ENERGY STAR® Program Requirements for Computer Servers

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Partner Commitments

Commitments

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

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

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

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

- provide clear and consistent identification of ENERGY STAR qualified Computer Server families and configurations. Partner must use the ENERGY STAR mark in all of the following ways:

  1. The ENERGY STAR mark will be included on the Computer Server manufacturer's Internet site specification sheet where product information is displayed and configurations are provided:

     − This ENERGY STAR mark will also serve as a link from the manufacturer's specification sheet to the corresponding *Power and Performance Data Sheet* for the qualified configuration or Product Family.

  2. The ENERGY STAR mark will be included on the ENERGY STAR *Power and Performance Data Sheet*; and

  3. The ENERGY STAR mark shall be used to identify qualified Product Families and/or configurations in collateral materials, which could include, but not be limited to: user manuals, product guides, marketing brochures, etc.

  If additional information about the ENERGY STAR program(s) or other products is provided by the Partner on its Web site, the ENERGY STAR Web Linking Policy should be followed. The Web Linking Policy can be found in the Partner Resources section on the ENERGY STAR Web site at www.energystar.gov.

- Work with Value Added Resellers (VARs) of Partner's products to help ensure that Computer Servers remain in compliance with ENERGY STAR requirements. Any party within the distribution channel of an ENERGY STAR qualified Computer Server that alters the power profile of a product after its date of manufacture through hardware or software modifications must ensure that the product continues to meet the ENERGY STAR requirements before delivering this product to the end customer. If the product no longer meets the requirements, it may not be marketed or sold as ENERGY STAR qualified.
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If a VAR makes any modifications to a product that was previously qualified under this Version 1.0 specification, re-brands the product, and promotes it as ENERGY STAR, it must become an ENERGY STAR Partner and follow the requirements outlined in this Version 1.0 specification.

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

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

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

Performance for Special Distinction

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

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

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

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

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

- feature the ENERGY STAR mark(s) on Partner Web site and in other promotional materials. If information concerning ENERGY STAR is provided on the Partner Web site as specified by the ENERGY STAR Web Linking Policy (this document can be found in the Partner Resources section on the ENERGY STAR Web site at www.energystar.gov), EPA may provide links where appropriate to the Partner Web site;

- provide a simple plan to EPA outlining specific measures Partner plans to undertake beyond the program requirements listed above. By doing so, EPA may be able to coordinate, communicate, and/or promote Partner's activities, provide an EPA representative, or include news about the event in the ENERGY STAR newsletter, on the ENERGY STAR Web pages, etc. The plan may be as simple as providing a list of planned activities or planned milestones that Partner would like EPA to be aware of.

For example, activities may include: (1) increase the availability of ENERGY STAR labeled products by converting the entire product line within two years to meet ENERGY STAR guidelines; (2) demonstrate the economic and environmental benefits of energy efficiency through special in-store displays twice a year; (3) provide information to users (via the Web site and user's manual) about energy-saving features and operating characteristics of ENERGY STAR qualified products, and (4) build awareness of the ENERGY STAR Partnership and brand identity by collaborating with EPA on one print advertorial and one live press event;

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

- join EPA's SmartWay Transport Partnership to improve the environmental performance of the company's shipping operations. SmartWay Transport works with freight carriers, shippers, and other stakeholders in the goods movement industry to reduce fuel consumption, greenhouse gases, and air pollution. For more information on SmartWay, visit www.epa.gov/smartway.

- join EPA's Climate Leaders Partnership to inventory and reduce greenhouse gas emissions. Through participation companies create a credible record of their accomplishments and receive EPA recognition as corporate environmental leaders. For more information on Climate Leaders, visit www.epa.gov/climateleaders.

- join EPA's Green Power partnership. EPA's Green Power Partnership encourages organizations to buy green power as a way to reduce the environmental impacts associated with traditional fossil fuel-based electricity use. The partnership includes a diverse set of organizations including Fortune 500 companies, small and medium businesses, government institutions as well as a growing number of colleges and universities, visit http://www.epa.gov/grnpower.

ENERGY STAR® Program Requirements
for Computer Servers

Eligibility Criteria

Below is the **Version 1.0** product specification for ENERGY STAR qualified Computer Servers. In order to be marketed and sold as ENERGY STAR, a product must meet all of the identified criteria as shipped to the customer, including all hardware or software alterations made to the product prior to sale.

This specification along with its complement, the specification for computers, intends to comprehensively cover a wide range of computer products. Manufacturers shall carefully examine their product designs and compare them to the detailed definitions (Section 1) and qualifying product descriptions (Section 2) for Computer Servers and Computers (visit http://www.energystar.gov/products) to determine the appropriate specification for ENERGY STAR qualification. Manufacturers may only qualify models under the one specification (i.e., Computer Servers OR Computers) that best reflects the product design.

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

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

   - 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); and
   - All processors have access to shared system memory and are independently visible to a single OS or hypervisor.

   B. <u>Blade System</u>: 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.

   C. <u>Blade Chassis</u>: 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.

   Computer Server Types

   D. <u>Blade Server</u>: A Computer Server consisting of, at minimum, a processor and system memory that relies on shared resources (e.g., power supplies, 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.

   E. <u>Direct Current (DC) Server</u>: A Computer Server with one or more DC-DC power supplies which runs directly off of DC power.

F. <u>Fully Fault Tolerant Server</u>: A Computer Server designed with complete redundancy, in which every computing component is replicated between two nodes running identical and concurrent workloads. If one node fails or needs repair, the second node can run the workload alone to avoid any downtime. A Fully Fault Tolerant Server uses two systems to simultaneously and repetitively run a single workload for continuous availability in a mission critical application.

G. <u>Managed Server</u>: Computer Servers designed for a high level of availability in a highly managed environment. A Managed Server *must have all* of the following characteristics:
- Capability to operate with redundant power supplies; and
- An installed dedicated management controller (e.g., service processor).

H. <u>Dual-Node Servers</u>: A Dual-Node Server consists of two independent Computer Servers (or nodes) contained in a single enclosure and sharing one or more power supplies. The combined power for all nodes is distributed through the shared power supply(s). Dual-Node Servers are designed and built as a single enclosure and are not designed to be hot-swappable.

I. <u>Multi-Node Server</u>: For purposes of this specification, a Multi-Node Server consists of more than two independent Computer Servers (or nodes) contained in a single enclosure and sharing one or more power supplies. The combined power for all nodes is distributed through the shared power supply(s). Multi-Node Servers are designed and built as a single enclosure and are not designed to be hot-swappable.

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

Other Data Center Equipment

K. <u>Blade Storage</u>: A storage-specific element that relies on shared resources (e.g., power supplies, cooling, etc.) for operation. Blade Storage units are designed to be installed in a Blade Chassis, are hot-swappable and are incapable of operating independent of the chassis.

L. <u>Network Equipment</u>: A product whose primary function is to provide data connectivity among devices connected to its several ports. Data connectivity is achieved via the routing of data packets encapsulated according to Internet Protocol, Fibre Channel, InfiniBand or similar protocol. Examples of network equipment commonly found in data centers are routers and switches.

M. <u>Storage Equipment</u>: A system composed of integrated storage controllers, storage devices (e.g., hard drives or solid state storage) and software that provides data storage services to one or more Computer Servers. While storage equipment may contain one or more embedded processors, these processors do not execute user-supplied software applications but may execute data-specific applications (e.g., data replication, backup utilities, data compression, install agents, etc.).

Computer Server Components

N. <u>Computer Server Power Supply Unit (PSU)</u>: A self-contained Computer Server component which converts a voltage input to one or more DC voltage outputs for the purpose of powering the Computer Server. The input voltage can be from either an AC or DC source. A Computer Server power supply must be separable from the main computer board and must connect to the system via a removable or hard-wired male/female electrical connection, cable, cord or other wiring (i.e. separate from, and not integrated with, the system motherboard).

O. <u>AC-DC Power Supply</u>: A power supply which converts line voltage AC input power into one or more different DC outputs for the purpose of powering the Computer Server.

P. <u>DC-DC Power Supply</u>: A power supply which converts a DC voltage input to one or more different DC voltage outputs for the purpose of powering the Computer Server. Any DC-to-DC converters (also known as voltage regulators) internal to the product and used to convert low DC voltage (e.g. 12 Volts DC) into other DC voltages for use by Computer Server components are not considered DC-DC power supplies under this specification.

Q. <u>Single-Output Power Supply</u>: A power supply which delivers most of its rated power through one primary DC output for the purpose of powering the Computer Server. Single-Output power supplies may include one or more standby outputs which remain active whenever connected to an input power source. There may be additional outputs besides the primary output and standby outputs, however, the combined power from all additional outputs must be no greater than 20 watts. **Note:** Power supplies with multiple outputs at the primary voltage are considered a Single-Output Power Supply, unless these outputs are either, (1) generated from separate converters or have separate output rectification stages, and/or (2) have independent current limits.

R. <u>Multi-Output Power Supply</u>: A power supply which delivers its power through more than one primary output, including one or more standby outputs which remain active whenever connected to an input power source. For Multi-Output Supplies, the combined power from additional outputs other than the primary and standby outputs is greater than 20 watts. This definition also applies to power supplies with multiple outputs at the same voltage that do not meet the definition of a Single-Output Power Supply, above.

S. <u>I/O Devices</u>: Devices which provide data input and output capability to the Computer Server from other devices. I/O Devices can either be integral to the main computer board or can be separate devices connected though expansion slots such as PCI or PCIe. Examples of I/O Devices include: Ethernet devices, InfiniBand devices, external RAID/SAS controllers and Fibre Channel devices.

T. <u>I/O Port</u>: Physical circuitry within an I/O Device where an independent I/O session can be established. A port is not the same as a connector receptacle; it is possible that a single receptacle that accepts a single connector can service multiple ports of the same interface.

Other Key Terms

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

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

- Use the same model motherboard;
- Use the same number of processors. All processors must be represented by the same model line and have identical power specifications and core counts (e.g., processors may vary in 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 components listed below (the relative numbers of these components may vary within the family):
    - Power supplies,
    - Memory DIMMs,
    - Hard drives (including solid state drives) , and
    - I/O Devices.

A configuration without add-in I/O Devices may be included in a Product Family with any number of additional I/O Devices included in other configurations. In addition, a configuration otherwise identical to the minimum configuration, but without an internal hard drive may also be included in a product family.

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

X. <u>Minimum Configuration:</u> The Minimum Configuration is a minimally configured system that represents the lowest possible power consumption within a Product Family, for configurations with at least one hard drive. Such a system would typically have the minimum number of power supplies, the least amount of system memory, a single hard drive, and a single I/O Device (either integrated or add-in). The Minimum Configuration must be currently available and sold in the marketplace (i.e. the system shall be minimally configured but not under-configured to a point which is unreasonable).

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

Z. <u>Base Configuration</u>: The base configuration is a reference configuration which does not qualify for any additional power allowances. Any applicable components above the level defined by the base configuration may qualify for additional power allowance(s) as described in Table 4, below. The base configuration includes:

- One hard drive (or solid state drive),
- Four Gigabytes (GB) of system memory,
- The minimum number of power supplies required to operate the Computer Server (i.e. no redundant power supplies), and
- Two ports of 1 Gigabit (Gbit), onboard Ethernet.

2) Qualifying Products: A Computer Server must meet the definition provided in Section 1.A, above, to be eligible for ENERGY STAR qualification under this specification. The Tier 1 specification coverage is limited to Computer Servers having <u>at most</u> four processor sockets (i.e. Computer Servers with 1 - 4 individual processor sockets). **Computer Servers with more than four processor sockets are currently ineligible for ENERGY STAR qualification under the Tier 1 specification but will be considered for inclusion under Tier 2 requirements.**

In addition to those products that do not meet the strict definition provided in Section 1.A, the following product types (as defined in Section 1, above) are **explicitly ineligible** for ENERGY STAR qualification:
- Blade Systems including Blade Servers and Blade Chassis,
- Fully Fault Tolerant Servers,
- Server Appliances,
- Multi-Node Servers,
- Storage Equipment including Blade Storage, and
- Network Equipment.

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

3) <u>Efficiency Requirements for Qualifying Products:</u> A Computer Server must meet all the requirements provided in Sections 3.A – 3.D, below, to qualify as ENERGY STAR.

<u>Tier 1 Requirements: Effective May 15, 2009</u>

A. Power Supply Efficiency Requirements

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

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%

In addition, power supplies must meet the minimum power factor requirements **for all loading conditions presented in Table 2, below, where the output power is <u>greater than or equal to</u> 75 watts.** Manufacturers are still required to measure and report power factor values for applicable loading conditions less than 75 watts to qualify for ENERGY STAR.

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	N/A	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

B. Active Power Requirements

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

Computer Servers with two or fewer processor sockets must have an Idle power consumption which does not exceed the allowed maximum Idle power levels determined from Tables 3 and 4, below, based on the components installed in the system. **Please note the following:**
- These Idle power limits are <u>applicable to single and dual socket systems only, regardless of the number of processors</u> (e.g., a three or four socket system with only one or two processors installed would not be subject to this requirement); and
- All quantities in Tables 3 and 4 <u>refer to the number of components installed in the system</u>, not the maximum number of components the system can support (e.g. installed processors, not processor sockets; installed memory, not supported memory; etc.).

Table 3 presents the Idle power allowance for base or lower configurations. One and two processor (1P & 2P) Computer Servers meeting the definition for Managed Servers in Section 1.G, above, must use the Managed Server Idle levels for Category B and Category D in Table 3, below. Any one or two processor Computer Server not meeting the definition for Managed Servers (i.e. "Standard" servers) must meet the Standard Server levels for Category A and C in Table 3, below. **Note:** The levels

provided in Table 3 below are for Computer Servers that must be tested and qualified with a minimum of one hard drive. Computer Servers sold without a hard drive may still qualify as ENERGY STAR if the configuration was originally tested and qualified with a single hard drive installed. In this case, the qualified configuration when shipped without a hard drive may also be marketed and sold as ENERGY STAR.

Table 3: Base Configuration Idle Power Requirements

Computer Server 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

Table 4 presents additional Idle power allowances for Computer Servers with additional capabilities above that of a base configuration. The maximum Idle power level should be determined by applying as many additional power allowances as are appropriate.

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 (including solid state 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 ports of 1 Gbit, onboard Ethernet [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]

* Notes on Additional Power Allowances:
1. Idle power allowances are granted for power supplies **in addition to** the minimum number needed to operate the Computer Server. For example, if a Computer Server requires two power supplies to operate, and the configuration includes three power supplies, the server would receive an additional 20.0 watt Idle power allowance. If the same server were instead shipped with four power supplies installed, it would receive an additional Idle power allowance of 40.0 watts.
2. For the purposes of determining Idle power allowances, all memory capacities shall be rounded to the nearest GB.
3. Idle power allowances are granted for all I/O Devices over the base configuration listed in Section 1.Z, including all add-in devices installed through expansion slots and all onboard devices above the base configuration.
4. I/O Device allowances are dependant on the rated link speed of a single connection, with speeds rounded to the nearest Gbit. Devices with speeds less than 1 Gbit do not qualify for any additional I/O Device allowances.
5. In order to claim an additional allowance, I/O Devices must be active (enabled) upon shipment and must be capable of functioning when connected to an active switch.

To determine the maximum Idle power consumption levels for ENERGY STAR qualification, manufacturers shall use the base configuration 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:

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 of Idle power to qualify. 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 Idle power to qualify.

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

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

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

In order to meet this requirement, all processors must be able to reduce power consumption in times of low utilization, by either:
- Reducing voltage and/or frequency through Dynamic Voltage and Frequency Scaling (DVFS), or
- Using processor or core reduced power states when a core or socket is not being used.

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

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

C. Standard Information Reporting Requirements

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

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

Templates for the *Version 1.0 Power and Performance Data Sheet* can be found on the ENERGY STAR Web page for Computer Servers at www.energystar.gov/products. Partners are encouraged to use the referenced data sheet template, but may also create their own template provided that it is identical in format and design as the referenced template, and has been approved by EPA. EPA may

periodically revise this template, as necessary, and will notify Partners of the revision process. Partners should always use the most recent version of the data sheet posted to the ENERGY STAR Web site.

Each *Power and Performance Data Sheet* must include the following information:
1. Model name and number, identifying SKU and/or configuration ID;
2. System characteristics (form factor, available sockets/slots, power specifications, etc.);
3. System configuration(s) (including maximum, minimum and typical configurations for product family qualification);
4. Power data for Idle and full load, estimated kWh/year, link to power calculator (where available);
5. Additional power and performance data for at least one benchmark chosen by the Partner;
6. Available and enabled power saving features (e.g., power management);
7. Information on the power measurement and reporting capabilities of the Computer Server;
8. Select thermal information from the ASHRAE thermal report; and
9. A list of additional qualified SKUs or configuration IDs, along with specific configuration information (for Product Family qualification only).

D. Data Measurement and Output Requirements

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

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

Measurement Accuracy:

- Input power measurements: EPA recommends the following Accuracy requirements for input power measurements on a system level:
   - ±10% accuracy with a cutoff at ± 10 watts (i.e. accuracy never needs to be better than ± 10 watts).

   Tier 2 Requirements: As indicated in the Tier 2 requirements, ± 5% accuracy with a cutoff of ± 5 watts (i.e. accuracy is never required to be better than ± 5 watts) will be required in the Tier 2 specification. **Note:** The above accuracy levels are solely in reference to the Power Measurement and Output Requirements included in this section. Accuracy requirements for Idle power and full load power tests are included in the test procedure in Appendix A of this specification.

- Processor utilization measurements: The Computer Server will provide an estimation of the processor utilization that is visible to the operator or user of the Computer Server through the operating environment (operating system or hypervisor). This estimation is not subject to specific accuracy requirements under this Tier1 specification.

- Inlet air temperature measurements: Computer Servers must meet an accuracy of ± 3° C on all air

temperature measurements.

Sampling Requirements: Data must be averaged on either a rolling basis or over a manufacturer specified time period. A default rolling average or time period of 30 seconds is recommended.

Reporting Requirements: Manufacturers must report the following on the *Power and Performance Data Sheet*:
- Guaranteed accuracy levels for power and temperature measurements, and
- The time period used for data averaging.

Tier 2 Requirements: Effective October 15, 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 **for an October 15, 2010 Tier 2 effective date**, a provisional Tier 2 specification will automatically go into effect and will remain in effect until such a metric is established under a subsequent Version or Tier. This provisional Tier 2 would include revised Idle power consumption requirements for all Computer Server types covered by Tier 1 of this specification. The new levels will be developed with the intention of capturing approximately the top 25% of products available in the marketplace at the time Tier 2 becomes effective. EPA may also consider developing Idle levels for product types currently excluded from this Tier 1 specification (Section 2: Qualifying Products). Development of a Provisional Tier 2, as well as all subsequent Versions or Tiers, will be done in accordance with ENERGY STAR's product development guidelines.

(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).

(3) Data Measurement and Output Requirements: EPA will include more stringent accuracy requirements under Tier 2 of this specification. Tier 2 will include a definition for processor/system utilization, with corresponding accuracy levels, and requirements for power measurement accuracy.

Accuracy requirements for power measurements will be ± 5% accuracy with a cutoff of ± 5 watt (i.e. accuracy is never required to be better than ± 5 watts). These accuracy levels will be at a system level and will have to be met only over the operating range of the Computer Server (i.e. measurements ranging from Idle to full load power).

In addition, EPA will require the Data Measurement and Output Requirements presented in this Version 1.0 Computer Servers specification of **all** ENERGY STAR qualified Computer Servers covered by the Tier 2 specification. EPA also plans to require a rolling average of data encompassing no greater than 30 seconds under Tier 2.

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

4) **Test Criteria:** Manufacturers are required to perform appropriate tests, as outlined below, in order to determine ENERGY STAR qualification for a given configuration or Product Family. These required tests include:
   - **Power Supply Efficiency Testing** as outlined in Section 4.A for power supply efficiency and power factor requirements and reporting on the *Power and Performance Data Sheet* for all Computer Servers.
   - **Idle Testing** as outlined in Section 4.B for Idle power requirements of Single and Dual socket Computer Servers, and for Idle power and full load power reporting of all Computer Servers on the *Power and Performance Data Sheet.*

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

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

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

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

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

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 DC or -53 Volts DC

2. **10% Loading Condition:** As referenced in the power supply efficiency requirements in Section 3.A, all Single-Output power supplies must be tested at 10% loading in addition to the standard 20%, 50% and 100% loading conditions indicated in the test procedure.

3. **Fan Power:** As indicated in the power supply test procedure referenced above, Multi-Output power supplies must be tested with internal fan power included in the measurement and efficiency calculation. Single-Output power supplies must exclude fan power from the measurement and the efficiency calculation.

4. **Efficiency and Power Factor Reporting:** Power supplies must meet the levels presented in Tables 1 and 2 without the assistance of rounding. When submitting power supply efficiency and power factor results, manufacturer shall report to the first decimal place (e.g. 85.2%) and three decimal points (e.g., 0.856), respectively.

B. Idle and Full Load Power Testing

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

1. **Test as shipped:** Computer Servers must be tested in their "as-shipped" configuration, unless otherwise indicated in the referenced test procedures. For power consumption testing, all power supplies must be connected and operational, and the as-shipped operating system or a representative operating system (see 4.B.3, below) must be installed. For all tests, manufacturers must ensure that the only power management techniques and/or power saving features enabled on systems under test are those which are also enabled on shipment.

2. **Computer Server shipped without a preinstalled hard drive:** Computer Servers shipped without hard drives may carry the ENERGY STAR mark only if (1) an otherwise identical configuration was tested and qualified with at least one hard drive installed.

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

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

C. Qualifying Computer Servers Through Value Added Resellers (VARs)

In some cases, ENERGY STAR qualfied Computer Servers may be shipped from the Original Equipment Manufatcurer (OEM) to a VAR that then determines the end configuration which is ultimately sold to the end user. In order for the VAR to sell the Computer Server as ENERGY STAR qualified under the OEM brand name, one of two conditions must be met:
   1. The end configuration sold by the VAR must have been originally qualified by the OEM, or
   2. In the case that the end configuration has not been qualified by the OEM, the VAR must become an ENERGY STAR partner, and test and qualify the configuration.

OEM partners selling Computer Servers to VARs must provide the VAR with a list of qualified configurations for that model, using approved components, which have been initially qualified and reported to EPA by the OEM Partner.

Ultimately, the party (i.e. the OEM or VAR) that markets and sells the ENERGY STAR Computer Server to the end user is responsible for ensuring the configuration has been qualified either by the party itself or by the OEM. If a VAR markets and sells a Computer Server under one of its own brands, that VAR must become an ENERGY STAR Partner and qualify the Computer Server under their own brand name.

D. Qualifying Configurations and Families Under this Specification

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

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

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

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

   A. Tier 1 Requirements: The first phase of this specification will commence on **May 15, 2009**. For products sold in the European Union, the effective date will be on the 20th day following its publication in the Official Journal of the European Union.

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

6) **Future Specification Revisions:** EPA reserves the right to change the specification should technological and/or market changes affect its usefulness to consumers, industry, or the environment. In keeping with current policy, revisions to the specification are arrived at through industry discussions. In the event of a specification revision, please note that ENERGY STAR qualification is not automatically granted for the life of a product model. To carry the ENERGY STAR mark, a product model must meet the ENERGY STAR program requirements that are in effect on the date of product 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. For analyzers that do not specify the current crest factor, the analyzer must be capable of measuring an amperage spike of at least 3 times the maximum amperage measured during any 1-second sample;
- 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.

The power measurement instrument must only meet the accuracy requirements above for loads experienced during testing (i.e. tests which do not include measurements at 10 watts or below do not have to be capable of meeting the 0.01 W accuracy requirement at these power levels).

Note: Multiple power analyzers may be used for measurements above of the rated capacity of a single analyzer, provided that the above accuracy requirements are maintained for the overall measurements.

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 or 60 Hz(± 1%) and/or, 115 (± 1%) Volts AC, 60 Hz (± 1%)
	DC Servers:	± 53 (± 1 V) Volts DC
	Optional Testing Conditions For AC-DC Japanese Market[†]:	100 (± 1%) Volts AC, 50 Hz / 60 Hz (± 1%)
		Note: For products rated for > 1.5 kW maximum power, the voltage range is ± 4%
Total Harmonic Distortion (THD) (Voltage):	< 2% THD (< 5% for products which are rated for > 1.5 kW maximum power)	
Ambient Temperature:	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.

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, and although the link must be ready and able to transmit packets, no specific traffic is required over the connection during testing.

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

III. **Test Procedure for All Computer Server Products**

Measurement of AC or DC power consumption of a Computer Server shall be conducted as follows. All measurements may be manually or automatically recorded.

A. UUT Preparation
1. Record the manufacturer and model name of the UUT. Also record all basic information about the UUT's configuration including, operating system name and version, processor type and speed, installed power supply(s), physical memory, hard drive configuration, installed I/O Devices, power management features enabled, etc.
2. Ensure that the UUT is connected to a live Ethernet (IEEE 802.3) network switch as specified in Section II., "Test Configuration," above. The UUT must maintain this live connection to the switch for the duration of testing, disregarding brief lapses when transitioning between link speeds.
3. Connect an appropriate power analyzer or analyzers (as defined in Section II, Testing Requirements) to an AC or DC voltage source set to the appropriate voltage for the test. AC sources shall also be set to the appropriate frequency for the test.
4. Plug the UUT into the measurement power outlet on the power analyzer, as follows:
    a. No UPS units may be connected between the power analyzer and the UUT.
    b. UUTs with multiple power supplies must have all power supplies connected and operational during the test. If necessary, a PDU, or Power Distribution Unit (such as a simple plug multiplier or power strip), may be used to connect multiple power supplies to a single source. In this case, any overhead electrical use from the PDU must be included in the measurement of Idle power for the UUT.
    c. For a valid test to take place the analyzer shall remain in place until all Idle and full load power data is fully recorded.
5. Install the benchmark software intended for use to acquire power at full load. This benchmark shall be run when testing for full load power in Section B., below, and shall not significantly impact the power levels during the Idle power measurement (e.g. automated benchmark software may automate a system Idle state, but this simulated Idle state must be functionally equivalent to the Idle state achieved in step 8, below). Record the installed benchmark workload and configuration, including any custom parameters or settings.
6. Record the AC or DC input voltage. Record the frequency for AC voltage sources.

B. Measuring Full Load and Idle Power
1. Boot the UUT and wait until the operating system has fully loaded. If necessary, run the initial system setup and allow all one-time/periodic processes to complete.
2. Ensure that the UUT is in an as-shipped configuration, including the operating system and all other software included with the UUT by default. Maintain configuration and tuning parameters throughout the testing process for both full load power and Idle power.
3. The UUT must be configured using the following requirements for all tests:
    a. The UUT must be configured with any applicable operating systems installed, and all user-configurable options should be set to their as-shipped settings. All other software must also be configured as shipped by default. If the UUT is shipped without an operating system, it must be tested with a representative operating system configured with only default settings.

      b. Only those power management features that are enabled by default by the Partner upon shipment may be enabled during testing. All power management features used during the test must be noted on the test report.

      c. If the UUT is shipped without accessories, it shall be configured with a standard mouse, keyboard and external computer display (if server has display output functionality), or accessed through a remote access application that is appropriate for the UUT's operating system to monitor UUT Idle status.

      d. Ensure the UUT is configured to boot from the primary installed boot device (hard drive or solid state drive). The UUT may not boot from external storage devices.

      e. Primary storage devices integral to the UUT must not be power managed ("spun-down") during Idle testing unless they contain non-volatile cache memory integral to the drive (e.g. "hybrid" hard drives). If more than one internal hard drive is installed as-shipped, the non-primary hard drive(s) must be tested with hard drive power management enabled as-shipped. If these additional drives are not power managed when shipped to customers, they must be tested without power management features enabled.

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 observed during benchmark operation at maximum load.

8. Between 5 and 15 minutes after the full load benchmark test has been completed, accumulate Idle power values for 5 additional minutes and record the average (arithmetic mean) value observed during that 5 minute period. The UUT must maintain an Idle state throughout this period and must not enter lower power states with limited availability (e.g., computer sleep or hibernate states).

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.