



# ENERGY STAR® Program Requirements Product Specification for Computer Servers

## Eligibility Criteria Draft 3, Version 3.0

1 Following is the Draft 3, Version 3.0 ENERGY STAR Product Specification for Computer Servers. A  
2 product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

### 3 **1 DEFINITIONS**

#### 4 A) Product Types:

- 5 1) Computer Server: A computer that provides services and manages networked resources for  
6 client devices (e.g., desktop computers, notebook computers, thin clients, wireless devices,  
7 PDAs, IP telephones, other computer servers, or other network devices). A computer server  
8 is sold through enterprise channels for use in data centers and office/corporate environments.  
9 A computer server is primarily accessed via network connections, versus directly-connected  
10 user input devices such as a keyboard or mouse. For purposes of this specification, a  
11 computer server must meet **all** of the following criteria:
- 12 A. is marketed and sold as a Computer Server;
  - 13 B. is designed for and listed as supporting one or more computer server operating systems  
14 (OS) and/or hypervisors;
  - 15 C. is targeted to run user-installed applications typically, but not exclusively, enterprise in  
16 nature;
  - 17 D. provides support for error-correcting code (ECC) and/or buffered memory (including both  
18 buffered dual in-line memory modules (DIMMs) and buffered on board (BOB)  
19 configurations).
  - 20 E. is packaged and sold with one or more ac-dc or dc-dc power supplies; and
  - 21 F. is designed such that all processors have access to shared system memory and are  
22 visible to a single OS or hypervisor.
- 23 2) Blade System: A system comprised of a blade chassis and one or more removable blade  
24 servers and/or other units (e.g., blade storage, blade network equipment). Blade systems  
25 provide a scalable means for combining multiple blade server or storage units in a single  
26 enclosure, and are designed to allow service technicians to easily add or replace (hot-swap)  
27 blades in the field.
- 28 A. Blade Server: A computer server that is designed for use in a blade chassis. A blade  
29 server is a high-density device that functions as an independent computer server and  
30 includes at least one processor and system memory, but is dependent upon shared blade  
31 chassis resources (e.g., power supplies, cooling) for operation. A processor or memory  
32 module that is intended to scale up a standalone server is not considered a Blade Server.
    - 33 (1) *Multi-bay Blade Server*: A blade server requiring more than one bay for installation in  
34 a blade chassis.
    - 35 (2) *Single-wide Blade Server*: A blade server requiring the width of a standard blade  
36 server bay.

- 37 (3) *Double-wide Blade Server*: A blade server requiring twice the width of a standard  
38 blade server bay.
- 39 (4) *Half-height Blade Server*: A blade server requiring one half the height of a standard  
40 blade server bay.
- 41 (5) *Quarter-height Blade Server*: A blade server requiring one quarter the height of a  
42 standard server bay.
- 43 (6) *Multi-Node Blade Server*: A blade server which has multiple nodes. The blade server  
44 itself is hot swappable, but the individual nodes are not.
- 45 B. Blade Chassis: An enclosure that contains shared resources for the operation of blade  
46 servers, blade storage, and other blade form-factor devices. Shared resources provided  
47 by a chassis may include power supplies, data storage, and hardware for dc power  
48 distribution, thermal management, system management, and network services.
- 49 C. Blade Storage: A storage device that is designed for use in a blade chassis. A blade  
50 storage device is dependent upon shared blade chassis resources (e.g., power supplies,  
51 cooling) for operation.
- 52 3) Fully Fault Tolerant Server: A computer server that is designed with complete hardware  
53 redundancy, in which every computing component is replicated between two nodes running  
54 identical and concurrent workloads (i.e., if one node fails or needs repair, the second node  
55 can run the workload alone to avoid downtime). A fully fault tolerant server uses two systems  
56 to simultaneously and repetitively run a single workload for continuous availability in a  
57 mission critical application.
- 58 4) Resilient Server: A computer server designed with extensive Reliability, Availability,  
59 Serviceability (RAS) and scalability features integrated in the micro architecture of the  
60 system, CPU and chipset. For purposes of ENERGY STAR certification under this  
61 specification, a Resilient Server shall have the following characteristics:
- 62 A. Processor RAS: The processor must have capabilities to detect, correct, and contain data  
63 errors, as described by all of the following:
- 64 (1) Error recovery by means of instruction retry for certain processor faults;
- 65 (2) Error detection on L1 caches, directories, and address translation buffers using parity  
66 protection; and
- 67 (3) Single bit error correction (or better) on caches that can contain modified data.  
68 Corrected data is delivered to the recipient as part of the request completion.
- 69 B. System Recovery & Resiliency: No fewer than six of the following characteristics shall be  
70 present in the server:
- 71 (1) Error recovery and containment by means of (a) data poison indication (tagging) and  
72 propagation which includes mechanism to notify the OS or hypervisor to contain the  
73 error, thereby reducing the need for system reboots and (b) containment of  
74 address/command errors by preventing possibly contaminated data from being  
75 committed to permanent storage;
- 76 (2) The processor technology is designed to provide additional capability and  
77 functionality without additional chipsets, enabling the design into systems with four or  
78 more processor sockets;
- 79 (3) Memory Mirroring: A portion of available memory can be proactively partitioned such  
80 that a duplicate set may be utilized upon non-correctable memory errors. This can be  
81 implemented at the granularity of DIMMs or logical memory blocks;
- 82 (4) Memory Sparing: A portion of available memory may be pre-allocated to a spare  
83 function such that data may be migrated to the spare upon a perceived impending  
84 failure;

- 85 (5) Support for making additional resources available without the need for a system  
 86 restart. This may be achieved either by processor (cores, memory, I/O) on-lining  
 87 support, or by dynamic allocation/deallocation of processor cores, memory, and I/O  
 88 to a partition;
- 89 (6) Support of redundant I/O devices (storage controllers, networking controllers);
- 90 (7) Has I/O adapters or storage devices that are hot-swappable;
- 91 (8) Can identify failing processor-to-processor lane(s) and dynamically reduce the width  
 92 of the link in order to use only non-failing lanes or provide a spare lane for failover  
 93 without disruption;
- 94 (9) Capability to partition the system such that it enables running instances of the OS or  
 95 hypervisor in separate partitions. Partition isolation is enforced by the platform and/or  
 96 hypervisor and each partition is capable of independently booting; and
- 97 (10) Uses memory buffers for connection of higher speed processor-memory links to  
 98 DIMMs attached to lower speed DDR channels. Memory buffer can be a separate,  
 99 standalone buffer chip which is integrated on the system board or integrated on  
 100 custom-built memory cards.
- 101 C. Power Supply RAS: All power supplies installed or shipped with the server shall be  
 102 redundant and concurrently maintainable. The redundant and repairable components  
 103 may also be housed within a single physical power supply, but must be repairable without  
 104 requiring the system to be powered down. Support must be present to operate the  
 105 system in a degraded mode.
- 106 D. Thermal and Cooling RAS: All active cooling components shall be redundant and  
 107 concurrently maintainable. The processor complex must have mechanisms to allow it to  
 108 be throttled under thermal emergencies. Support must be present to operate the system  
 109 in a degraded mode when thermal emergencies are detected in the system components.

110 **Note:** EPA received stakeholder feedback recommending changes to simplify the existing resilient server  
 111 definition to incorporate the necessary Appendix B language from Draft 2 directly into the specification.  
 112 The resulting definition above merges the essential characteristics for identifying resilient servers, while  
 113 shortening the existing definition significantly. EPA welcomes stakeholder feedback on the revised  
 114 definition.

- 115 5) Multi-node Server: A computer server that is designed with two or more independent server  
 116 nodes that share a single enclosure and one or more power supplies. In a multi-node server,  
 117 power is distributed to all nodes through shared power supplies. Server nodes in a multi-node  
 118 server are not designed to be hot-swappable.
- 119 A. Dual-node Server: A common multi-node server configuration consisting of two server  
 120 nodes.
- 121 6) Server Appliance: A computer server that is bundled with a pre-installed OS and application  
 122 software that is used to perform a dedicated function or set of tightly coupled functions.  
 123 Server appliances deliver services through one or more networks (e.g., IP or SAN), and are  
 124 typically managed through a web or command line interface. Server appliance hardware and  
 125 software configurations are customized by the vendor to perform a specific task (e.g., name  
 126 services, firewall services, authentication services, encryption services, and voice-over-IP  
 127 (VoIP) services), and are not intended to execute user-supplied software.
- 128 7) High Performance Computing (HPC) System: A computing system which is designed and  
 129 optimized to execute highly parallel applications for high performance, deep learning, and  
 130 artificial intelligence applications. HPC systems feature clustered nodes often featuring high  
 131 speed inter-processing interconnects as well as high memory capability and bandwidth. HPC  
 132 systems may be purposely built, or assembled from more commonly available computer  
 133 servers. HPC systems must meet ALL the following criteria:

- 134 A. Marketed and sold as a Computer Server optimized for higher performance computing,  
135 augmented or artificial intelligence, and deep learning applications;
- 136 B. Designed (or assembled) and optimized to execute highly parallel applications;
- 137 C. Consist of multiple computing nodes, clustered primarily to increase computational  
138 capability;
- 139 D. Includes high speed inter-processing interconnections between nodes.

140 **Note:** EPA received stakeholder feedback suggesting minor updates to the HPC definition to address  
141 recent advancements in the HPC market and has proposed revised language to address those changes.

- 142 8) Direct Current (dc) Server: A computer server that is designed solely to operate on a dc  
143 power source.
- 144 9) Large Server: A resilient/scalable server which ships as a pre-integrated/pre-tested system  
145 housed in one or more full frames or racks and that includes a high connectivity I/O  
146 subsystem with a minimum of 32 dedicated I/O slots.

147 B) Computer Server Form Factors:

- 148 1) Rack-mounted Server: A computer server that is designed for deployment in a standard 19-  
149 inch data center rack as defined by EIA-310, IEC 60297, or DIN 41494. For the purposes of  
150 this specification, a blade server is considered under a separate category and excluded from  
151 the rack-mounted category.
- 152 2) Pedestal/Tower Server: A self-contained computer server that is designed with PSUs,  
153 cooling, I/O devices, and other resources necessary for stand-alone operation. The frame of  
154 a pedestal server is similar to that of a tower client computer.

155 **Note:** EPA has clarified that pedestal and tower server form factors are equivalent for the purposes of this  
156 specification.

157 C) Computer Server Components:

- 158 1) Power Supply Unit (PSU): A device that converts ac or dc input power to one or more dc  
159 power outputs for the purpose of powering a computer server. A computer server PSU must  
160 be self-contained and physically separable from the motherboard and must connect to the  
161 system via a removable or hard-wired electrical connection.
- 162 A. Ac-Dc Power Supply: A PSU that converts line-voltage ac input power into one or more  
163 dc power outputs for the purpose of powering a computer server.
- 164 B. Dc-Dc Power Supply: A PSU that converts line-voltage dc input power to one or more dc  
165 outputs for the purpose of powering a computer server. For purposes of this specification,  
166 a dc-dc converter (also known as a voltage regulator) that is internal to a computer server  
167 and is used to convert a low voltage dc (e.g., 12 V dc) into other dc power outputs for use  
168 by computer server components is not considered a dc-dc power supply.
- 169 C. Single-output Power Supply: A PSU that is designed to deliver the majority of its rated  
170 output power to one primary dc output for the purpose of powering a computer server.  
171 Single-output PSUs may offer one or more standby outputs that remain active whenever  
172 connected to an input power source. For purposes of this specification, the total rated  
173 power output from any additional PSU outputs that are not primary and standby outputs  
174 shall be no greater than 20 watts. PSUs that offer multiple outputs at the same voltage as  
175 the primary output are considered single-output PSUs unless those outputs (1) are  
176 generated from separate converters or have separate output rectification stages, or (2)  
177 have independent current limits.
- 178 D. Multi-output Power Supply: A PSU that is designed to deliver the majority of its rated  
179 output power to more than one primary dc output for the purpose of powering a computer

180 server. Multi-output PSUs may offer one or more standby outputs that remain active  
181 whenever connected to an input power source. For purposes of this specification, the  
182 total rated power output from any additional PSU outputs that are not primary and  
183 standby outputs is greater than or equal to 20 watts.

184 2) I/O Device: A device which provides data input and output capability between a computer  
185 server and other devices. An I/O device may be integral to the computer server motherboard  
186 or may be connected to the motherboard via expansion slots (e.g., PCI, PCIe). Examples of  
187 I/O devices include discrete Ethernet devices, InfiniBand devices, RAID/SAS controllers, and  
188 Fibre Channel devices.

189 A. I/O Port: Physical circuitry within an I/O device where an independent I/O session can be  
190 established. A port is not the same as a connector receptacle; it is possible that a single  
191 connector receptacle can service multiple ports of the same interface.

192 3) Motherboard: The main circuit board of the server. For purposes of this specification, the  
193 motherboard includes connectors for attaching additional boards and typically includes the  
194 following components: processor, memory, BIOS, and expansion slots.

195 4) Processor: The logic circuitry that responds to and processes the basic instructions that drive  
196 a server. For purposes of this specification, the processor is the central processing unit  
197 (CPU) of the computer server. A typical CPU is a physical package to be installed on the  
198 server motherboard via a socket or direct solder attachment. The CPU package may include  
199 one or more processor cores.

200 5) Memory: For purposes of this specification, memory is a part of a server external to the  
201 processor in which information is stored for immediate use by the processor.

202 6) Storage Device: A collective term for disk drives (HDDs), solid state drives (SSDs), tapes  
203 cartridges, and any other mechanisms providing non-volatile data storage. This definition is  
204 specifically intended to exclude aggregating storage elements such as RAID array  
205 subsystems, robotic tape libraries, filers, and file servers. Also excluded are storage devices  
206 which are not directly accessible by end-user application programs, and are instead  
207 employed as a form of internal cache.

208 D) Other Datacenter Equipment:

209 1) Network Equipment: A device whose primary function is to pass data among various network  
210 interfaces, providing data connectivity among connected devices (e.g., routers and switches).  
211 Data connectivity is achieved via the routing of data packets encapsulated according to  
212 Internet Protocol, Fibre Channel, InfiniBand or similar protocol.

213 2) Storage Product: A fully-functional storage system that supplies data storage services to  
214 clients and devices attached directly or through a network. Components and subsystems that  
215 are an integral part of the storage product architecture (e.g., to provide internal  
216 communications between controllers and disks) are considered to be part of the storage  
217 product. In contrast, components that are normally associated with a storage environment at  
218 the data center level (e.g., devices required for operation of an external SAN) are not  
219 considered to be part of the storage product. A storage product may be composed of  
220 integrated storage controllers, storage devices, embedded network elements, software, and  
221 other devices. While storage products may contain one or more embedded processors, these  
222 processors do not execute user-supplied software applications but may execute data-specific  
223 applications (e.g., data replication, backup utilities, data compression, install agents).

224 3) Uninterruptible Power Supply (UPS)<sup>1</sup>: Combination of convertors, switches, and energy  
225 storage devices (such as batteries) constituting a power system for maintaining continuity of  
226 load power in case of input power failure.

<sup>1</sup> Input power failure occurs when voltage and frequency are outside rated steady-state and transient tolerance bands or when distortion or interruptions are outside the limits specified for the UPS.

227 E) Operational Modes and Power States:

228 1) Idle State: The operational state in which the OS and other software have completed loading,  
229 the computer server is capable of completing workload transactions, but no active workload  
230 transactions are requested or pending by the system (i.e., the computer server is operational,  
231 but not performing any useful work). For systems where ACPI standards are applicable, Idle  
232 State correlates only to ACPI System Level S0.

233 2) Active State: The operational state in which the computer server is carrying out work in  
234 response to prior or concurrent external requests (e.g., instruction over the network). Active  
235 state includes **both** (1) active processing and (2) data seeking/retrieval from memory, cache,  
236 or internal/external storage while awaiting further input over the network.

237 F) Other Key Terms:

238 1) Controller System: A computer or computer server that manages a benchmark evaluation  
239 process. The controller system performs the following functions:

240 A. start and stop each segment (phase) of the performance benchmark;

241 B. control the workload demands of the performance benchmark;

242 C. start and stop data collection from the power analyzer so that power and performance  
243 data from each phase can be correlated;

244 D. store log files containing benchmark power and performance information;

245 E. convert raw data into a suitable format for benchmark reporting, submission and  
246 validation; and

247 F. collect and store environmental data, if automated for the benchmark.

248 2) Network Client (Testing): A computer or computer server that generates workload traffic for  
249 transmission to a unit under test (UUT) connected via a network switch.

250 3) RAS Features: An acronym for reliability, availability, and serviceability features. The three  
251 primary components of RAS as related to a computer server are defined as follows:

252 A. Reliability Features: Features that support a server's ability to perform its intended  
253 function without interruption due to component failures (e.g., component selection,  
254 temperature and/or voltage de-rating, error detection and correction).

255 B. Availability Features: Features that support a server's ability to maximize operation at  
256 normal capacity for a given duration of downtime (e.g., redundancy [both at micro- and  
257 macro-level]).

258 C. Serviceability Features: Features that support a server's ability to be serviced without  
259 interrupting operation of the server (e.g., hot plugging).

260 4) Server Processor Utilization: The ratio of processor computing activity to full-load processor  
261 computing activity at a specified voltage and frequency, measured instantaneously or with a  
262 short term average of use over a set of active and/or idle cycles.

263 5) Hypervisor: A type of hardware virtualization technique that enables multiple guest operating  
264 systems to run on a single host system at the same time.

265 6) Auxiliary Processing Accelerators (APAs): An additional compute device installed in the  
266 computer server that handles parallelized workloads in place of the CPU.

267 A. Expansion APA: An APA that is an add-in card installed in a general-purpose add-in  
268 expansion slot (e.g., GPGPUs installed in a PCI slot).

269 B. Integrated APA: An APA that is integrated into the motherboard or CPU package.

270 7) Buffered DDR Channel: Channel or Memory Port connecting a Memory Controller to a  
271 defined number of memory devices (e.g., DIMMs) in a computer server. A typical computer

272 server may contain multiple Memory Controllers, which may in turn support one or more  
273 Buffered DDR Channels. As such, each Buffered DDR Channel serves only a fraction of the  
274 total addressable memory space in a computer server.

275 G) Product Family: A high-level description referring to a group of computers sharing one  
276 chassis/motherboard combination that often contains hundreds of possible hardware and software  
277 configurations. Products within a product family may differ in color.

278 1) Common Product Family Attributes: A set of features common to all models/configurations  
279 within a product family that constitute a common basic design. All models/configurations  
280 within a product family must share the following:

281 A. Be from the same model line or machine type;

282 B. Either share the same form factor (i.e., rack-mounted, blade, pedestal) or share the same  
283 mechanical and electrical designs with only superficial mechanical differences to enable  
284 a design to support multiple form factors;

285 C. Either share processors from a single defined processor series or share processors that  
286 plug into a common socket type. All configurations shipped as ENERGY STAR within the  
287 product family shall contain the same number of populated sockets used during testing.

288 D. Share PSUs that perform with efficiencies greater than or equal to the efficiencies at all  
289 required load points specified in Section 3.2 (i.e., 10%, 20%, 50%, and 100% of  
290 maximum rated load for single-output; 20%, 50%, and 100% of maximum rated load for  
291 multi-output).

292 E. Have all memory channels populated with the same model DIMM. In all cases, the  
293 minimum memory capacity is the number of memory channels in the server multiplied by  
294 the minimum DIMM size offered in the family.

295 2) Product Family Tested Configurations:

296 A. Low-end Performance Configuration: The combination of Processor Socket Power,  
297 PSUs, Memory, Storage Devices, and I/O devices that represents the lowest-  
298 performance computing platform within the Product Family. This configuration shall  
299 include the lowest processor performance per socket, as represented by the lowest  
300 numerical value resulting from the multiplication of the core count by the frequency in  
301 GHz, offered for sale and capable of meeting ENERGY STAR requirements.<sup>2</sup> It shall also  
302 include a memory capacity at least equal to the number of DIMM slots in the server  
303 multiplied by the smallest DIMM size offered in the family.

304 B. High-end Performance Configuration: The combination of Processor Socket Power,  
305 PSUs, Memory, Storage Devices, and I/O devices that represents the highest-  
306 performance computing platform within the Product Family. This configuration shall  
307 include the highest processor performance per socket, as represented by the highest  
308 numerical value resulting from the multiplication of the core count by the frequency in  
309 GHz, offered for sale and capable of meeting ENERGY STAR requirements.<sup>2</sup> It shall also  
310 include a memory capacity equal to the value found in Equation 1 below:

311 **Equation 1: Minimum Memory Capacity of High-end Performance Configuration**

$$Mem\_Capacity\_High \geq 3 \times (\# \text{ of Sockets} \times \# \text{ of Physical Cores} \times \# \text{ Threads per Core})$$

312 C. Typical Configuration: A product configuration that lies between the Low-end  
313 Performance and High-end Performance configurations and is representative of a

<sup>2</sup> Processor performance per socket = [# of processor cores] x [processor clock speed (GHz)], where # of cores represents the number of physical cores and processor clock speed represents the Max TDP core frequency as reported by SERT for a given processor.

314 deployed product with high volume sales. It shall also include a memory capacity equal to  
315 the value found in Equation 2 below:

316 **Equation 2: Minimum Memory Capacity of Typical Configuration**

$$Mem\_Capacity\_Typ \geq 2 \times (\# \text{ of Sockets} \times \# \text{ of Physical Cores} \times \# \text{ Threads per Core})$$

317 **Note:** EPA received stakeholder feedback requesting more guidance on memory capacity requirements  
318 for the three test product family configurations in the product family definition. These changes are  
319 intended to increase the consistency of system configurations within each product testing configuration  
320 category. EPA welcomes feedback on these proposed additions to the product family definition.

321 EPA has also clarified that all configurations shipped as ENERGY STAR must contain the same number  
322 of populated sockets as used during testing as defined in Section 6.1.2.

323 **2 SCOPE**

324 **2.1 Included Products**

325 2.1.1 A product must meet the definition of a Computer Server provided in *Section 1* of this document  
326 to be eligible for ENERGY STAR certification under this specification. Eligibility under Version 3.0  
327 is limited to Blade-, Multi-node, Rack-mounted, or Pedestal form factor computer servers with no  
328 more than four processor sockets in the computer server (or per blade or node in the case of  
329 blade or multi-node servers). Products explicitly excluded from Version 3.0 are identified in  
330 *Section 2.2*.

331 **2.2 Excluded Products**

332 2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for  
333 certification under this specification. The list of specifications currently in effect can be found at  
334 [www.energystar.gov/products](http://www.energystar.gov/products).

335 2.2.2 The following products are not eligible for certification under this specification:

- 336 i. Computer Servers shipped with Integrated APAs;
- 337 ii. Fully Fault Tolerant Servers;
- 338 iii. Server Appliances;
- 339 iv. High Performance Computing Systems;
- 340 v. Large Servers;
- 341 vi. Storage Products including Blade Storage; and
- 342 vii. Network Equipment.

343 **3 CERTIFICATION CRITERIA**

344 **3.1 Significant Digits and Rounding**

345 3.1.1 All calculations shall be carried out with directly measured (unrounded) values.

346 3.1.2 Unless otherwise specified, compliance with specification limits shall be evaluated using directly  
347 measured or calculated values without any benefit from rounding.



348 3.1.3 Directly measured or calculated values that are submitted for reporting on the ENERGY STAR  
 349 website shall be rounded to the nearest significant digit as expressed in the corresponding  
 350 specification limit.

351 **3.2 Power Supply Requirements**

352 3.2.1 Power supply test data and test reports from testing entities recognized by EPA to perform power  
 353 supply testing shall be accepted for the purpose of certifying the ENERGY STAR product.

354 3.2.2 Power Supply Efficiency Criteria: Power Supplies used in products eligible under this specification  
 355 must meet the following requirements when tested using the *Generalized Internal Power Supply*  
 356 *Efficiency Test Protocol, Rev. 6.7* (available at [www.efficientpowersupplies.org](http://www.efficientpowersupplies.org)). Power Supply  
 357 data generated using Rev. 6.4.2 (as required in Version 1.1), 6.4.3, 6.5, or 6.6 are acceptable  
 358 provided the test was conducted prior to the effective date of Version 3.0 of this specification.

359 i. Pedestal and Rack-mounted Servers: To certify for ENERGY STAR, a pedestal or rack-  
 360 mounted computer server must be configured with **only** PSUs that meet or exceed the  
 361 applicable efficiency requirements specified in Table 1 **prior to shipment**.

362 ii. Blade and Multi-node Servers: To certify for ENERGY STAR, a Blade or Multi-node computer  
 363 server shipped with a chassis must be configured such that **all** PSUs supplying power to the  
 364 chassis meet or exceed the applicable efficiency requirements specified in Table 1 **prior to**  
 365 **shipment**.

366 **Table 1: Efficiency Requirements for PSUs**

Power Supply Type	Rated Output Power	10% Load	20% Load	50% Load	100% Load
Multi-output (Ac-Dc)	All Output Levels	N/A	90%	92%	89%
Single-output (Ac-Dc)	All Output Levels	83%	90%	94%	91%

367 3.2.3 Power Supply Power Factor Criteria: Power Supplies used in Computers Servers eligible under  
 368 this specification must meet the following requirements when tested using the *Generalized*  
 369 *Internal Power Supply Efficiency Test Protocol, Rev. 6.7* (available at  
 370 [www.efficientpowersupplies.org](http://www.efficientpowersupplies.org)). Power Supply data generated using Rev. 6.4.2 (as required in  
 371 Version 1.1), 6.4.3, 6.5 or 6.6 are acceptable provided the test was conducted prior to the  
 372 effective date of Version 3.0.

373 **Note:** EPA has updated the latest reference of the Generalized Internal Power Supply Efficiency Test  
 374 Protocol from Rev. 6.6 to 6.7 in this section to align with Section 3.2.2 above.

375 i. Pedestal and Rack-mounted Servers: To certify for ENERGY STAR, a pedestal or rack-  
 376 mounted computer server must be configured with **only** PSUs that meet or exceed the  
 377 applicable power factor requirements specified in Table 2 **prior to shipment**, under all  
 378 loading conditions for which output power is greater than or equal to 75 watts. Partners are  
 379 required to measure and report PSU power factor under loading conditions of less than 75  
 380 watts, though no minimum power factor requirements apply.

382 ii. Blade or Multi-node Servers: To certify for ENERGY STAR, a Blade or Multi-node computer  
 383 server shipped with a chassis must be configured such that **all** PSUs supplying power to the  
 384 chassis meet or exceed the applicable power factor requirements specified in Table 2 **prior**  
 385 **to shipment**, under all loading conditions for which output power is greater than or equal to  
 386 75 watts. Partners are required to measure and report PSU power factor under loading  
 387 conditions of less than 75 watts, though no minimum power factor requirements apply.

388

**Table 2: Power Factor Requirements for PSUs**

Power Supply Type	Rated Output Power	10% Load	20% Load	50% Load	100% Load
Ac-Dc Multi-output	All Output Ratings	N/A	0.80	0.90	0.95
Ac-Dc Single-output	Output Rating ≤ 500 W	N/A	0.80	0.95	0.95
	Output Rating > 500 W and Output Rating ≤ 1,000 W	0.65	0.80	0.95	0.95
	Output Rating > 1,000 watts	0.80	0.90	0.95	0.95

389

**3.3 Power Management Requirements**

391 3.3.1 Server Processor Power Management: To certify for ENERGY STAR, a Computer Server must  
392 offer processor power management that is enabled by default in the BIOS and/or through a  
393 management controller, service processor, and/or the operating system shipped with the  
394 computer server. **All** processors must be able to reduce power consumption in times of low  
395 utilization by:

- 396 i. reducing voltage and/or frequency through Dynamic Voltage and Frequency Scaling (DVFS),  
397 or
- 398 ii. enabling processor or core reduced power states when a core or socket is not in use.

399 3.3.2 Supervisor Power Management: To certify for ENERGY STAR, a product which offers a pre-  
400 installed supervisor system (e.g., operating system, hypervisor) must offer supervisor system  
401 power management that is enabled by default.

402 3.3.3 Power Management Reporting: To certify for ENERGY STAR, all power management techniques  
403 that are enabled by default must be itemized on the Power and Performance Data Sheet. This  
404 requirement applies to power management features in the BIOS, operating system, or any other  
405 origin that can be configured by the end-user.

**3.4 Blade and Multi-Node System Criteria**

407 3.4.1 Blade and Multi-Node Thermal Management and Monitoring: To certify for ENERGY STAR, a  
408 blade or multi-node server must provide real-time chassis or blade/node inlet temperature  
409 monitoring and fan speed management capability that is enabled by default.

410 3.4.2 Blade and Multi-Node Server Shipping Documentation: To certify for ENERGY STAR, a blade or  
411 multi-node server that is shipped to a customer independent of the chassis must be accompanied  
412 with documentation to inform the customer that the blade or multi-node server is ENERGY STAR  
413 qualified only if it is installed in a chassis meeting requirements in *Section 3.4.1* of this document.  
414 A list of certified chassis and ordering information must also be provided as part of product  
415 collateral provided with the blade or multi-node server. These requirements may be met via either  
416 printed materials, electronic documentation provided with the blade or multi-node server, or  
417 information publicly available on the Partner’s website where information about the blade or multi-  
418 node server is found.

**3.5 Active State Efficiency Criteria**

420 3.5.1 Active State Efficiency Reporting: To certify for ENERGY STAR, a Computer Server or Computer  
421 Server Product Family must be submitted for certification with the following information disclosed  
422 in full and in the context of the complete Active State efficiency rating test report:

423 i. Final SERT rating tool results, which include the results files (in xml, html, and text format)  
424 and all results-chart png files; and

425 ii. Intermediate SERT rating tool results over the entire test run, which include the results-details  
426 files (in xml, html, and text format) and all results-details-chart png files.

427 Data reporting and formatting requirements are discussed in Section 4.1 of this specification.

428 3.5.2 Incomplete Reporting: Partners shall not selectively report individual workload module results, or  
429 otherwise present efficiency rating tool results in any form other than a complete test report, in  
430 customer documentation or marketing materials.

431 3.5.3 Active State Efficiency Requirements: Calculated Active State efficiency score ( $Eff_{ACTIVE}$ ) shall be  
432 greater than or equal to the minimum Active State efficiency thresholds listed in Table 3.

433 **Equation 3: Calculation  $Eff_{ACTIVE}$**

434 
$$Eff_{ACTIVE} = EXP(0.65 * \ln(Eff_{CPU}) + 0.30 * \ln(Eff_{MEMORY}) + 0.05 * \ln(Eff_{STORAGE}))$$

435  
436 *Where:*

- 437
  - $Eff_{ACTIVE}$  is comprised of  $Eff_{CPU}$ ,  $Eff_{MEMORY}$  and  $Eff_{STORAGE}$
- 438 which are defined in equations 4 through 6 below:

439 **Equation 4: Calculation  $Eff_{CPU}$**

440 
$$Eff_{CPU} = Geomean(Eff_{COMPRESS}, Eff_{LU}, Eff_{SOR}, Eff_{CRYPTO}, Eff_{SORT}, Eff_{SHA256}, Eff_{HYBRIDSSJ})$$

441 *Where:*

- 442
  - $Eff_{COMPRESS}$  is the measured Compression worklet score
  - 443   - $Eff_{LU}$  is the measured LU worklet score
  - 444   - $Eff_{SOR}$  is the measured SOR worklet score
  - 445   - $Eff_{CRYPTO}$  is the measured Crypto worklet score
  - 446   - $Eff_{SORT}$  is the measured Sort worklet score
  - 447   - $Eff_{SHA256}$  is the measured SHA256 worklet score
  - 448   - $Eff_{HYBRIDSSJ}$  is the measured Hybrid SSJ worklet score
  - 449

450 **Equation 5: Calculation  $Eff_{MEMORY}$**

451 
$$Eff_{MEMORY} = Geomean(Eff_{FLOOD2}, Eff_{CAPACITY2})$$

452 *Where:*

- 453
  - $Eff_{FLOOD2}$  is the measured Flood2 worklet score
  - 454   - $Eff_{CAPACITY2}$  is the measured Capacity2 worklet score
  - 455

456 **Equation 6: Calculation  $Eff_{STORAGE}$**

457 
$$Eff_{STORAGE} = Geomean(Eff_{SEQUENTIAL}, Eff_{RANDOM})$$

458 *Where:*

- 459
  - $Eff_{SEQUENTIAL}$  is the measured Sequential worklet score
  - 460   - $Eff_{RANDOM}$  is the measured Random worklet score
  - 461
  - 462

**Table 3: Active State Efficiency Thresholds for all Computer Servers**

Product Type	Minimum <i>Eff<sub>ACTIVE</sub></i>
<b>One Installed Processor</b>	
Rack	11.0
Tower	9.4
Blade or Multi-Node	9.0
Resilient	4.8
<b>Two Installed Processors</b>	
Rack	13.0
Tower	12.0
Blade or Multi-Node	14.0
Resilient	5.2
<b>Greater Than Two Installed Processors</b>	
Rack	16.0
Blade or Multi-Node	9.6
Resilient	4.2

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**Note:** After the release of the Draft 2, Version 3.0 specification, stakeholders provided an updated dataset, which included the most recent products released to the market and updated the test data to account for SERT Version 2.0.0, which incorporates a newer, more modern reference server in the benchmark. This dataset represents the best dataset available for server systems and is a good proxy for the market. In addition, EPA participated in lengthy discussions, including two stakeholder meetings, to discuss if SERT Version 2.0.0 sufficiently incorporates idle test results within the overall active state metric. The result of these discussions and the additional test data is incorporated in this proposal, which focuses on active state efficiency requirements with idle state reporting. The proposed levels are based primarily on model data from 2014 and later, though older available data was included for one socket tower systems and four socket resilient systems since there was not sufficient data to set levels using just 2014+ data in those subcategories. For reference, the cutoff date for new data included in the analysis was November 13, 2017. Although the Agency is aware of newer chipsets coming into the market, the current (post 2014) configurations will continue to be sold over the lifetime of the specification and therefore this data was considered. Due to the removal of standalone idle state efficiency requirements, EPA has increased the stringency of the active state requirements from those proposed in Draft 2 (Note: The change to SERT Version 2.0.0 data scaled the efficiency score values down significantly as compared to the Draft 2 values). For the purposes of its analysis, EPA counted a product as passing if at least two of the three applicable, previously measured configurations met the requirements proposed in Table 3. With the proposed levels, EPA found that pass rates in the dataset were at least 24%. This included models between 2014 and November 2017, with the exception of one socket tower products and greater than two socket resilient servers, where there was not enough data in that range to set levels.

With these proposed levels, EPA is recognizing the top quartile of the market in each category where the data support such differentiation, and striving to come as close to this mark as possible where the data do not segment well.

489 **3.6 Idle State Efficiency Criteria**

490 3.6.1 Idle State Data Reporting: Idle State power ( $P_{IDLE}$ ,  $P_{BLADE}$ , or  $P_{NODE}$ ) shall be measured and  
491 reported, both in certification materials and as required in Section 4 for all computer server types.  
492 In addition, for blade and multi-node products,  $P_{TOT\_BLADE\_SYS}$  and  $P_{TOT\_NODE\_SYS}$  shall also be  
493 reported respectively. Please see Section 3.7 for details on how to calculate  $P_{BLADE}$  and  
494  $P_{TOT\_BLADE\_SYS}$ , and Section 3.8 for details on how to calculate  $P_{NODE}$  and  $P_{TOT\_NODE\_SYS}$ .

495 **Note:** As noted previously, EPA believes that the active state efficiency metric adequately incorporates  
496 idle power behavior and; therefore, there is no longer a need for standalone idle state efficiency criteria.  
497 However, EPA will maintain idle state data reporting requirements and has harmonized that requirement  
498 across all computer server products. As such, Sections 3.7 and 3.8 (per Draft 2) have been removed.

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500 **3.7 Calculating Idle State Values – Blade Servers**

- 501 3.7.1 The testing of Blade Servers for compliance with Section 3.6.1 shall be carried out under all of the  
502 following conditions:
- 503 i. Power values shall be measured and reported using a half-populated Blade Chassis. Blade  
504 Servers with multiple power domains, choose the number of power domains that is closest to  
505 filling half of the Blade Chassis. In a case where there are two choices that are equally close  
506 to half, test with the domain or combination of domains which utilize a higher number of Blade  
507 Servers. The number of blades tested during the half-populated Blade Chassis test shall be  
508 reported.
  - 509 ii. Power for a fully-populated blade chassis may be optionally measured and reported, provided  
510 that half-populated chassis data is also provided.
  - 511 iii. All Blade Servers installed in the Blade Chassis shall share the same configuration  
512 (homogeneous).
  - 513 iv. Per-blade power values shall be calculated using Equation 7.

514 **Equation 7: Calculation of Single Blade Power**

515 
$$P_{BLADE} = \frac{P_{TOT\_BLADE\_SYS}}{N_{INST\_BLADE\_SRV}}$$

516  
517 *Where:*

- 518 ▪  $P_{BLADE}$  is the per-Blade Server Power,  $P_{TOT\_BLADE\_SYS}$  is  
519 total measured power of the Blade System,
  - 520 ▪  $N_{INST\_BLADE\_SRV}$  is the number of installed Blade Servers in  
521 the tested Blade Chassis.
- 522

523 **3.8 Calculating Idle State Values – Multi-Node Servers**

- 524 3.8.1 The testing of Multi-Node Servers for compliance with Section 3.6.1 shall be carried out under all  
525 of the following conditions:
- 526 i. Power values shall be measured and reported using a fully-populated Multi-Node Chassis.
  - 527 ii. All Multi-Node Servers in the Multi-Node Chassis shall share the same configuration  
528 (homogeneous).
  - 529 iii. Per-node power values shall be calculated using Equation 8.

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### Equation 8: Calculation of Single Node Power

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$$P_{NODE} = \frac{P_{TOT\_NODE\_SYS}}{N_{INST\_NODE\_SRV}}$$

532

Where:

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- $P_{NODE}$  is the per-Node Server Power,  $P_{TOT\_NODE\_SYS}$  is total measured power of the Multi-Node Server,

534

- $N_{INST\_NODE\_SRV}$  is the number of installed Multi-Node Servers in the tested Multi-Node Chassis.

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## 3.9 Other Testing Criteria

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3.9.1 APA Requirements: For all computer servers sold with expansion APAs, the following criteria and provisions apply:

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- i. For all configurations, Active State and Idle State testing shall be conducted without any APAs installed which may be offered with the product. Where an APA relies on a separate PCIE switch for communication between the APA and CPU, the separate PCIE card(s) or riser(s) shall be removed for Active State and Idle State testing of all configurations.

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- ii. Manufacturers shall report the model name and model number as well as idle power consumption of each APA offered as an accessory within an ENERGY STAR product family.

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**Note:** EPA received feedback from several stakeholders showing that there are multiple divergent APA technologies developing which require higher idle power consumption to provide significantly greater processing capability compared to the APA technology considered in Version 2.0. An apple to apple comparison of different high memory bandwidth and performance options (e.g. GPGPUs vs. FPGAs) is not feasible at this time.

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Due to the lack of a test method available to assess the performance of APAs, which can no longer be ignored for comparison purposes, EPA is proposing that all computer servers be tested without expansion APAs installed during test, and that manufacturers shall report the APA details and idle power consumption as part of the certification. EPA welcomes stakeholder feedback on this proposed approach.

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## 4 STANDARD INFORMATION REPORTING REQUIREMENTS

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### 4.1 Data Reporting Requirements

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4.1.1 All required data fields in the ENERGY STAR Version 3.0 Computer Servers Qualified Product Exchange form shall be submitted to EPA for each ENERGY STAR certified Computer Server or Computer Server Product Family.

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- i. Partners are encouraged to provide one set of data for each ENERGY STAR certified product configuration, though EPA will also accept a data set for each qualified product family.

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- ii. A product family certification must include data for all defined test points in 1.G)2), as applicable.

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- iii. Whenever possible, Partners must also provide a hyperlink to a detailed power calculator on their Web site that purchasers can use to understand power and performance data for specific configurations within the product family.

565

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4.1.2 The following data will be displayed on the ENERGY STAR Web site through the product finder tool:

568

569

- i. model name and number, identifying SKU and/or configuration ID;

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- ii. system characteristics (form factor, available sockets/slots, power specifications, etc.);

571

- iii. system type (e.g. resilient.);

- 572 iv. system configuration(s) (including Low-end Performance Configuration, High-end  
573 Performance Configuration, and Typical Configuration for Product Family certification);
- 574 v. power consumption and performance data from required Active and Idle State Efficiency  
575 Criteria testing including results.xml, results.html, results.txt, all results-chart png files,  
576 results-details.html, results-details.txt, results-details.xml, all results-details-chart png files;
- 577 vi. available and enabled power saving features (e.g., power management);
- 578 vii. a list of selected data from the ASHRAE Thermal Report;
- 579 viii. inlet air temperature measurements made prior to the start of testing, at the conclusion of Idle  
580 State testing, and at the conclusion of Active State testing;
- 581 ix. for product family certifications, a list of qualified configurations with qualified SKUs or  
582 configuration IDs; and
- 583 x. for a blade server, a list of compatible blade chassis that meet ENERGY STAR certification  
584 criteria.
- 585 4.1.3 EPA may periodically revise this list, as necessary, and will notify and invite stakeholder  
586 engagement in such a revision process.

## 587 **5 STANDARD PERFORMANCE DATA MEASUREMENT AND OUTPUT** 588 **REQUIREMENTS**

### 589 **5.1 Measurement and Output**

- 590 5.1.1 A computer server must provide data on input power consumption (W), inlet air temperature (°C),  
591 and average utilization of all logical CPUs. Data must be made available in a published or user-  
592 accessible format that is readable by third-party, non-proprietary management software over a  
593 standard network. For blade and multi-node servers and systems, data may be aggregated at the  
594 chassis level.
- 595 5.1.2 Computer servers classified as Class B equipment as set out in EN 55022:2006 are exempt from  
596 the requirements to provide data on input power consumption and inlet air temperature in 5.1.1.  
597 Class B refers to household and home office equipment (intended for use in the domestic  
598 environment). All computer servers in the program must meet the requirement and conditions to  
599 report utilization of all logical CPUs.

### 600 **5.2 Reporting Implementation**

- 601 5.2.1 Products may use either embedded components or add-in devices that are packaged with the  
602 computer server to make data available to end users (e.g., a service processor, embedded power  
603 or thermal meter (or other out-of-band technology), or pre-installed OS);
- 604 5.2.2 Products that include a pre-installed OS must include all necessary drivers and software for end  
605 users to access standardized data as specified in this document. Products that do not include a  
606 pre-installed OS must be packaged with printed documentation of how to access registers that  
607 contain relevant sensor information. This requirement may be met via either printed materials,  
608 electronic documentation provided with the computer server, or information publically available on  
609 the Partner's website where information about the computer server is found.
- 610 5.2.3 When an open and universally available data collection and reporting standard becomes  
611 available, manufacturers should incorporate the universal standard into their systems;
- 612 5.2.4 Evaluation of the accuracy (5.3) and sampling (5.4) requirements shall be completed through  
613 review of data from component product datasheets. If this data is absent, Partner declaration  
614 shall be used to evaluate accuracy and sampling.

615 **5.3 Measurement Accuracy**

- 616 5.3.1 *Input power:* Measurements must be reported with accuracy of at least ±5% of the actual value,  
617 with a maximum level of accuracy of ±10W for each installed PSU (i.e., power reporting accuracy  
618 for each power supply is never required to be better than ± 10 watts) through the operating range  
619 from Idle to full power;
- 620 5.3.2 *Processor utilization:* Average utilization must be estimated for each logical CPU that is visible to  
621 the OS and must be reported to the operator or user of the computer server through the operating  
622 environment (OS or hypervisor);
- 623 5.3.3 *Inlet air temperature:* Measurements must be reported with an accuracy of at least ±2°C.

624 **5.4 Sampling Requirements**

- 625 5.4.1 *Input power and processor utilization:* Input power and processor utilization measurements must  
626 be sampled internally to the computer server at a rate of greater than or equal to measurement  
627 per contiguous 10 second period. A rolling average, encompassing a period of no more than 30  
628 seconds, must be sampled internally to the computer server at a frequency of greater than or  
629 equal to once per ten seconds.
- 630 5.4.2 *Inlet air temperature:* Inlet air temperature measurements must be sampled internally to the  
631 computer server at a rate of greater than or equal to 1 measurement every 10 seconds.
- 632 5.4.3 *Time stamping:* Systems that implement time stamping of environmental data shall sample  
633 internally to the computer server data at a rate of greater than or equal to 1 measurement every  
634 30 seconds.
- 635 5.4.4 *Management Software:* All sampled measurements shall be made available to external  
636 management software either via an on-demand pull method, or via a coordinated push  
637 method. In either case the system’s management software is responsible for establishing the  
638 data delivery time scale while the computer server is responsible to assuring data delivered  
639 meets the above sampling and currency requirements.

640 **6 TESTING**

641 **6.1 Test Methods**

- 642 6.1.1 When testing Computer Server products, the test methods identified in 6 shall be used to  
643 determine ENERGY STAR certification.

644 **Table 6: Test Methods for ENERGY STAR Certification**

Product Type or Component	Test Method
All	ENERGY STAR Test Method for Computer Servers (Rev. April-2018)
All	Standard Performance Evaluation Corporation (SPEC) most current <sup>3</sup> Server Efficiency Rating Tool (SERT)

- 645 6.1.2 When testing Computer Server products, UUTs must have all Processor Sockets populated  
646 during testing.

<sup>3</sup> For the purposes of this document, the most current SERT version will be listed in the most recently published Servers 3.0 Clarification Memo, located on the Enterprise Servers Specification Version 3.0 website ([https://www.energystar.gov/products/spec/enterprise\\_servers\\_specification\\_version\\_3\\_0\\_pd](https://www.energystar.gov/products/spec/enterprise_servers_specification_version_3_0_pd))



647 i. If a Computer Server cannot support populating all Processor Sockets during testing, then  
648 the system must be populated to its maximum functionality. These systems will be subject  
649 to the base idle state power allowance based on the number of sockets in the system.

## 650 **6.2 Number of Units Required for Testing**

651 6.2.1 Representative Models shall be selected for testing per the following requirements:

652 i. For certification of an individual product configuration, the unique configuration that is  
653 intended to be marketed and labeled as ENERGY STAR is considered the Representative  
654 Model.

655 ii. For certification of a product family of all product types, one product configuration for each  
656 of the three points identified in definitions 1.G)2) within the family are considered  
657 Representative Models. All such representative models shall have the same Common  
658 Product Family Attributes as defined in 1.G)1).

659 **Note:** EPA has revised the number of points required from four to three configurations to match the  
660 revised product family definition in Section 1.G)2).

661 6.2.2 All product configurations within a product family that is submitted for certification must meet  
662 ENERGY STAR requirements, including products for which data is not reported.

## 663 **7 EFFECTIVE DATE**

664 7.1.1 Effective Date: This ENERGY STAR Computer Servers specification shall take effect on **TBD**. To  
665 certify for ENERGY STAR, a product model shall meet the ENERGY STAR specification in effect  
666 on its date of manufacture. The date of manufacture is specific to each unit and is the date on  
667 which a unit is considered to be completely assembled.

668 7.1.2 Future Specification Revisions: EPA reserves the right to change this specification should  
669 technological and/or market changes affect its usefulness to consumers, industry, or the  
670 environment. In keeping with current policy, revisions to the specification are arrived at through  
671 stakeholder discussions. In the event of a specification revision, please note that the ENERGY  
672 STAR certification is not automatically granted for the life of a product model.

## 673 **8 CONSIDERATIONS FOR FUTURE REVISIONS**

### 674 **8.1 TBD**

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686 **Note:** EPA has removed Appendices A and B found in Draft 2, as the idle state efficiency example is no  
687 longer applicable and the supplemental resilient server definition language has been condensed and  
688 worked directly into the definition section at the beginning of this document (Section 1).