ENERGY STAR® Program Requirements
Product Specification for Computers

Eligibility Criteria
Final Draft Version 6.0

Following is the Version 6.0 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.

   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 and integrated keyboard and pointing device and are capable of being powered by an integrated battery or other portable power source. Notebook computers are typically designed to provide similar functionality to Desktops, including operation of software similar in functionality as that used in Desktops. For purposes of this specification, Notebook Computers include models with touch-sensitive screens.

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

4) Slate/Tablet: TBD.

Note: In response to stakeholder comments and to avoid confusion with industry terms, EPA has integrated the text of the former definition of "Tablet Computer" into that for Notebook, such that all computers with Integrated Displays and integrated keyboards and pointing devices (with or without touchscreens) are considered Notebooks. All other devices are excluded from the scope of Version 6.0, but may be added back in Version 6.1 once the a new definition for a "Slate/Tablet" can be developed.

5) 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).

6) 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).

7) 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) provide mean time between failures (MTBF) of at least 15,000 hours (based on either Bellcore TR-NWT-000332, issue 6, 12/97 or field collected data); and (c) support error-correcting code (ECC) and/or buffered memory. In addition, a workstation meets three or more of the following criteria:

   a) Provide supplemental power support for high-end graphics (e.g., PCI-E 6-pin 12V supplemental power feed);

b) Wired for greater than x4 PCI-E on the motherboard in addition to the graphics slot(s) and/or PCI-X support;

c) Do not provide support for Uniform Memory Access (UMA) graphics;

d) Provide 5 or more PCI, PCI-E, or PCI-X slots;

e) Provide multi-processor support for 2 or more processors (shall support physically separate processor packages/sockets, i.e., requirement cannot be met with support for a single multi-core processor); and/or

f) Qualification by 2 or more Independent Software Vendor (ISV) product certifications; these certifications can be in process, but shall be completed within 3 months of qualification.

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 qualification and test requirements.

C) Computer Components:

1) Graphics Processing Unit (GPU): An integrated circuit, apart 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) with a local memory controller interface and local graphics-specific memory.

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

Note: EPA has revised the proposed definition for Discrete Graphics (dGfx) per stakeholder recommendation to avoid confusion and remove any restrictions that would have mandated that the dGfx be in card format only. This change will allow systems using new types of dGfx technologies to qualify.

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.

Note: EPA has updated the EPS definition for consistency with the DOE regulatory definition in 10 CFR Part 430.2.

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.

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 set to as-shipped brightness, 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 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. For systems where ACPI standards are applicable, Sleep Mode most commonly correlates to ACPI System Level S3 (suspend to RAM) state.

E) Networking and Additional Capabilities:

1) Additional Internal Storage: Any and all internal hard disk drives (HDD) or solid state drives (SSD) shipping with a computer beyond the first. 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.

Note: EPA has added a definition for Energy Efficient Ethernet (EEE) harmonized with the Small and Large Network Equipment specifications and has proposed incentives for various product types throughout the specification.

3) Full Network Connectivity: The ability of the computer to maintain network presence while in Sleep Mode or another low power mode of equal or lower power consumption ("LPM") 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 a LPM. From the vantage point of the network, a computer with full network connectivity that is in LPM is functionally equivalent to an idle computer with respect to common applications and usage models. Full network connectivity in LPM 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 LPM, the system handles IPv4 ARP and IPv6 NS/ND.

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

   c) Network Proxy - Remote Wake: While in LPM, 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 LPM, the system allows for advertising host services and network name. Includes Base Capability.

4) 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).

5) 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.

6) 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.

7) Switchable Graphics: Functionality that allows both integrated and discrete graphics to be used at different times depending on the graphics rendering needs of the user.

   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 the user requires it.

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 qualification 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 qualification, with the exception of products listed in Section 2.2:

i. Desktop Computers and Integrated Desktop Computers;

ii. Notebook Computers and Tablet Computers;

iii. Workstations;

iv. Small-scale Servers that are marketed and sold for non-data center use; and

v. Thin Clients.

2.2 Excluded Products

2.2.1 Products that are covered under other ENERGY STAR product specifications are not eligible for qualification 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 qualification under this specification:

i. Game Consoles;

ii. Handheld Computers (including eReaders);

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

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

v. Personal Digital Assistant devices (PDAs);

vi. Point of Sale (POS) products that do not use internal components common to Desktop Computers, including a processor, motherboard, and memory, or that do not run a standard Desktop Computer operating system;

vii. Slate/Tablets;

viii. Small-scale Servers that are marketed and sold for use in data centers;

ix. Smart Phones; and

x. Ultra-thin Clients.

Note: EPA has moved the newly-defined Slate/Tablets to the list of excluded products. EPA plans to launch a v6.1 update to this specification later this year to include Slate/Tablets.

Also, EPA has clarified that only those POS systems not based on Desktop Computer designs are excluded. All other POS systems can be qualified as Desktop Computers or Integrated Desktop Computers if they meet the definitions provided in Section 1.

3 QUALIFICATION 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, 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 qualifying 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 www.efficientpowersupplies.org).

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.

Table 1: Requirements for Internal Power Supplies

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

Note: EPA has updated the multi-output EPS requirements below with standard language used in other ENERGY STAR specifications, which references the DOE test method for multi-output EPSs and clarifies that the Level V efficiency level applies, even if the multi-output EPS does not have the Level V marking.

3.2.3 External Power Supply (EPS) Requirements: Single- and Multiple-voltage EPSs shall meet the Level V 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.

- Single-voltage EPSs shall include the Level V marking.

- Additional information on the Marking Protocol is available at www.energystar.gov/powersupplies

3.3 Power Management Requirements

3.3.1 Products shall include power management features in their "as-shipped" condition as specified in Table 2, 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.

Table 2: Power Management Requirements

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Notebooks	Small-scale Servers	Thin Clients	Workstations
System Sleep Mode[i]	(1) Sleep Mode shall be set to activate after no more than 30 minutes of user inactivity. (2) The speed of any active 1 Gb/s Ethernet network links shall be reduced when transitioning to Sleep Mode or Off Mode.	Yes	Yes	Yes	No	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
Wake on LAN (WOL)[i]	(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.	Yes	Yes	Yes	Yes	Yes	Yes

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

Mode or Mode Transition	Requirement	Desktops	Integrated Desktops	Notebooks	Small-scale Servers	Thin Clients	Workstations
Wake Management[i]	(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	Yes	Yes

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 2), 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 all 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

Note: EPA recognizes that the accessibility of online documentation has increased greatly since Computers Version 5 and supports company efforts to avoid print and paper waste. As such, EPA has amended the language above to allow manufacturers to provide this information electronically.

ii. Documentation is included either (a) only with ENERGY STAR qualified 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 qualified.

3.5 Requirements for Desktop, Integrated Desktop, and Notebook Computers

3.5.1 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. For Enhanced-performance Integrated Displays, the adder is calculated as presented in Table 7 and Equation 3.

iii. For a product to qualify for the Full Network Connectivity weightings, the following criteria shall be satisfied:

- Products shall meet a non-proprietary Full Network Connectivity standard such as ECMA 393 or another standard that has been approved by EPA as meeting the goals of ENERGY STAR. Such approval must be in place prior to submittal of product data for qualification.
- Products shall have the applied level of functionality enabled and configured by default upon shipment. If Full Network Connectivity features are not enabled by default, the system shall be tested and reported with Conventional TEC weightings.
- Products shall be capable of Sleep Mode.

iv. For Notebooks, Desktops, and Integrated Desktops that use a Connected Sleep State in place of System Sleep Mode, power in Long Idle (P_{LONG_IDLE}) may be used in place of power in Sleep (P_{SLEEP}) in Equation 1. In such instances, ($P_{SLEEP} \times T_{SLEEP}$), is replaced by ($P_{LONG\_IDLE} \times T_{SLEEP}$); 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 7 in Equation 2. However, for Desktop and Integrated Desktop systems providing Switchable Graphics and enabling it in ac mode, an allowance equal to 50% of the G1 graphics allowance for the platform type (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 3 (for Desktops, Integrated Desktops, and Thin Clients) or Table 4 (for Notebooks).*

Table 3: Mode Weightings for Desktop, Thin Clients, and Integrated Desktop Computers

Mode Weighting	Conventional	Full Network Connectivity			
		Base Capability	Remote Wake	Service Discovery/ Name Services	Full Capability
T_{OFF}	45%	40%	30%	25%	20%
T_{SLEEP}	5%	15%	28%	36%	45%
T_{LONG_IDLE}	15%	12%	10%	8%	5%
T_{SHORT_IDLE}	35%	33%	32%	31%	30%

Table 4: 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%

Note: EPA has revised the Notebook mode weightings in Table 4 to provide less time in Off Mode and more time in Sleep Mode for products with Full Network Connectivity. EPA is not proposing any edits to the mode weightings for Desktops, Integrated Desktops, and Thin Clients.

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

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

Where:

- $ALLOWANCE_{PSU}$ *is an allowance provided to power supplies that meet the optional more stringent efficiency levels specified in Table 5; power supplies that do not meet the requirements receive an allowance of 0;*
- TEC_{BASE} *is the Base allowance specified in Table 6; and,*
- $TEC_{GRAPHICS}$ *is the discrete graphics allowance as specified in Table 7, with the exception of systems with integrated graphics, which do not receive an allowance, or Desktops and Integrated Desktops with switchable graphics enabled in ac mode, which receive an allowance through* $TEC_{SWITCHABLE}$*; and*
- TEC_{MEMORY} *,* $TEC_{STORAGE}$*,* $TEC_{INT\_DISPLAY}$*,* $TEC_{SWITCHABLE}$*, and* TEC_{EEE} *are adder allowances as specified in Table 7.*

Table 5: Power Supply Efficiency Allowance

Power Supply Type	Computer Type	Minimum Efficiency at Specified Proportion of Rated Output Current[ii]				Minimum Average Efficiency[iii]	$Allowance_{PSU}$
		10%	20%	50%	100%		
IPS	Desktop	0.81	0.85	0.88	0.85	-	0.015
		0.84	0.87	0.90	0.87	-	0.03
	Integrated Desktop	0.81	0.85	0.88	0.85	-	0.015
		0.84	0.87	0.90	0.87	-	0.04
EPS	Notebook	0.83	-	-	-	0.88	0.015
		0.84	-	-	-	0.89	0.03
	Integrated Desktop	0.83	-	-	-	0.88	0.015
		0.84	-	-	-	0.89	0.04

Note: In response to stakeholder feedback on Draft 3, EPA has increased the incentive allowance for Notebooks and Integrated Desktops using EPSs to equal those of computers using IPSs.

Table 6: Base TEC (TEC_{BASE}) Allowances

Category Name	Graphics Capability[iv]	Desktop or Integrated Desktop		Notebook	
		Performance Score, P[v]	Base Allowance	Performance Score, P[v]	Base Allowance
0	Any Graphics dGfx ≤ G7	$P \leq 3$	69.0	$P \leq 2$	14.0
I1	Integrated or Switchable Graphics	$3 < P \leq 6$	112.0	$2 < P \leq 5.2$	22.0
I2		$6 < P \leq 7$	120.0	$5.2 < P \leq 9$	24.0
I3		$P > 7$	135.0	$P > 9$	28.0
D1	Discrete Graphics dGfx ≤ G7	$3 < P \leq 9$	115.0	$2 < P \leq 9$	16.0
D2		$P > 9$	135.0	$P > 9$	18.0

ii EPSs shall meet the specified requirements when tested using the *Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.* IPSs shall meet the specified requirements when tested using the *EPRI 306 Generalized Internal Power Supply Efficiency Test Protocol, Rev. 6.6*.

iii Average efficiency is the arithmetic mean of efficiencies tested at 25%, 50%, 75%, and 100% of rated output current. EPSs shall meet the specified requirements when tested using the *Uniform Test Method for Measuring the Energy Consumption of External Power Supplies, Appendix Z to 10 CFR Part 430.*

iv Discrete Graphics capability is categorized based on frame buffer bandwidth, as shown in Table 7.

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

Note: Based on stakeholder feedback that this categorization best differentiates performance, EPA is proposing the ITI category system for both Desktops and Notebooks in the Final Draft. The ITI categories are based on a performance score, calculated by multiplying the number of CPU cores by the clock speed, and do not take into account memory. Due to the simplicity of the categorization and the similarity between Desktop and Notebook categories, EPA has also combined the categories and requirements into one table for easy reference.

EPA is not proposing any increases to the base allowances for Notebooks from Draft 3 in favor of changes to the graphics allowance, presented in Table 7, below. However, based on discussions with stakeholders and further analysis of graphics and base allowances, EPA will be proposing a decrease in the total allowance for high-end Desktop systems. EPA had reflected this decrease in both the base allowances Table 6, above, and the high-end graphics allowances, listed in Table 7, below.

Table 7: Functional Adder Allowances for Desktop, Integrated Desktop, Thin Client, and Notebook Computers

Function			Desktop	Integrated Desktop	Notebook
TEC_{MEMORY} (kWh) *vi*			0.8		
$TEC_{GRAPHICS}$ (kWh) *vii*	**Graphics Category** *viii*	**G1** *(FB_BW ≤ 16)*	36		14
		G2 *(16< FB_BW ≤ 32)*	51		20
		G3 *(32 < FB_BW ≤ 64)*	64		26
		G4 *(64 < FB_BW ≤ 96)*	83		32
		G5 *(96 < FB_BW ≤ 128)*	105		42
		G6 *(FB_BW > 128; Frame Buffer Data Width < 192 bits)*	115		48
		G7 *(FB_BW > 128; Frame Buffer Data Width ≥ 192 bits*	130		60
$TEC_{SWITCHABLE}$ (kWh) *ix*			0.5 × G1		N/A
TEC_{EEE} (kWh) *x*			8.76 × 0.2 × (0.15 + 0.35)		8.76 × 0.2 × (0.10 + 0.30)
$TEC_{STORAGE}$ (kWh) *xi*			26		2.6

vi TEC_{MEMORY} Adder: Applies per GB installed in the system.
vii $TEC_{GRAPHICS}$ Adder: Applies for dGfx installed in the system, but not Switchable Graphics.
viii FB_BW: Is the display frame buffer bandwidth in gigabytes per second (GB/s)
ix $TEC_{SWITCHABLE}$ Incentive: Applies to automated switching that is enabled by default in Desktops and Integrated Desktops.
x TEC_{EEE}: Applies per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.
xi $TEC_{STORAGE}$ Adder: Applies once if system has more than one Additional Internal Storage element.

$TEC_{INT\_DISPLAY}$ (kWh) [xii]	N/A	8.76 × *0.35* × *(1+EP)* × (4×*r* + 0.05×*A*)	8.76 × *0.30* × (1+*EP)* × (2×*r* + 0.02×*A*)

Note: Discrete Graphics Allowances: Based on further analysis of currently-available discrete graphics systems, EPA proposes to increase the Notebook graphics adder allowances for categories G1–G3 and decrease the Desktop allowances for categories G5–G7.

Energy Efficient Ethernet (EEE) Allowance: EPA has added an Energy Efficiency Ethernet Incentive (TEC_{EEE}) of 0.2W for Computer products that ship with IEEE 802.3az compliant Gigabit Ethernet ports. This allowance level is based on the Small Network Equipment specification and is intended to encourage the adoption of EEE in Computer products. EPA believes there is a savings potential in reducing the power consumption of Ethernet ports with EEE functionality. EPA welcomes stakeholder feedback on the proposed incentive.

Switchable Graphics Allowance ($TEC_{SWITCHABLE}$): EPA has provided the "50% of G1" allowance for automated switchable graphics systems in Desktops and Integrated Desktops that is enabled by default.

The switchable graphics incentive only applies to automated switching that is enabled by default. However, as no test method for this functionality is currently available, EPA proposes to make this a manufacturer-reported parameter.

Integrated Display Allowance: EPA has modified the Integrated Display Allowance equations to refer to the conventional mode weightings (35% or 0.35 for Integrated Desktops and 30% or 0.3 for Notebooks in Short Idle Mode)—making the allowance dependent on the proxy weightings could serve as a disincentive for implementing proxying.

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 Workstations

3.6.1 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_{IDLE} *= Measured power consumption in Idle Mode (W);*

xii $TEC_{INT\_DISPLAY}$ 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.

- P_{IDLE} = *Measured power consumption in Idle Mode (W);*
- T_{OFF}, T_{SLEEP}, T_{LONG_IDLE}, *and* T_{SHORT_IDLE} *are mode weightings as specified in Table 8; and*

Table 8: Mode Weightings for Workstations

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

Note: EPA has divided the Idle State into Short Idles State and Long Idles State, consistent with other computer types and the Version 6.0 ENERGY STAR test method, as well as provided mode weightings for both modes.

Equation 5: P_{TEC_MAX} Calculation for Workstations

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

Where:

- P_{MAX} = *Measured maximum power consumption (W)*
- N_{HDD} = *Number of installed hard disk drives (HDD) or solid state drives (SSD)*
- P_{EEE} *is an EEE allowance of 0.2 W per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.*

Note: EPA has included an Energy Efficiency Ethernet Incentive (TEC_{EEE}) of 0.2W in Equation 4, above, for Workstation products that ship with IEEE 802.3az-compliant Gigabit Ethernet ports.

3.6.2 Active State Benchmark: To qualify for ENERGY STAR, a Workstation must be submitted for qualification with the following information disclosed in full:

i. Linpack 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.

3.6.3 Desktop Workstations: Products marketed as workstations may qualify for ENERGY STAR under the Desktop requirements in Section 3.5 instead of the Workstation requirements in Section 3.6, at the Partner's option. EPA will identify Workstations qualified as Desktops as "Desktops" in all ENERGY STAR marketing materials, on qualified product lists, etc.

Note: EPA received significant feedback from stakeholders in response to Draft 3 stating that the additional testing burden imposed from CINEBENCH and SPEC CPU 2006 benchmark testing would not provide additional insight over the Linpack and SPECviewperf benchmarks. As a result, EPA has removed the CINEBENCH and SPEC CPU 2006 benchmarks from the Active State testing requirement for Workstations. DOE has also revised the Final Draft Test Method to use only Linpack and SPECviewperf. Linpack and SPEC benchmark results shall be reported to EPA for use in future specification revisions, but will not published on the Qualified Product List.

3.7 Requirements for Small-scale Servers

3.7.1 Measured Off Mode power (P_{OFF}) shall be less than or equal to the Maximum Off Mode Power Requirement(P_{OFF_MAX}), as calculated per Equation 6, subject to the following requirements:

i. The Off Mode Wake-on-LAN (WOL) adder allowance (P_{OFF_WOL}) shall only be applied to products that offer WOL enabled by default upon shipment.

Equation 6: Calculation of P_{OFF_MAX} for Small-scale Servers

$$P_{OFF\_MAX} = P_{OFF\_BASE} + P_{OFF\_WOL}$$

Where:

- *P_{OFF_BASE} is the base allowance as specified in Table 9; and*
- *P_{OFF_WOL} is the Wake-on-LAN allowance as specified in Table 9.*

Table 9: Off Mode Power Allowances for Small-scale Servers

P_{OFF_BASE} (watts)	P_{OFF_WOL} (watts)
1.0	0.4

3.7.2 Measured Long Idle State power (P_{LONG_IDLE}) shall be less than or equal to the Maximum Idle State Power Requirement (P_{IDLE_MAX}), as calculated per Equation 7.

Equation 7: Calculation of P_{IDLE_MAX} for Small-scale Servers

$$P_{IDLE\_MAX} = P_{IDLE\_BASE} + (N - 1) \times P_{IDLE\_HDD} + P_{EEE}$$

Where:

- *N is equal to the number of installed storage devices in the Small Scale Server (either hard disk drives or solid state drives);*
- *P_{IDLE_BASE} is the base allowance as specified in Table 10;*
- *P_{IDLE_HDD} is the hard drive allowance as specified in Table 10; and*
- *P_{EEE} is an EEE allowance of 0.2 W per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.*

Note: EPA has included an Energy Efficiency Ethernet Incentive (TEC_{EEE}) of 0.2 W for Small Scale Server products that ship with IEEE 802.3az-compliant Gigabit Ethernet ports in Equation 7 above.

Table 10: Idle Mode Power Allowances for Small-scale Servers

P_{IDLE_BASE} (watts)	P_{IDLE_HDD} (watts)
24.0	8.0

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 8, subject to the following requirements.

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

ii. Thin Clients can utilize the proxy weightings in Table 3 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.

Equation 8: Calculation of E_{TEC_MAX} for Thin Clients

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

Where:

- *TEC_{BASE} is the Base Allowance specified in Table 11;*
- *$TEC_{GRAPHICS}$ is the Discrete Graphics allowance specified in Table 11 if applicable;*
- *TEC_{WOL} is the Wake-on-LAN allowance specified in Table 11 if applicable;*
- *$TEC_{INT\_DISPLAY}$ is the Integrated Display allowance for Integrated Desktops specified in Table 7 if applicable; and*
- *TEC_{EEE} is the Energy Efficiency Ethernet incentive for Desktops specified in Table 7 if applicable, per IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet port.*

Note: EPA has clarified that for Thin Clients that do not support Sleep Mode the E_{TEC} shall be calculated using Long Idle Power measurement in place of the Sleep Power measurement.

Also, EPA has included an Energy Efficiency Ethernet Incentive (TEC_{EEE}) of 0.2 W for Thin Client products that ship with IEEE 802.3az-compliant (Energy Efficient Ethernet) Gigabit Ethernet ports in Equation 8 above.

Table 11: Adder Allowances for Thin Clients

Adder	Allowance (kWh)
TEC_{BASE}	55
$TEC_{GRAPHICS}$	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 12 shall be used to determine ENERGY STAR qualification.

Table 12: Test Methods for ENERGY STAR Qualification

Product Type or Component	Test Method
All	ENERGY STAR Test Method for Computers, Rev. Jul-2013

4.2 Number of Units Required for Testing

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

i. For qualification 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 qualification 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.

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 qualify. For example, a system that could be configured as either a Category 0 or 1 Desktop, as defined in Table 6 would require submittal of the highest power configuration for both categories in order to qualify as ENERGY STAR. 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 qualification 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 qualify a configuration with more than one graphics device, provided the additional hardware configuration is identical with the exception of the additional graphics device(s). The use of multiple graphics includes, but is not limited to, driving multiple 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 qualification, must meet the ENERGY STAR requirements. However, if a Partner wishes to qualify configurations of a model for which non-qualifying alternative 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).

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 qualifying configuration, and not one of the presumably even higher-energy consuming non-qualifying configurations.

4.3 International Market Qualification

4.3.1 Products shall be tested for qualification 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 qualified 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 6.0 ENERGY STAR Computers specification shall take effect **April 28, 2014**. To qualify for ENERGY STAR, 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.

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 qualification is not automatically granted for the life of a product model.

7 CONSIDERATIONS FOR FUTURE REVISIONS

7.1.1 **Slates and Detachable Keyboard Tablets**: EPA will work with stakeholders to appropriately define Slate/Tablets and other portable products as well as develop appropriate ENERGY STAR requirements. These updates would be finalized in Version 6.1 later in 2013 or early in 2014.

7.1.2 **Dc-powered Computers:** EPA remains interested in including Dc-powered Computers in a future specification revision.

7.1.3 **New Benchmark for Workstation Testing:** EPA will work with stakeholders to develop a workstation benchmark in time for the future ENERGY STAR Computers Version 7.0.

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, Energy Efficient Ethernet (EEE), and 1 hard disk drive (HDD).

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

1) Off Mode = 1.0 W
2) Sleep Mode = 1.7 W
3) Long Idle State = 8.0 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) $E_{TEC} = \frac{8760}{1000} \times (1.0\ \text{W} \times 25\% + 1.7\ \text{W} \times 35\% + 8.0\ \text{W} \times 10\% + 10.0\ \text{W} \times 30\%)$
3) E_{TEC} = 40.7 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 6: Base TEC (TEC_{BASE}) Allowances

Category Name	Graphics Capability	Notebook	
		Performance Score, *P*	Base Allowance
I1	Integrated or Switchable Graphics	2 < *P* ≤ 5.2	22.0

E) Determine which Functional Adder Allowances apply:

1) Memory: *8 GB installed, so a TEC_{MEMORY} allowance of* $8\ \text{GB} \times 0.8\frac{\text{kWh}}{\text{GB}} = 6.4\ \text{kWh}$ *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, and assuming one EEE-compliant Ethernet port, a TEC_{EEE} allowance of* 8.76 × 0.2 × (0.10 + 0.30) = 0.7 kWh *applies*

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 ×*0.30* × (1+*EP)* × (2×*r* + 0.02×*A*) = 8.76 ×*0.30* × (2×*1.05* MP+ 0.02×83.4 in^2) = 9.9 kWh *applies.*

F) Calculate E_{TEC_MAX}:

1) E_{TEC_MAX} = 22.0 kWh + 6.4 kWh + 0.7 kWh + 9.9 kWh

2) E_{TEC_MAX} = 39.0 kWh/yr

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

40.7 kWh/yr > 39.0 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% × P_{OFF} + 10% × P_{SLEEP} + 15% × P_{LONG_IDLE} + 40% × P_{SHORT_IDLE})

2) P_{TEC} = (35% × 2 W + 10% × 4 W + 15% × 50 W + 40% × 80 W)

3) P_{TEC} = 40.6 W

C) Calculate the P_{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:

40.6 W ≤ 53.2 W

Therefore, the Workstation meets ENERGY STAR requirements.