I. Introduction

The ENERGY STAR Version 5 Computer Requirements have been in effect since July 2009. EPA, in partnership with the European Commission (EC), is now reviewing the current eligibility requirements in light of changes in both products and the computer market and has developed this Discussion Document to begin the conversation with stakeholders on Version 6.0 ENERGY STAR Computer requirements. Included in this document are a summary of qualification activity under Version 5 and the performance of these qualified products, and EPA's thoughts on new and modified definitions, eligible products, test protocols, and eligibility criteria. After each section is a set of questions designed to facilitate discussion with stakeholders and further EPA's understanding of the computer product category.

Stakeholders are encouraged to provide feedback on the concepts and definitions presented in this document. Communication between EPA and industry stakeholders is critical to the success of the ENERGY STAR program, especially in this early stage of the specification development process. Any and all creative suggestions for improvements to the basic ENERGY STAR approach outlined in this document will be considered for inclusion in subsequent draft and final specifications. ENERGY STAR representatives are available for additional discussions with interested parties at any time during the specification development process. Please send a message to computers@energystar.gov or to Robert Meyers at Meyers.Robert@epa.gov to arrange a meeting.

EPA encourages stakeholders to review this document in conjunction with the ENERGY STAR Version 5.2 specification for Computers, as the current specification will serve as a starting point for development of the Version 6.0 specification. EPA has, for each section of the specification, noted possible revisions and questions associated with these revisions.

- ## ENERGY STAR Qualification Activity: Version 5 (*through January 2011*)

  Table 1 presents a summary of current ENERGY STAR qualified computers. The *Partner Count* column represents the number of ENERGY STAR Partners with at least one product qualified in the listed *Product Type*. Qualified Product counts reference unique model numbers. Product qualification numbers are separated into models sold in the US and models sold in any ENERGY STAR market including US, Australia/New Zealand, Canada, European Union, Japan and Taiwan.

Table 1: Partner and Qualification Activity by Product Type

Product Type	Partner Count	Qualified Products (US)	Qualified Products (Total)
Desktops & Integrated Desktops	72	1170	2645
Notebooks & Tablets	47	3552	4053
Workstations	6	96	97
Small-scale Servers	4	58	58
Thin Clients	9	56	57

Table 2 lists the number of qualified models or configurations divided by category. For Workstations, the structure of the specification does not include categorization, so the number of qualified units matches Table 1. For all other computer types presented, configurable models available in more than one category are counted uniquely in each category (e.g., a desktop qualified in categories B and C would be added to the totals for both B and C).

Table 2: Qualifications by Product Category

Product Type	Qualified Products (US)				Qualified Products (Total)			
Category:	A	B	C	D	A	B	C	D
Desktops & Integrated Desktops	414	888	404	457	569	1770	987	1125
Notebooks & Tablets	2549	1374	63	-	2865	1568	69	-
Small-scale Servers	28	32	-	-	28	32	-	-
Thin Clients	13	43	-	-	13	44	-	-
No Category:								
Workstations	96				97			

Table 3 and Table 4 provide a breakdown of average performance levels among the computer types and categories. ENERGY STAR requirements are marked in parentheses where appropriate. Idle State has been included as the primary requirement of interest for Small-scale Servers and Thin Clients, as well as a point of interest for the categories subject to TEC requirements.

Table 3: Average TEC and Idle Power for Qualified Products, by Category (All Models)

Product Type	Calculated TEC (*kWh/year*) (*requirement shown in parenthesis*)				Idle State (*W*) (*requirement shown in parenthesis where applicable*)			
	A	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Desktops & Integrated Desktops	120 (*148*)	151 (*175*)	174 (*209*)	196 (*234*)	32	41	48	54
Notebooks & Tablets	29 (*40*)	41 (*53*)	74 (*88.5*)	-	10	14	26	-
Workstations	75[i]	-	-	-	136	-	-	-
Small-scale Servers	-	-	-	-	20 (*50*)	49 (*65*)	-	-
Thin Clients	-	-	-	-	9 (*12*)	12 (*15*)	-	-

Table 4: Average TEC and Idle Power for Qualified Products, by Category (US Models)

Product Type	Calculated TEC (*kWh/year*) (*requirement shown in parenthesis*)				Idle State (*W*) (*requirement shown in parenthesis*)			
	A	**B**	**C**	**D**	**A**	**B**	**C**	**D**
Desktops & Integrated Desktops	119 (*148*)	151 (*175*)	176 (*209*)	198 (*234*)	32	42	48	54
Notebooks & Tablets	29 (*40*)	41 (*53*)	75 (*88.5*)	-	9	14	26	-
Workstations	76[i]	-	-	-	135	-	-	-
Small-scale Servers	-	-	-	-	20 (*50*)	49 (*65*)	-	-
Thin Clients	-	-	-	-	9 (*12*)	12 (*15*)	-	-

[i] TEC is a power-based metric for Workstations, only, and not an annual kWh number.

II.   Key Discussion Topics

- ## Scope

EPA proposes the following updates to the existing scope of the ENERGY STAR computer program.

Table 5: Discussion Topics - Scope

Topic Description	Proposed Action	Rationale
New Mobile Computing Platforms. EPA is considering an Ultra-low Energy Mobile (ULEM) Computer product classification to group Netbook and Tablet (Slate) computers under the same set of efficiency requirements.	• Group netbook and Tablet (Slate) computers under the same set of efficiency criteria. Consider feature-based requirements that foster development of energy-efficient technologies that may not be adequately identified in a TEC structure, as well as those that help optimize energy use to mobile usage patterns. • Clarify the **Notebook Computer** definition to include Clamshell-Tablets and exclude Tablet (Slate) computers. • Define **Tablet (Slate) Computer** as follows: *A portable computer lacking a physical keyboard, relying primarily on touch-screen input, lacking integral wired network capability (e.g., Ethernet), and primarily powered from an internal battery charged via an external power supply or low-voltage dc (e.g., USB cable). For a computer to be considered a Tablet, any wired power connection to the mains must be designed to charge the battery and to be disconnected from device during normal operation.*	EPA sees Tablet (Slate) computers and other sub-notebook devices in particular as an area of both sales and market share growth during the lifetime of this specification. Grouping these products together would recognize similarities in assumed usage patterns and operation. Further, EPA believes that this product category sees more extensive operation while on battery power than notebooks which calls for a tailored TEC profile instead of relying on the Notebook Computer TEC profile.

Topic Description	Proposed Action	Rationale
Ultra-thin Clients. EPA intends to investigate the addition of "Ultra-thin Clients" to the program's scope.	• Work with stakeholders to investigate common sales practices (e.g., bundling), available operating systems, and effect on existing power management criteria, among other issues. • Define **Ultra-thin Client** as follows: *A Thin Client that lacks a traditional operating system, has no internal storage capability, and is controlled by a kernel that provides capability only for network initialization and display of graphics generated from remote computing resources.*	There are similarities between the ultra-thin client computing model and approaches underway for thin client set-top boxes: a single higher-power device serves a series of low-power devices, yielding a net energy savings for the system. Further investigation would allow validation of this hypothesis.
Mobile Thin Clients	• Include mobile Thin Clients under the Notebook categorization.	In discussions with stakeholders, EPA was presented expected power levels for Mobile Thin Clients on the same order as standard Notebooks (10-15 W in Idle, < 3 Watts in Sleep/Off).
Desktops, Notebooks, Workstations, and Small-scale Servers	• Maintain the existing scope for these product types.	Existing product scopes are sufficiently broad to capture the computer market.

- **Scope - Questions for Discussion:**

    1) What, if any, products are missing from the list of products under consideration that EPA should consider?

    2) What product development trends in the computer industry should be considered that may have an impact on power consumption or proper categorization of devices?

    3) Does EPA need to address any other disruptive technology trends that may substantially change the way energy is distributed or consumed in the computing industry in the Version 6.0 specification (e.g., lower powered mobile products, new power management strategies)? If so what are these trends and how do they affect aspects of the computer program?

4) Should EPA handle low power, mobile devices (Tablet [Slate], Thin Client, etc.) differently from standard Notebook computers? Given the pace of change in markets for these categories, how can EPA create a program flexible enough to encompass these products during the lifetime of the Version 6 specification?

5) How can combined systems savings be accounted for in the Thin Client computing model in addition to individual product savings? Are there any standard ultra-thin client sales patterns that support this concept (e.g., ten ultra-thin clients sold with one ENERGY STAR base computer as a packaged purchase)? Is it suggested that EPA develop requirements to recognize purchase of ENERGY STAR base computers and ultra-thin clients together?

6) Given the minimal amount of internal processing Ultra-thin Clients perform, are such products truly computers? What separates an ultra-thin client from a series of KVM switches? Is the product name "Terminal" likely to be clearly understood if applied as an alternative description of this product type?

7) What are the use patterns for ULEM computers? How can they be tested to accurately represent their power consumption, given these use patterns?

8) What are the power management savings strategies for low power devices (Tablet [Slate], Thin Client, etc.)?

9) Is it relevant to group Netbook and Tablet (Slate) computers in a single class?

10) Are there any studies available on battery charging patterns for ULEM and Notebook computers? Do manufacturers currently consider the efficiency of the battery charger in their designs for either category, and if so, how?

- **Test Methods**

    Table 7 includes a list of topics dealing with the process for testing of ENERGY STAR computer equipment and related development concerns.
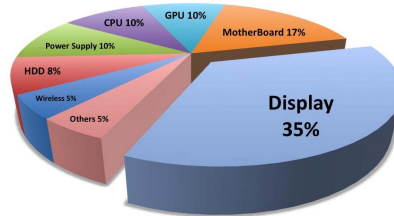
Table 7: Discussion Topics - Test Methods

Topic Description	Proposed Action	Rationale
Harmonization, where appropriate, with developments in product energy efficiency international standards	• Evaluate changes to the existing ENERGY STAR test method for further alignment with the Ecma-383 standard.	EPA and stakeholders would have the opportunity to identify the impact on existing test methods to allow for a smooth transition to greater harmonization.

Topic Description	Proposed Action	Rationale
Testing enhancements – Long/Short Idle and Display Power	• Modify test methods to account for the Long and Short Idle States. • Define Long and Short Idle as follows: *Short Idle: The mode where the computer has reached Idle State (e.g. 5 minutes after OS boot, after completing an active workload, or after resuming from sleep), the computer display is on and set to its as-shipped brightness, and Long Idle power management features have not engaged (e.g., the HDD is spinning and the computer is prevented from entering Sleep Mode).* *Long Idle: The mode where the computer has reached Idle State (e.g., 15 minutes after OS boot, after completing an active workload, or after resuming from sleep), the computer display has entered a low-power state where the screen contents cannot be observed (e.g., backlight has been turned off turning the screen black), and the computer remains in ACPI G0/S0.* • Incorporate the energy consumption of integral displays into the TEC metric. A possible option is to provide a display TEC allowance equal to the relative TEC performance of an equally-sized ENERGY STAR Display.	Partitioning Idle State presents an opportunity for innovation in fine-grained power management during brief periods of Idle. Also, the state of the display in Short Idle allows for display power to be referenced in TEC efficiency requirements, recognizing the impact of display power on overall system energy consumption (roughly 30% of notebook power consumption, for example – see *Figure 1*).

Topic Description	Proposed Action	Rationale
TEC pattern research	• Consider new sources of data on existing TEC weightings. Review the relative impact of non-idle active mode in usage patterns.	Accounting for any updated usage pattern data will ensure the continued applicability of TEC metric to product use.

Figure 1: Power Consumption Breakdown: Notebook Computer

Source: *STMicroelectronics*

- ## Test Method - Questions for Discussion

1) What specific challenges exist for testing of products with integrated displays enabled? What modifications are required to the existing ENERGY STAR test method to allow for such testing?

2) The definitions for Short and Long Idle reference work done in the Ecma-383 working group. What, if any, levels of acceptable latency describe the Short and Long Idle modes? Under the definitions, where are individual sub-systems power managed (e.g., GPU, Memory, I/O devices)?

3) What special testing considerations should EPA consider for small-form factor and all-in-one desktops (e.g., applicability of internal power supply requirements for supplies less than 75 watts, passive cooling)?

4) Is powering a computer via low-voltage DC (e.g., Power over Ethernet, USB) expected to become more common in the coming years? How prominent is it today?

5) Do requirements and test methods need to account for USB-powered devices? For other low-voltage DC powering (Power over Ethernet)? If so, how?

- **Efficiency Requirements**

Table 8: Discussion Topics - Efficiency Requirements

Topic Description	Proposed Action	Rationale
Typical Energy Consumption levels	- Develop more stringent energy-efficiency requirements for existing products based on qualified and non-qualified product data, market observations, recent ENERGY STAR market share indications, and future data collection efforts. - Evaluate the existing TEC category structure.	The 2009 ENERGY STAR Unit Shipment Data effort presented market penetration rates of 74% for Notebook Computers and 27% for Desktops. Qualification data has shown a wide spread in TEC performance among products in the same TEC categories. EPA will assemble and analyze data associated with non qualified products, as needed.
Power Supplies	Evaluate the appropriateness of existing performance levels for internal and external power supplies and cost/benefits of increasing the stringency.	Efficiency and power factor requirements for internal and external power supplies will remain an important component of the Computers specification. EPA will work with stakeholders to evaluate the cost versus efficiency benefit of more stringent internal power supply efficiency criteria and to assess the role of low-output internal power supplies in future system designs.

Topic Description	Proposed Action	Rationale
Graphics Capability	• Consider if allowances should be developed for graphics capability. Consider scaled allowances based on graphics categories as presented in Ecma-383.	Stakeholders have suggested that requirements for graphics capability need to be revised to account for new technologies and features. EPA has also received input that the power used in graphics processing in computers is both increasing and needs to be monitored.
Energy Efficiency – Desktops and Notebooks	• Assemble a dataset to allow study of power consumption for products within the scope of the program.	EPA strives to ensure continued rigorous efficiency levels in the program. Resulting data will be analyzed to support this goal or to revise TEC categories as determined to be relevant.
Energy Efficiency – Workstations	• Reinstate efforts from Version 5.0 specification development to incorporate active mode efficiency into the requirements for Workstations. EPA proposes development of an active mode reporting requirement - similar to what is being developed within the ENERGY STAR Computer Server effort - using an industry-standard benchmark.	EPA believes that workstation purchasers are performance-focused and deeply knowledgeable about their computing needs, traits shared with purchasers of Computer Servers but not necessarily purchasers of other product types in the Computer program. Adding a reporting requirement will give Workstation purchasers information helpful in finding the right balance of performance and power consumption.
Energy Efficiency – Small-scale Servers	• Revisit Small-scale Server categories and power allowances based on data received as part of the Version 5.0 qualification process.	Power allowances in this category date back to Version 4.0. While data remains limited, data associated with qualification under Version 5 will be evaluated.

Topic Description	Proposed Action	Rationale
Energy Efficiency – Thin Clients	• Revisit Thin Client categorization and evaluate related definitions (e.g., graphics capability within Thin Clients). • Consider whether Ultra-thin Clients are a fit for the computer program.	The requirements for Thin Clients were developed with limited data. Evaluation of the continued applicability of categories and performance levels is necessary.

- **Efficiency Requirements - Questions for Discussion**
  1) Power Supplies: What is the price premium for an internal power supply meeting ENERGY STAR requirements versus a standard model (retail and wholesale)?
  2) Usage Patterns: Which, if any, product studies or sources of data on computer usage patterns should EPA review to develop usage pattern assumptions in the specification?
  3) Efficiency Criteria - Desktops/Notebooks: How do provisions for graphics capability (e.g., integrated/discrete GPU) in Notebooks and Desktops need to be revised to account for current and upcoming technologies?
  4) Efficiency Criteria - Thin Clients: The current categories for Thin Clients are divided by support for "local multimedia encode/decode." If there is a better means of delineating Thin Client categories (e.g., based on specific product features), what is suggested? Is there any feedback on the effectiveness of the current categories?
  5) Efficiency Criteria – Workstations: EPA proposes incorporation of an active mode benchmark to create a data disclosure requirement for Workstations. How could EPA structure the Workstation requirements to incorporate such a testing requirement?
  6) Efficiency Criteria – Workstations: EPA is currently developing an active mode efficiency disclosure requirement for computer servers. This approach is in part predicated on a customer base that is both motivated to pursue such information and has the resources and capacity to make use of the information. Do commercial Workstation purchasers share these characteristics to any degree?

- **Power Management**

Table 9: Discussion Topics - Power Management

Topic Description	Proposed Action	Rationale
Power Management Criteria	• Maintain Version 5.2 power management requirements. • Seek information on relevant power management criteria for new areas of the program (e.g., ULEM) as well as any recent advances in power management technologies that could be encouraged through the program. • Consider network-based reporting standards to enable efficient operation of networked devices (e.g., IETF Energy Management effort)	EPA intends to maintain the successes of the power management program and support efforts for continued innovation.
Energy Efficient Ethernet and Efficient Networking	• Consider requirements for incorporating EEE-compliant network hardware into ENERGY STAR computers and seek input from stakeholders on implementation measures. • Discuss opportunities for energy-efficient Wi-Fi networking.	The IEEE 802.3az standard for Energy Efficient Ethernet (EEE) was approved in September 2010. Products complying with the standard have been available since 2010.

Topic Description	Proposed Action	Rationale
Full Network Connectivity	• Revisit the proposed TEC weightings for Notebook computers using proxying technology. • Seek information on Full Network Connectivity over Wi-Fi.	EPA retained its initial proposal for full network connectivity ("proxying") requirements when finalizing the Version 5.2 specification for computers, but some stakeholders raised concerns that the weightings for notebook computers did not provide appropriate benefits in the TEC evaluation.

- **Power Management – Questions for Discussion**

    1) What (if any) emerging power management techniques should EPA become aware of for reference in the program requirements?
    2) Is USB Selective Suspend a feature commonly implemented by default?
    3) How can intermediate display power management features, such as turning off backlighting for a period of time before completely switching off a display, be added to an idle test based on the concepts of Short and Long Idle?

- **Other Requirements**

Table 10: Discussion Topics - Other Requirements

Topic Description	Proposed Action	Rationale
Consumer information	- Provide consumers with relevant product information on a range of computing products regarding features, benefits, and energy-efficient performance. - Evaluate various means to effectively provide energy performance information to consumers (e.g., the ENERGY STAR Power and Performance Datasheet ["PPDS"]).	The Version 5.2 Computers specification requires manufacturers to distribute only limited marketing materials related to power management. EPA plans to expand user information requirements in Version 6.0 to ensure that purchasers have the information necessary to operate their computer in the most energy-efficient manner possible.

Topic Description	Proposed Action	Rationale
Multi-attribute Environmental Requirements	• Evaluate requirements for environmental benefits outside of the energy efficiency scope. • Investigate study or reporting of life-cycle energy. Discuss with stakeholders how the results of the Laptop PAIA project can be applied to the requirements for Notebook Computers.	In order to guard against unintended consequences where ENERGY STAR (ES) recommends a product based on use phase data exclusively, EPA has screened many product categories for opportunities or risks represented by non use-phase greenhouse gas (GHG) emissions. Where non-use phase GHG impacts are similar to or exceed use phase impact, EPA has initiated more detailed research into the life cycle costs and benefits of specific life cycle options. For the screening effort, EPA worked with Dr. Sangwon Suh, Bren School of Environmental Science & Management at UC Santa Barbara, to run an economic input output life cycle assessment (LCA) of many ES products. This analysis cannot compare different products within a product category, but served to flag product categories that justify additional research to further evaluate opportunities for reducing GHG emissions. Dr. Suh's analysis showed that short lived products, as expected, presented a potential vulnerability for the program as well as an opportunity for EPA to offer consumers a higher level of environmental benefit. To follow up on this result for laptops while recognizing that process-based LCA does not align with the lifetimes of short-lived products, EPA has also supported the development of a laptop Product Attribute to Impact Algorithm (PAIA). This is a research-based shortcut process LCA that will associate life cycle GHG impacts with product attributes. EPA will propose consideration of the results of the laptop PAIA project in the V6 specification. Further, as the ES program and the marketplace mature, EPA is considering how it can respond to consumer interest in other environmental benefits such as lower toxicity in their ENERGY STAR products. EPA plans to look at existing, tested industry standards for a source of such environmental criteria.

- **Other Requirements - Questions for Discussion**

  1) Would adding a PPDS-like requirement be useful to customers for any of the existing or suggested product classifications in the program (Desktops, Workstations, etc.)? What data/metrics should be included in this documentation, how should it be presented, and where should it be presented?