



ENERGY STAR® Program Requirements for Computers

Version 5.0
DRAFT FINAL

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ENERGY STAR® Program Requirements for Computers

Partner Commitments

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52 **Commitments**

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

- 56
- 57 • comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be
58 met for use of the ENERGY STAR certification mark on computers and specifying the testing criteria
59 for computers. EPA may, at its discretion, conduct tests on products that are referred to as ENERGY
60 STAR qualified. These products may be obtained on the open market, or voluntarily supplied by
61 Partner at EPA's request;
- 62
- 63 • comply with current ENERGY STAR Identity Guidelines, describing how the ENERGY STAR marks
64 and name may be used. Partner is responsible for adhering to these guidelines and for ensuring that
65 its authorized representatives, such as advertising agencies, dealers, and distributors, are also in
66 compliance;
- 67
- 68 • work with resellers of Partner's products to help ensure that these products remain in compliance with
69 ENERGY STAR requirements. Any party within the distribution channel of an ENERGY STAR
70 qualified computer product that alters the power profile of a product after its date of manufacture
71 through hardware or software modifications must ensure that the product continues to meet the
72 ENERGY STAR requirements before delivering this product to the end customer. If the product no
73 longer meets the requirements, it may not bear the ENERGY STAR mark;
- 74
- 75 • qualify at least one ENERGY STAR computer model within one year of activating the computers
76 portion of the agreement. When Partner qualifies the product, it must meet the specification (e.g., Tier
77 1 or 2) in effect at that time;
- 78
- 79 • provide clear and consistent labeling of ENERGY STAR qualified computers. The ENERGY STAR
80 mark must be clearly displayed:

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

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

- 87 – The ENERGY STAR mark in cyan, black, or white (as described in "The ENERGY STAR
88 Identity Guidelines" available at www.energystar.gov/logos) appears at system start-up. The
89 electronic mark must display for a minimum of 5 seconds;
- 90
- 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:
- 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;
- 105
- 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;
 - 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" 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
- 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;
 - participate in the ENERGY STAR Verification Testing Program. EPA will select computers each year for verification testing. The manufacturer of each selected product will be required to conduct testing of the specified products as outlined in the Verification Testing Guidelines and Procedures Manual. These requirements will be effective with Version 5.0, and may be modified and updated outside the official specification revision process. The manual for this program will be available on the ENERGY

147 STAR Office Equipment Partner Resources page on the ENERGY STAR website. If the sample fails
148 to meet the performance requirements of the ENERGY STAR specification, the failure will be
149 addressed under EPA's product failure and dispute protocol and if applicable, the procedure for
150 delisting products.

151 **Note:** The verification testing text, previously present in Appendix A, has been moved to Partner Commitments.
152 Please contact Kathleen Vokes, US EPA, at vokes.kathleen@epa.gov, with feedback on this requirement.
153
154
155

156 **Performance for Special Distinction**

157 In order to receive additional recognition and/or support from EPA for its efforts within the
158 Partnership, the ENERGY STAR Partner may consider the following voluntary measures and should keep
159 EPA informed on the progress of these efforts:
160

- 161 • consider energy efficiency improvements in company facilities and pursue the ENERGY STAR mark
162 for buildings;
- 163
- 164 • purchase ENERGY STAR qualified products. Revise the company purchasing or procurement
165 specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA
166 for periodic updates and coordination. Circulate general ENERGY STAR qualified product information
167 to employees for use when purchasing products for their homes;
- 168
- 169 • ensure the power management feature is enabled on all ENERGY STAR qualified displays and
170 computers in use in company facilities, particularly upon installation and after service is performed;
- 171
- 172 • provide general information about the ENERGY STAR program to employees whose jobs are relevant
173 to the development, marketing, sales, and service of current ENERGY STAR qualified product
174 models;
- 175
- 176 • provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the
177 program requirements listed above. By doing so, EPA may be able to coordinate, communicate,
178 and/or promote Partner's activities, provide an EPA representative, or include news about the event in
179 the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may be as simple
180 as providing a list of planned activities or planned milestones that Partner would like EPA to be aware
181 of. For example, activities may include: (1) increase the availability of ENERGY STAR qualified
182 products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2)
183 demonstrate the economic and environmental benefits of energy efficiency through special in-store
184 displays twice a year; (3) provide information to users (via the Web site and user's manual) about
185 energy-saving features and operating characteristics of ENERGY STAR qualified products: and (4)
186 build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on
187 one print advertorial and one live press event;
- 188
- 189 • provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase
190 availability of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and
191 its message;
- 192
- 193 • join EPA's SmartWay Transport Partnership to improve the environmental performance of the
194 company's shipping operations. SmartWay Transport works with freight carriers, shippers, and other
195 stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air
196 pollution. For more information on SmartWay, visit www.epa.gov/smartway;
- 197
- 198 • join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions.
199 Through participation, companies create a credible record of their accomplishments and receive EPA
200 recognition as corporate environmental leaders. For more information on Climate Leaders, visit
201 www.epa.gov/climateleaders;
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- 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) DRAFT FINAL

214
215 Below is the Version 5.0 product specification for ENERGY STAR qualified computers. A product must
216 meet all of the identified criteria to earn the ENERGY STAR.
217

218 **1) Definitions:** Below are the definitions of the relevant terms in this document.
219

- 220 A. Computer: A device which performs logical operations and processes data. Computers are
221 composed of, at a minimum: (1) a central processing unit (CPU) to perform operations; (2) user
222 input devices such as a keyboard, mouse, digitizer or game controller; and (3) a computer display
223 screen to output information. For the purposes of this specification, computers include both
224 stationary and portable units, including desktop computers, gaming consoles, integrated desktop
225 computers, notebook computers, small-scale servers, thin clients, and workstations. Although
226 computers must be capable of using input devices and computer displays, as noted in numbers 2
227 and 3 above, computer systems do not need to include these devices on shipment to meet this
228 definition.
229

230
231 **Components**
232

- 233 B. Computer Display: A display screen and its associated electronics encased in a single housing, or
234 within the computer housing (e.g., notebook or integrated desktop computer), that is capable of
235 displaying output information from a computer via one or more inputs, such as a VGA, DVI, and/or
236 IEEE 1394. Examples of computer display technologies are the cathode-ray tube (CRT) and
237 liquid crystal display (LCD).
238
239 C. Discrete Graphics Processing Unit (GPU): A graphics processor with a local memory controller
240 interface and a local, graphics-specific memory.
241

242 **Note:** "Display device" has been changed to "processor" in the "Discrete Graphics Processing Unit (GPU)"
243 definition based on stakeholder comment.
244

- 245
246 D. External Power Supply: A component contained in a separate physical enclosure external to the
247 computer casing and designed to convert line voltage ac input from the mains to lower dc
248 voltage(s) for the purpose of powering the computer. An external power supply must connect to
249 the computer via a removable or hard-wired male/female electrical connection, cable, cord or
250 other wiring.
251

252 **Note:** The definition of Integrated GPU has been removed by stakeholder request. It is not referenced elsewhere in
253 the Specification.
254

- 255 E. Internal Power Supply: A component internal to the computer casing and designed to convert ac
256 voltage from the mains to dc voltage(s) for the purpose of powering the computer components.
257 For the purposes of this specification, an internal power supply must be contained within the
258 computer casing but be separate from the main computer board. The power supply must connect
259 to the mains through a single cable with no intermediate circuitry between the power supply and
260 the mains power. In addition, all power connections from the power supply to the computer
261 components, with the exception of a DC connection to a computer display in an Integrated
262 Desktop Computer, must be internal to the computer casing (i.e., no external cables running from

263 the power supply to the computer or individual components). Internal dc-to-dc converters used to
264 convert a single dc voltage from an external power supply into multiple voltages for use by the
265 computer are not considered internal power supplies.
266

267 **Computer Types**

- 268
- 269
- 270 F. Desktop Computer: A computer where the main unit is intended to be located in a permanent
271 location, often on a desk or on the floor. Desktops are not designed for portability and utilize an
272 external computer display, keyboard, and mouse. Desktops are designed for a broad range of
273 home and office applications.
274
- 275 G. Small-Scale Server: A computer that typically uses desktop components in a desktop form factor,
276 but is designed explicitly to be a storage host for other computers. A computer must have the
277 following characteristics to be considered a Small-Scale Server:
278
- 279 • Designed in a pedestal, tower, or other form factor similar to those of desktop computers such
280 that all data processing, storage, and network interfacing is contained within one box/product;
 - 281 • Intended to be operational 24 hours/day and 7 days/week, and unscheduled downtime is
282 extremely low (on the order of hours/year);
 - 283 • Capable of operating in a simultaneous multi-user environment serving several users through
284 networked client units; and
 - 285 • Designed for an industry accepted operating system for home or low-end server applications
286 (e.g., Windows Home Server, Mac OS X Server, Linux, UNIX and Solaris).
287

288 Small-Scale Servers are designed to perform functions such as providing network infrastructure
289 services (e.g., archiving) and hosting data/media. These products are not designed to process
290 information for other systems or run web servers as a primary function.
291

292 This specification does not cover Computer Servers as defined in the ENERGY STAR Version 1.0
293 Computer Server specification. Small-Scale Servers covered by this specification are limited to
294 computers marketed for non-datacenter operation (e.g. homes, small offices).
295

- 296 H. Game Console: A standalone computer-like device whose primary use is to play video games.
297 Game consoles use a hardware architecture based in part on typical computer components (e.g.,
298 processors, system memory, video architecture, optical and/or hard drives, etc.). The primary
299 input for game consoles are special hand held controllers rather than the mouse and keyboard
300 used by more conventional computer types. Game consoles are also equipped with audio visual
301 outputs for use with televisions as the primary display, rather than (or in addition to) an external or
302 integrated display. These devices do not typically use a conventional PC operating system, but
303 often perform a variety of multimedia functions such as: DVD/CD playback, digital picture viewing,
304 and digital music playback. Handheld gaming devices, typically battery powered and intended for
305 use with an integral display as the primary display, are not covered by this specification.
306

307 **Note:** A stakeholder suggested that language should be added to the description of game consoles that explicitly
308 excludes battery powered handheld devices in which a display screen included. The last sentence above reflects
309 this revision, which is in line with EPA's original intent.
310

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

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- 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 integral to the computer. The main unit of a Thin Client covered by this specification must be intended for location in a permanent location (e.g. on a desk) and not for portability.
- K. Notebook Computer: A computer designed specifically for portability and to be operated for extended periods of time either with or without a direct connection to an ac power source. Notebooks must utilize an integrated computer display and be capable of operation off an integrated battery or other portable power source. In addition, most notebooks use an external power supply and have an integrated keyboard and pointing device. Notebook computers are typically designed to provide similar functionality to desktops, including operation of software similar in functionality as that used in desktops. 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. Tablet PCs, which may use touch-sensitive screens along with or instead of other input devices, are considered Notebook Computers in this specification.
- L. Workstation: A high-performance, single-user computer typically used for graphics, CAD, software development, financial and scientific applications among other compute intensive tasks. 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.

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Operational Modes

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- M. 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 systems where ACPI standards are applicable, Off Mode correlates to ACPI System Level S5 state.
- N. Sleep Mode: A low power state that the computer is capable of entering automatically after a

369 period of inactivity or by manual selection. A computer with sleep capability can quickly “wake” in
370 response to network connections or user interface devices with a latency of ≤ 5 seconds from
371 initiation of wake event to system becoming fully usable including rendering of display. For
372 systems where ACPI standards are applicable, Sleep mode most commonly correlates to ACPI
373 System Level S3 (suspend to RAM) state.
374

- 375 O. Idle State: The state in which the operating system and other software have completed loading, a
376 user profile has been created, the machine is not asleep, and activity is limited to those basic
377 applications that the system starts by default.
378
- 379 P. Active State: The state in which the computer is carrying out useful work in response to a) prior or
380 concurrent user input or b) prior or concurrent instruction over the network. This state includes
381 active processing, seeking data from storage, memory, or cache, including idle state time while
382 awaiting further user input and before entering low power modes.
383
- 384 Q. Typical Energy Consumption (TEC): A method of testing and comparing the energy performance
385 of computers, which focuses on the typical electricity consumed by a product while in normal
386 operation during a representative period of time. For Desktops and Notebooks, the key criterion of
387 the TEC approach is a value for typical annual electricity use, measured in kilowatt-hours (kWh),
388 using measurements of average operational mode power levels scaled by an assumed typical
389 usage model (duty cycle). For Workstations, requirements are based on a TEC power value
390 calculated from operational mode power levels, maximum power, and an assumed duty cycle.
391

392 **Note:** The last sentence of the TEC definition above was updated to account for inclusion of the Workstation
393 methodology reintroduced in Draft 3 and to clarify how the TEC concept applies to Desktop/Notebook and
394 Workstation requirements.
395

396 **Networking and Power Management**

- 397
- 398 R. Network Interface: The components (hardware and software) whose primary function is to make
399 the computer capable of communicating over one or more network technologies. Network
400 Interface refers to IEEE 802.3 (Ethernet) or IEEE 802.11 (Wi-Fi).
401
- 402 S. Wake Event: A user, scheduled, or external event or stimulus that causes the computer to
403 transition from Sleep or Off to active mode of operation. Examples of wake events include, but are
404 not limited to: movement of the mouse, keyboard activity, controller input, real-time clock event, or
405 a button press on the chassis, and in the case of external events, stimulus conveyed via a remote
406 control, network, modem, etc.
407
- 408 T. Wake On LAN (WOL): Functionality which allows a computer to wake from Sleep or Off when
409 directed by a network request.
410
- 411 U. Full Network Connectivity: The ability of the computer to maintain network presence while in sleep
412 and intelligently wake when further processing is required. Maintaining network presence may
413 include obtaining and/or defending an assigned interface or network address, responding to
414 requests from other nodes on the network, or sending periodic network presence messages to the
415 network all while in the sleep state. In this fashion, presence of the computer, its network services
416 and applications, is maintained even though the computer is in sleep. (Note: More information on
417 this can be found at: <http://efficientnetworks.lbl.gov/enet-proxying.html>)
418
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420 **Marketing and Shipment Channels**

- 421
- 422 V. Enterprise Channels: Sales channels normally used by large and medium-sized business,
423 government organizations, educational institutions, or other organizations purchasing computers
424 used in managed client/server environments.

425
 426 W. Model Number: A unique marketing name that applies to a specific hardware/software
 427 configuration (i.e. operating system, types or processors, memory, GPU, etc.) that is either pre-
 428 defined, or a configuration that is selected by the customer.

429 **Note:** Additional detail has been added to the definition for Model Number above based on Stakeholder feedback.
 430

431
 432 X. Model Name: A marketing name that includes reference to both the PC model family number, a
 433 short description of the product, or branding references.
 434
 435 Y. Product Family: A high-level description referring to a group of computers typically sharing one
 436 chassis/motherboard combination that often contains hundreds of possible hardware and software
 437 configurations.
 438
 439

440 **2) Qualifying Products:** Computers must meet the computer definition as well as one of the product
 441 type definitions provided in Section 1, above, to qualify as ENERGY STAR. The following table
 442 provides a list of the types of computers that are (and are not) eligible for ENERGY STAR.
 443

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 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, PDAs, and Smartphones

444
 445 In order to conduct testing in support of qualification for ENERGY STAR, the computer must be tested
 446 in a laboratory that is accredited by an accreditation body that is a signatory, in good standing, to a
 447 mutual recognition arrangement of a laboratory accreditation cooperation (i.e. ILAC, APLAC, etc.) that
 448 verifies, by evaluation and peer assessment, that its signatory members are in full compliance with
 449 ISO/IEC 17011 and that their accredited laboratories comply with ISO/IEC 17025.
 450

451 A laboratory's Scope of Accreditation must reflect its specific competence to carry out the test
 452 procedures as outlined in the ENERGY STAR Program Requirements for Computers.
 453

454 **Note:** The scope of accreditation language above has been slightly modified from Draft 3 to align with the current
 455 draft Verification Testing Manual. EPA intends for the laboratory requirements to continue to allow testing in well-
 456 equipped manufacturer test facilities and it is EPA's understanding that the requirements above are reasonable for
 457 such a manufacturer facility. EPA encourages stakeholder comment to confirm this understanding. If these
 458 accreditation requirements do not seem appropriate for well-equipped test facilities, please provide information on
 459 possible alternative laboratory qualifications that assure test facility quality and are reasonable to allow continued
 460 manufacturer testing of products.
 461

462 **3) Energy Efficiency and Power Management Criteria:** Computers must meet the requirements below
 463 to qualify as ENERGY STAR. The Version 5.0 effective date is covered in Section 5 of this
 464 specification.
 465

466 **(A) Power Supply Efficiency Requirements** - Requirements are applicable to all product categories
 467 covered by the ENERGY STAR Computer Specification:
 468

469 **Computers Using an Internal Power Supply:** 85% minimum efficiency at 50% of rated output and
470 82% minimum efficiency at 20% and 100% of rated output, with Power Factor \geq 0.9 at 100% of rated
471 output.

472
473 **Computers Using an External Power Supply:** Must be ENERGY STAR qualified or meet the no-
474 load and active mode efficiency levels provided in the ENERGY STAR Program Requirements for
475 Single Voltage External Ac-Ac and Ac-Dc Power Supplies, Version 2.0. The ENERGY STAR
476 specification and qualified product list can be found at www.energystar.gov/powersupplies. Note: This
477 performance requirement also applies to multiple voltage output external power supplies as tested in
478 accordance to the Internal Power Supply test method referenced in Section 4, below.

479
480 **(B) Efficiency and Performance Requirements:**

481
482 **1) Desktop, Integrated Desktop, and Notebook Levels:**

483
484 **Desktop Categories for TEC Criteria:** For the purposes of determining TEC levels, desktops
485 and integrated desktops must qualify under Categories A, B, C, or D as defined below:

486
487 **Category A:** All desktop computers that do not meet the definition of Category B, Category
488 C, or Category D below will be considered under Category A for ENERGY STAR
489 qualification.

490
491 **Category B:** To qualify under Category B, desktops must have:

- 492
- 493 ▪ Greater than or equal to 2 Cores; and
 - 494 ▪ Greater than or equal to 2 gigabytes (GB) of system memory.

495
496 **Category C:** To qualify under Category C, desktops must have:

- 497
- 498 ▪ Greater than 2 Cores.
- In addition to the requirement above, models qualifying under Category C must be
499 configured with a minimum of 1 of the following 2 characteristics:

- 500
- 501 ▪ Greater than or equal to 2 gigabytes (GB) of system memory; and/or
 - 502 ▪ A Discrete GPU.

503
504 **Category D:** To qualify under Category D, desktops must have:

- 505
- 506 ▪ Greater than or equal to 4 Cores.
- In addition to the requirement above, models qualifying under Category D must be
507 configured with a minimum of 1 of the following 2 characteristics:

- 508
- 509 ▪ Greater than or equal to 4 gigabytes (GB) of system memory; and/or
 - 510 ▪ A Discrete GPU with a Frame Buffer Width greater than 128-bit.

511
512 **Note:** EPA received and evaluated numerous stakeholder comments, and supporting data, on the Draft 3
513 categories for Desktops, which called for mid-range categories for both institutional/commercial purchasers as well
514 as individual customers. The structure above is based on a close review of all comments and data. This four
515 categories structure includes two mid-range categories:

- 516
- 517 ▪ Category B aligns with an industry proposal for a mainstream desktop for institutional purchaser market. Stakeholders commented that such a category held continued relevance based on current technology roadmaps.
 - 518 ▪ Category C is intended to capture mainstream consumer desktops as processors with increasing core counts become increasingly common.

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

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

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

- A Discrete GPU.

Category C: To qualify under Category C, notebooks must have:

- Greater than or equal to 2 Cores;
- Greater than or equal to 2 gigabytes (GB) of system memory; and
- A Discrete GPU with a Frame Buffer Width greater than 128-bit.

Note: EPA received feedback and data from Stakeholders supporting creation of a mobile workstation category of notebooks. Such products were characterized as under-represented in the current Version 4.0 program, but with the potential for energy savings as a desktop replacement. EPA evaluated stakeholder proposals and data supporting the characteristics of this product class and added Category C, accordingly. Categories A and B remain unchanged from Draft 3.

TEC (Desktop and Notebook product categories): The following tables indicate the required TEC levels for the 5.0 Specification. Table 1 below lists TEC requirements for Version 5.0, while Table 2 gives weightings for each operational mode by product type. TEC will be determined using the formula below:

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

where all P_x are power values in watts, all T_x are Time values in % of year, and the TEC E_{TEC} is in units of kWh and represents annual energy consumption based on mode weightings in Table 2.

Note: E_{TEC} replaces the annual energy consumption for clarity with the TEC definition in Section 1.

Table 1: E_{TEC} Requirement – Desktops and Notebooks

	Desktops and Integrated Computers (kWh)	Notebook Computers (kWh)
TEC (kWh)	Category A: ≤ 148 Category B: ≤ 167 Category C: ≤ 209 Category D: ≤ 231	Category A: ≤ 39.5 Category B: ≤ 52 Category C: ≤ 82
Capability Adjustments		
Memory	1 kWh (per GB over base) <u>Base Memory:</u> Categories A, B and C: 2 GB Category D: 4 GB	0.4 kWh (per GB over 4)
Premium Graphics (for Discrete GPUs with specified Frame Buffer Widths)	60 kWh (FB Width > 128-bit)	3 kWh (FB Width > 64-bit)
Additional Internal Storage	25 kWh	3 kWh

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Note: Table 1 reflects the updated categories for Desktops and Notebooks along with revised capability adjustments and corresponding levels for qualification. Further details on the dataset analysis and development of adjustments considered for the Draft Final specification, both those included above and others suggested by stakeholders, are provided in a companion document, “ENERGY STAR Notes on Draft Final Data.doc,” distributed with this specification.

Desktops: In addition to creating a scaling set of TEC requirements (see “Summary” worksheet in the Draft Final Dataset), the structure provides a stakeholder-suggested channel for mid-range in Category B and a revised adjustment for premium graphics based on the Draft Final Dataset.

Notebooks: The notebook capability adjustments remained largely the same from Draft 3, with adjustment of the storage amount to account for higher-end mobile hard drives intended for RAID applications.

Table 2: Operational Mode Weighting – Desktops and Notebooks

	Desktop		Notebook	
	Conventional	Proxying*	Conventional	Proxying*
Toff	55%	40%	60%	45%
Tsleep	5%	30%	10%	30%
Tidle	40%	30%	30%	25%

Note: Proxying refers to a computer that maintains Full Network Connectivity as defined in Section 1 of this specification. For a system to qualify under the proxying weightings above, it must meet a non-proprietary proxying standard that has been approved by the EPA as meeting the goals of ENERGY STAR. Such approval must be in place prior to submittal of product data for qualification. See Section 4.C, Qualifying Computers with Power Management Capabilities, for further information and testing requirements.

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2) Workstation Levels:

P_{TEC} (Workstation product category): The following tables indicate the required P_{TEC} levels for the 5.0 Specification. Table 1 below lists P_{TEC} requirements for Version 5.0, while Table 2 gives weightings for each operational mode. P_{TEC} will be determined using the formula below:

$$P_{TEC} = 0.35 * P_{off} + 0.10 * P_{sleep} + 0.55 * P_{idle}$$

where all P_x are power values in watts.

Note: Terminology for workstation TEC requirements has been revised to use the variable “P_{TEC}.” This variable is consistent with the reference used in Version 4.0 of the Computer Specification.

Table 3: P_{TEC} Requirement - Workstations

$P_{TEC} \leq 0.28 * [P_{max} + (\# \text{ HDD} * 5)]$
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Table 4: Operational Mode Weighting - Workstations

Toff	35%
Tsleep	10%
Tidle	55%

Note: Weightings are included in the P_{TEC} formula, above.

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Multiple Graphics Devices: Workstations that meet ENERGY STAR requirements with a single graphics device may also qualify a configuration with more than one graphics device, provided the additional hardware configuration is identical with the exception of the additional graphics device(s). The use of multiple graphics includes, but is not limited to, driving multiple

585 displays and ganging for high-performance, multi-GPU configurations (e.g. ATI Crossfire,
 586 NVIDIA SLI). In such cases, and until such time as SPECviewperf® supports multiple graphics
 587 threads, manufacturers may submit the test data for the workstation with the single graphics
 588 device for both configurations without retesting the system.

589 **Note:** The graphics scaling language above has been revised based on stakeholder feedback on the Draft 3
 590 language.
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 594 **3) Game Console Levels:**
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Table 5: Game Console Requirements – Effective July 1, 2010

Note: To allow for time to further refine requirements and commence efforts to engage game publishers in the ENERGY STAR process, development of game console requirements will continue through the close of the calendar year. This effort will continue building on the concepts and requirements present in previous drafts of the Computer specification, and EPA will release a next draft of Game Console requirements shortly. The continued work on game consoles will not impact the effective date for the remainder of the computer specification.

Once extended development of these game console requirements is completed, the final requirements will be wrapped into the Final Version 5.0 Specifications, with no further revisions to requirements for other product types.

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 598 **4) Small-Scale Server Levels:**
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Table 6: Small-Scale Server Efficiency Requirements
Small-Scale Server Operational Mode Power Requirements

Off: ≤ 2.0 W	
Idle State: Category A: ≤ 50.0 W Category B: ≤ 65.0 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 or B, 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. 	

600
 601 **Note:** As forecasted in Draft 3, EPA has removed the former Category C from the Small-Scale Server
 602 requirements. To reiterate the reasoning provided in Draft 3, current Small-Scale Servers in the program under 4.0
 603 were qualified under Category B or A, and elements of the Category C definition do not apply to a Small-Scale
 604 Server (primarily the graphics options).
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5) Thin Client Levels

Thin Client Categories for Idle Criteria: For the purposes of determining Idle levels, Thin Clients must qualify under Categories A or B as defined below:

Category A: All Thin Clients 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, Thin Clients must:

- Support local multimedia encode/decode.

Table 7 : Thin Client Efficiency Requirements

Thin Client Operational Mode Power Requirements	
Off Mode: $\leq 2\text{ W}$ Sleep Mode (if applicable): $\leq 2\text{ W}$	
Idle State: Category A: $\leq 12.0\text{ W}$ Category B: $\leq 15.0\text{ W}$	
Capability	Additional Power Allowance
Wake On LAN (WOL) <i>(Applies only if computer is shipped with WOL enabled)</i>	+ 0.7 W for Sleep + 0.7 W for Off

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Note: After reviewing all feedback on the Draft 3 requirements for Thin Clients, no changes have been proposed above. In addition to stakeholder support of the Draft 3 proposal, below is a brief summary of stakeholder feedback:

- *A stakeholder suggested that the terms “support local multimedia encode/decode” be more clearly defined in the text, to avoid any potential confusion / misinterpretation.* EPA engaged industry on this topic and efforts are ongoing to add clarity to the definition of the category. EPA intends to review proposals and include as applicable.
- *A stakeholder requested an increase in Idle power for Category B.* EPA was not aware of data supporting the increase in Idle for Category B, and no related changes have been included.
- *A stakeholder proposed that Off Mode power be reduced to 1W, consistent with Laptops and to support the EU’s EuP program.* Given that Version 5.0 marks the first time Thin Clients are addressed by ENERGY STAR, in keeping with the overall market transformation goals of the program, EPA feels that creating holistic requirements that are feasible for the highest efficiency products on the market creates not only a recognition opportunity for qualifying products, but also provides design incentive for future technology. EPA believes that the requirements in place in Draft 3 create a balance of efficiency for Off Mode with adequate incentive for greater efficiency in Idle. Few products under consideration in EPA’s dataset could meet the 1W off mode requirement at this time, and as such a revision has not been included in the Draft Final Specification. EPA will continue to encourage and monitor improvements in Off Mode Power in the Computer Program.

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

Note: The Sleep Mode requirement in Draft 3 inadvertently remained in Draft 3 as mandatory for Thin Clients. Such a requirement was determined at the September 26 Stakeholder meeting to be not universally applicable with current products available and a potential barrier to product availability in Version 5.0. EPA has removed the requirement as originally intended in Draft 3 accordingly and intends to revisit Thin Client Sleep Mode requirements in future revisions of the specification. Display Sleep requirements do remain applicable to Thin Clients. Table 8 remains otherwise unchanged from Draft 3.

Table 8: Power Management Requirements

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: Game Consoles may transition to a full off mode within the timeframe above in lieu of sleep.</i>)	Desktop Computers	√
		Integrated Desktop Computers	√
		Notebook Computers	√
		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	√
		Workstations	√
		Game Consoles	√
		Small-Scale Servers (if computer 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	√
		Workstations	√
		Game Consoles	
		Small-Scale Servers	√
		Thin Clients (<i>Only applies if software updates from the centrally managed network are conducted while the unit is in sleep or off mode. Thin Clients whose standard framework for upgrading client software does not require off-hours scheduling are exempt from the requirement.</i>)	√
	<i>Applies to computers shipped through Enterprise Channels, only:</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 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. 	Desktop Computers	√
		Integrated Desktop Computers	√
		Notebook Computers	√
		Workstations	√
		Game Consoles	
		Small-Scale Servers	√
		Thin Clients (<i>Only applies if software updates from the centrally managed network are conducted while the unit is in sleep or off mode. Thin Clients whose standard framework for upgrading client software does not require off-hours scheduling are exempt from the requirement.</i>)	√

Wake Management	Applies to computers shipped through Enterprise Channels, only:	Desktop Computers	√
		Integrated Desktop Computers	√
	Computers with Ethernet capability shall be capable of both remote and scheduled wake events from Sleep mode.	Notebook Computers	√
		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 shall be tested and reported as shipped for Off. Models that will be shipped with WOL enabled for Off shall be tested with WOL enabled. Likewise, products shipped with WOL disabled for Off shall be tested with WOL disabled.

Sleep: Computers shall be tested and reported as shipped for Sleep. Models sold through enterprise channels, as defined in Section 1, definition V, shall be tested, qualified, and shipped with WOL enabled/disabled based on the requirements in Table 8. 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.

Proxying: Desktop, Integrated Desktop, and Notebook Computers shall be tested and reported for Idle, Sleep, and Off with proxying features enabled or disabled as shipped. For a system to qualify using TEC weightings for proxying, it must meet a proxying standard that has been approved by the EPA as meeting the goals of ENERGY STAR. Such approval must be in place prior to submittal of product data for qualification.

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:

- 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.

688 Although EPA believes that Partners in partnership with EPA can help ensure their products
689 continue to be leadership products when it comes to efficiency once deployed. EPA is committed
690 to helping to reduce the likelihood that custom images will disrupt a product's ability to meet
691 ENERGY STAR requirements. For example, EPA is engaging in federal desktop core
692 configuration discussions with the intention of facilitating the development of a core configuration
693 for Federal Agencies that supports energy efficiency. In April 2008, EPA also launched the
694 ENERGY STAR Low Carbon IT Campaign in an effort to get more businesses and organizations
695 to implement power management. More information on the campaign can be found at:
696 www.energystar.gov/lowcarbonit.
697

698 **User Information Requirement:** In order to ensure that purchasers/users are properly informed on
699 the benefits of power management, the manufacturer will include with each computer, one of the
700 following:
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- 702 • Information on ENERGY STAR and the benefits of power management in either a hard copy or
- 703 electronic copy of the user manual. This information should be near the front of the user guide; or
- 704 • A package or box insert on ENERGY STAR and the benefits of power management.

705 Either option must at least include the following information:
706

- 707
- 708 • Notice that the computer has been shipped enabled for power management and what the time
- 709 settings are; and
- 710 • How to properly wake the computer from Sleep mode.

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713 **(D) Voluntary Requirements**

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715 **User Interface:** Although not mandatory, manufacturers are strongly recommended to design
716 products in accordance with the Power Control User Interface Standard — IEEE 1621 (formally known
717 as “Standard for User Interface Elements in Power Control of Electronic Devices Employed in
718 Office/Consumer Environments”). Compliance with IEEE 1621 will make power controls more
719 consistent and intuitive across all electronic devices. For more information on the standard see
720 <http://eetd.LBL.gov/Controls>.
721

722

723 **4) Test Procedures:** Manufacturers are required to perform tests and self-certify those models that meet
724 the ENERGY STAR guidelines.
725

- 726 • In performing these tests, partner agrees to use the test procedures provided in Table 9, below.
- 727 • The test results must be reported to EPA or the European Commission, as appropriate.

728

729 Additional testing and reporting requirements are provided below.
730

731 A. **Number of Units Required for TEC or Idle Testing:** Manufacturers may initially test a single unit for
732 qualification. If the initial unit tested is less than or equal to the applicable requirement for TEC or
733 Idle but falls within 10% of that level, one additional unit of the same model with an identical
734 configuration must also be tested. Manufacturers shall report test values for both units. To qualify
735 as ENERGY STAR, both units must meet the maximum TEC or Idle level for that product and that
736 product category.
737

738 **Note:** This additional testing is only required for TEC qualification (*Desktops, Integrated Desktops,*
739 *Notebooks, Workstations*) and Idle qualification (*Small-Scale Servers, Thin Clients*) – only one unit
740 is required to be tested for Sleep and Off if such requirements apply. The following examples
741 further illustrate this approach:
742

- 743 1. Category A Desktops must meet a TEC level of 148 kWh or less, making 133.2 kWh the
744 10% threshold for additional testing.
- 745 • If the first unit is measured at 130 kWh, no more testing is needed and the model qualifies
746 (130 kWh is 12% more efficient than the specification and is therefore “outside” the 10%
747 threshold).
 - 748 • If the first unit is measured at 133.2 kWh, no more testing is needed and the model
749 qualifies (133.2 kWh is exactly 10% more efficient than the specification).
 - 750 • If the first unit is measured at 135 kWh, then an additional unit must be tested to
751 determine qualification (135 kWh is only 9% more efficient than the specification and is
752 “within” the 10% threshold).
 - 753 • If the two units are then tested at 135 and 151 kWh, the model does not qualify as
754 ENERGY STAR—even though the average is 143 kWh — because one of the values
755 exceeds the ENERGY STAR specification.
 - 756 • If the two units are then tested at 135 and 147 kWh, the model does qualify as ENERGY
757 STAR because both values meet the ENERGY STAR specification of 148 kWh.

758
759 2. A Category A Small-Scale Server must meet an Idle level of 50 watts or less, making
760 45 Watts the 10% threshold for additional testing. The following scenarios could then
761 occur when testing a model for qualification:

- 762 • If the first unit is measured at 44 watts, no more testing is needed and the model qualifies
763 (44 watts is 12% more efficient than the specification and is therefore “outside” the 10%
764 threshold).
- 765 • If the first unit is measured at 45 watts, no more testing is needed and the model qualifies
766 (45 watts is exactly 10% more efficient than the specification).
- 767 • If the first unit is measured at 47 watts, then an additional unit must be tested to determine
768 qualification (47 Watts is only 6% more efficient than the specification and is “within” the
769 10% threshold).
- 770 • If the two units are then tested at 47 and 51 watts, the model does not qualify as
771 ENERGY STAR—even though the average is 49 watts— because one of the values (51)
772 exceeds the ENERGY STAR specification.
- 773 • If the two units are then tested at 47 and 49 watts, the model does qualify as ENERGY
774 STAR because both values meet the ENERGY STAR specification of 50 watts.

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

780
781 For products that are sold as ENERGY STAR in multiple international markets and, therefore,
782 rated at multiple input voltages, the manufacturer must test at and report the required measured
783 power consumption and efficiency values at all relevant voltage/frequency combinations. For
784 example, a manufacturer that is shipping the same model to the United States and Europe must
785 measure, meet the specification, and report test values at both 115 Volts/60 Hz and 230 Volts/50
786 Hz in order to qualify the model as ENERGY STAR in both markets. If a model qualifies as
787 ENERGY STAR at only one voltage/frequency combination (e.g., 115 Volts/60 Hz), then it may
788 only be qualified and promoted as ENERGY STAR in those regions that support the tested
789 voltage/frequency combination (e.g., North America and Taiwan).

Table 9: Test Procedures

Product Category	Specification Requirement	Test Protocol	Source
All Computers	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>
Desktop, Integrated, and Notebook Computers	E_{TEC} (from measurements of Off Mode, Sleep Mode, and Idle State)	ENERGY STAR Computer Test Method (Version 5.0), Section III	Appendix A
Workstations	P_{TEC} (from measurements of Off Mode, Sleep Mode, Idle State, and Maximum Power)	ENERGY STAR Computer Test Method (Version 5.0), Section III-IV	

Note: Column 2 has been revised with the clarified terminology for TEC from Section 3.B.

Game Consoles	Off Mode, and Sleep/Auto-Off	ENERGY STAR Computer Test Method (Version 5.0), Section V	
Small-Scale Servers	Off Mode and Idle State	ENERGY STAR Computer Test Method (Version 5.0), Section III	
Thin Clients	Off Mode, Sleep Mode, and Idle State	ENERGY STAR Computer Test Method (Version 5.0), Section III	

793 C. Qualifying Families of Products: Models that are unchanged or that differ only in finish from those
794 sold in a previous year may remain qualified without the submission of new test data assuming the
795 specification remains unchanged. If a product model is offered in the market in multiple
796 configurations or styles, as a product “family” or series, the partner may report and qualify the
797 product under a single model number, as long as all of the models within that family or series
798 meet either of the following requirements:
799

- 800 • Computers that are built on the same platform and are identical in every respect except for
801 housing and color may be qualified through submission of test data for a single,
802 representative model.
803
- 804 • If a product model is offered in the market in multiple configurations, the partner may report
805 and qualify the product under a single unique model identifier number that represents the
806 highest power configuration available in the family, rather than reporting each and every
807 individual model in the family; there must not be higher consuming configurations of the same
808 product model than the representative configuration. In this case, the highest configuration
809 would consist of: the highest power processor, the maximum memory configuration, the
810 highest power GPU, etc. For desktop systems which meet the definition for multiple desktop
811 categories (as defined in section 3.B.1) depending on the specific configuration,
812 manufacturers will have to submit the highest power configuration for each category under
813 which they would like the system to qualify. For example, a system that could be configured
814 either as a Category A or a Category B desktop would require a submittal of the highest
815 power configuration for both categories in order to qualify as ENERGY STAR. If a product
816 could be configured to meet all three categories, it would then have to submit data for the
817 highest power configuration in all categories. Manufacturers will be held accountable for any
818 efficiency claims made about all other models in the family, including those not tested or for
819 which data was not reported.
820

821 All units/configurations associated with a product model designation, for which a Partner is
822 seeking ENERGY STAR qualification, must meet the ENERGY STAR requirements. If a Partner
823 wishes to qualify configurations of a model for which non-qualifying alternative configurations
824 exist, the Partner must assign the qualifying configurations an identifier in the model name/number
825 that is unique to ENERGY STAR Qualified configurations. This identifier must be used
826 consistently in association with the qualifying configurations in marketing/sales materials and on
827 the ENERGY STAR list of qualified products (e.g. model A1234 for baseline configurations and
828 A1234-ES for ENERGY STAR qualifying configurations).
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831 **5) Effective Date:** The date that manufacturers may begin to qualify products as ENERGY STAR will be
832 defined as the *effective date* of the agreement. The ENERGY STAR Version 5.0 Computers
833 Specification effective date is July 1, 2009. All products (except for Game Consoles), including
834 models originally qualified under Version 4.0, with a **date of manufacture** on or after **July 1, 2009**
835 must meet the Version 5.0 requirements in order to qualify for ENERGY STAR. Game Consoles with a
836 **date of manufacture** on or after **July 1, 2010** must meet the Version 5.0 requirements in order to
837 qualify for ENERGY STAR. Any previously executed agreement on the subject of ENERGY STAR
838 qualified computers shall be terminated effective June 30, 2009.
839
840

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

847
848 **APPENDIX A:**
849 **ENERGY STAR Test Procedure for Determining the**
850 **Power Use of Computers/Game Consoles in Off, Sleep, and Idle**

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

858
859 *Computers must be tested with configuration and settings as shipped, unless otherwise specified in the*
860 *test procedure in this Appendix A. Steps requiring alternative setup are marked with an asterisk (“ * ”).*

861 **Note:** The lines above have been added to emphasize the as shipped nature of the test procedure and to clarify
862 the few situations in which settings are specified to change for testing purposes.
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866 **I. Definitions**

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

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871 **UUT**

872 UUT is an acronym for “unit under test,” which in this case refers to the computer being tested.
873

874 **UPS**

875 UPS is an acronym for “Uninterruptible Power Supply,” which refers to a combination of converters,
876 switches and energy storage means, for example batteries, constituting a power supply for
877 maintaining continuity of load power in case of input power failure.
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880 **II. Testing Requirements**

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882 **Approved Meter**

883 Approved meters will include the following attributes¹:

- 884
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 - 886 • Power resolution of 1 mW or better;
 - 887 • An available current crest factor of 3 or more at its rated range value; and
 - 888 • Lower bound on the current range of 10mA or less.

889 The following attributes in addition to those above are suggested:

- 890
891
 - 892 • Frequency response of at least 3 kHz; and
 - 893 • Calibration with a standard that is traceable to the U.S. National Institute of Standards and
894 Technology (NIST).

895 It is also desirable for measurement instruments to be able to average power accurately over any user
896 selected time interval (this is usually done with an internal math’s calculation dividing accumulated
897 energy by time within the meter, which is the most accurate approach). As an alternative, the
898 measurement instrument would have to be capable of integrating energy over any user selected time

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

899 interval with an energy resolution of less than or equal to 0.1 mWh and integrating time displayed with
900 a resolution of 1 second or less.

901
902 **Accuracy**
903 Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to
904 2% at the 95% confidence level. Measurements of power of less than 0.5 W shall be made with an
905 uncertainty of less than or equal to 0.01 W at the 95% confidence level. The power measurement
906 instrument shall have a resolution of:

- 907
- 908 • 0.01 W or better for power measurements of 10 W or less;
- 909 • 0.1 W or better for power measurements of greater than 10 W up to 100 W; and
- 910 • 1 W or better for power measurements of greater than 100 W.

911
912 All power figures should be in watts and rounded to the second decimal place. For loads greater than
913 or equal to 10 W, three significant figures shall be reported.

914
915 **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:</i> 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)

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918
919 **Test Configuration**

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

921
922 The UUT must be connected to an Ethernet network switch capable of the UUT’s highest and lowest
923 network speeds. The network connection must be live during all tests.

924
925
926 **III. Test Procedure for Off, Sleep and Idle for All Computer Products**

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

928
929 **UUT Preparation**

- 930 1. Record the manufacturer and model name of the UUT.
- 931 2. Ensure that the UUT is connected to network resources as detailed below, and that the UUT
932 maintains this live connection for the duration of testing, disregarding brief lapses when
933 transitioning between link speeds.
 - 934 a. *Desktops, Integrated Desktops, and Notebooks* shall be connected to a live Ethernet
935 (IEEE 802.3) network switch as specified in Section II., “Test Configuration,” above. The
936 computer must maintain this live connection to the switch for the duration of testing,
937 disregarding brief lapses when transitioning between link speeds. Computers without
938 Ethernet capability must maintain a live wireless connection to a wireless router or
939 network access point for the duration of testing.

- 940 b. *Small-Scale Servers* shall be connected to a live Ethernet (IEEE 802.3) network switch as
941 specified in Section II., "Test Configuration," above, and that the connection is live.
- 942 c. *Thin Clients* shall be connected to a live server via a live Ethernet (IEEE 802.3) network
943 switch and shall run intended terminal/remote connection software.
- 944 3. Connect an approved meter capable of measuring true power to an ac line voltage source set to
945 the appropriate voltage/frequency combination for the test.
- 946 4. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
947 should be connected between the meter and the UUT. For a valid test to take place the meter
948 should remain in place until all Off, Sleep, and Idle power data is recorded.
- 949 5. Record the ac voltage.
- 950 6. Boot computer and wait until the operating system has fully loaded. If necessary, run the initial
951 operating system setup and allow all preliminary file indexing and other one-time/periodic
952 processes to complete.
- 953 7. Record basic information about the computer's configuration – computer type, operating system
954 name and version, processor type and speed, and total and available physical memory, etc.
- 955 8. Record basic information about the video card or graphics chipset (if applicable) - video
956 card/chipset name, resolution, amount of onboard memory, and bits per pixel.
- 957 9. * Ensure that the UUT is configured as shipped including all accessories, WOL enabling, and
958 software shipped by default. UUT should also be configured using the following requirements for
959 all tests:
- 960 a. *Desktop* systems shipped without accessories should be configured with a standard
961 mouse, keyboard and external computer display.
- 962 b. *Notebooks* should include all accessories shipped with the system, and need not include
963 a separate keyboard or mouse when equipped with an integrated pointing device or
964 digitizer.
- 965 c. *Notebooks* should have the battery pack(s) removed for all tests. For systems where
966 operation without a battery pack is not a supported configuration, the test may be
967 performed with fully charged battery pack(s) installed, making sure to report this
968 configuration in the test results.
- 969 d. *Small-Scale Servers* and *Thin Clients* shipped without accessories should be configured
970 with a standard mouse, keyboard and external computer display (if server has display
971 output functionality).
- 972 e. For Computers with Ethernet capability, power to wireless radios should be turned off for
973 all tests. This applies to wireless network adapters (e.g., 802.11) or device-to-device
974 wireless protocols. For Computers without Ethernet capability, power to wireless radios
975 should remain on during testing and must maintain a live wireless connection to a
976 wireless router or network access point for the duration of testing.
- 977 f. If more than one internal hard drive is installed during shipment, additional internal hard
978 drives may be tested with hard drive power management enabled as shipped. If additional
979 drives are not power managed when shipped to customers, they must be tested without
980 such features implemented.
- 981
- 982 10. * The following guidelines should be followed to configure power settings for computer displays
983 (adjusting no other power management settings):
- 984 a. For computers with external computer displays (most desktops): use the computer
985 display power management settings to prevent the display from powering down to ensure
986 it stays on for the full length of the Idle test as described below.
- 987 b. For computers with integrated computer displays (notebooks and integrated systems):
988 use the power management settings to set the display to power down after 1 minute.
- 989 11. Shut down the UUT.
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Off Mode Testing

12. With the UUT shut down and in Off, set the meter to begin accumulating true power values at an interval of less than or equal to 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

1002 **Note:** The measurement interval language has been revised throughout the test procedure based on a stakeholder
1003 suggestion to allow for meters capable of collecting data at faster intervals.

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Idle Mode Testing

13. 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. Between 5 and 15 minutes after the initial boot or log in, set the meter to begin accumulating true power values at an interval of greater than or equal to 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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Sleep Mode Testing

14. 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 greater than or equal to 1 reading per second. Accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.
15. 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.

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Reporting Test Results

16. 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.

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IV. Maximum Power Test for Workstations

1031 The maximum power for workstations is found by the simultaneous operation of two industry standard
1032 benchmarks: Linpack to stress the core system (e.g., processor, memory, etc.) and SPECviewperf[®]
1033 (latest available version for the UUT) to stress the system's GPU. Additional information on these
1034 benchmarks, including free downloads, can be found at the URLs found below:

1035

Linpack <http://www.netlib.org/linpack/>
SPECviewperf[®] <http://www.spec.org/benchmarks.html#gpc>

1036

1037 This test must be repeated three times on the same UUT, and all three measurements must fall within
1038 a $\pm 2\%$ tolerance relative to the average of the three measured maximum power values.

1039 Measurement of the maximum ac power consumption of a workstation should be conducted as
1040 follows:

1041

UUT Preparation

² 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.

- 1042 1. Connect an approved meter capable of measuring true power to an ac line voltage source set to
1043 the appropriate voltage/frequency combination for the test. The meter should be able to store and
1044 output the maximum power measurement reached during the test or be capable of another
1045 method of determining maximum power.
1046 2. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
1047 should be connected between the meter and the UUT.
1048 3. Record the ac voltage.
1049 4. * Boot the computer and, if not already installed, install Linpack and SPECviewperf as indicated
1050 on the above Websites.
1051 5. Set Linpack with all the defaults for the given architecture of the UUT and set the appropriate
1052 array size “n” for maximizing power draw during the test.
1053 6. Ensure all guidelines set by the SPEC organization for running SPECviewperf are being met.
1054

1055 **Maximum Power Testing**

- 1056 7. Set the meter to begin accumulating true power values at an interval of less than or equal to 1
1057 reading per second, and begin taking measurements. Run SPECviewperf and as many
1058 simultaneous instances of Linpack as needed to fully stress the system.
1059 8. Accumulate power values until SPECviewperf and all instances have completed running. Record
1060 the maximum power value attained during the test.
1061

1062 **Reporting Test Results**

- 1063 9. The test results must be reported to EPA or the European Commission, taking care to ensure that
1064 all required information has been included.
1065 10. Upon submittal of data, manufacturers must also include the following data:
1066 a. Value of the n (the array size) used for Linpack,
1067 b. Number of simultaneous copies of Linpack run during the test,
1068 c. Version of SPECviewperf run for test,
1069 d. All compiler optimizations used in compiling Linpack and SPECviewperf, and
1070 e. A precompiled binary for end users to download and run of both SPECviewperf and
1071 Linpack. These can be distributed either through a centralized standards body such as
1072 SPEC, by the OEM or by a related third party.
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1076 **V. Test Procedure for All Modes for Game Consoles**

1076 Measurement of ac power consumption of a computer should be conducted as follows:
1077

1078 **UUT Preparation**

- 1079 1. Record the manufacturer and model name of the UUT.
1080 2. Record basic information about the computer’s configuration – computer type, operating system
1081 name and version, processor type and speed, and total and available physical memory, etc.
1082 3. Ensure that the UUT is connected to a TV(s) which support all of the output types supported by
1083 the UUT.
1084 a. *For each output that supports APD, repeat step 10 of this procedure.*
1085 4. Connect an approved meter capable of measuring true power to an ac line voltage source set to
1086 the appropriate voltage/frequency combination for the test.
1087 5. Plug the UUT into the measurement power outlet on the meter. No power strips or UPS units
1088 should be connected between the meter and the UUT. For a valid test to take place the meter
1089 should remain in place until all power data is recorded.
1090 6. Record the ac voltage.
1091 7. Turn on the console and wait until the operating system has fully loaded.
1092 8. If necessary, run the initial system setup and allow all preliminary tasks and other one-
1093 time/periodic processes to complete.
1094 9. Ensure that the UUT is configured as shipped including all accessories, power management
1095 settings and software shipped by default.

- 1096 10. For each applicable output, wait for 15 minutes and ensure the output drops after the prescribed
1097 time.
1098 11. Place the system in a state without the game loaded.
1099 12. Then wait one hour and verify the system goes into a low power state.
1100 13. Bring the console back into its OS loaded state.
1101 14. Load a game and bring it to the games menu.
1102 15. Begin game play and pause the game.
1103 16. Wait one hour and verify the system goes into a low power state. (Applicable after Version 5.0)
1104 17. Shut down the UUT.
1105

Off Mode Testing

- 1106 18. With the UUT shut down and in Off, set the meter to begin accumulating true power values at an
1107 interval of greater than or equal to 1 reading per second. Accumulate power values for 5
1108 additional minutes and record the average (arithmetic mean) value observed during that 5 minute
1109 period.³
1110

Sleep/APD Mode Testing

- 1111 19. After completing the Off mode measurements, place the computer in it's Sleep/APD mode. Reset
1112 the meter (if necessary) and begin accumulating true power values at an interval of greater than or
1113 equal to 1 reading per second. Accumulate power values for 5 additional minutes and record the
1114 average (arithmetic mean) value observed during that 5 minute period.
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VI. Continuing Verification

1118 This testing procedure describes the method by which a single unit may be tested for compliance. An
1119 ongoing testing process is highly recommended to ensure that products from different production runs
1120 are in compliance with ENERGY STAR.
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³ *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.*

**APPENDIX B:
Sample Calculations**

- I. **Desktop, Integrated Desktop, Notebook Computers:** Below is a sample TEC calculation intended to show how levels for compliance are determined based on functional adders and operational mode measurements.

Example: Notebook Computer, Category A

1. Measure values using the Appendix A test procedure.
Off = 1W
Sleep = 1.7W
Idle = 10W
2. Determine which Capability Adjustments apply.
Integrated Graphics? Does not apply for Premium Graphics.
*8GB Memory installed. Does meet memory adjustment level: 8 yields a 1.6kWh adjustment (4 * 0.4kWh).*
3. Apply Weightings based on Table 2 to calculate TEC:

Table 2 (for conventional notebook):

Toff	60%
Tsleep	10%
Tidle	30%

$$\begin{aligned}
 E_{TEC} &= (8760/1000) * (P_{off} * T_{off} + P_{sleep} * T_{sleep} + P_{idle} * T_{idle}) \\
 &= (8760/1000) * (P_{off} * .60 + P_{sleep} * .10 + P_{idle} * .30) \\
 &= (8760/1000) * (1 * .60 + 1.7 * .10 + 10 * .30) \\
 &= \mathbf{33.03 kWh}
 \end{aligned}$$

4. Determine “adjusted TEC” for evaluation by subtracting any capability adjustments (step 2) from the measured TEC (step 3).

$$33.03 \text{ kWh} - 1.6 \text{ kWh} = 31.43 \text{ kWh}$$
5. Compare the adjusted TEC to the ENERGY STAR levels to determine if the model qualifies.

Category A requirement: Category A: ≤ 39.5
Adjusted TEC: 31.43 kWh
31.43kWh < 39.5
Notebook meets ENERGY STAR requirements.

- II. **Workstations:** Below is a sample P_{TEC} calculation for a Workstation with 2 hard drives.

1. Measure values using the Appendix A test procedure.
Off = 2 W
Sleep = 4W
Idle = 80W
Max Power = 180W

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- Note number of Hard Drives installed.
Two hard drives installed during test.
- Apply Weightings based on Table 4 to calculate P_{TEC} :

Table 2 (for conventional notebook):

Toff	35%
Tsleep	10%
Tidle	55%

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$$\begin{aligned} P_{TEC} &= (.35 * P_{off} + .10 * P_{sleep} + .55 * P_{idle}) \\ &= (.35 * 2 + .10 * 4 + .55 * 80) \\ &= \mathbf{45.10 \text{ W}} \end{aligned}$$

- Calculate the P_{TEC} requirement.

$$\begin{aligned} P_{TEC} &= 0.28 * [P_{max} + (\# \text{ HDD} * 5)] \\ P_{TEC} &= 0.28 * [180 + 2 * 5] \\ P_{TEC} &= 53.2 \end{aligned}$$

- Compare the adjusted P_{TEC} to the ENERGY STAR levels to determine if the model qualifies.

$$45.10 < 53.2$$

Workstation meets ENERGY STAR requirements.