gov; and
115 5. ENERGY STAR logo (used in accordance with "The ENERGY STAR Identity Guidelines"
116 available at www.energystar.gov/logos).
- 117 In addition, a link should be made available to www.energystar.gov/powermanagement from computer
118 product pages, product specifications, and related content pages.
119
- 120 At the manufacturer's request, EPA will supply suggested facts and figures related to the above
121 criteria, template elements, or a complete template suitable for use in user guides or box inserts.
122
- 123 • provide to EPA, on an annual basis, an updated list of ENERGY STAR qualified computer models.
124 Once the Partner submits its first list of ENERGY STAR qualified computer models, the Partner will be
125 listed as an ENERGY STAR Partner. Partner must provide annual updates in order to remain on the
126 list of participating product manufacturers;
127
- 128 • provide to EPA, on an annual basis, unit shipment data or other market indicators to assist in
129 determining the market penetration of ENERGY STAR. Specifically, Partner must submit the total
130 number of ENERGY STAR qualified computers shipped (in units by model) or an equivalent
131 measurement as agreed to in advance by EPA and Partner. Partner is also encouraged to provide
132 ENERGY STAR qualified unit shipment data segmented by meaningful product characteristics (e.g.,
133 capacity, size, speed, or other as relevant), total unit shipments for each model in its product line, and
134 percent of total unit shipments that qualify as ENERGY STAR. The data for each calendar year
135 should be submitted to EPA, preferably in electronic format, no later than the following March and may
136 be provided directly from the Partner or through a third party. The data will be used by EPA only for
137 program evaluation purposes and will be closely controlled. Any information used will be masked by
138 EPA so as to protect the confidentiality of the Partner;
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- 140 • notify EPA of a change in the designated responsible party or contacts for computers within 30 days.
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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 displays 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;
- join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. SmartWay Transport works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway;
- join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation, companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders;
- join EPA's Green Power partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities, visit <http://www.epa.gov/grnpower>.



ENERGY STAR® Program Requirements for Computers

Eligibility Criteria (Version 5.0)

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202 Below is the Version 5.0 product specification for ENERGY STAR qualified computers. A product must
203 meet all of the identified criteria to earn the ENERGY STAR.
204

205 **1) Definitions:** Below are the definitions of the relevant terms in this document.
206

207 A. Computer: A device which performs logical operations and processes data. Computers are
208 composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user
209 input devices such as a keyboard, mouse, digitizer or game controller; and (3) a display screen to
210 output information. For the purposes of this specification, computers include both stationary and
211 portable units, including desktop computers, gaming consoles, integrated desktop computers,
212 notebook computers, tablet PCs, small-scale servers, thin clients, and workstations. Although
213 computers must be capable of using input devices and displays, as noted in numbers 2 and 3
214 above, computer systems do not need to include these devices on shipment to meet this
215 definition.
216

217 **Components**

218 B. Display: A display screen and its associated electronics encased in a single housing, or within the
219 computer housing (e.g., notebook or integrated desktop computer), that is capable of displaying
220 output information from a computer via one or more inputs, such as a VGA, DVI, and/or IEEE
221 1394. Examples of display technologies are the cathode-ray tube (CRT) and liquid crystal display
222 (LCD).
223

224 C. External Power Supply: A component contained in a separate physical enclosure external to the
225 computer casing and designed to convert line voltage ac input from the mains to lower dc
226 voltage(s) for the purpose of powering the computer. An external power supply must connect to
227 the computer via a removable or hard-wired male/female electrical connection, cable, cord or
228 other wiring.
229

230 D. Internal Power Supply: A component internal to the computer casing and designed to convert ac
231 voltage from the mains to dc voltage(s) for the purpose of powering the computer components.
232 For the purposes of this specification, an internal power supply must be contained within the
233 computer casing but be separate from the main computer board. The power supply must connect
234 to the mains through a single cable with no intermediate circuitry between the power supply and
235 the mains power. In addition, all power connections from the power supply to the computer
236 components, with the exception of a DC connection to a display in an Integrated Desktop
237 Computer, must be internal to the computer casing (i.e., no external cables running from the
238 power supply to the computer or individual components). Internal dc-to-dc converters used to
239 convert a single dc voltage from an external power supply into multiple voltages for use by the
240 computer are not considered internal power supplies.
241

242 E. Integrated Graphics Processing Unit (GPU): A graphics processing unit (GPU) is connected
243 directly to an internal peripheral controller only device or to internal peripheral devices (storage,
244 network, etc.). A discrete GPU does not comply with the definition of an integrated GPU.
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246 **Note:** EPA added the definition above on stakeholder request to better delineate discrete and integrated graphics
247 components referenced elsewhere in this specification.
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Computer Types

- F. 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 display, keyboard, and mouse. Desktops are designed for a broad range of home and office applications.
- G. Small-Scale Server: A computer that typically uses desktop components in a desktop form factor, but is designed explicitly to be a storage host for other computers. These products must be marketed as a server and have the following characteristics to be considered a Small-Scale Server:
- 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;
 - Intended to 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 home or low-end server applications (e.g., Windows Home Server, Mac OS X Server, Linux, UNIX and Solaris).

Small-Scale Servers are designed to perform functions such as providing network infrastructure services (e.g., archiving) and hosting data/media. These products are not designed to process information for other systems or run web servers as a primary function.

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

Note: EPA received limited response to calls for data supporting the Small-Scale Server category and believes that the limitations of the dataset do not warrant further development of separate requirements for this product class outside of those present in Version 4.0 (e.g. exemption from the Sleep requirement). Requirements have been entered in Section 3.B.4 later of this document.

- H. Game Console: A standalone computer-like device whose primary use is to play video games. Game consoles use a hardware architecture based in part 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 (or in addition to) an external or integrated display. These devices do not typically use a conventional PC operating system, but often perform a variety of multimedia functions such as: DVD/CD playback, digital picture viewing, and digital music playback.
- I. Integrated Desktop 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 desktop 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 desktop computers are typically designed to provide similar functionality as desktop systems.
- J. Thin Client: An independently-powered computer that relies on a connection to remote computing resources to obtain primary functionality. Main computing (e.g., program execution, data storage, interaction with other Internet resources, etc.) takes place using the remote computing resources. Thin Clients covered by this specification are limited to devices with no rotational storage media

305 **Note:** The definition for Thin Client has been further revised to account for stakeholder comments and EPA
306 responses previously shared via the Comment Response Document.

307
308 K. Notebook/Tablet Computer: A computer designed specifically for portability and to be operated for
309 extended periods of time either with or without a direct connection to an ac power source.
310 Notebooks and tablets must utilize an integrated display and be capable of operation off an
311 integrated battery or other portable power source. In addition, most notebooks and tablets use an
312 external power supply and have an integrated keyboard and pointing device, though tablets use
313 touch-sensitive screens. Notebook and tablet computers are typically designed to provide similar
314 functionality to desktops, including operation of software similar in functionality as that used in
315 desktops. For the purposes of this specification, docking stations are considered accessories and
316 therefore, the performance levels associated with notebooks presented in Section 3, below, do not
317 include them.

318
319 L. Workstation: A high-performance, single-user computer typically used for graphics, CAD, software
320 development, financial and scientific applications among other compute intensive tasks. To qualify
321 as a workstation, a computer must:

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

326
327 In addition, a workstation must meet three of the following six optional characteristics:

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

339 **Note:** Additional common uses for Workstations have been added to the beginning of the definition in response to
340 Stakeholder comment and to further clarify the product class and differences with standard desktop client
341 computers.

342 343 344 **Operational Modes**

345
346 M. Off Mode: The power consumption level in the lowest power mode which cannot be switched off
347 (influenced) by the user and that may persist for an indefinite time when the appliance is
348 connected to the main electricity supply and used in accordance with the manufacturer's
349 instructions. For systems where ACPI standards are applicable, Off Mode correlates to ACPI
350 System Level S5 state.

351
352 N. Sleep Mode: A low power state that the computer is capable of entering automatically after a
353 period of inactivity or by manual selection. A computer with sleep capability can quickly "wake" in
354 response to network connections or user interface devices with a latency of ≤ 5 seconds from

355 initiation of wake event to system becoming fully usable including rendering of display. For
356 systems where ACPI standards are applicable, Sleep mode most commonly correlates to ACPI
357 System Level S3 (suspend to RAM) state.
358

359 **Note:** As relayed to Stakeholders in the Computers Definitions Guide and Comment Response documents, ACPI
360 levels had been included in the operational mode definitions to provide stakeholders with a reference for systems
361 where ACPI applied. During the Version 5.0 development process, Stakeholders have noted systems in
362 development where ACPI does not apply and situations where it is possible to implement suspend-to-disk (ACPI
363 S4) without increasing resume latency significantly. To address the first concern, the Off and Sleep definitions have
364 been modified to clarify the nature of the ACPI references. To address the latter, a latency requirement has been
365 added to the Sleep Mode definition.
366

- 367 O. Idle State: The state in which the operating system and other software have completed loading, a
368 user profile has been created, the machine is not asleep, and activity is limited to those basic
369 applications that the system starts by default.
370
- 371 P. Active State: The state in which the computer is carrying out useful work in response to a) prior or
372 concurrent user input or b) prior or concurrent instruction over the network. This state includes
373 active processing, seeking data from storage, memory, or cache, including idle state time while
374 awaiting further user input and before entering low power modes.
375
- 376 Q. Typical Energy Consumption (TEC): A method of testing and comparing the energy performance
377 of computers, which focuses on the typical electricity consumed by a product while in normal
378 operation during a representative period of time. The key criterion of the TEC approach for
379 computers is a value for typical annual electricity use, measured in kilowatt-hours (kWh), using
380 measurements of average operational mode power levels scaled by an assumed typical usage
381 model (duty cycle).
382

383 **Note:** The TEC definition above describes the approach used to unify the operational mode measurements under
384 a single figure for evaluation in the requirements for Desktops, Integrated Desktops, Notebooks, and Tablets.
385 While the initial intent of Version 5.0 was to include a measured active value from an EEPA tool, the approach in
386 this document includes Idle, Sleep and Off in the calculation, with the aggregated base value of annual energy
387 consumption set to account for active usage.
388

389 For Workstations, an active measured component does exist and therefore is included in the calculation for that
390 product group.
391

392 **Networking and Power Management**

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- 394 R. Network Interface: The components (hardware and software) whose primary function is to make
395 the computer capable of communicating over one or more network technologies. Network
396 Interface refers to IEEE 802.3 (Ethernet) or IEEE 802.11 (Wi-Fi).
397
- 398 S. Wake Event: A user, scheduled, or external event or stimulus that causes the computer to
399 transition from Sleep or Off to active mode of operation. Examples of wake events include, but are
400 not limited to: movement of the mouse, keyboard activity, controller input, real-time clock event, or
401 a button press on the chassis, and in the case of external events, stimulus conveyed via a remote
402 control, network, modem, etc.
403
- 404 T. Wake On LAN (WOL): Functionality which allows a computer to wake from Sleep or Off when
405 directed by a network request.
406
- 407 U. Full Network Connectivity: The ability of the computer to maintain network presence while in sleep
408 and intelligently wake when further processing is required. Maintaining network presence may
409 include obtaining and/or defending an assigned interface or network address, responding to
410

411 requests from other nodes on the network, or sending periodic network presence messages to the
412 network all while in the sleep state. In this fashion, presence of the computer, its network services
413 and applications, is maintained even though the computer is in sleep. (Note: More information on
414 this can be found at: <http://efficientnetworks.lbl.gov/enet-proxying.html>)

415 **Note:** In August 2008, Ecma International created a standards committee tasked with producing a standard which
416 implements this function. EPA intends to recognize this standard once it is developed. The key for the computer
417 specification is that the time values for calculating the annual electricity consumption are different for machines
418 which have this functionality (see **Table 2: Operational Mode Weighting**). More on the committee can be found
419 at: <http://www.ecma-international.org/memento/TC32-TG21.htm>.

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422 It is expected that the committee will first convene via teleconference in early October.

423 **Shipment Channels**

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425 V. Enterprise Channels: Sales channels normally used by large and medium-sized business,
426 government organizations, educational institutions, or other organizations purchasing computers
427 used in managed client/server environments.
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429

430 **Note:** This definition has been revised for clarity per stakeholder comment.
431
432

- 433 **2) Qualifying Products:** Computers must meet the computer definition as well as one of the
434 product type definitions provided in Section 1, above, to qualify as ENERGY STAR. The following
435 table provides a list of the types of computers that are (and are not) eligible for ENERGY STAR.
436

Products Covered by Version 5.0 Specification	Products Not Covered by Version 5.0 Specification
<ul style="list-style-type: none">• Desktop Computers• Integrated Desktop Computers• Notebook/Tablet Computers• Workstations• Game Consoles• Small-Scale Servers• Thin Clients	<ul style="list-style-type: none">• Computer Servers (as defined in Version 1.0 computer server specification)• Handhelds and PDAs

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439 **3) Energy Efficiency and Power Management Criteria:** Computers must meet the
440 requirements below to qualify as ENERGY STAR. The Version 5.0 effective date is covered in
441 Section 5 of this specification.
442

443 **(A) Power Supply Efficiency Requirements** - Requirements are applicable to all product categories
444 covered by the ENERGY STAR Computer Specification:
445

446 **Computers Using an Internal Power Supply:** 85% minimum efficiency at 50% of rated output and
447 82% minimum efficiency at 20% and 100% of rated output, with Power Factor ≥ 0.9 at 100% of rated
448 output.
449

450 **Computers Using an External Power Supply:** Must be ENERGY STAR qualified or meet the no-
451 load and active mode efficiency levels provided in the ENERGY STAR Program Requirements for
452 Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0. The ENERGY STAR
453 specification and qualified product list can be found at www.energystar.gov/powersupplies. Note: This
454 performance requirement also applies to multiple voltage output external power supplies as tested in
455 accordance to the Internal Power Supply test method referenced in Section 4, below.
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(B) Efficiency and Performance Requirements:

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

Note: EPA proposes a TEC approach below for combining the discrete modal power values measured for computers into an annualized energy value. Such an approach, used in other ENERGY STAR home/office electronics specifications including Imaging Equipment and Set Top Boxes, provides end users with a single, easy to understand, point of comparison for energy consumption. This approach provides incentive for component efficiency innovations to counter more consumptive capabilities, while at the same time allowing computer designers flexibility to choose appropriate measures.

As stated in the TEC definition, this approach was presented in Draft 1 with an Active component based on measured values from an EEPA tool. While such a tool is not available for use in Version 5.0, the formula below applies the TEC approach to Off, Sleep, and Idle. As tools and methods become available in the future to measure active computer energy usage, EPA would investigate expanding the approach presented above allocate a discrete active component. The approach set forth below puts in place the structure to more easily allow such a modification to happen in future specifications.

Desktop Categories for TEC Criteria: For the purposes of determining TEC levels, desktops and integrated desktops must qualify under Categories A, B, or C as defined below:

Category A: All desktop computers that do not meet the definition of either Category B or Category C below will be considered under Category A for ENERGY STAR qualification.

Category B: To qualify under Category B desktops must have:

- A discrete graphics card.

Category C: To qualify under Category C desktops must have:

- Greater than or equal to 3 Cores per discrete processor.

In addition to the requirements above, models qualifying under Category C must be configured with a minimum of 1 of the following 2 characteristics:

- 2 or more Hard Drives; and/or
- Discrete graphics with >128-bit frame buffer width.

Notebook Categories for TEC Criteria: For the purposes of determining TEC levels, notebooks and tablets must qualify under Categories A or B as defined below:

Category A: All notebook computers that do not meet the definition of Category B below will be considered under Category A for ENERGY STAR qualification.

Category B: To qualify under Category B notebooks must have:

- Discrete graphics with > 64-bit frame buffer width.

Annual Energy Consumption (Desktop and Notebook product categories): The following tables indicate the required TEC annual energy consumption levels for the 5.0 Specification. Table 1 below lists annual energy consumption requirements for Version 5.0, while Table 2 gives weightings for each operational mode by product type. Annual energy consumption will

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be determined using the formula below:

$$E_{\text{annual}} = (8760/1000) * (P_{\text{off}} * T_{\text{off}} + P_{\text{sleep}} * T_{\text{sleep}} + P_{\text{idle}} * T_{\text{idle}})$$

where all P_x are power values in watts, all T_x are Time values in % of year, and E_{annual} is in units of kWh.

Table 1: Annual Energy Consumption

	Desktops and Integrated Computers (kWh)	Notebook and Tablet Computers (kWh)
TEC (kWh)	Category A: ≤ 155 Category B: ≤ 188 Category C: ≤ 275	Category A: ≤ 30 Category B: ≤ 49
Capability Adjustments		
Memory (for computers with ≥ 4 GB)	- 15 kWh	- 10 kWh

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Note:

Wake On LAN: No functional adder is proposed. Given the limited annual energy impact of Wake On LAN enablement (assuming ~60% spent in Sleep and Off, even the V4.0 allowance of 0.7W translates to only 3.5 kWh/year), EPA proposes building WOL enablement into the base TEC allowance rather than introducing the added complexity of a functional adder. This approach properly reflects EPA's dataset, in which 65-70% of systems were tested with WOL enabled from sleep.

Table 2: Operational Mode Weighting

	Desktop		Notebook	
	Conventional	Proxying*	Conventional	Proxying*
Toff	55%	30%	60%	40%
Tsleep	5%	50%	10%	45%
Tidle	40%	20%	30%	15%

Note: Proxying refers to a computer that maintains Full Network Connectivity as defined in Section 1 of this specification.

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Note: A source for usage pattern assumptions are EPA's savings estimates for ENERGY STAR labeled products, developed by Lawrence Berkeley National Lab (LBL). LBL bases commercial operating patterns on equipment audits that provide time spent in operating modes, nighttime turn-off rates, and power management success rates. Operating patterns for residential computers are derived from hours-of-use monitoring of a large sample of computer users. For additional detail on these estimates, please see "Savings Estimates for the United States Environmental Protection Agency's ENERGY STAR Voluntary Product Labeling Program," Sanchez, Marla, C; Brown, Richard, E; Webber, Carrie; Homan, Gregory, K; *Energy Policy 26 (2008) 2098-2108*.

The source above contains a mix of commercial and residential system information. In further refining these assumptions, EPA made use of industry data of more recent vintage that largely agreed with the findings of the studies above. EPA believes that the relative agreement of these independent sources makes the weightings relevant for both residential and commercial computers.

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544 **2) Workstation Levels:**

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546 **Workstation Categories for TEC Criteria:**

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548 **Note:** From the limited data provided thus far, it appears that the SPEC benchmark for workstations does
549 accurately reflect the energy efficiency goals of this specification.

550 The framework/calculations for this approach is as follows (and included below this note box):

551 There will be 2 Categories for TEC Criteria:

552 Category A: graphics-based systems; and

553 Category B: non-graphics systems.

554
555 EPA will entertain more categories as data is submitted illustrating the need for more categories. Each class will
556 have a specific amount of active commensurate with the level of capability for workstations in the class.

557 Comparisons would be made between the energy consumed in the TEC. Performance is reflected in the benefit of
558 going into an idle/sleep state when not running the fixed number of active workloads. Performance can also be
559 used to place particular devices into classes.
560

561
562 **Annual Energy Consumption (Workstation product category):** The following tables indicate
563 the required TEC annual energy consumption levels for the 5.0 Specification. Table 1 below
564 lists annual energy consumption requirements for Version 5.0, while Table 2 gives weightings
565 for each operational mode. Annual energy consumption will be determined using the formula
566 below:

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568
$$N_{\text{runs}} = 567;$$

569
$$E_{\text{modes}} = (8760/1000) * (P_{\text{off}} * T_{\text{off}} + P_{\text{sleep}} * T_{\text{sleep}} + P_{\text{idle}} * T_{\text{idle}});$$

570
$$E_{\text{padding}} = (T_{\text{active}} - (T_{\text{run}} * N_{\text{runs}})) * P_{\text{idle}};$$

571
$$E_{\text{annual}} = E_{\text{modes}} + E_{\text{active}} + E_{\text{padding}};$$

572
573 where all P_x are power values in watts, all T_x are Time values in % of year, and E_x are in units
574 of kWh.
575

Table 3: Annual Energy Consumption - Workstations

	Desktops and Integrated Computers (kWh)
TEC (kWh)	Category A: TBD Category B: TBD

576
577 **Note:** As noted above, EPA has received limited data using the SPEC Benchmark to date. EPA is requesting
578 additional SPEC workstation data **by Monday, September 22, 2008**. If EPA receives adequate data to complete
579 analysis and propose workstation TEC levels using SPEC, EPA will propose for review and discussion TEC levels
580 for workstations at the September 26, 2008 stakeholder meeting.

581
582 If EPA does not receive ample SPEC data by the 22nd to complete analysis and propose TEC levels, EPA will
583 inform stakeholders that the Agency will move to a Plan B of reducing Version 5.0 workstation TEC levels by 25%,
584 using the same weightings proposed below.
585

Table 4: Operational Mode Weighting - Workstations

Toff	35%
Tsleep	10%
Tidle	35%
Tactive	20%

3) Game Console Levels:

Note: In the requirements on the following page, EPA has included both requirements intended for adoption with the effective date of this Version 5.0 specification and also forward-looking requirement information on a tentative basis. EPA felt such an approach was uniquely necessary for the Game Console section of this document due to the less frequent product and technology refreshes as compared to the conventional Desktop and Notebook product categories. The future requirements presented here are intended to be incorporated into the Computer Program at the effective date of the *next* version of the requirements, noted here with a tentative date of July 2011; this date is subject to change.

Based on stakeholder feedback, EPA would like to further explore the following ideas for a future draft.

- Clarify the definition of inactivity in a game console. For instance, paused games are one form of inactivity and so are ended movies, etc;
- Ensure that there is a means for a user to place the device into a low power state in a transparent and simple manner (e.g., readily actionable within a few clicks);
- Define the power levels for the additional functionalities such as movie/DVD/Blu Ray playback, wireless, etc.;
- Require any game created/published/branded by an OEM supports the APD feature in Tier 2; and
- Investigate the feasibility of a maximum power level limit.

Note: *(requirements for game consoles begin on the following page)*

Table 5: Game Console Requirements
Operational Mode Requirements

Operational Mode Requirements	
Off Mode: $\leq 1\text{ W}$ Sleep or Auto-Off: $\leq 5\text{ W}$ (TBD)	
Power Management and Efficient Operation Requirements	
<i>Note: The table below refers both to requirements put in place with the effective date of this Version 5.0 Specification and those scoped for the next tier or version of the ENERGY STAR Computer Program.</i>	
Sleep or Auto-Off	<p align="center">Version 5.0 (July X, 2009)</p> <ul style="list-style-type: none"> The console shall power down to the level specified above when at the dashboard (defined as a state when no game is loaded)
	<p align="center">Future Tier (TENTATIVE July 1, 2011)</p> <ul style="list-style-type: none"> The console shall meet Version 5.0 APD requirements (Sleep only; Auto-off not allowed); and provide Game Developers the tools/features allowing APD within games or programs designed for the console; and automatically APD when games are in an inactive or paused game state; and Provide for Full Network Connectivity in sleep.
TV/Display Sleep	<p align="center">Version 5.0 and Future Tier</p> <ul style="list-style-type: none"> The console shall have the ability to drop Component, Composite, DVI outputs (using in-place standards where applicable) when the system is inactive for 15 minutes. Ability to do this in HDMI should be implemented once a HDMI standard for doing so exists; and Provide visual feedback on the console's integrated display or LEDs calling attention to the consoles continued active state while outputs are dropped
Power Scaling	<p align="center">Version 5.0</p> <p>No requirements for Version 5.0.</p>
	<p align="center">Future Tier (TENTATIVE July 1, 2011)</p> <ul style="list-style-type: none"> Set Top Box (STB) and DVD/Blu Ray/Movie Playback functions must come within xx% of the requirements in place for ENERGY STAR STB and Audio/DVD specifications as scheduled for the time the next tier of requirements for Game Consoles is adopted.
Efficient Networking	<p align="center">Version 5.0</p> <p>No requirements for Version 5.0.</p>
	<p align="center">Future Tier (TENTATIVE July 1, 2011)</p> <ul style="list-style-type: none"> Implement IEEE 802.3az and Full Network Connectivity in Sleep for Ethernet and Wi-Fi. Wireless Access Point functions must come within xx% of the requirements in place for the ENERGY STAR Networking specification as scheduled for the time the next tier of requirements for Game Consoles is adopted.

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4) Small-Scale Server Levels:

Note: The levels and categories presented below are consistent with those from Version 4.0. Though data was not provided to support modification of these levels, EPA continues to believe that energy efficiency should be an inherent consideration in this product class and is therefore maintaining Version 4.0 requirements in this area. Additionally, products have been qualified under the V4.0 Desktop-Derived Server category for the first time during the summer of 2008; while the number of qualifications have been limited, this activity supports allowing further time for the Small-Scale Server market to develop under maintained requirements.

Table 6: Small-Scale Server Efficiency Requirements

Desktop-Derived Server Operational Mode Power Requirements	
Off: ≤ 2.0 W Idle State: Category A: ≤ 50.0 W Category B: ≤ 65.0 W Category C: ≤ 95.0 W	
Capability	Additional Power Allowance
Wake On LAN (WOL) (Applies only if computer is shipped with WOL enabled)	+ 0.7 W for Off
<p>For the purposes of determining Idle state levels, Small-Scale Servers must qualify under Categories A, B, or C as defined below:</p> <p>Category A: All Small-Scale Servers that do not meet the definition of either Category B or Category C below will be considered under Category A for ENERGY STAR qualification.</p> <p>Category B: To qualify under Category B Small-Scale Servers must have:</p> <ul style="list-style-type: none"> • Multi-core processor(s) or greater than 1 discrete processor; and • Minimum of 1 gigabyte of system memory. <p>Category C: To qualify under Category C Small-Scale Servers must have:</p> <ul style="list-style-type: none"> • Multi-core processor(s) or greater than 1 discrete processor; and • A GPU with greater than 128 megabytes of dedicated, non-shared memory. <p>In addition to the requirements above, models qualifying under Category C must be configured with a minimum of 2 of the following 3 characteristics:</p> <ul style="list-style-type: none"> • Minimum of 2 gigabytes of system memory; • TV tuner and/or video capture capability with high definition support; and/or • Minimum of 2 hard disk drives. 	

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5) Thin Client Levels

Table 7 : Thin Client Efficiency Requirements

Thin Client Operational Mode Power Requirements
<p>Thin Client Low Power Mode (i.e. Sleep Mode or Off Mode): ≤ 1 W</p> <p>Idle State: ≤ 11.5 W</p>

Note: The idle power level above represents the top 22% of stakeholder-submitted data and 33% of EPA’s total dataset. EPA proposes a single level for compliance as complete configuration data was not available for all systems in the analysis. A masked dataset “TC_Dataset_8 29 08.xls” was provided with the initial message for review of these requirements and will be available on the ENERGY STAR website.

Capability	Additional Power Allowance
<p>Wake On LAN (WOL) <i>(Applies only if computer is shipped with WOL enabled)</i></p>	<p>+ 0.7 W for Sleep + 0.7 W for Off</p>

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Note: EPA remains committed to encouraging computer power management through the ENERGY STAR computer program but recognizes that some thin clients on the market lack the capability to meet established requirements for Sleep Mode. After discussion with manufacturers regarding prospective requirements to minimize energy used during periods of inactivity, EPA proposes a single power level for the low power mode enabled as shipped to engage after thirty minutes of inactivity (further details on activation times are provided in the power management requirements table later in this document). Such an approach is intended to establish and encourage power management in this new product category for the program and allow manufacturers flexibility in achieving this goal.

The 1W level is proposed as a starting point to align with the level for notebook computers and due to the limited dataset available to EPA for sleep and off power. As noted, stakeholders are encouraged to share product data in support of modified levels.

Note: During the advance comment period for the thin client requirements, one stakeholder requested that requirement tiers be implemented based on processor technology (x86, MIPS, ARM). EPA believes that the dataset provided in advance of Draft 2 release is not robust enough to support this modification, but will consider such an approach should Stakeholders be able to address this concern.

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

Table 8: Power Management Requirements

Note: EPA received numerous comments about products available on the market that ship with Wi-Fi network capability and no Ethernet. To account for these devices and the lack of a technology-appropriate WOL equivalent for Wi-Fi, the requirements below reflect where applicable only to Ethernet. EPA will seek to identify a technology suitable for Wi-Fi WOL for possible use in future specification revisions.

Specification Requirement		Applicable to		
Shipment Requirements				
Sleep Mode	Shipped with a Sleep mode which is set to activate within 30 minutes (1 hr for Game Consoles) of user inactivity. <i>(Note: Thin Clients and Game Consoles may transition to a full off mode within the timeframe above in lieu of sleep provided such functionality is capable of meeting the desired ≤ 5 second latency listed in definition M, above. Game Consoles need not take latency into consideration)</i>	Desktop Computers	√	
		Integrated Desktop Computers	√	
		Notebook Computers/Tablet PCs	√	
		Workstations	√	
		Game Consoles	√	
		Small-Scale Servers		
		Thin Clients	√	
Display Sleep Mode	Shipped with the display's Sleep mode set to activate within 15 minutes of user inactivity.	Desktop Computers	√	
		Integrated Desktop Computers	√	
		Notebook Computers/Tablet PCs	√	
		Workstations	√	
		Game Consoles	√	
		Small-Scale Servers (if display is present)	√	
		Thin Clients	√	
Network Requirements for Power Management				
Wake on LAN (WOL)	Computers with Ethernet capability shall have the ability to enable and disable WOL for Sleep mode.	Desktop Computers	√	
		Integrated Desktop Computers	√	
		Notebook Computers/Tablet PCs	√	
		Workstations	√	
		Game Consoles		
		Small-Scale Servers	√	
		Thin Clients (<i>only applies to supporting centrally managed network software updates</i>)	√	
		<i>Applies to computers shipped through Enterprise Channels, only:</i>	Desktop Computers	√
			Integrated Desktop Computers	√
			Notebook Computers/Tablet PCs	√
			Workstations	√
			Game Consoles	
			Small-Scale Servers	√
			Thin Clients (<i>only applies to supporting centrally managed network software updates</i>)	√
	Computers with Ethernet capability must meet one of the following requirements: <ul style="list-style-type: none"> ▪ be shipped with Wake On LAN (WOL) enabled from the Sleep mode when operating on ac power (i.e. notebooks may 			

	<ul style="list-style-type: none"> automatically disable WOL when disconnected from the mains); or provide control to enable WOL that is sufficiently-accessible from both the client operating system user interface and over the network if computer is shipped to enterprise without WOL enabled. 	
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Note: EPA has revised the WOL requirements to allow for enterprise systems to ship without enablement provided that such functionality is easily implemented. Additionally, Thin Clients that do not support remote software upgrade functionality, and therefore do not benefit from WOL, are now exempt from the requirement.

Wake Management	<i>Applies to computers shipped through Enterprise Channels, only:</i> Computers with Ethernet capability shall be capable of both remote and scheduled wake events from Sleep mode.	Desktop Computers	√
		Integrated Desktop Computers	√
	Notebook Computers/Tablet PCs	√	
	Workstations	√	
	Game Consoles		
	Small-Scale Servers	√	
	Thin Clients	√	
	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.		

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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:

The Partner will remain responsible for testing products and qualifying them as they ship them. If the product meets and is qualified as ENERGY STAR at this point, it can be labeled as such.

If the Partner is hired by a customer to load a custom image, the Partner must take the following steps:

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- The Partner must let the customer know that their product may not meet ENERGY STAR with the custom image loaded (*a sample letter is available for use from the ENERGY STAR website that can be shared with customers*).
 - The Partner must encourage their customer to test the product for ENERGY STAR compliance.
 - The Partner must encourage their customer, should the product no longer meet ENERGY STAR, to make use of EPA's free technical assistance that can assist with Power Management performance. Please see tools as well as contact information at: www.energystar.gov/fedofficeenergy.

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Although EPA believes that Partners in partnership with EPA can help ensure their products continue to be leadership products when it comes to efficiency once deployed. EPA is committed to helping to reduce the likelihood that custom images will disrupt a product's ability to meet ENERGY STAR requirements. For example, EPA is engaging in federal desktop core configuration discussions with the intention of facilitating the development of a core configuration for Federal Agencies that supports energy efficiency. In April 2008, EPA also launched the ENERGY STAR Low Carbon IT Campaign in an effort to get more businesses and organizations to implement power management. More information on the campaign can be found at: www.energystar.gov/lowcarbonit.

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Note: This pre-provisioning text above was originally vetted with Stakeholders in a July 10, 2008 email distribution.

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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:

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- 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.

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Either option must at least include the following information:

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- 688
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- 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.

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(D) Voluntary Requirements

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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>.

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

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- 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.

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Additional testing and reporting requirements are provided below.

710 A. Models Capable of Operating at Multiple Voltage/Frequency Combinations: Manufacturers shall
711 test their products based on the market(s) in which the models will be sold and promoted as
712 ENERGY STAR qualified.
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714 For products that are sold as ENERGY STAR in multiple international markets and, therefore,
715 rated at multiple input voltages, the manufacturer must test at and report the required power
716 consumption or efficiency values at all relevant voltage/frequency combinations. For example, a
717 manufacturer that is shipping the same model to the United States and Europe must measure,
718 meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50 Hz in order
719 to qualify the model as ENERGY STAR in both markets. If a model qualifies as ENERGY STAR
720 at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may only be qualified
721 and promoted as ENERGY STAR in those regions that support the tested voltage/frequency
722 combination (e.g., North America and Taiwan).
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Table 9: Test Procedures

Product Category	Specification Requirement	Test Protocol	Source
Desktop, Integrated, Notebook, and Tablet PCs	Annual Energy Consumption	ENERGY STAR Computer Test Method (Version 5.0), Section III	Appendix A
	Power Supply Efficiency	<p>IPS: Internal Power Supply Efficiency Protocol</p> <p>EPS: ENERGY STAR Test Method for External Power Supplies</p> <p><i>Note: Should any information/procedures in addition to those described by the Internal Power Supply Efficiency Protocol be required in order to test an Internal Power Supply, partners must make available to EPA upon request the test setup used to acquire IPS data used in a product submittal.</i></p>	<p>IPS: www.efficientpowersupplies.org</p> <p>EPS: www.energystar.gov/powersupplies</p>

Note: To support its compliance/verification testing programs and future specification development, EPA may occasionally contact manufacturers to request details on Internal Power Supply measurement test setup used in acquiring values for IPS efficiency submitted to ENERGY STAR. The intent of such requests would be to better understand any steps outside of the general procedure necessary to test a particular supply. Such information, if requested, would be kept confidential.

Workstations	TBD	SPEC Workstation Benchmark	TBD
Game Consoles	Off Mode, and Sleep/Auto-Off	ENERGY STAR Computer Test Method (Version 5.0), Section IV	Appendix A
Desktop-Derived Servers	Off Mode and Idle State	ENERGY STAR Computer Test Method (Version 5.0), Section III	Appendix A

Thin Clients	Off Mode, Sleep Mode, and Idle State	ENERGY STAR Computer Test Method (Version 5.0) , Section III	Appendix A
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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.

All units/configurations associated with a product model designation, for which a Partner is seeking ENERGY STAR qualification, must meet the ENERGY STAR requirements. If, however, a Partner wishes to qualify configurations of a model for which non-qualifying alternative configurations exist, the Partner must assign the qualifying configurations an identifier in the model name/number that is unique to ENERGY STAR Qualified configurations. This identifier must be used consistently in association with the qualifying configurations in marketing/sales materials and channels through which the product can be purchase and on the ENERGY STAR list of qualified products (e.g. model A1234 for baseline configurations and A1234-ES for ENERGY STAR qualifying configurations).

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 x, 2009 (TBD). All products, including models originally qualified under Version 4.0, with a **date of manufacture** on or after **July x, 2009** (TBD) 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/July X, 2009 (TBD).

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

Note: EPA remains interested in making use of an EEPAs tool. Should one be completed, vetted, and accepted, EPA will make use of such a tool with its next computer specification revision. 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).

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APPENDIX A: ENERGY STAR Test Procedure for Determining the Power Use of Computers/Game Consoles in Off, Sleep, and Idle

Note: The test procedure below incorporates updates presented in the various data collection efforts and adds a section specific to the requirements for Game Consoles.

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The following protocol should be followed when measuring power consumption levels of computers/game consoles 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.*

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I. Definitions

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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.

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

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UPS

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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.

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II. Testing Requirements

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Approved Meter

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Approved meters will include the following attributes¹:

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- 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.

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The following attributes in addition to those above are suggested:

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- 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).

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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.

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Accuracy

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

834 Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to
 835 2% at the 95% confidence level. Measurements of power of less than 0.5 W shall be made with an
 836 uncertainty of less than or equal to 0.01 W at the 95% confidence level. The power measurement
 837 instrument shall have a resolution of:
 838

- 839 • 0.01 W or better for power measurements of 10 W or less;
- 840 • 0.1 W or better for power measurements of greater than 10 W up to 100 W; and
- 841 • 1 W or better for power measurements of greater than 100 W.

842
 843 All power figures should be in watts and rounded to the second decimal place. For loads greater than
 844 or equal to 10 W, three significant figures shall be reported.

845 **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%)
		<i>Note: For products rated for > 1.5 kW maximum power, the voltage range is ± 4%</i>
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 %	

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

849 **Test Configuration**

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

851
 852 The UUT must be connected to an Ethernet network switch capable of the UUT’s highest and lowest
 853 network speeds. The network connection must be live during all tests.

854
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 857 **III. Test Procedure for Off, Sleep and Idle for All Computer Products**

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

859 **UUT Preparation**

- 860 1. Record the manufacturer and model name of the UUT.
- 861 2. Ensure that the UUT is connected to network resources as detailed below, and that the UUT
 862 maintains this live connection for the duration of testing, disregarding brief lapses when
 863 transitioning between link speeds.
 - 864 a. *Desktops, Integrated Desktops, Notebooks, and Tablet PCs* shall be connected to a live
 865 Ethernet (IEEE 802.3) network switch as specified in Section II., “Test Configuration,”
 866 above. The computer must maintain this live connection to the switch for the duration of
 867 testing, disregarding brief lapses when transitioning between link speeds
 - 868 b. *Small-Scale Servers* shall be connected to a live Ethernet (IEEE 802.3) network switch as
 869 specified in Section II., “Test Configuration,” above, and that the connection is live.
 - 870 c. *Thin Clients* shall be connected to a live server via a live Ethernet (IEEE 802.3) network
 871 switch and shall run intended terminal/remote connection software.
 872
 873

874 **Note:** Step 2 is revised to include network connection directions for Small-Scale Servers and Thin Clients.
875

- 876
- 877 3. Connect an approved meter capable of measuring true power to an ac line voltage source set to
878 the appropriate voltage/frequency combination for the test.
 - 879 4. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
880 should be connected between the meter and the UUT. For a valid test to take place the meter
881 should remain in place until all Off, Sleep, and Idle power data is recorded.
 - 882 5. Record the ac voltage.
 - 883 6. Boot computer and wait until the operating system has fully loaded. If necessary, run the initial
884 operating system setup and allow all preliminary file indexing and other one-time/periodic
885 processes to complete.
 - 886 7. Record basic information about the computer's configuration – computer type, operating system
887 name and version, processor type and speed, and total and available physical memory, etc.²
 - 888 8. Record basic information about the video card or graphics chipset (if applicable) - video
889 card/chipset name, resolution, amount of onboard memory, and bits per pixel.³
 - 890 9. Ensure that the UUT is configured as shipped including all accessories, power management
891 settings, WOL enabling and software shipped by default. UUT should also be configured using
892 the following requirements for all tests:
 - 893 a. *Desktop* systems shipped without accessories should be configured with a standard
894 mouse, keyboard and external display.
 - 895 b. *Notebooks and Tablets* should include all accessories shipped with the system, and need
896 not include a separate keyboard or mouse when equipped with an integrated pointing
897 device or digitizer.
 - 898 c. *Notebooks and Tablets* should have the battery pack(s) removed for all tests. For
899 systems where operation without a battery pack is not a supported configuration, the test
900 may be performed with fully charged battery pack(s) installed, making sure to report this
901 configuration in the test results.
 - 902 d. *Small-Scale Servers and Thin Clients* shipped without accessories should be configured
903 with a standard mouse, keyboard and external display (if server has display output
904 functionality).
 - 905 e. Power to wireless radios should be turned off for all tests. This applies to wireless
906 network adapters (e.g., 802.11) or device-to-device wireless protocols.

907 **Note:** Step 9 now includes configuration directions for Small-Scale Servers and Thin Clients.
908

- 909
- 910 10. The following guidelines should be followed to configure power settings for displays (adjusting no
911 other power management settings):
 - 912 a. For computers with external displays (most desktops): use the display power
913 management settings to prevent the display from powering down to ensure it stays on for
914 the full length of the Idle test as described below.
 - 915 b. For computers with integrated displays (notebooks, tablets and integrated systems): use
916 the power management settings to set the display to power down after 1 minute.

917 **Note:** Based on Stakeholder feedback with respect to testing with monitors on, the test procedure in this draft is
918 representative of the calls for data that were released over the summer, which did not include this provision.
919 However, EPA believes there is merit to this proposal and intends to discuss this topic at the September 26
920 stakeholder meeting. EPA's proposal is as follows:

- 921
- 922 1. All computers are tested for Idle *with displays active, not power managed*. This is consistent for external
displays, but a modification for integrated; and
 2. A capability adjustment, based on the ENERGY STAR Displays/Monitors requirements in effect at the time
of test and percentage of time in Idle, is subtracted from the TEC level of compliance to adjust for the
additional TEC amount.

EPA welcomes comments during the comment period of this document and in advance of the meeting to allow for
a more productive discussion of potential approaches.

923
924 11. Shut down the UUT.

925
926 **Off Mode Testing**

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

930
931 **Idle Mode Testing**

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

939
940 **Sleep Mode Testing**

941 14. After completing the Idle measurements, place the computer in Sleep mode. Reset the meter (if
942 necessary) and begin accumulating true power values at an interval of 1 reading per second.
943 Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value
944 observed during that 5 minute period.
945 15. If testing both WOL enabled and WOL disabled for Sleep, wake the computer and change the
946 WOL from Sleep setting through the operating system settings or by other means. Place the
947 computer back in Sleep mode and repeat step 15, recording Sleep power necessary for this
948 alternate configuration.

949
950 **Reporting Test Results**

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

953
954 **IV. Test Procedure for All Modes for Game Consoles**

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

956
957 **Note:** The Maximum Power test for workstations present in V4.0 has been removed. This section has been added
958 to provide an ordered test procedure for collecting ENERGY STAR compliance data for Game Consoles.
959

960 **UUT Preparation**

- 961 1. Record the manufacturer and model name of the UUT.
962 2. Record basic information about the computer's configuration – computer type, operating system
963 name and version, processor type and speed, and total and available physical memory, etc.
964 3. Ensure that the UUT is connected to a TV(s) which support all of the output types supported by
965 the UUT.
966 a. *For each output that supports APD, this test needs to be rerun between steps x & y.*
967 4. Connect an approved meter capable of measuring true power to an ac line voltage source set to
968 the appropriate voltage/frequency combination for the test.
969 5. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
970 should be connected between the meter and the UUT. For a valid test to take place the meter
971 should remain in place until all power data is recorded.
972 6. Record the ac voltage.
973 7. Turn on the console and wait until the operating system has fully loaded.

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.

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8. If necessary, run the initial system setup and allow all preliminary tasks and other one-time/periodic processes to complete.
 9. Ensure that the UUT is configured as shipped including all accessories, power management settings and software shipped by default
 10. For each applicable output, wait for 15 minutes and ensure the output drops after the prescribed time.
 11. Place the system in a state without the game loaded.
 12. Then wait one hour and verify the system goes into a low power state.
 13. Bring the console back into its OS loaded state
 14. Load a game and bring it to the games menu.
 15. Begin game play and pause the game.
 16. Wait one hour and verify the system goes into a low power state. (Applicable after Version 5.0)
 17. Shut down the UUT.

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Off Mode Testing

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18. 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.⁵

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Sleep/APD Mode Testing

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19. After completing the Off mode measurements, place the computer in it's Sleep/APD 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.

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V. Continuing Verification

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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.

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VI. Verification Testing Requirements

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Note: EPA and computer partners have been in discussion regarding verification testing for this product category. The above proposal reflects multiple discussions with stakeholders and drafts of such requirements. EPA is seeking feedback on this proposed verification program and comments may be emailed by October 2, 2008 to Kathleen Vokes, US EPA, at vokes.kathleen@epa.gov.

EPA will select no more than five (5) computer models from any given manufacturer per year.

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The following requirements outline a manufacturer-financed quality assurance system that allows for independent evaluation of ENERGY STAR qualified computers. These requirements will be effective with Version 5.0. EPA may request manufacturers to submit products for verification testing as described below. EPA reserves the right to modify these procedures based on experience gained in their implementation. The Procedures Manual for this program will be available on the ENERGY STAR Office Equipment Partner Resources page on the ENERGY STAR website.

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Product Selection: EPA will select computers each year for verification testing. The manufacturer of each selected product will be required to commission third-party testing of the specified computer by a manufacturer-independent testing lab. The testing lab will procure one (1) sample of each computer

⁵ 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.

1025 model on the open market (if possible). EPA will make exceptions on a case-by-case basis for
1026 computers that are unreasonable to obtain on the open market (e.g., cost more than \$5000 or highly
1027 customized), by allowing the manufacturer to provide a model directly to the laboratory for testing.
1028 Specific testing details are outlined in the ENERGY STAR for Computers Verification Testing
1029 Guidelines and Procedures Manual.

1030
1031 Schedule Requirements: The manufacturer must retain a qualified third-party testing lab within
1032 fourteen (14) business days of EPA notification. The laboratory must complete all testing within 30
1033 calendar days of notification of test start date to EPA.

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1035 If the sample fails to meet the performance requirements of the ENERGY STAR specification, the
1036 failure will be addressed under EPA's product failure and dispute protocol and if applicable, the
1037 procedure for delisting products.

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