



ENERGY STAR® Program Requirements for Computer Servers

FINAL DRAFT

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ENERGY STAR® Program Requirements for Computer Servers

FINAL DRAFT: Partner Commitments

41

42 **Commitments**

43 The following are the terms of the ENERGY STAR Partnership Agreement as it pertains to the
44 manufacturing of ENERGY STAR qualified Computer Servers. The ENERGY STAR Partner must adhere
45 to the following program requirements:

- 46
- 47 • comply with current ENERGY STAR Eligibility Criteria, defining the performance criteria that must be
48 met for use of the ENERGY STAR certification mark on Computer Servers and specifying the testing
49 criteria for Computer Servers. EPA may, at its discretion, conduct tests on products that are referred to
50 as ENERGY STAR qualified. These products may be obtained on the open market, or voluntarily
51 supplied by Partner at EPA's request;
 - 52
 - 53 • comply with current ENERGY STAR Identity Guidelines, describing how the ENERGY STAR marks
54 and name may be used. Partner is responsible for adhering to these guidelines and for ensuring that
55 its authorized representatives, such as advertising agencies, dealers, and distributors, are also in
56 compliance;
 - 57
 - 58 • qualify at least one ENERGY STAR Computer Server within one year of activating the Computer
59 Servers' portion of the agreement. When Partner qualifies a product, it must meet the specification
60 (e.g., Tier 1 or 2) in effect at that time;
 - 61
 - 62 • provide clear and consistent identification of ENERGY STAR qualified Computer Server families and
63 configurations. Partner must use the ENERGY STAR mark in all of the following ways:
64
 - 65 1. The ENERGY STAR mark will be included on the Computer Server manufacturer's Internet site
66 specification sheet where product information is displayed and configurations are provided:
 - 67 – This ENERGY STAR mark will also serve as a link from the manufacturer's specification sheet
68 to the corresponding *Power and Performance Data Sheet* for the qualified configuration or
69 Product Family.
 - 70 2. The ENERGY STAR mark will be included on the ENERGY STAR *Power and Performance Data*
71 *Sheet*, and
 - 72 3. The ENERGY STAR mark shall be used to identify qualified Product Families and/or
73 configurations in collateral materials, which could include, but not be limited to: user manuals,
74 product guides, marketing brochures, etc.
 - 75 If additional information about the ENERGY STAR program(s) or other products is provided by the
76 Partner on its Web site, the ENERGY STAR Web Linking Policy should be followed. The Web Linking
77 Policy can be found in the Partner Resources section on the ENERGY STAR Web site at
78 www.energystar.gov.
 - 79 • Work with Value Added Resellers (VARs) of Partner's products to help ensure that Computer Servers
80 remain in compliance with ENERGY STAR requirements. Any party within the distribution channel of
81 an ENERGY STAR qualified Computer Server that alters the power profile of a product after its date of
82 manufacture through hardware or software modifications must ensure that the product continues to
83 meet the ENERGY STAR requirements before delivering this product to the end customer. If the
84 product no longer meets the requirements, it may not bear the ENERGY STAR mark.
85

86 If a VAR makes any modifications to a product that was previously qualified under this Version 1.0
87 specification, re-brands the product, and promotes it as ENERGY STAR, it must become an ENERGY
88 STAR Partner and follow the requirements outlined in this Version 1.0 specification.
89

- 90 • provide to EPA, on an annual basis, an updated list of ENERGY STAR qualifying Computer Server
91 models. Once the Partner submits its first list of ENERGY STAR qualified Computer Servers, the
92 Partner will be listed as an ENERGY STAR Partner. Partner must provide annual updates in order to
93 remain on the list of participating product manufacturers;
94
- 95 • provide to EPA, on an annual basis, unit shipment data or other market indicators to assist in
96 determining the market penetration of ENERGY STAR. Specifically, Partner must submit the total
97 number of ENERGY STAR qualified Computer Servers shipped (in units by model) or an equivalent
98 measurement as agreed to in advance by EPA and Partner. Partner is also encouraged to provide
99 ENERGY STAR qualified unit shipment data segmented by meaningful product characteristics (e.g.,
100 capacity, size, speed, or other as relevant), total unit shipments for each model in its product line, and
101 percent of total unit shipments that qualify as ENERGY STAR. The data for each calendar year should
102 be submitted to EPA, preferably in electronic format, no later than the following March and may be
103 provided directly from the Partner or through a third party. The data will be used by EPA only for
104 program evaluation purposes and will be closely controlled. If requested under the Freedom of
105 Information Act (FOIA), EPA will argue that the data is exempt. Any information used will be masked
106 by EPA so as to protect the confidentiality of the Partner;
107
- 108 • notify EPA of a change in the designated responsible party or contacts for Computer Servers within 30
109 days.
110

111 **Performance for Special Distinction**

112 In order to receive additional recognition and/or support from EPA for its efforts within the
113 Partnership, the ENERGY STAR Partner may consider the following voluntary measures and should keep
114 EPA informed on the progress of these efforts:
115

- 116 • consider energy efficiency improvements in company facilities and pursue the ENERGY STAR mark for
117 buildings;
118
- 119 • purchase ENERGY STAR qualified products. Revise the company purchasing or procurement
120 specifications to include ENERGY STAR. Provide procurement officials' contact information to EPA for
121 periodic updates and coordination. Circulate general ENERGY STAR qualified product information to
122 employees for use when purchasing products for their homes;
123
- 124 • ensure the power management feature is enabled on all ENERGY STAR qualified monitors in use in
125 company facilities, particularly upon installation and after service is performed;
126
- 127 • provide general information about the ENERGY STAR program to employees whose jobs are relevant
128 to the development, marketing, sales, and service of current ENERGY STAR qualified product models;
129
- 130 • feature the ENERGY STAR mark(s) on Partner Web site and in other promotional materials. If
131 information concerning ENERGY STAR is provided on the Partner Web site as specified by the
132 ENERGY STAR Web Linking Policy (this document can be found in the Partner Resources section on
133 the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where appropriate to the
134 Partner Web site;
135
- 136 • provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the
137 program requirements listed above. By doing so, EPA may be able to coordinate, communicate,
138 and/or promote Partner's activities, provide an EPA representative, or include news about the event in
139 the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may be as simple
140 as providing a list of planned activities or planned milestones that Partner would like EPA to be aware
141 of. For example, activities may include: (1) increase the availability of ENERGY STAR labeled

- 142 products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2)
143 demonstrate the economic and environmental benefits of energy efficiency through special in-store
144 displays twice a year; (3) provide information to users (via the Web site and user's manual) about
145 energy-saving features and operating characteristics of ENERGY STAR qualified products, and (4)
146 build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on
147 one print advertorial and one live press event;
148
- 149 • provide quarterly, written updates to EPA as to the efforts undertaken by Partner to increase availability
150 of ENERGY STAR qualified products, and to promote awareness of ENERGY STAR and its message.
151
 - 152 • join EPA's SmartWay Transport Partnership to improve the environmental performance of the
153 company's shipping operations. SmartWay Transport works with freight carriers, shippers, and other
154 stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air
155 pollution. For more information on SmartWay, visit www.epa.gov/smartway.
156
 - 157 • join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through
158 participation companies create a credible record of their accomplishments and receive EPA recognition
159 as corporate environmental leaders. For more information on Climate Leaders, visit
160 www.epa.gov/climateleaders.
161
 - 162 • join EPA's Green Power partnership. EPA's Green Power Partnership encourages organizations to buy
163 green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based
164 electricity use. The partnership includes a diverse set of organizations including Fortune 500
165 companies, small and medium businesses, government institutions as well as a growing number of
166 colleges and universities, visit <http://www.epa.gov/grnpower>.



ENERGY STAR® Program Requirements for Computer Servers

FINAL DRAFT: Eligibility Criteria

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172 Below is the **Version 1.0 FINAL DRAFT** product specification for ENERGY STAR qualified Computer
173 Servers. A product must meet all of the identified criteria if it is to earn the ENERGY STAR.

174

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

176

177 A. Computer Server: A computer that provides services and manages networked resources for client
178 devices, e.g., desktop computers, notebook computers, thin clients, wireless devices, PDAs, IP
179 telephones, other Computer Servers and other networked devices. Computer Servers are sold
180 through enterprise channels for use in data centers and office/corporate environments. Computer
181 Servers are designed to respond to requests and are primarily accessed via network connections,
182 and not through direct user input devices such as a keyboard, mouse, etc. In addition, Computer
183 Servers **must have all** of the following characteristics:

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- Marketed and sold as a Computer Server;
- Designed for and listed as supporting Computer Server Operating Systems (OS) and/or hypervisors, and targeted to run user-installed enterprise applications;
- Support for error-correcting code (ECC) and/or buffered memory (including both buffered DIMMs and buffered on board (BOB) configurations);
- Packaged and sold with one or more AC-DC or DC-DC power supply(s);
- Includes at least one installed hard drive able to store and boot a local operating system or hypervisor; and
- All processors have access to shared system memory and are independently visible to a single OS or hypervisor.

196 **Note:** EPA added language to the definition above to clarify that a Computer Server must include at
197 least one installed hard drive to be eligible for ENERGY STAR. This requirement was added because
198 the current ENERGY STAR Idle test procedure, provided in Appendix A of this specification, does not
199 contain provisions for testing systems without hard drives.

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B. Blade System: A system composed of both a Blade Chassis and one or more removable Blade Servers or Blade Storage units. Blade Systems are designed as a scalable solution to efficiently package and operate multiple Computer Servers or Storage units in a single enclosure, and are designed for technicians to be able to easily add or replace hot-swappable Computer Server boards (e.g., Blade Servers) in the field.

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C. Blade Chassis: An enclosure containing shared resources for the operation of Blade Servers and Blade Storage units. These resources may include power supply(s) for power conversion, shared storage, and hardware for DC power distribution, thermal management, system management, and network services. A Blade Chassis features multiple slots which can be populated with blades of different types.

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Computer Server Types

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D. Blade Server: A Computer Server consisting of, at minimum, a processor and system memory that relies on shared resources (e.g., power supply, cooling, etc.) for operation. Blade Servers are designed to be installed in a Blade Chassis, are hot-swappable and are incapable of operating independent of the chassis.

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E. Direct Current (DC) Server: A Computer Server with a DC-DC power supply which runs directly off of DC power.

- 223 F. Fully Fault Tolerant Server: A Computer Server designed with complete redundancy, in which
224 every computing component is replicated between two nodes running identical and concurrent
225 workloads. If one node fails or needs repair, the second node can run the workload alone to avoid
226 any downtime. A Fully Fault Tolerant Server uses two systems to simultaneously and repetitively
227 run a single workload for continuous availability in a mission critical application.
228
- 229 G. Managed Server: Computer Servers designed for a high level of availability in a highly managed
230 environment. A Managed Server **must have all** of the following characteristics:
231
- 232 • Capability to operate with redundant power supplies; and
 - 233 • An installed dedicated management controller (e.g., service processor).
- 234
- 235 H. Dual-Node Servers: A Dual-Node Server consists of two independent Computer Servers (or
236 nodes) contained in a single enclosure and sharing one or more power supplies. The combined
237 power for all nodes is distributed through the shared power supply(s). Dual-Node Servers are
238 designed and built as a single enclosure and are not designed to be hot-swappable.
239
- 240 I. Multi-Node Server: For purposes of this specification, a Multi-Node Server consists of more than
241 two independent Computer Servers (or nodes) contained in a single enclosure and sharing one or
242 more power supplies. The combined power for all nodes is distributed through the shared power
243 supply(s). Multi-Node Servers are designed and built as a single enclosure and are not designed
244 to be hot-swappable.
245

Note: EPA has added a definition for Multi-Node Servers and modified the definition of Dual-Node Servers to provide further clarification regarding product eligibility. Multi-Node Servers (i.e., greater than two nodes) are not eligible for ENERGY STAR under this Version 1.0 specification. In addition, text has been added to both definitions regarding the inability to be hot-swappable to delineate these product types from Blade Servers. Blade definitions have also been updated accordingly.

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- 252 J. Server Appliance: A self-contained Computer Server system bundled with a pre-installed
253 operating system and application software that is used to perform a dedicated function or set of
254 tightly coupled functions. Server Appliances deliver services through one or more networks (e.g,
255 IP or SAN), and are typically managed through a web or command line interface. Server
256 Appliance hardware and software configurations are customized by the vendor to perform a
257 specific task, and are not intended to execute user-supplied software. Example services that may
258 be made available via a Server Appliance include: name services, firewall services, authentication
259 services, encryption services, and voice-over-IP (VoIP) services.
260

261 **Other Data Center Equipment**

262

- 263 K. Blade Storage: A storage-specific element that relies on shared resources (e.g., power supply,
264 cooling, etc.) for operation. Blade Storage units are designed to be installed in a Blade Chassis,
265 are hot-swappable and are incapable of operating independent of the chassis.
266
- 267 L. Network Equipment: A product whose primary function is to provide data connectivity among
268 devices connected to its several ports. Data connectivity is achieved via the routing of data
269 packets encapsulated according to Internet Protocol, Fibre Channel, InfiniBand or similar protocol.
270 Examples of network equipment commonly found in data centers are routers and switches.
271
- 272 M. Storage Equipment: A system composed of integrated storage controllers, storage devices (e.g.
273 disk drives) and software that provides data storage services to one or more Computer Servers.
274 While storage equipment may contain one or more embedded processors, these processors do
275 not execute user-supplied software applications but may execute data-specific applications (e.g.
276 data replication, backup utilities, data compression, install agents, etc.).
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281 **Computer Server Components**

- 282
- 283 N. Computer Server Power Supply Unit (PSU): A self-contained Computer Server component which
- 284 converts a voltage input to one or more DC voltage outputs for the purpose of powering the
- 285 Computer Server. The input voltage can be from either an AC or DC source. A Computer Server
- 286 power supply must be separable from the main computer board and must connect to the system
- 287 via a removable or hard-wired male/female electrical connection, cable, cord or other wiring (i.e.
- 288 separate from, and not integrated with, the system motherboard).
- 289
- 290 O. AC-DC Power Supply: A power supply which converts line voltage AC input power into one or
- 291 more different DC outputs for the purpose of powering the Computer Server.
- 292
- 293 P. DC-DC Power Supply: A power supply which converts a DC voltage input to one or more different
- 294 DC voltage outputs for the purpose of powering the Computer Server. Any DC-to-DC converters
- 295 (also known as voltage regulators) internal to the product and used to convert low DC voltage
- 296 (e.g. 12 V DC) into other DC voltages for use by Computer Server components are not considered
- 297 DC-DC power supplies under this specification.
- 298
- 299 Q. Single-Output Power Supply: A power supply which delivers most of its rated power through one
- 300 primary DC output for the purpose of powering the Computer Server. Single-Output power
- 301 supplies may include one or more standby outputs which remain active whenever connected to an
- 302 input power source. There may be additional outputs besides the primary output and standby
- 303 outputs, however, the combined power from all additional outputs must be no greater than 20
- 304 watts. **Note:** Power supplies with multiple outputs at the primary voltage are considered a Single-
- 305 Output Power Supply, unless these outputs are either, (1) generated from separate converters or
- 306 have separate output rectification stages, and/or (2) have independent current limits.
- 307
- 308 R. Multi-Output Power Supply: A power supply which delivers its power through more than one
- 309 primary output, including one or more standby outputs which remain active whenever connected
- 310 to an input power source. For Multi-Output Supplies, the combined power from additional outputs
- 311 other than the primary and standby outputs is greater than 20 watts. This definition also applies to
- 312 power supplies with multiple outputs at the same voltage that do not meet the definition of a
- 313 Single-Output Power Supply, above.
- 314

Note: Based on stakeholder comments, EPA has altered the definitions for Single-Output and Multi-Output Power Supplies to further clarify how to classify units with multiple outputs at a single voltage.

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- 317
- 318 S. I/O Devices: Devices which provide data input and output capability to the Computer Server from
- 319 other networked devices. I/O Devices can either be integral to the main computer board or can be
- 320 separate devices connected through expansion slots such as PCI or PCIe. Examples of I/O
- 321 Devices include: Ethernet devices, InfiniBand devices, external RAID/SAS controllers and Fibre
- 322 Channel devices.
- 323
- 324 T. I/O Port: Physical circuitry within an I/O Device where an independent I/O session can be
- 325 established. A port is not the same as a connector receptacle; it is possible that a single
- 326 receptacle that accepts a single connector can service multiple ports of the same interface.
- 327

Note: RAID/SAS controllers are now listed as examples of acceptable I/O Devices under this specification. These controllers are now eligible for the additional Idle power allowances for I/O Devices presented in Section 3.B, below. A new definition for I/O Port has also been added to clarify how the “per port” allowances for I/O Devices presented in Table 4, below, shall be applied in determining the maximum Idle power consumption level allowed for qualification.

333

334 **Other Key Terms**

335
336 U. Idle: An operational state in which the operating system and other software have completed
337 loading and the Computer Server is capable of completing workload transactions, but no active
338 workload transactions are requested or pending by the system (i.e., the Computer Server is
339 operational, but not processing any useful work).

340
341 V. Product Family: A group of Computer Server configurations where every configuration includes
342 base components with the same or similar technical specifications and power specifications. In
343 order to be considered a Product Family, all configurations must:

- 344
345
- Use the same model motherboard;
 - Use the same number of processors. All processors must be represented by the same model
347 line and have identical power specifications and core counts (e.g., processors may vary in
348 speed within the same power specification within a given model line); and
 - Incorporate the same model, with the same technical and power specifications, for the base
349 components listed below (the relative numbers of these components may vary within the
350 family):
 - Power supply(s)
 - Memory DIMM(s)
 - Hard drive(s)
 - I/O Device(s)
- 351
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357 A configuration does not need to incorporate every base component listed above to be
358 considered as part of a qualified Product Family. For example, a configuration without add-in
359 I/O Devices may be included as a base configuration in a Product Family with any number of
360 additional I/O Devices included in other configurations.

361
362 **Note:** EPA received several comments that processor models are typically grouped by power and
363 then further characterized based on speed within each particular model. Based on this feedback, EPA
364 has amended the product family definition above to allow for varying processor speed within the same
365 family as long as the processor model and power profiles are identical.

366
367 W. Maximum Configuration: The Maximum Configuration is a highly configured system that includes
368 the combination of power supplies, memory, hard drives, I/O Devices, etc. which provide the
369 maximum possible power consumption within a Product Family.

370
371 **Note:** EPA removed the text describing the Maximum configuration as being the “highest performance
372 system”. Instead, the Maximum Configuration must represent the highest power consumption model
373 within the family.

374
375 X. Minimum Configuration: A base-model system that is minimally configured and represents the
376 lowest possible power consumption within a Product Family. Such a system would typically have
377 the minimum number of power supplies, the least amount of system memory, a single hard drive,
378 and a single I/O Device (either integrated or add-in). The Minimum Configuration must be
379 currently available and sold in the marketplace (i.e. the system shall be minimally configured but
380 not under-configured to a point which is unreasonable).

381
382 Y. Typical Configuration: An intermediate configuration between the Maximum Configuration and
383 Minimum Configuration of a Product Family. The Typical Configuration shall be representative of
384 a configuration with high volume sales which contains a typical number of hard drives and I/O
385 Devices, an average amount of installed memory, etc.

386
387 **2) Qualifying Products:** A Computer Server must meet the definition provided in Section 1.A, above,
388 to be eligible for ENERGY STAR qualification under this specification. The Tier 1 specification
389 coverage is limited to Computer Servers having at most four processor sockets (i.e. Computer Servers
390 with 1 - 4 individual processor sockets). **Computer Servers with more than four processor**

391 **sockets are currently ineligible for ENERGY STAR qualification under the Tier 1 specification**
 392 **but will be considered for inclusion under Tier 2 requirements.**

393
 394 In addition to those products that do not meet the strict definition provided in Section 1.A, the following
 395 product types (as defined in Section 1, above) are **explicitly ineligible** for ENERGY STAR
 396 qualification:

- 397 • Blade Systems including Blade Servers and Blade Chassis
- 398 • Fully Fault Tolerant Servers
- 399 • Server Appliances
- 400 • Multi-Node Systems
- 401 • Storage Equipment including Blade Storage
- 402 • Network Equipment

403
 404 **Tier 2 Coverage:** For the Tier 2 specification, EPA intends to expand the coverage of this
 405 specification, and will investigate including the additional Computer Server types excluded in this Tier
 406 1 specification, including: systems with greater than four sockets, Blade Systems, Fully Fault Tolerant
 407 Servers, Server Appliances, and Multi-Node systems. EPA also intends to investigate covering
 408 Storage Equipment and Networking Equipment under separate future specifications.

409
 410 **Note:** EPA has excluded Blade Servers under this Version 1.0 specification. As such, Blade Servers
 411 are included in the list of product types above that are currently ineligible for ENERGY STAR. Despite
 412 efforts to collect Idle performance data for these product types, EPA only received one data point for
 413 purposes of analysis. Stakeholders have also expressed concern over the proposed method for
 414 measuring Idle power in Blade Servers, as they are much more complex than rack or pedestal
 415 servers. Addressing Blade Systems with processor power management requirements (similar to
 416 EPA's approach for three and four socket systems) is not feasible at this time because the reporting of
 417 Idle power consumption would still be required and there is currently no agreed upon test methodology
 418 for these systems. Furthermore, EPA continues to believe that Blade Systems can compete directly
 419 with single and dual socket Computer Servers and therefore, one and two socket Blades Servers
 420 should also be required to meet appropriate Idle levels. EPA will consider amending this specification
 421 to include Blade Systems at a later date based on whether a proper test method can be developed
 422 and performance data collected to assess appropriate levels for Idle power consumption. Language
 423 has also been included to further clarify that EPA intends to expand the scope of this specification
 424 under Tier 2, attempting to cover all server types defined in Section 1, above.

425
 426 **3) Efficiency Requirements for Qualifying Products:** A Computer Server must meet all the
 427 requirements provided in Sections 3.A – 3.D, below, to qualify as ENERGY STAR.

428
 429 **Tier 1 Requirements: Effective May 15, 2009**

430
 431 **A. Power Supply Efficiency Requirements**

432
 433 All power supplies used in Computer Servers eligible under this specification must meet the minimum
 434 efficiency requirements presented in Table 1, below.

435
Table 1: Efficiency Requirements for Computer Server Power Supplies

Power Supply Type	Rated Output Power	10% Load	20% Load	50% Load	100% Load
Multi-Output (AC-DC & DC-DC)	All Output Levels	N/A	82%	85%	82%
Single-Output (AC-DC & DC-DC)	≤ 500 watts	70%	82%	89%	85%
	> 500 - 1,000 watts	75%	85%	89%	85%
	> 1,000 watts	80%	88%	92%	88%

436
 437 In addition, power supplies must meet the minimum power factor requirements presented in Table 2,
 438 below, **for all loading conditions where the output power is greater than or equal to 75 watts.**

439 Manufacturers are still required to measure and report power factor values for loading conditions less
 440 than 75 watts to qualify for ENERGY STAR.
 441

Table 2: Power Factor Requirements for Computer Server Power Supplies

Power Supply Type	Rated Output Power	10% Load	20% Load	50% Load	100% Load
DC-DC (All)	All Output Levels	N/A	N/A	N/A	N/A
AC-DC Multi-Output	All Output Levels	N/A	0.80	0.90	0.95
AC-DC Single-Output	≤ 500 watts	0.65	0.80	0.90	0.95
	> 500 - 1,000 watts	0.65	0.80	0.90	0.95
	> 1,000 watts	0.80	0.90	0.90	0.95

Note: In response to stakeholder concerns regarding the variability of power factor measurements at low loading, EPA has included an exemption for any loading condition less than 75 watts output power. Partners are still required to test and report power factor at these conditions but do not have to meet the requirements for purposes of qualification. EPA also received comments from utility partners requesting increased power factor requirements at 100% load to meet the necessary levels for adoption by incentive programs. This comment echoes concern from other stakeholders asking for more stringent power factor requirements. Therefore, EPA has increased the Power Factor level for all power supplies to 0.95 at 100% load.

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 452 **B. Active Power Requirements**

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 454 **1. Single and Dual Processor Socket Computer Servers (1S & 2S)**

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 456 Computer Servers with two or fewer processor sockets must have an Idle power consumption which
 457 does not exceed the allowed maximum Idle power levels determined from Tables 3 and 4, below,
 458 based on the components installed in the system. These Idle power limits **are applicable to single
 459 and dual socket systems only** (e.g., a three or four socket system with only one or two processors
 460 installed would not be subject to this requirement). **Please note that all quantities in Tables 3 and 4
 461 refer to the number of components installed in the system, not the maximum number of
 462 components the system can support (e.g. installed processors, not processor sockets;
 463 installed memory, not supported memory; etc.).**

464
 465 Table 3 presents the Idle power allowance for a base Computer Server system (e.g., minimal memory,
 466 single power supply, one hard drive, minimal I/O configuration). One and Two processor (1P & 2P)
 467 Computer Servers meeting the definition for Managed Servers in Section 1.G, above, must use the
 468 base system Idle levels for Category B and Category D in Table 3, below. Any One or Two processor
 469 Computer Server not meeting the definition for Managed Servers (i.e. "Standard" servers) must meet
 470 the Standard Computer Servers levels for Category A and C in Table 3, below.
 471

Table 3: Base System Idle Power Requirements

Computer Server System Type	Idle Power Limit
Category A: Standard Single Installed Processor (1P) Servers	55.0 watts
Category B: Managed Single Installed Processor (1P) Servers	65.0 watts
Category C: Standard Dual Installed Processor (2P) Servers	100.0 watts
Category D: Managed Dual Installed Processor (2P) Servers	150.0 watts

472
 473 Table 4 presents additional Idle power allowances for systems with additional capabilities above that
 474 of a base configuration. Systems with multiple add-ins are granted all applicable allowances.

Table 4: Additional Idle Power Allowances for Extra Components

System Characteristic	Applies To:	Additional Idle Power Allowance
Additional Power Supplies	Power supplies installed explicitly for power redundancy ¹	20.0 watts per Power Supply
Additional Hard Drives	Installed hard drives greater than one	8.0 watts per Hard Drive
Additional Memory	Installed memory greater than 4 GB ²	2.0 watts per GB ²
Additional I/O Devices	Installed Devices greater than two onboard, 1 Gigabit (Gbit) Ethernet ports ³	< 1Gbit ⁴ : No Allowance = 1 Gbit ⁴ : 2.0 watts / Active Port ⁵ > 1 Gbit ⁴ and < 10 Gbit ⁴ : 4.0 watts / Active Port ⁵ ≥ 10 Gbit ⁴ : 8.0 watts / Active Port ⁵

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*** Notes on Additional Power Allowances:**

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Note: Several stakeholders submitted data on I/O Devices to EPA. Based on this data, EPA has modified the I/O Device allowances to be technology neutral and based only on the link speed and the number of active ports on the device. This technology neutral approach recognizes the variety of I/O technologies available in the marketplace, provides Computer Server manufacturers greater design flexibility, and allows different I/O technologies to compete on energy efficiency. This approach has also allowed EPA to incorporate allowances for external RAID and SAS controllers despite receiving limited data for these devices. The masked data set used to create these levels is available on the ENERGY STAR Computer Server development Web site at www.energystar.gov/NewSpecs. In addition, and in response to multiple stakeholder comments, EPA has modified and rearranged the text above for added clarity.

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To determine the maximum Idle power consumption levels for ENERGY STAR qualification, manufacturers shall use the base system Idle level from Table 3, based on installed processors and level of manageability, and then add power allowances from Table 4, where appropriate. An example is provided below:

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EXAMPLE: A standard single processor Computer Server with 4 GB of memory and a single hard drive could consume no more than 55.0 watts in Idle to qualify for ENERGY STAR. The same Computer Server with an additional hard drive would be provided with an additional 8.0 watt allowance and therefore, could consume no more than 63.0 watts in Idle. If this server was then upgraded to 8.0 GB of memory, it would be granted another 8.0 watts (4 extra GB x 2.0 watts/GB) and would be expected to consume no more than 71.0 watts in Idle.

Dual-Node Servers: Dual-Node Servers with one or two sockets per node must meet the above Idle power levels on a per node basis, provided each node in the system is identical in configuration and

519 uses identical components. In this case, the Idle power per node would be found by measuring the
520 combined Idle power of the whole unit (including both Computer Server nodes), as outlined in the Idle
521 power test procedure in Appendix A of this specification, and dividing that total Idle power by two. For
522 example, if two Computer Server nodes share a single power supply, the combined Idle power of the
523 two Computer Servers (measured through the single power supply) would be measured and then the
524 result would be divided by two. The resulting Idle power per node would need to meet the
525 requirements presented in Tables 3 and 4, above, based on the per node configuration, to qualify for
526 ENERGY STAR. However, the full Idle power of the complete system (including both nodes) must be
527 reported on the *Power and Performance Data Sheet*, as presented in Section 3.C of this specification.

528 **2. Computer Servers with Greater than Two Processor Sockets (3S & 4S)**

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530
531 All three and four socket Computer Servers must enable processor level power management to
532 reduce power use of the processor during times of low utilization such as Idle, and these systems are
533 not subject to Idle power limits under this Version 1.0 specification. **Systems must be shipped with**
534 **this power management functionality enabled** in the system BIOS, and/or a management controller
535 or service processor. All systems shipping with a preinstalled supervisor system (operating system or
536 hypervisor) must also have this power management functionality enabled by default in the supervisor
537 system. This requirement is not applicable to 1S and 2S Computer Servers, though manufacturers
538 are encouraged to use these techniques in 1S and 2S Computer Servers to reduce power
539 consumption in Idle.

540
541 In order to meet this requirement, all processors must be able to reduce power consumption in times
542 of low utilization, by either:

- 543 • Reducing voltage and/or frequency through Dynamic Voltage and Frequency Scaling (DVFS), or
- 544 • Using processor or core reduced power states when a core or socket is not being used.

545
546 As with all Computer Servers covered under this specification, Partners must disclose all power
547 management techniques that are enabled upon product shipment on the *Power and Performance*
548 *Data Sheet* described in Section 3.C of this specification.

549
550 **Dual Node Servers:** Dual-Node Servers with three or four sockets per node must also meet this
551 processor power management requirement.

552 **C. Standard Information Reporting Requirements**

553
554
555 Partners must provide a standardized *Computer Server Version 1.0 Power and Performance Data*
556 *Sheet* with each ENERGY STAR qualified Computer Server. This information must be posted on the
557 Partner's Web site where information on the qualified model, or qualified configurations, is posted.
558 Partners are encouraged to provide one data sheet per qualified configuration, but may also provide
559 one data sheet per Product Family (as defined in Section 1.V above) with data on the Computer
560 Server's power and performance in Maximum, Minimum and Typical configurations as defined in
561 Sections 1.W through 1.Y.

562
563 If one data sheet is used to represent many configurations under one Product Family, partners shall,
564 when available, also provide a link to a more detailed power calculator where information on the
565 power consumption of specific system configurations can be found.

566
567 Templates for the *Server Version 1.0 Power and Performance Data Sheet* can be found on the
568 ENERGY STAR Web page for Computer Servers at www.energystar.gov/products. Partners are
569 encouraged to use the referenced data sheet template, but may also create their own template
570 provided that it is identical in format and design as the referenced template, and has been approved
571 by EPA. EPA may periodically revise this template, as necessary, and will notify Partners of the
572 revision process. Partners should always use the most recent version of the data sheet posted to the
573 ENERGY STAR Web site.

577 Each *Power and Performance Data Sheet* must include the following information:

- 578 1. Model name and number, identifying SKU and/or configuration ID;
- 579 2. System Characteristics (form factor, available sockets/slots, power specifications, etc.);
- 580 3. System configuration(s) (including maximum, minimum and typical configurations for product
- 581 family qualification);
- 582 4. Power data for Idle and full load, estimated kWh/year, link to power calculator (where
- 583 available);
- 584 5. Additional power and performance data for at least one benchmark chosen by the Partner;
- 585 6. Available and enabled power saving features (e.g., power management);
- 586 7. Information on the power measurement and reporting capabilities of the Computer Server;
- 587 8. Select thermal information from the ASHRAE thermal report; and
- 588 9. A list of additional qualified SKUs or configuration IDs, along with specific configuration
- 589 information (for Product Family Qualification only).
- 590

Note: A list of required information for the *Power and Performance Data Sheet* has been added and additional guidance provided regarding the format and design of the data sheet template. EPA **strongly encourages** stakeholders to provide additional comments on the Final Draft *Power and Performance Data Sheet* and will continue to work with stakeholders to refine the content and format of the template.

597 D. Data Measurement and Output Requirements

598
599 **Standardized Data Measurement:** One and two socket (1S and 2S) Computer Servers which meet
600 the definition of a Managed Server in Section 1.G and all Computer Servers with greater than two
601 sockets (3S and 4S) must have the ability to provide data on input power consumption in watts, inlet
602 air temperature, and utilization of all logical CPUs during normal operation. **Single socket and dual**
603 **socket (1S and 2S) products that do not meet the definition of a Managed Server are exempt**
604 **from this requirement.**
605

606 To meet the data measurement and output requirements, Computer Servers may rely on a service
607 processor, embedded power or thermal meter (or other out-of-band technology shipped with the
608 Computer Server), or preinstalled operating system to collect data and make it available for collection
609 and dissemination over a standard network to third-party management systems such as a data center
610 management software suite. Data must be made available in a published or user accessible format so
611 as to be readable by third-party, non-proprietary management systems. All systems shipped with
612 preinstalled operating systems must have all necessary drivers/software installed to make this
613 information openly available. For systems not shipped with an operating system, documentation of
614 how to access the registers containing the relevant sensor information must be provided in user
615 manuals and online documentation. In addition, when an open and universally available standard
616 becomes available to report and collect this data, manufacturers should incorporate the universal
617 standard into their systems.
618

619 **Note:** Based on stakeholder comments, EPA has removed the word “open” in reference to the
620 available data format and replaced it with “published or user accessible” as this will allow for
621 proprietary formats as long as they are published or accessible. EPA believes this meets the intention
622 of having the information available for 3rd party, non-proprietary, monitoring systems without restricting
623 solutions to open standards.
624

625 **Required Accuracy:** All measurements must meet the following accuracy levels within typical
626 operating conditions of the Computer Server:
627

- 628 • Input power measurements:
 - 629 - Measurements greater than 100 watts: +/-10%
 - 630 - Measurements less than or equal to 100 watts: +/- 10 watts

631
632 **Note:** In response to stakeholder comments, EPA has changed the power measurement accuracy
633 requirement to a straight wattage requirement at low loads. EPA has chosen +/- 10 watts for low
634 loads, which will result in the required accuracy being continuous at the cutoff of 100 watts.

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- Processor utilization measurements: +/-5% accuracy for CPU utilization, where utilization ($U_{t_{proc}}$) is expressed for each logical CPU (equivalent to the number of independent CPUs presented to the OS), per core, per socket, and defined as:

$$U_{t_{proc}} = (1 - T_{IDLE\%}) * (F_A / F_S)$$

Where:

$T_{IDLE\%}$ = OS idle time% for the time slice

F_A = average frequency for the time slice (average frequency of the CPU during the time slice including any overclocking of the CPU during that time)

F_S = CPU frequency specification (i.e. maximum frequency not accounting for any temporary bursts of clock frequency)

Note: Stakeholders expressed concerns that the processor utilization accuracy requirements proposed in Draft 4 would be difficult to meet due to transient processor frequencies from processor level power management and performance state transitions. In response, EPA has included a new definition for processor utilization based on the time in Idle, the average frequency, and the frequency specification which takes into account these issues.

- Inlet air temperature measurements: +/- 3° C

Sampling Requirements: Data must be averaged on either a rolling basis or over a manufacturer specified time period. The time period used for averaging must be reported on the *Power and Performance Data Sheet*. A default rolling average or time period of 30 seconds is recommended.

Note: The 1-second sampling requirement has also been removed and manufacturers may now institute a rolling average or averaging over a specific time period for measurements of input power. The time period or range of time periods available must be reported on the *Power and Performance Data Sheet*. EPA still plans to require a rolling average of data encompassing no greater than 30 seconds under Tier 2.

Tier 2 Requirements: Effective October 1, 2010

(1a) Tier 2: TBD

- OR -

(1b) Provisional Tier 2 Idle State Requirements. If an energy efficiency performance metric and associated performance levels are not available **by October 15, 2010**, a provisional Tier 2 specification will automatically go into effect and will remain in effect until such a metric is established. This provisional Tier 2 would include revised Idle power consumption requirements for all Computer Server types covered by Tier 1 of this specification with the intention of capturing the top 25% most energy efficient products at the time Tier 2 would become effective. In this scenario, EPA would also consider developing Idle levels for product types currently excluded from this specification (Section 2: Qualifying Products).

(2) Power Supply Requirements: EPA intends to explore a *Net Power Loss* approach for Computer Server power supplies under Tier 2 of this specification. This approach would aim to specify a maximum allowed power loss through the power supply at actual operating conditions of the Computer Server (e.g., Idle and full load power). If a *Net Power Loss* approach is not developed, EPA plans to reevaluate both Multi-Output and Single-Output power supply efficiency and power factor levels. At a minimum, EPA intends to eliminate the lower efficiency requirement for all Single-Output power supplies with less than or equal to 1000 W power output and requiring that all Single-Output power supplies meet the same efficiency levels (i.e., 80% efficiency at 10% load; 88% at 20% load; 92% at 50% load; and 88% at 100% load).

694 **(3) Data Measurement and Output Requirements:** EPA will require the Data Measurement and
695 Output Requirements presented in this Version 1.0 Computer Servers specification of **all** ENERGY
696 STAR qualified Computer Servers covered by the Tier 2 specification. EPA also plans to require a
697 rolling average of data encompassing no greater than 30 seconds under Tier 2.
698

699 **(4) Energy Efficient Ethernet:** EPA plans to investigate the use of the Energy Efficient Ethernet
700 (IEEE 802.3az) standard for all external physical layer Ethernet (e.g., 1 Gbit and 10 Gbit wired
701 Ethernet) following its ultimate approval by IEEE. More information on the developing standard can
702 be found at <http://grouper.ieee.org/groups/802/3/az/>.
703

Note: EPA continues to support the development of the IEEE 802.3az standard and is still very interested in investigating its potential inclusion under a future version of this specification. However, EPA also recognizes that a thorough review and evaluation of the standard, once finalized, will be required prior to determining whether it is appropriate for ENERGY STAR qualification under Tier 2. The note above regarding Energy Efficient Ethernet has been slightly revised to clarify this intention.

710 **4) Test Criteria:** Manufacturers are required to perform appropriate tests, as outlined below, in order to
711 determine ENERGY STAR qualification for a given configuration or Product Family. These required
712 tests include:

- 713 • **Power Supply Efficiency Testing** as outlined in Section 4.A for power supply efficiency
714 requirements and reporting on the *Power and Performance Data Sheet* for all Computer Servers.
- 715 • **Idle Testing** as outlined in Section 4.B for Idle power requirements of Single and Dual socket
716 Computer Servers, and for Idle power reporting of all Computer Servers on the *Power and*
717 *Performance Data Sheet*.

718
719 The results of those tests may be self-certified by the ENERGY STAR Partner, or by a third-party
720 laboratory on behalf of the Partner, and must be reported to EPA using the most current procedures
721 put in place by EPA at time of submittal (e.g. Qualified Product Information [QPI] form or Online
722 Product Submittal [OPS]). Models that are unchanged or that differ only in finish from those sold in a
723 previous year may remain qualified without the submission of new test data assuming the specification
724 remains unchanged.
725

726 **Tier 2 Accreditation Requirement for Testing Laboratories:** EPA is working toward a quality
727 assurance requirement for all testing conducted in support of qualification for ENERGY STAR. Ideally,
728 Computer Servers would be tested in an accredited, independent laboratory. To meet this
729 requirement, the testing laboratory would be accredited by an accreditation body that is a signatory, in
730 good standing, to a mutual recognition arrangement of a laboratory accreditation cooperation (e.g.,
731 International Laboratory Accreditation Cooperation, ILAC, Asia Pacific Laboratory Accreditation
732 Cooperation, APLAC) that verifies, by evaluation and peer assessment, that its signatory members
733 are in full compliance with ISO/IEC 17011 and that their accredited laboratories comply with ISO/IEC
734 17025. The laboratory's Scope of Accreditation would need to reflect their specific competence to
735 carry out the test procedures in this Section 4 of the ENERGY STAR requirements for Computer
736 Servers. Once finalized, EPA will include the new testing requirements under Tier 2, which will
737 provide manufacturers with sufficient time to either obtain accreditation or locate an accredited third-
738 party laboratory to conduct testing.
739

740 **A. Power Supply Testing**

741 Computer Server manufacturer Partners are required to guarantee power supplies have been tested
742 and found to comply with the power supply efficiency levels in Section 3.A of this specification. Testing
743 shall be conducted as follows:
744

- 745 • A Computer Server power supply must be tested for ENERGY STAR qualification using the **most**
746 **recent version of the** *Generalized Internal Power Supply Efficiency Test Protocol* maintained by
747 the Electric Power Research Institute (EPRI) and found at
748 <http://efficientpowersupplies.epri.com/methods.asp>.
749

750 **Note:** EPA has changed the reference to the power supply efficiency test method to indicate that
751 manufacturers must use the “most recent version” of the protocol for purposes of ENERGY STAR
752 testing and qualification. This avoids the need for future specification amendments to account for
753 additional revisions that might be made to the test procedure. EPA will continue to participate in
754 discussions regarding test procedure revisions to ensure continued relevance to ENERGY STAR.
755

756
757 **Additional Guidance on Power Supply Testing**

- 758 1. Power supplies shall be tested using the input test conditions specified in Table 5, below, and as
759 indicated in the above referenced test procedure. For AC-DC Multi-Output power supplies
760 capable of operating at both 230 and 115 Volts input, **testing shall be conducted at both input**
761 **voltages** for purposes of ENERGY STAR qualification. AC-DC Multi-Output power supplies
762 capable of operating at only one of these indicated voltages must test only at the applicable
763 voltage. Testing at 230 Volts may be done at either 50Hz or 60Hz.

764 **Table 5: Input Conditions for Power Supply Efficiency Testing**

Power Supply Type	Input Test Conditions
AC-DC Single-Output	230 Volts, 50Hz or 60 Hz
AC-DC Multi-Output	115 Volts, 60 Hz and/or 230 Volts, 50Hz or 60Hz
DC-DC	53 Volts or -53 Volts DC

765 **Note:** EPA has increased the test input condition provided for DC Servers and DC-DC power
766 supplies in Table 5, above, from $\pm 48V$ to $\pm 53V$. Based on several stakeholder comments, requiring
767 testing at this voltage will harmonize the specification with a number of industry accepted ANSI
768 Standards including ATIS-0600315-2007, ATIS-0600015.2009, and ATIS-0600015.01.2009. EPA
769 also understands that the power supply test procedure referenced above will be revised to
770 accommodate 53 VDC testing.
771

- 772 2. **10% Loading Condition:** As referenced in the power supply efficiency requirements in Section
773 3.A, all Single-Output power supplies must be tested at 10% loading in addition to the standard
774 20%, 50% and 100% loading conditions indicated in the test procedure.
775
- 776 3. **Fan Power:** As indicated in the power supply test procedure referenced above, Multi-Output
777 power supplies must be tested with internal fan power included in the measurement and efficiency
778 calculation. Single-Output power supplies must exclude fan power from the measurement and the
779 efficiency calculation.
780
- 781 4. **Efficiency and Power Factor Reporting:** Power supplies must meet the levels presented in
782 Tables 1 and 2 without the assistance of rounding. When submitting power supply efficiency and
783 power factor results, manufacturer shall report to the first decimal place (e.g. 85.2%) and three
784 decimal points (e.g., 0.856), respectively.
785

786 **B. Idle and Full Load Power Testing**

787 Partners must use the *ENERGY STAR Test Procedure for Determining the Power Use of Computer*
788 *Servers at Idle and Full Load*, included in **Appendix A** of this specification to measure Idle and full
789 load power consumption for purposes of ENERGY STAR qualification. All single socket (1S) and dual
790 socket (2S) Computer Servers must meet the Idle power levels presented in Tables 3 and 4 in section
791 3.B.1 depending on system configuration. Partner must test and report Idle and full load power
792 consumption test results for all Computer Servers, including three socket (3S) and four socket (4S)
793 Computer Servers.
794

- 795 1. **Test as shipped:** Computer Servers must be tested in their “as-shipped” configuration, unless
796 otherwise indicated in the referenced test procedures. For power consumption testing, all power
797 supplies must be connected and operational, and the as-shipped operating system or a
798 representative operating system (see 4.B.2, below) must be installed. For all tests, manufacturers
799 must ensure that the only power management techniques and/or power saving features enabled
800 on systems under test are those which are also enabled on shipment.
801

802 2. **Computer Servers shipped without a preinstalled operating system:** For Computer Servers
803 shipped without a pre-installed operating system, manufacturers must clearly indicate on the
804 *Power and Performance Data Sheet* (Section 3.B) which operating system was used in testing for
805 the purposes of ENERGY STAR qualification. In addition, as outlined in Appendix A, any power
806 management features which require the presence of an operating system (i.e. those that are not
807 explicitly controlled by the BIOS or management controller) must be tested using only those power
808 management features enabled by the operating system by default. Manufacturers must also
809 clearly indicate on the *Power and Performance Data Sheet* which power management features
810 were active during testing.

811
812 3. **Idle Reporting:** Computer Servers must meet the Idle power consumption levels determined from
813 Tables 3 and 4 without the assistance of rounding. When submitting Idle results, manufacturer
814 shall report power consumption to the first decimal place (e.g. 125.6 watts).
815

816 C. Qualifying Configurations and Families Under this Specification

817
818 Partners are encouraged to test and submit qualified product data on all individual configurations for
819 ENERGY STAR. However, a partner may qualify multiple configurations under one Product Family
820 designation as long as all of the configurations within that Product Family meet one of the following
821 requirements:
822

- 823 • Subsequent units are built on the same platform and are identical in every respect to the tested,
824 representative model except for housing and color.
- 825 • Subsequent units meet the requirements of a Product Family, as defined in Section 1.V, above. In
826 this case, partners must test and submit power data on a maximum and minimum configuration,
827 as defined in Sections 1.W and 1.X of this specification. Partners are also required to include a
828 *Power and Performance Data Sheet* for each Product Family as described in Section 3.C of this
829 specification.
830

831 All configurations associated with a Product Family, for which a Partner is seeking ENERGY STAR
832 qualification, must meet the ENERGY STAR requirements, including those for which data was not
833 reported. If a Partner wishes to qualify individual configurations within a Product Family for which non-
834 qualifying configurations exist, the Partner must assign the qualifying configurations an identifier in the
835 model name/number that is unique to ENERGY STAR Qualified configurations. This identifier must be
836 used consistently in association with the qualifying configurations in marketing/sales materials and on
837 the ENERGY STAR list of qualified products (e.g. model A1234 for baseline configurations and
838 A1234-ES for ENERGY STAR qualifying configurations).
839
840

841 5) **Effective Date:** The date that manufacturers may begin to label and promote qualifying products as
842 ENERGY STAR will be defined as the *effective date* of the agreement.

843
844 A. **Tier 1 Requirements:** The first phase of this specification will commence on **May 15, 2009**.

845
846 B. **Tier 2 Requirements:** The second phase of this specification, Tier 2, will commence on **October**
847 **15, 2010**. All products, including models originally qualified under Tier 1, with a **date of**
848 **manufacture** on or after **October 15, 2010**, must meet the Tier 2 requirements in order to qualify
849 for ENERGY STAR.
850

851 **Note:** EPA received several detailed comments on the Draft 4 specification, which required additional
852 research, data analysis, and discussions with industry members. Therefore, EPA is moving the effective
853 date from May 1 to May 15, 2009 to allow stakeholders a full two weeks to review this Final Draft and to
854 provide EPA sufficient time to finalize the document. As of this date, manufacturers who have signed onto
855 the ENERGY STAR program as a Partner, and submitted QPI forms for review and approval, may begin
856 promoting qualified models and families as ENERGY STAR. **Please note that stakeholders must**
857 **submit any final comments to EPA no later than May 8, 2009 to be considered prior to finalization.**
858

859 **6) Future Specification Revisions:** EPA reserves the right to change the specification should
860 technological and/or market changes affect its usefulness to consumers, industry, or the environment.
861 In keeping with current policy, revisions to the specification are arrived at through industry
862 discussions. In the event of a specification revision, please note that ENERGY STAR qualification is
863 not automatically granted for the life of a product model. To carry the ENERGY STAR mark, a product
864 model must meet the ENERGY STAR program requirements that are in effect on the date of product
865 manufacture.

APPENDIX A:

ENERGY STAR Test Procedure for Determining the Power Use of Computer Servers at Idle and Full Load

The following protocol shall be followed when testing Computer Servers for compliance with the Idle power consumption requirements provided in the ENERGY STAR Version 1.0 Computer Server Specification, and when acquiring test data for reporting Full Load power on the *Power and Performance Data Sheet*. Partners must measure a representative sample of the configuration as it would be shipped to the customer. However, the Partner does not need to consider power consumption changes made by the end-user that may result from component additions, BIOS and/or software settings made by the Computer Server end-user after purchase of the product. *This procedure is intended to be followed in the specified sequence.*

Computer Servers must be tested with configuration and settings as shipped, unless otherwise specified. Partners wishing to qualify Computer Servers that are shipped without operating systems must test the Computer Server with a representative operating system and make clear in all program literature which operating system and power management settings were used to qualify the model.

I. Definitions

Unless otherwise specified, all terms used in this document are consistent with the definitions contained in the Version 1.0 ENERGY STAR Eligibility Criteria for Computer Servers.

UUT

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

UPS

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

II. Testing Requirements

Required Power Analyzer Attributes

Approved analyzers will include the following attributes:

- Ability to measure true RMS power for all AC sources;
- An available current crest factor of 3 or more at its rated range value;
- 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) or similar relevant standards for other countries. Calibration must be current and within the past year.

Approved analyzers also must have the capability to either:

- Average power accurately over any user selected time interval (this is usually done with an internal calculation dividing accumulated energy by time within the analyzer, which is the most accurate approach); or
- Be capable of integrating energy over any user selected time interval and integrating time displayed with a resolution of 1 second or less.

Accuracy

Measurements of power of 0.5 W or greater shall be made with an uncertainty of less than or equal to 2% at the 95% confidence level. For all applicable loads, the power measurement instrument shall have a resolution of:

- 0.01 W or better for power measurements of 10 W or less;

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

All power figures shall be reported in watts and rounded to the first decimal place.

Test Conditions

Idle power consumption must be tested with the test conditions specified in the table below. Input voltage and frequency conditions for AC Powered Computer Servers are based on the power supply type (i.e. Single-Output vs. Multi-Output). **Computer Servers with Multi-Output PSUs must be tested at all applicable conditions (e.g., 115 V and/or 230 V) where the unit is capable of operating.**

Supply Voltage:	Servers with AC-DC Single-Output PSUs:	230 (± 1%) Volts AC, 50 Hz or 60 Hz (± 1%)
	Servers with AC-DC Multi-Output PSUs:	230 (± 1%) Volts AC, 50 Hz (± 1%) and/or, 115 (± 1%) Volts AC, 60 Hz (± 1%)
	DC Servers:	± 53 (± 1%) Volts DC
	Optional Testing Conditions For AC-DC Japanese Market†:	100 (± 1%) Volts AC, 50 Hz / 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:	18°C - 27°C	
Low End Moisture	5.5°C Dew Point	
High End Moisture:	60% Relative Humidity, 15°C Dew Point	

References:

- IEC 62301: Household Electrical Appliances – Measurement of Standby Power, Sections 4.2, 4.3, 4.4;
- 2008 ASHRAE Environmental Guidelines for Datacom Equipment, Table 1;
- ANSI ATIS-0600315-2007; and
- Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies – Revision 6.4.2, Section 5.2

†**Note on Japanese Test Voltage:** Partners must test at the above referenced standard voltages for products with Single-Output or Multiple-Output power supplies. However, products sold into the Japanese market may also be tested at the optional 100V testing condition, in addition to the 115V/230V conditions, for Idle and full load power testing.

Note: EPA has revised the ambient air temperature and moisture (humidity) specifications to coincide with the new ASHRAE Environmental Guidelines (2008). These are the conditions Computer Servers are most likely to see in a data center environment. A reference to ANSI ATIS-0600315-2007 has also been included for DC Powered system testing at ± 53 Volts.

Test Configuration

Power consumption of the UUT shall be measured and tested from an external AC or DC source to the UUT.

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

960 **Dual-Node Servers** must have identical configurations for each node including all hardware
961 components and software/power management settings. These systems must also be measured in a
962 way to ensure that all power from both nodes is being captured by the analyzer during the entire test.
963

964 III. Test Procedure for All Computer Server Products

965 Measurement of AC or DC power consumption of a Computer Server shall be conducted as follows:
966
967

968 A. UUT Preparation

- 969 1. Record the manufacturer and model name of the UUT. Also record all basic information about the
970 UUT's configuration including, operating system name and version, processor type and speed,
971 installed power supply(s), physical memory, hard drive configuration, installed I/O Devices, power
972 management features enabled, etc.
- 973 2. Ensure that the UUT is connected to a live Ethernet (IEEE 802.3) network switch as specified in
974 Section II., "Test Configuration," above. The UUT must maintain this live connection to the switch
975 for the duration of testing, disregarding brief lapses when transitioning between link speeds.
- 976 3. Connect an appropriate power analyzer (as defined in Section II, Testing Requirements) to an AC
977 or DC voltage source set to the appropriate voltage for the test. AC sources shall also be set to
978 the appropriate frequency for the test.
- 979 4. Plug the UUT into the measurement power outlet on the power analyzer, as follows:
 - 980 a. No UPS units may be connected between the power analyzer and the UUT.
 - 981 b. UUTs with multiple power supplies must have all power supplies connected and operational
982 during the test. If necessary, a PDU, or Power Distribution Unit (such as a simple plug
983 multiplier or power strip), may be used to connect multiple power supplies to a single source.
984 In this case, any overhead electrical use from the PDU must be included in the measurement
985 of Idle power for the UUT.
 - 986 c. For a valid test to take place the analyzer shall remain in place until all full load and Idle
987 power data is fully recorded.
- 988 5. Install the benchmark software intended for use to acquire power at full Load. This benchmark
989 shall be run when testing for full load power in Section B., below, and not during testing for Idle
990 power. Record the installed benchmark workload and configuration, including any custom
991 parameters or settings.
- 992 6. Record the AC or DC input voltage. Record the frequency for AC voltage sources.
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994 B. Measuring Full Load and Idle Power

- 995 1. Boot the UUT and wait until the operating system has fully loaded. If necessary, run the initial
996 system setup and allow all one-time/periodic processes to complete.
- 997 2. Ensure that the UUT is in an as-shipped configuration, including the operating system and all
998 other software included with the UUT by default. Maintain configuration and tuning parameters
999 throughout the testing process for both full load power and Idle power.
- 1000 3. The UUT must be configured using the following requirements for all tests:
 - 1001 a. The UUT must be configured with any applicable operating systems installed, and all user-
1002 configurable options should be set to their as-shipped settings. All other software must also be
1003 configured as shipped by default. If the UUT is shipped without an operating system, it must
1004 be tested with a representative operating system configured with only default settings.
 - 1005 b. Only those power management features that are enabled by default upon shipment may be
1006 enabled during testing. All power management features used during the test must be reported.
 - 1007 c. If the UUT is shipped without accessories, it shall be configured with a standard mouse,
1008 keyboard and external computer display (if server has display output functionality), or accessed
1009 through a remote access application that is appropriate for the UUT's operating system to
1010 monitor UUT Idle status.
 - 1011 d. Primary storage devices integral to the UUT must not be power managed ("spun-down") during
1012 Idle testing unless they contain non-volatile cache memory integral to the drive (e.g. "hybrid"
1013 hard drives). If more than one internal hard drive is installed as-shipped, the non-primary hard
1014 drive(s), including any shared hard drives installed in a Blade Chassis, must be tested with
1015 hard drive power management enabled as-shipped. If these additional drives are not power
1016 managed when shipped to customers, they must be tested without power management
1017 features enabled.

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4. Shut down the UUT.
 5. Switch on the UUT and begin recording elapsed time, starting either when the UUT is initially switched on, or immediately after completing any log in activity necessary to fully boot the system. Dual-Node Servers shall be booted and logged on concurrently. 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.
 6. Between 5 and 15 minutes after the initial boot or log in, set the analyzer to begin accumulating power values at an interval of greater than or equal to 1 reading per second and commence benchmark operation at the greatest possible output (e.g., 100% load). For benchmarks that measure multiple load points, only the greatest load point should be measured.
 7. At the end of benchmark operation, calculate and record the average (arithmetic mean) power at observed during benchmark operation at maximum load.
 8. Between 5 and 15 minutes after the full load benchmark test has been completed, accumulate power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period.

Note: Section B now includes test conditions and methodology for testing power consumption at full load in order to ensure that products are tested in the same configuration and same conditions used for Idle power testing.

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All test results must be reported to the EPA, European Commission or other relevant international body, as appropriate, taking care to ensure that all required information has been included, for purposes of ENERGY STAR qualification.