ENERGY STAR® Program Requirements
Product Specification for Computers

Eligibility Criteria
Final Draft, Version 8.0

Following is the **Final Draft, Version 8.0** ENERGY STAR Product Specification for Computers. A product shall meet all of the identified criteria if it is to earn the ENERGY STAR.

1 DEFINITIONS

A) Product Types:

1) Computer: A device which performs logical operations and processes data. For the purposes of this specification, computers include both stationary and portable units, including Desktop Computers, Integrated Desktop Computers, Notebook Computers, Small-Scale Servers, Thin Clients, and Workstations. Although computers are capable of using input devices and displays, such devices are not required to be included with the computer upon shipment. Computers are composed of, at a minimum:

   a) A central processing unit (CPU) to perform operations. If no CPU is present, then the device must function as a client gateway to a server which acts as a computational CPU;

   b) User input devices such as a keyboard, mouse, or touchpad; and

   c) An Integrated Display screen and/or the ability to support an external display screen to output information.

2) Desktop Computer: A computer whose main unit is designed to be located in a permanent location, often on a desk or on the floor. Desktop computers are not designed for portability and are designed for use with an external display, keyboard, and mouse. Desktop computers are intended for a broad range of home and office applications, including point of sale applications.

   a) Integrated Desktop Computer: A Desktop Computer in which the computing hardware and display are integrated into a single housing, and which is connected to ac mains power through a single cable. Integrated Desktop Computers come in one of two possible forms: (1) a system where the display and computer are physically combined into a single unit; or (2) a system packaged as a single system where the display is separate but is connected to the main chassis by a dc power cord and both the computer and display are powered from a single power supply. As a subset of Desktop Computers, Integrated Desktop Computers are typically designed to provide similar functionality as Desktop systems.

3) Notebook Computer: A computer designed specifically for portability and to be operated for extended periods of time both with and without a direct connection to an ac mains power source. Notebook Computers include an Integrated Display, a non-detachable, mechanical keyboard (using physical, moveable keys), and pointing device.

   a) Mobile Thin Client: A computer meeting the definition of a Thin Client, designed specifically for portability, and meeting the definition of a Notebook Computer. These products are considered to be Notebook Computers for the purposes of this specification.

   b) Two-In-One Notebook: A computer which resembles a traditional Notebook Computer with a clam shell form factor but has a detachable display which can act as an independent Slate/Tablet when disconnected. The keyboard and display portions of the product must be shipped as an integrated unit. Two-In-One Notebooks are considered Notebooks in the remainder of this specification and are therefore not referenced explicitly.

   c) Mobile Workstation: A computer which meets the definition of Notebook Computer but also meets all of the following criteria:

(1) Has a mean time between failures (MTBF) of at least 13,000 hours (based on either Telcordia SR-332, Issue X or field collected data);

(2) Certification by 2 or more Independent Software Vendor (ISV) product certifications; these certifications can be in process, but partner shall ensure they are completed within 3 months of certification;

(3) Supports at least 32 gigabytes of system memory; and

(4) Supports either:

(a) At least one integrated or discrete GPU with frame buffer bandwidth of 96 gigabytes per second or greater; or

(b) A total of 4 gigabytes or more of system memory with a bandwidth of 134 gigabytes per second or greater and an integrated GPU.

d) Multi-Screen Notebook: A computer which resembles a traditional Notebook Computer with a clam shell form factor but has a secondary display with touch and/or pen capability that can be used as a touch screen keyboard in place of a traditional mechanical keyboard. These products are considered to be Notebook Computers for purposes of this specification.

4) Slate/Tablet: A computing device designed for portability that meets all of the following criteria:

a) Includes an integrated display with a diagonal size greater than 6.5 inches and less than 17.4 inches;

b) Lacking an integrated, physical attached keyboard in its as-shipped configuration;

c) Includes and primarily relies on touchscreen input; (with optional keyboard);

d) Includes and primarily relies on a wireless network connection (e.g., Wi-Fi, 3G, etc.); and

e) Includes and is primarily powered by an internal battery (with connection to the mains for battery charging, not primary powering of the device).

5) Portable All-In-One Computer: A computing device designed for portability that meets all of the following criteria:

a) Includes an integrated display with a diagonal size greater than or equal to 17.4 inches;

b) Lacking keyboard integrated into the physical housing of the product in its as-shipped configuration;

c) Includes and primarily relies on touchscreen input; (with optional keyboard);

d) Includes wireless network connection (e.g. Wi-Fi, 3G, etc.); and

e) Includes an internal battery

6) E-Reader: A device designed for display and consumption of static images. The display is characterized by a low refresh rate and a display made of bistable materials where no energy is needed to maintain a visible image, only to alter the image.

7) Small-scale Server: A computer that typically uses desktop components in a desktop form factor but is designed primarily to be a storage host for other computers. Small-scale Servers are designed to perform functions such as providing network infrastructure services (e.g., archiving) and hosting data/media. These products are not designed to process information for other systems or run web servers as a primary function. A Small-scale Server has the following characteristics:

a) Designed in a pedestal, tower, or other form factor similar to those of desktop computers such that all data processing, storage, and network interfacing is contained within one box/product;

b) Designed to operate 24 hours/day, 7 days/week, with minimal unscheduled downtime (on the order of hours/year);

c) Capable of operating in a simultaneous multi-user environment serving several users through networked client units; and

d) Designed for an industry accepted operating system for home or low-end server applications (e.g., Windows Home Server, Mac OS X Server, Linux, UNIX, Solaris).

8) Thin Client: An independently-powered computer that relies on a connection to remote computing resources (e.g., computer server, remote workstation) to obtain primary functionality. Main computing functions (e.g., program execution, data storage, interaction with other Internet resources) are provided by the remote computing resources. Thin Clients covered by this specification are (1) limited to devices with no rotational storage media integral to the computer and (2) designed for use in a permanent location (e.g. on a desk) and not for portability.

a) Integrated Thin Client: A Thin Client in which computing hardware and display are connected to ac mains power through a single cable. Integrated Thin Client computers come in one of two possible forms: (1) a system where the display and computer are physically combined into a single unit; or (2) a system packaged as a single system where the display is separate but is connected to the main chassis by a dc power cord and both the computer and display are powered from a single power supply. As a subset of Thin Clients, Integrated Thin Clients are typically designed to provide similar functionality as Thin Client systems.

b) Ultra-thin Client: A computer with lesser local resources than a standard Thin Client that sends raw mouse and keyboard input to a remote computing resource and receives back raw video from the remote computing resource. Ultra-thin clients cannot interface with multiple devices simultaneously nor run windowed remote applications due to the lack of a user-discernible client operating system on the device (i.e., beneath firmware, user inaccessible).

9) Workstation: A high-performance, single-user computer typically used for graphics, CAD, software development, financial and scientific applications among other compute intensive tasks. Workstations covered by this specification (a) are marketed as a workstation; (b) do not support altering frequency or voltage beyond the CPU and GPU manufacturers' as shipped operating specifications; and (c) has system hardware that supports error-correcting code (ECC) that detects and corrects errors with dedicated circuitry on and across the CPU, interconnect, and system memory. In addition, a workstation meets two or more of the following criteria:

a) Supports one or more discrete GPU or discrete compute accelerators

b) Supports four or more slots of PCI-express, other than discrete GPU, connected to accessory expansion slots or ports where each lane has a bandwidth of 8 gigabits per second (Gb/s) or more.

c) Provide multi-processor support for two or more physically separate processor packages or sockets. (this requirement cannot be met with support for a single multi-core processor); and/or

d) Certification by 2 or more Independent Software Vendor (ISV) product certifications; these certifications can be in process, but partner shall ensure they are completed within 3 months of certification.

10) Rack-mounted Workstation: A workstation that is designed to be natively rack mounted as described in IEC 60297-3-101:2004. The rack-mounted workstation may be accessed locally by direct connection to the workstation and display or accessed remotely across a network by one or more users.

B) Product Category: A second-order classification or sub-type within a product type that is based on product features and installed components. Product categories are used in this specification to determine certification and test requirements.

C) Computer Components:

1) Graphics Processing Unit (GPU): An integrated circuit, separate from the CPU, designed to accelerate the rendering of either 2D and/or 3D content to displays. A GPU may be mated with a CPU, on the system board of the computer or elsewhere to offload display capabilities from the CPU.

2) Discrete Graphics (dGfx): A graphics processor (GPU) which must contain a local memory controller interface and local graphics-specific memory.

3) Integrated Graphics (iGfx): A graphics solution that does not contain Discrete Graphics.

4) Display: A commercially-available product with a display screen and associated electronics, often encased in a single housing, that as its primary function displays visual information from (1) a computer, workstation or server via one or more inputs (e.g., VGA, DVI, HDMI, DisplayPort, IEEE 1394, USB), (2) external storage (e.g., USB flash drive, memory card), or (3) a network connection.

   a) Enhanced-performance Integrated Display: An integrated Computer Display that has all of the following features and functionalities:

      (1) A contrast ratio of at least 60:1 at a horizontal viewing angle of at least 85°, with or without a screen cover glass;

      (2) A native resolution greater than or equal to 2.3 megapixels (MP); and

      (3) A color gamut of at least sRGB as defined by IEC 61966-2-1. Shifts in color space are allowable as long as 99% or more of defined sRGB colors are supported.

5) External Power Supply (EPS): Also referred to as External Power Adapter. An external power supply circuit that is used to convert household electric current into dc current or lower-voltage ac current to operate a consumer product.

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

7) System Memory Bandwidth: The rate at which data can be read or stored into computer system's memory, expressed in gigabytes per second (GB/s).

D) Operational Modes:

1) Active State: The power state in which the computer is carrying out useful work in response to a) prior or concurrent user input or b) prior or concurrent instruction over the network. Active State includes active processing, seeking data from storage, memory, or cache, including Idle State time while awaiting further user input and before entering low power modes.

2) Idle State: The power state in which the operating system and other software have completed loading, a user profile has been created, activity is limited to those basic applications that the system starts by default, and the computer is not in Sleep Mode. Idle State is composed of two sub-states: Short Idle and Long Idle.

a) Long Idle: The mode where the Computer has reached an Idle condition (i.e., 15 minutes after OS boot or after completing an active workload or after resuming from Sleep Mode) and the main Computer Display has entered a low-power state where screen contents cannot be observed (i.e., backlight has been turned off) but remains in the working mode (ACPI G0/S0). If power management features are enabled as-shipped in the scenario described in this definition, such features shall engage prior to evaluation of Long Idle (e.g., display is in a low power state, HDD may have spun-down), but the Computer is prevented from entering Sleep Mode. P_{LONG_IDLE} represents the average power measured when in the Long Idle Mode.

b) Short Idle: The mode where the Computer has reached an Idle condition (i.e., 5 minutes after OS boot or after completing an active workload or after resuming from Sleep Mode), the screen is on, and Long Idle power management features have not engaged (e.g. HDD is spinning and the Computer is prevented from entering sleep mode). P_{SHORT_IDLE} represents the average power measured when in the Short Idle Mode.

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

4) Sleep Mode: A low power mode that the computer enters automatically after a period of inactivity or by manual selection. A computer with Sleep capability can quickly "wake" in response to network connections or user interface devices from initiation of wake event to a readable display. For systems where ACPI standards are applicable, Sleep Mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state. P_{SLEEP} represents the average power measured when in the Sleep Mode.

5) Alternative Low Power Mode (ALPM): A low power mode that the computer enters automatically after a period of inactivity or by manual selection that is defined by the display turning off and the computer entering a state of reduced functionality. A computer with Alternative Low Power Mode must maintain immediate responsiveness to network connections or user interface devices. P_{ALPM} represents the average power measured when in the Alternative Low Power Mode.

E) Networking and Additional Capabilities:

1) Additional Internal Storage: Any and all internal hard disk drives (HDD) or solid-state drives (SSD) installed beyond the primary storage device where the operating system is installed in the products as shipped state. This definition does not include external drives.

2) Energy Efficient Ethernet (EEE): A technology which enables reduced power consumption of Ethernet interfaces during times of low data throughput. Specified by IEEE 802.3az.

3) Full Network Connectivity: The ability of the computer to maintain network presence while in Sleep Mode or an Alternative Low Power Mode (ALPM) with power demand of less than or equal to 10 watts and intelligently wake when further processing is required (including occasional processing required to maintain network presence). Presence of the computer, its network services and applications, is maintained even though the computer is in an ALPM. From the vantage point of the network, a computer with full network connectivity that is in ALPM is functionally equivalent to an idle computer with respect to common applications and usage models. Full network connectivity in ALPM is not limited to a specific set of protocols but can cover applications installed after initial installation. Also referred to as "network proxy" functionality and as described in the *Ecma-393* standard.

a) Network Proxy - Base Capability: To maintain addresses and presence on the network while in Sleep Mode or ALPM, the system handles IPv4 ARP and IPv6 NS/ND.

b) Network Proxy - Full Capability: While in Sleep Mode or ALPM, the system supports Base Capability, Remote Wake, and Service Discovery/Name Services.

c) Network Proxy - Remote Wake: While in Sleep Mode or ALPM, the system is capable of remotely waking upon request from outside the local network. Includes Base Capability.

d) Network Proxy - Service Discovery/Name Services: While in Sleep Mode or ALPM, the system allows for advertising host services and network name. Includes Base Capability.

4) Constant Network Connectivity: A capability that allows the wake of system operating system or software to facilitate communication and downloads from the network (e.g. instant messaging, email, management and maintenance tasks, etc.)

5) Network Interface: The components (hardware and software) whose primary function is to make the computer capable of communicating over one or more network technologies. Examples of Network Interfaces are IEEE 802.3 (Ethernet) and IEEE 802.11 (Wi-Fi).

6) Wake Event: A user, scheduled, or external event or stimulus that causes the computer to transition from Sleep Mode or Off Mode to an active state of operation. Examples of wake events include, but are not limited to: movement of the mouse, keyboard activity, controller input, real-time clock event, or a button press on the chassis, and in the case of external events, stimulus conveyed via a remote control, network, modem, etc.

7) Wake On LAN (WOL): Functionality which allows a computer to transition from Sleep Mode or Off Mode to an Active State of operation when directed by a network Wake Event via Ethernet.

8) Switchable Graphics: Functionality that allows Discrete Graphics to be disabled when not required in favor of Integrated Graphics.

Note: This functionality allows lower power and lower capability integrated GPUs to render the display while on battery or when the output graphics are not overly complex while then allowing the more power consumptive but more capable discrete GPU to provide rendering capability when required.

F) Marketing and Shipment Channels:

1) Enterprise Channels: Sales channels typically used by large and medium-sized business, government, educational, or other organizations to purchase computers for use in managed client/server environments.

2) Model Name: A marketing name that includes reference to the computer model number, product description, or other branding references.

3) Model Number: A unique marketing name or identification reference that applies to a specific hardware and software configuration (e.g., operating system, processor type, memory, GPU), and is either pre-defined or selected by a customer.

G) Product Family: A high-level description referring to a group of computers sharing one chassis/motherboard combination that often contains hundreds of possible hardware and software configurations. Product models within a family differ from each other according to one or more characteristics or features that either (1) have no impact on product performance with regard to ENERGY STAR certification criteria, or (2) are specified herein as acceptable variations within a product family. For Computers, acceptable variations within a product family include:

1) Color;

2) Housing; and

3) Electronic components other than the chassis/motherboard, such as the processor, memory, GPU, etc.

2 SCOPE

2.1 Included Products

2.1.1 Products that meet the definition of a Computer and one of the following Product Type definitions, as specified herein, are eligible for ENERGY STAR certification, with the exception of products listed in Section 2.2:

i. Desktop Computers and Integrated Desktop Computers;

ii. Notebook Computers;

iii. Slates/Tablets;

iv. Portable All-In-One Computers;

v. Workstations; and

vi. Thin Clients.

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for certification under this specification. The list of specifications currently in effect can be found at www.energystar.gov/products.

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

i. Docking Stations;

ii. Game Consoles;

iii. E-Readers;

iv. Handheld gaming devices, typically battery powered and intended for use with an integral display as the primary display;

v. Mobile Thin Clients not meeting the definition of Notebook Computer;

vi. Personal Digital Assistant devices (PDAs);

vii. Point of Sale (POS) products that do not use internal components common to Notebook, Desktop, or Integrated Desktop Computers, including a processor, motherboard, and memory;

viii. Slate/Tablet based POS products;

ix. Handheld Computers and Slates/Tablets which contain cellular voice capability;

x. Ultra-thin Clients; and

xi. Small-scale Servers.

3 CERTIFICATION CRITERIA

3.1 Significant Digits and Rounding

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

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

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

3.2 General Requirements

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

3.2.2 Internal Power Supply (IPS) Requirements: IPSs used in Computers eligible under this specification must meet the following requirements when tested using the *Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.6* (available at http://www.plugloadsolutions.com/docs/collatrl/print/Generalized_Internal_Power_Supply_Efficiency_Test_Protocol_R6.6.pdf).

i. IPS with maximum rated output power less than 75 watts shall meet minimum efficiency requirements as specified in Table 1.

ii. IPS with maximum rated output power greater than or equal to 75 watts shall meet both minimum efficiency requirements and minimum power factor requirements, as specified in Table 1 and Table 2 as applicable.

Table 1: Requirements for Internal Power Supplies with Rated Output of 500 Watts and Below

Loading Condition (Percentage of Nameplate Output Current)	Minimum Efficiency	Minimum Power Factor
10%	0.80	
20%	0.82	-
50%	0.85	0.90
100%	0.82	-

Table 2: Requirements for Internal Power Supplies with Rated Output Above 500 Watts

Loading Condition (Percentage of Nameplate Output Current)	Minimum Efficiency	Minimum Power Factor
10%	0.80	
20%	0.87	-
50%	0.90	0.90
100%	0.87	-

3.2.3 External Power Supply (EPS) Requirements: Single- and Multiple-voltage EPSs shall meet the Level VI or higher performance requirements under the International Efficiency Marking Protocol when tested according to the Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.

i. Single-voltage EPSs shall include the Level VI or higher marking.

ii. Multiple-voltage EPSs meeting Level VI or higher shall include the Level VI or higher marking.

iii. Additional information on the Marking Protocol is available at http://www.regulations.gov/#!documentDetail;D=EERE-2008-BT-STD-0005-0218

3.2.4 Energy Efficient Ethernet (EEE) Requirements: All products which contain one or more Ethernet ports with a bandwidth of 1Gb/s or higher shall have EEE supported in each of these ports in their as-shipped configuration.

3.3 Power Management Requirements

3.3.1 Products shall include power management features in their “as-shipped” condition as specified in Table 3, subject to the following conditions:

i. For Thin Clients, the Wake-on-LAN (WOL) requirement shall apply for products designed to receive software updates from a centrally managed network while in Sleep Mode or in Off Mode. Thin Clients whose standard software upgrade framework does not require off-hours scheduling are exempt from the WOL requirement.

ii. For Notebooks, WOL may be automatically disabled when the product is disconnected from ac mains power.

iii. For all products with WOL, directed packet filters shall be enabled and set to an industry standard default configuration.

iv. Products that do not support Sleep Mode by default are only subject to the Display Sleep Mode requirement.

351 **Table 3: Power Management Requirements**

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Portable All-In-Ones	Notebooks	Slates/Tablets	Thin Clients	Workstations
System Sleep[i]/Alternative Low Power Mode	(1) Sleep/Alternative Low Power Mode shall be set to activate after no more than 30 minutes of user inactivity. (2) The speed of any active 1 Gb/s or faster Ethernet network links shall be reduced when transitioning to Sleep Mode or Off Mode. Or the links shall enter Energy Efficient Ethernet state when transitioning to Alternative Low Power Mode	Yes	Yes	Yes	Yes	N/A	Yes	Yes
Display Sleep Mode	(1) Display Sleep Mode shall be set to activate after no more than 15 minutes of user inactivity.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wake on LAN (WOL)	(1) Computers with Ethernet capability shall provide users with an option to enable and disable WOL for Sleep Mode. (2) Computers with Ethernet capability that are shipped through enterprise channels shall either: (a) be shipped with WOL enabled by default for Sleep Mode, when the computer is operating on ac mains power; or (b) provide users with the ability to enable WOL that is accessible from both the client operating system user interface and over the network[ii].	Yes	Yes	Yes	Yes	N/A	Yes	Yes
Wake Manage-ment	(1) Computers with Ethernet capability that are shipped through enterprise channels shall: (a) be capable of both remote (via network) and scheduled (via real-time clock) wake events from Sleep Mode, and (b) provide clients with the ability to centrally manage (via vendor tools) any wake management settings that are configured through hardware settings if the manufacturer has control over such features.	Yes	Yes	Yes	Yes	N/A	Yes	Yes

352

3.4 User Information Requirements

3.4.1 Products shall be shipped with informational materials to notify customers of the following:

i. A description of power management settings that have been enabled by default,

ii. A description of the timing settings for various power management features, and

iii. Instructions for properly waking the product from Sleep Mode.

3.4.2 Products shall be shipped with one or more of the following:

i. A list of default power management settings.

ii. A note stating that default power management settings have been selected for compliance with ENERGY STAR (within 15 min of user inactivity for the display, within 30 min for the computer, if applicable per Table 3), and are recommended by the ENERGY STAR program for optimal energy savings.

iii. Information about ENERGY STAR and the benefits of power management, to be located at or near the beginning of the hard copy or electronic user manual, or in a package or box insert.

3.4.3 Provisions 3.4.1 and 3.4.2 may be met through use of either electronic or printed product documentation, provided it adheres to <u>all</u> of the following:

i. Documentation is shipped with the product (e.g., in a printed manual or insert, on included optical media, in a file installed with the software load shipped to the customer) or available electronically on the manufacturer's website. In the latter case, instructions for accessing the information on the website shall be provided in the product package or on the Desktop or home screen; and

ii. Documentation is included either (a) only with ENERGY STAR certified Computers; or (b) as part of the standard documentation if and only if accompanied by EPA-approved customer guidance on how to identify if their computer configuration is ENERGY STAR certified.

3.5 Requirements for Desktop, Integrated Desktop, and Notebook Computers

3.5.1 <u>Resume Time Requirement:</u> Notebook computers are required to wake from sleep or an alternative low power mode with a latency of less than or equal to 5 seconds from initiation of wake event to system becoming fully usable including rendering of display. Desktop and Integrated Desktop Computers shall meet this same requirement, but with a latency of less than or equal to 10 seconds. Manufacturers shall self-declare that the product can meet this requirement[iii].

3.5.2 Calculated Typical Energy Consumption (E_{TEC}) for Desktop, Integrated Desktop, and Notebook Computers per Equation 1 shall be less than or equal to the maximum TEC requirement (E_{TEC_MAX}) per Equation 2, subject to the following requirements:

i. The Additional Internal Storage adder allowance ($TEC_{STORAGE}$) shall be applied if there are more than one internal storage devices present in the product, in which case it shall only be applied once.

ii. The Integrated Display adder allowance ($TEC_{INT\_DISPLAY}$) applies only for Integrated Desktops and Notebooks and may be applied for each display. For Enhanced-performance Integrated Displays, the adder is calculated as presented in Table 11 and Equation 3.

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[i] Where Sleep Mode is supported by the UUT by default and Sleep Mode power is used as part of the TEC equation for qualification.

[ii] Option (b) is not permitted for systems that use WOL in order to meet the definition of Full Network Connectivity to claim the Full Capability mode weighting.

iii For purposes of ENERGY STAR third-party certification, these requirements shall not be reviewed when products are initially certified nor during subsequent verification testing. Rather, EPA reserves the right to request supporting documentation at any time.

iii. For a product to certify for the Full Network Connectivity mode weighting or incentive, one of the following sets of criteria shall be satisfied:

- Option 1:
  - Products shall meet ECMA 393.
  - Notebook Computer products shall have the applied level of functionality in Table 5 enabled and configured by default upon shipment.
  - Desktop and Integrated Desktop products shall apply the appropriate $ALLOWANCE_{PROXY}$ incentive addressed in Equation 2 below.
- Option 2:
  - Products shall be capable of Sleep Mode or an Alternative Low Power Mode which maintains constant network connectivity with energy consumption less than or equal to 2.5 watts for Notebook or Integrated Desktop Computers in order to qualify for the Full Capability mode weighting and applicable incentives in Table 7 respectively The same requirement applies for Desktop Computers, but with an energy consumption less than or equal to 3.0 watts.

Note: If a Notebook Computer product does not comply with Option 1 or 2 above, the product shall be tested and reported with Conventional mode weightings shown in Table 5. Full Network Connectivity is a manufacturer-reported parameter. On Mac computers, "Wake for network access" enabled within the Energy Saver/Power Adapter Preferences signifies Base Capability or better. On Windows computers, "ARP Offload" or "NS Offload" or similar enabled within the Advanced Properties of the Network Interface Card (accessed through the Device Manager) signifies Base Capability or better. For systems with a dual Network Interface Card (NIC) configuration, only one NIC configuration needs to comply. The manufacturer can provide further guidance on how to confirm Proxy Support.

Note: EPA has revised the Full Network Connectivity language in Option 1 and Option 2 above to clarify how these options apply to Notebook Computers, Integrated Desktop Computers, and Desktop Computers due to the new incentive structure. In addition, EPA has clarified that Option 1 can only be met by compliance with ECMA 393, while other Network Connectivity implementations need to meet requirements outlined in Option 2.

The existing 2.5 watt maximum limit in Option 2 has remained in place for notebook and integrated desktop computers, but a maximum 3.0 watt limit has been introduced for desktop computers to accommodate the proxy incentive in Table 7 below.

iv. For Notebooks, Desktops, and Integrated Desktops that use an Alternative Low Power Mode in place of System Sleep Mode and Long Idle Mode, power in Alternative Low Power Mode (P_{ALPM}) may be used in place of both the power in Sleep (P_{SLEEP}) and the power in Long Idle (P_{LONG_IDLE}) in Equation 1 if the Alternative Low Power Mode measured power is less than or equal to 10 watts. In such instances, ($P_{SLEEP} \times T_{SLEEP}$) and ($P_{LONG\_IDLE} \times T_{LONG\_IDLE}$) are replaced by ($P_{ALPM} \times T_{SLEEP}$) and ($P_{ALPM} \times T_{LONG\_IDLE}$); Equation 1 remains otherwise unchanged.

v. Notebooks, Desktops, and Integrated Desktops with switchable graphics may not apply the Discrete Graphics allowance, $TEC_{GRAPHICS}$, from Table 11 in Equation 2. However, for Desktop and Integrated Desktop systems providing Switchable Graphics and enabling it by default, an allowance equal to 14.4 watts (Desktop or Integrated Desktop) may be applied. The switchable graphics incentive only applies to automated switching that is enabled by default. This capability is manufacturer-declared.

Equation 1: TEC Calculation (E_{TEC}) for Desktop, Integrated Desktop, Thin Client and Notebook Computers

$$E_{TEC} = \frac{8760}{1000} \times (P_{OFF} \times T_{OFF} + P_{SLEEP} \times T_{SLEEP} + P_{LONG\_IDLE} \times T_{LONG\_IDLE} + P_{SHORT\_IDLE} \times T_{SHORT\_IDLE})$$

Where:

- *P_{OFF} = Measured power consumption in Off Mode (W);*
- *P_{SLEEP} = Measured power consumption in Sleep Mode (W);*
- *P_{LONG_IDLE} = Measured power consumption in Long Idle Mode (W);*
- *P_{SHORT_IDLE} = Measured power consumption in Short Idle Mode (W); and*
- *T_{OFF}, T_{SLEEP}, T_{LONG_IDLE}, and T_{SHORT_IDLE} are mode weightings as specified in Table 4 (for Desktops, Integrated Desktops, and Thin Clients) or Table 5 (for Notebooks).*

Table 4: Mode Weightings for Desktops and Integrated Desktop Computers

Mode Weighting	Conventional
T_{OFF}	15%
T_{SLEEP}	45%
T_{LONG_IDLE}	10%
T_{SHORT_IDLE}	30%

Table 5: Mode Weightings for Notebook Computers

Mode Weighting	Conventional	Full Network Connectivity			
		Base Capability	Remote Wake	Service Discovery / Name Services	Full Capability
T_{OFF}	25%	25%	25%	25%	25%
T_{SLEEP}	35%	39%	41%	43%	45%
T_{LONG_IDLE}	10%	8%	7%	6%	5%
T_{SHORT_IDLE}	30%	28%	27%	26%	25%

Equation 2: E_{TEC_MAX} Calculation for Desktop, Integrated Desktop, and Notebook Computers

$$E_{TEC\_MAX} = (1+ALLOWANCE_{PSU}+ALLOWANCE_{PROXY}) \times (TEC_{BASE} + TEC_{MEMORY} + TEC_{GRAPHICS} + TEC_{STORAGE} + TEC_{INT\_DISPLAY} + TEC_{SWITCHABLE} + TEC_{MOBILEWORKSTATION})$$

Where:

- *$ALLOWANCE_{PSU}$ is an allowance provided to power supplies that meet the optional more stringent efficiency levels specified in Table 6; power supplies that do not meet the requirements receive an allowance of 0;*

- *$ALLOWANCE_{PROXY}$ is an allowance provided only to desktops and integrated desktops which implement a full capability - full network proxy solution. Products meeting Option 1 in Section 3.5.2 above may claim an allowance of 0.12, while products meeting Option 2 can apply the applicable adder in Table 7 below. This allowance can only be applied once per product.*
- *TEC_{BASE} is the Base allowance specified in Table 8, Table 9, or Table 10; and,*
- *$TEC_{GRAPHICS}$ is the discrete graphics allowance as specified in Table 11, with the exception of systems with integrated graphics, which do not receive an allowance, or Desktops and Integrated Desktops with switchable graphics enabled by default, which receive an allowance through $TEC_{SWITCHABLE}$; and*
- *TEC_{MEMORY} , $TEC_{STORAGE}$, $TEC_{INT\_DISPLAY}$, $TEC_{SWITCHABLE}$, and $TEC_{MOBILEWORKSTATION}$ are adder allowances as specified in Table 11.*

Note: Stakeholders provided more granular data and information supporting a change to the products eligible for and size of Full Network Connectivity incentive levels. In response, EPA has modified products eligible for the *$ALLOWANCE_{PROXY}$* from Draft 2 to now include integrated desktops and is referencing the new Table 7 below for any products meeting Option 2 in Section 3.5.2. EPA believes that this revised incentive will push products to ultimately use less overall energy than they currently use with a combination of traditional sleep and long idle modes, while also providing additional functionality for end-users through alternative low power modes.

Table 6: Internal Power Supply Efficiency Allowance

Power Supply Type	Computer Type	Minimum Efficiency at Specified Proportion of Rated Output Current				$Allowance_{PSU}$
		10%	20%	50%	100%	
IPS	Desktop	0.86	0.90	0.92	0.89	0.015
		0.90	0.92	0.94	0.90	0.03
	Integrated Desktop	0.86	0.90	0.92	0.89	0.015
		0.90	0.92	0.94	0.90	0.04

Table 7: Alternative Low Power Mode – Full Network Proxy Allowance

Computer Type	Maximum Measured Power Limit of ALPM (Watts)	$Allowance_{PROXY}$
Desktop	2.5	0.12
	3.0	0.06
Integrated Desktop	2.0	0.06
	2.5	0.03

Table 8: Base TEC (TEC_{BASE}) Allowances for Desktops

Category Name	Graphics Capability[iv]	Desktop	
		Performance Score, *P*[v]	Base Allowance
I1	Integrated or Switchable Graphics	$P \leq 8$	26.0
I2		$P > 8$	46.0
D1	Discrete Graphics	$P \leq 8$	35.0
D2		$P > 8$	45.0

Note: Stakeholders conducted energy testing of 3.5" hard disk drives in response to Draft 2, which was vetted by EPA and resulted in the reduction of the 3.5" hard disk drive adder to 16.5 kWh/year in Table 11 below.

EPA also received feedback regarding the integrated desktop base allowances. In particular, stakeholders noted that there is an overall benefit to increasing the base allowance for Category I2 integrated desktops as they offer a more energy efficient option to traditional desktop computers in many corporate settings.

In addition to the adder noted above, EPA received feedback indicating that retaining a single storage adder of 2.6 (as in Version 7.1) for notebook computers is more appropriate than raising these levels as proposed in Draft 2. EPA references the Version 7.1 adder in the Final Draft in Table 11.

Finally, industry provided additional feedback on the $TEC_{2.5\text{-}5GLAN}$ adder, explaining that the rollout and use cases of these ports is not dissimilar from that of TEC_{10GLAN}. As such, EPA is proposing an adder in Table 11 which accounts for adoption of these higher throughput ports which is expected in higher end content creation products.

iv Discrete Graphics capability is categorized based on frame buffer bandwidth, as shown in Table 11.

v P = [# of CPU cores] × [CPU clock speed (GHz)] , where # of cores represents the number of physical CPU cores and CPU clock speed represents the Max TDP core frequency, not the turbo boost frequency.

The result of these adjustments is an overall pass rate of 26%, with a range of 25% to 33% for all categories.

Table 9: Base TEC (TEC_{BASE}) Allowances for Integrated Desktops

Category Name	Integrated Desktop	
	Performance Score, P^{ivo}	Base Allowance
1	$P \leq 8$	9.0
2	$P > 8$	27.0

Table 10: Base TEC (TEC_{BASE}) Allowances for Notebooks

Category Name	Notebook	
	Performance Score, P^{iv}	Base Allowance
0	$P \leq 2$	6.5
1	$2 < P < 8$	8.0
2	$P \geq 8$	14.0

Table 11: Functional Adder Allowances for Desktop, Integrated Desktop, Thin Client, and Notebook Computers

Function		Desktop	Integrated Desktop	Notebook
TEC_{MEMORY} (kWh)[vi]		1.7 + (0.24 × *GB)*		2.4 + (0.294 × *GB)*
$TEC_{GRAPHICS}$ (kWh)[vii],[viii]		50.4 × tanh(0.0038 × FB_BW – 0.137) + 23		29.3 × tanh(0.0038 × FB_BW – 0.137) + 13.4
$TEC_{SWITCHABLE}$ (kWh)[ix]		14.4		N/A
$TEC_{STORAGE}$ (kWh)[x]	3.5” HDD	16.5		N/A
	2.5” HDD	2.1		2.6
	Hybrid HDD/SSD	0.8		
	SSD (including M.2 port solutions)	0.4		
$TEC_{INT\_DISPLAY}$ (kWh)[xi]	*A* < 190	N/A	[(3.43 × r) + (0.148 × *A*) + 1.30] × (1 + *EP*)	8.76 × *0.30* × (1+*EP)* × (0.43×*r* + 0.0263×*A*)
	190 ≤ *A* < 210		[(3.43× r) + (0.018 × *A*) + 26.1] × (1 + *EP*)	
	210 ≤ *A* < 315		[(3.43 × r) + (0.078 × *A*) + 13.2] × (1 + *EP*)	
	A ≥ 315		[(3.43 × r) + (0.156 × *A*) - 11.3] × (1 + *EP*)	
$TEC_{MOBILEWORKSTATION}$ (kWh)[xii]		N/A		4.0
$TEC_{2.5\text{-}5GLAN}$ (kWh)[xiii]		4.0		N/A
TEC_{10GLAN} (kWh)[xiv]		18.0		N/A

vi TEC_{MEMORY} Adder: *GB* applies per GB installed in the system.

vii $TEC_{GRAPHICS}$ Adder: Applies to only the first dGfx installed in the system, but not Switchable Graphics.

viii FB_BW: Is the display frame buffer bandwidth in gigabytes per second (GB/s). This is a manufacturer declared parameter and should be calculated as follows: (Data Rate [Mhz] × Frame Buffer Data Width [bits]) / (8 × 1000)

ix $TEC_{SWITCHABLE}$ Incentive: Applies to automated switching that is enabled by default in Desktops and Integrated Desktops.

x $TEC_{STORAGE}$ Adder: Applies once if system has an Additional Internal Storage device.

xi $TEC_{INT\_DISPLAY}$ Adder: EP is the Enhanced Performance Display allowance calculated per Equation 3; r is the Screen resolution in megapixels; and A is viewable screen area in square inches. This adder may be applied for each display if there are multiple displays in the system which are enabled as-shipped and in testing.

xii $TEC_{MOBILEWORKSTATION}$ Adder: Applies once if the system meets the full Mobile Workstation definition in Section 1.

xiii $TEC_{2.5\text{-}5GLAN}$ Adder: Applies once if system contains an Ethernet port with rated throughput greater than 1Gb/s but less than 10 Gb/s.

xiv TEC_{10GLAN} Adder: Applies once if the system contains a 10 Gb/s Ethernet port.

Equation 3: Calculation of Allowance for Enhanced-performance Integrated Displays

$$EP = \begin{cases} 0, & No\ Enhanced\ Performance\ Display \\ 0.3, & Enhanced\ Performance\ Display, d < 27 \\ 0.75, & Enhanced\ Performance\ Display, d \geq 27 \end{cases}$$

Where:

- *d is the diagonal of the screen, in inches*

3.6 Requirements for Slates/Tablets and Portable All-In-One Computers

3.6.1 Slates/Tablets and Portable All-In-One Computers shall follow **all** of the requirements for Notebook Computers in Section 3.5 above, including calculations of the following:

i. Calculated Typical Energy Consumption (E_{TEC}), using Equation 1 with the Notebook Computer Mode Weightings from Table 5.

ii. Calculated Maximum Allowed Typical Energy Consumption (E_{TEC_MAX}), using Equation 2 with the appropriate base Notebook Computer allowance from Table 10, and applicable Notebook Computer functional adder allowances from Table 11.

3.7 Requirements for Workstations

3.7.1 Weighted power consumption (P_{TEC}) as calculated per Equation 4 shall be less than or equal to the maximum weighted power consumption requirement (P_{TEC_MAX}) as calculated per Equation 5.

Equation 4: P_{TEC} Calculation for Workstations

$$P_{TEC} = P_{OFF} \times T_{OFF} + P_{SLEEP} \times T_{SLEEP} + P_{LONG\_IDLE} \times T_{LONG\_IDLE} + P_{SHORT\_IDLE} \times T_{SHORT\_IDLE}$$

Where:

- *P_{OFF} = Measured power consumption in Off Mode (W);*
- *P_{SLEEP} = Measured power consumption in Sleep Mode (W);*
- *P_{LONG_IDLE} = Measured power consumption in Long Idle Mode (W);*
- *P_{SHORT_IDLE} = Measured power consumption in Short Idle Mode (W); and*
- *T_{OFF}, T_{SLEEP}, T_{LONG_IDLE}, and T_{SHORT_IDLE} are mode weightings as specified in Table 12.*

Table 12: Mode Weightings for Workstations

T_{OFF}	T_{SLEEP}	T_{LONG_IDLE}	T_{SHORT_IDLE}
10%	35%	20%	35%

Equation 5: P_{TEC_MAX} Calculation for Workstations

$$P_{TEC\_MAX} = 0.28 \times (P_{MAX} + N_{HDD} \times 5)$$

Where:

- *P_{MAX} = Measured maximum power consumption (W)*
- *N_{HDD} = Number of installed hard disk drives (HDD) or solid-state drives (SSD)*

3.7.2 Active State Benchmark: To be ENERGY STAR certified, a Workstation must be submitted for certification with the following information disclosed in full:

i. LINPAC benchmark test results, compiler optimizations, and total energy consumed over the duration of the test; and

ii. SPECviewperf benchmark test results, configuration options, total duration of the test, and total energy consumed over the duration of the test.

3.7.3 Desktop Workstations: Products marketed as workstations may be ENERGY STAR certified under the Desktop requirements in Section 3.5 instead of the Workstation requirements in Section 3.7, at the Partner's option. EPA will identify Workstations certified as Desktops as "Desktops" in all ENERGY STAR marketing materials, on certified product lists, etc.

3.8 Requirements for Thin Clients

3.8.1 Calculated Typical Energy Consumption (E_{TEC}) per Equation 1 shall be less than or equal to the Maximum TEC Requirement (E_{TEC_MAX}), as calculated per Equation 6, subject to the following requirements.

i. Allowances can only be applied if the corresponding adders are enabled by default.

ii. Thin Clients shall utilize the mode weightings in Table 13 when calculating E_{TEC}.

iii. For Thin Clients that lack a discrete System Sleep Mode, Long Idle State power (P_{LONG_IDLE}) may be used in place of Sleep Mode Power (P_{SLEEP}) in Equation 1 so long as the system meets the Thin Client TEC allowance. In such instances, ($P_{SLEEP} \times T_{SLEEP}$), is replaced by ($P_{LONG\_IDLE} \times T_{SLEEP}$); Equation 1 remains otherwise unchanged.

Table 13: Mode Weightings for Thin Clients

T_{OFF}	T_{SLEEP}	T_{LONG_IDLE}	T_{SHORT_IDLE}
45%	5%	15%	35%

Equation 6: Calculation of E_{TEC_MAX} for Thin Clients

$$E_{TEC\_MAX} = TEC_{BASE} + TEC_{GRAPHICS} + TEC_{WOL} + TEC_{INT\_DISPLAY}$$

Where:

- TEC_{BASE} *is the Base Allowance specified in Table* Table *14;*
- $TEC_{GRAPHICS}$ *is the Discrete Graphics allowance specified in Table 14 if applicable;*
- TEC_{WOL} *is the Wake-on-LAN allowance specified in Table* Table *14 if applicable;*
- $TEC_{INT\_DISPLAY}$ *is the Integrated Display allowance for Integrated Desktops specified in Table 11 if applicable; and*

Table 14: Adder Allowances for Thin Clients

Adder	Allowance (kWh)
TEC_{BASE}	31
$TEC_{GRAPHICS}$	36
TEC_{WOL}	2

Note: Products intended for sale in the US market are subject to minimum toxicity and recyclability requirements. Please see ENERGY STAR® Program Requirements for Computers: Partner Commitments for details.

4 TESTING

4.1 Test Methods

4.1.1 When testing Computer products, the test methods identified in Table 15 shall be used to determine ENERGY STAR certification.

Table 15: Test Methods for ENERGY STAR Certification

Product Type or Component	Test Method
All	ENERGY STAR Draft Test Method for Computers, Rev. September 2019

Note: The test method reference has been updated to reflect the date for the current draft test method.

4.2 Number of Units Required for Testing

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

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

ii. For certification of a Product Family of all product types, with the exception of Workstations, product configurations that represent the worst-case power consumption for each product category within the family are considered Representative Models. When submitting Product Families, manufacturers continue to be held accountable for any efficiency claims made about their products, including those not tested or for which data were not reported. This includes ensuring that all models shipped as ENERGY STAR certified within the product family maintain the same power management settings when testing the Representative Model(s).

iii. For systems that meet the definition for multiple categories (as defined in Section 1.B) depending on the specific configuration, manufacturers will have to submit the highest power configuration for each category under which they would like the system to be ENERGY STAR certified. For example, a system that could be configured as either a Category 0 or 1 Desktop, as defined in Table 8 would require submittal of the highest power configuration for both categories in order to be ENERGY STAR certified. If a product could be configured to meet all categories, it would then have to submit data for the highest power configuration in all categories.

iv. For certification of a Product Family of Workstations under the Workstation or Desktop product type, the product configuration that represents the worst-case power consumption with a single GPU within the family is considered the Representative Model.

Note: Workstations that meet ENERGY STAR requirements with a single graphics device may also have a configuration with more than one graphics device be ENERGY STAR certified, provided the additional hardware configuration is identical with the exception of the additional graphics device(s). The use of multiple graphics includes, but is not limited to, driving multiple displays and ganging for high performance, multi-GPU configurations (e.g. ATI Crossfire, NVIDIA SLI). In such cases, and until such time as SPECviewperf® supports multiple graphics threads, manufacturers may submit the test data for the workstation with the single graphics device for both configurations without retesting the system.

4.2.2 A single unit of each Representative Model shall be selected for testing.

4.2.3 All units/configurations for which a Partner is seeking ENERGY STAR certification, must meet the ENERGY STAR requirements. However, if a Partner wishes to certify configurations of a model for which non-ENERGY STAR certified alternative configurations exist, the Partner must assign the certified configurations an identifier in the model name/number that is unique to ENERGY STAR certified configurations. This identifier must be used consistently in association with the certified configurations in marketing/sales materials and on the ENERGY STAR list of certified products (e.g. model A1234 for baseline configurations and A1234-ES for ENERGY STAR certified configurations).

Note: There may be cases—as described in the paragraph above—where not all units/configurations will meet ENERGY STAR requirements. If so, the worst-case configuration for test will be the worst-case certified configuration, and not one of the presumably even higher-energy consuming non-certified configurations.

4.3 International Market Certification

4.3.1 Products shall be tested for certification at the relevant input voltage/frequency combination for each market in which they will be sold and promoted as ENERGY STAR.

4.4 Customer Software and Management Service Pre-Provisioning

4.4.1 If a manufacturing Partner is hired by a customer to load a custom image on an ENERGY STAR certified computer, the Partner shall take the following steps:

i. Inform the customer that their product may not meet ENERGY STAR with the custom image. A sample notification letter is available on the ENERGY STAR Web site.

ii. Encourage the customer to test the product for ENERGY STAR compliance.

iii. Encourage the customer, should the product no longer meet ENERGY STAR, to make use of EPA's free technical assistance that can assist with Power Management performance, which can be found at www.energystar.gov/fedofficeenergy.

5 USER INTERFACE

5.1.1 Manufacturers are encouraged to design products in accordance with the user interface standard IEEE 1621: Standard for User Interface Elements in Power Control of Electronic Devices Employed in Office/Consumer Environments. For details, see http://eetd.LBL.gov/Controls.

6 EFFECTIVE DATE

6.1.1 Effective Date: The Version 8 ENERGY STAR Computers specification shall take effect July 15, 2020. To be ENERGY STAR certified, a product model shall meet the ENERGY STAR specification in effect on its date of manufacture. The date of manufacture is specific to each unit and is the date on which a unit is considered to be completely assembled.

Note: EPA anticipates completing the Version 8.0 process in no later than October 15, 2019 with an effective date of July 15, 2019.

6.1.2 Future Specification Revisions: EPA reserves the right to change this 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 stakeholder discussions. In the event of a specification revision, please note that the ENERGY STAR certification is not automatically granted for the life of a product model.

7 CONSIDERATIONS FOR FUTURE REVISIONS

7.1.1 **Active Mode:** EPA will continue to monitor developments in test methodology that addresses active mode, where the computer is actively performing tasks, and assess whether these measurements warrant inclusion into the ENERGY STAR Computers specification.

7.1.2 **Energy Efficient Ethernet**: EPA intends to require that EEE is enabled as-shipped for all 1Gb/s or faster Ethernet ports provided in computer products in the next revision of the ENERGY STAR Computers specification.

APPENDIX A:
Sample Calculations

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

Following is a sample E_{TEC} evaluation for a 2.0 GHz, dual core Notebook with Switchable Graphics, 8 GB Memory, and 1 hard disk drive (HDD).

A) Measure values using the ENERGY STAR Computers Test Method:

1) Off Mode = 0.5 W
2) Sleep Mode = 1.0 W
3) Long Idle State = 6.0 W
4) Short Idle State = 10.0 W

B) Determine the proxy support provided by the operating system and network card. This is a manufacturer-reported parameter.

1) On Mac computers, “Wake for network access” enabled within the Energy Saver/Power Adapter Preferences signifies Base Capability or better.
2) On Windows computers, “ARP Offload” or “NS Offload” or similar enabled within the Advanced Properties of the Network Interface Card (accessed through the Device Manager) signifies Base Capability or better. OEM can provide further guidance on how to confirm Proxy Support

C) Calculate E_{TEC} from power measurements and mode weightings—this example assumes no Proxy Support/Conventional Weightings:

T_{OFF}	25%
T_{SLEEP}	35%
T_{LONG_IDLE}	10%
T_{SHORT_IDLE}	30%

1) $E_{TEC} = \frac{8760}{1000} \times (P_{OFF} \times T_{OFF} + P_{SLEEP} \times T_{SLEEP} + P_{LONG\_IDLE} \times T_{LONG\_IDLE} + P_{SHORT\_IDLE} \times T_{SHORT\_IDLE})$
2) $E_{TEC} = \frac{8760}{1000} \times (0.5\ \text{W} \times 25\% + 1.0\ \text{W} \times 35\% + 6.0\ \text{W} \times 10\% + 10.0\ \text{W} \times 30\%)$
3) E_{TEC} = 35.7 kWh / year

D) Determine which Base TEC allowance applies based on graphics capability and performance score: *P = [# of CPU cores] × [CPU clock speed (GHz)] = 2×2 GHz = 4.*

Table 8: Base TEC (TEC_{BASE}) Allowances for Notebooks

Category Name	Notebook	
	Performance Score, P^v	Base Allowance
1	**$2 < P \leq 8$**	8.0

E) Determine which Functional Adder Allowances apply:

1) Memory: *8 GB installed, so a TEC_{MEMORY} allowance of* $2.4 + (0.294 \times 8) = 4.75$ kWh *applies*

2) Discrete Graphics? *No, therefore $TEC_{GRAPHICS}$ allowance does not apply.*

3) Switchable Graphics? *Yes, but $TEC_{SWITCHABLE}$ allowance does not apply to Notebooks.*

4) Energy Efficient Ethernet (EEE)? *Yes, but TEC_{EEE} allowance does not apply to Notebooks.*

5) Storage? *No, the notebook has only one hard disk drive, so no storage allowance applies.*

6) Integrated Display? *Yes, and assuming a non-enhanced performance, 14 inch display with an area of 83.4 square inches and a resolution of 1.05 megapixels, a $TEC_{INT\_DISPLAY}$ allowance of* $8.76 \times 0.30 \times (1+EP) \times (0.43 \times r + 0.0263 \times A) = 8.76 \times 0.30 \times (0.43 \times 1.05 \text{ MP} + 0.0263 \times 83.4 \text{ in}^2) = 6.95$ kWh *applies.*

F) Calculate E_{TEC_MAX}:

1) $E_{TEC\_MAX} = 8.0$ kWh + 4.75 kWh + 6.95 kWh

2) $E_{TEC\_MAX} = 19.7$ kWh/yr

G) Compare E_{TEC} to the E_{TEC_MAX} to determine if the model qualifies:

35.7 kWh/yr > 19.7 kWh/yr

Therefore, the Notebook does not meet ENERGY STAR requirements.

II. **Workstations:** Below is a sample P_{TEC} calculation for a Workstation with 2 hard drives and no Energy Efficient Ethernet capability.

A) Measure values using the ENERGY STAR Computers Test Method:

1) Off Mode = 2 W

2) Sleep Mode = 4 W

3) Long Idle State = 50 W

4) Short Idle State = 80 W

5) Max Power = 180 W

A) Note number of Hard Drives installed: Two hard drives installed during test.

B) Calculate P_{TEC} from power measurements and mode weightings using Equation 4:

T_{OFF}	T_{SLEEP}	T_{LONG_IDLE}	T_{SHORT_IDLE}
35%	10%	15%	40%

1) $P_{TEC} = (35\% \times P_{OFF} + 10\% \times P_{SLEEP} + 15\% \times P_{LONG\_IDLE} + 40\% \times P_{SHORT\_IDLE})$

2) $P_{TEC} = (35\% \times 2 \text{ W} + 10\% \times 4 \text{ W} + 15\% \times 50 \text{ W} + 40\% \times 80 \text{ W})$

3) $P_{TEC} = 40.6$ W

C) Calculate the P_{TEC_MAX} requirement using Equation 5:

1) $P_{TEC\_MAX} = 0.28 \times (P_{MAX} + N_{HDD} \times 5) + 8.76 \times P_{EEE} \times (T_{SLEEP} + T_{LONG\_IDLE} + T_{SHORT\_IDLE})$

2) $P_{TEC\_MAX} = 0.28 \times (180 + 2 \times 5) + 8.76 \times 0 \times (T_{SLEEP} + T_{LONG\_IDLE} + T_{SHORT\_IDLE})$

3) $P_{TEC\_MAX} = 53.2 + 0$

D) Compare P_{TEC} to the ENERGY STAR levels to determine if the model qualifies:

749 40.6 W ≤ 53.2 W
750
751 **Therefore, the Workstation meets ENERGY STAR requirements.**
752