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California IOUs & NRDC Response to CEC Standards Proposal - Computers

Additional submitted attachment is included below.

Computers

Codes and Standards Enhancement (CASE) Initiative
For PY 2015: Title 20 Standards Development

Response to CEC Standards Proposal for
Computers

Docket #14-AAER-2A

May 29, 2015

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1 Executive Summary

The Pacific Gas and Electric Company (PG&E), Southern California Edison (SCE), Southern California Gas (SCG), San Diego Gas & Electric (SDG&E) Codes and Standards Enhancement (CASE) Initiative Project seek to address energy efficiency opportunities through development of new and updated Title 20 standards. Individual reports document information and data helpful to the California Energy Commission (CEC) and other stakeholders in the development of these new and updated standards. The objective of this project is to develop CASE Reports and subsequent documents that provide comprehensive technical, economic, market, and infrastructure information on each of the potential appliance standards.

This document provides recommendations and supporting analysis in response to the CEC's Computers Staff Report to ensure that California maximizes cost-effective and feasible energy savings. Here is a summary of the CASE Team's recommendations by topic:

1. **TEC Base Allowance:**

- *Desktops:* The CASE Team supports CEC's proposed levels based on analysis of the current market, though we recommend the levels be more stringent to account for future market improvement by the effective date of 2018.

- *Notebooks:* Based on analysis of the current market, CEC's proposed levels overstate the allowance needed even for high-performing notebooks. The CASE Team proposes more stringent levels based on the current market and accounting for future improvement by the effective date of 2017.

- *Thin clients:* CEC's proposed levels overstate the allowance needed given that these products do not need an allowance for storage. The CASE Team proposes more stringent levels based on analysis of the current market and to account for future market improvement by the effective date of 2018.

2. **Display adder:** CEC's proposed levels significantly overstate the adder needed. The CASE Team proposes more stringent levels based on current market analysis and includes a new display adder equation.
3. **Discrete graphics adder:** The CASE Team supports the proposed no-adder approach given existing technology and market trends of graphics switching, though recognizes a need to re-examine products without integrated graphics.
4. **Memory adder:** CEC's proposed levels overstate the adder needed. The CASE Team proposes calculating this adder on a per-memory-module basis rather than the per-GB basis in the current proposal.
5. **Secondary storage adder**: CEC's proposed adder is not needed, as secondary internal storage drives need not be powered on during idle modes. The CASE Team proposes this adder to be zero, with a clarification to the test procedure to ensure that the specifications for secondary storage are explicit and they are allowed power down during testing.
6. **Duty cycle:** The CASE Team reiterates the need to adjust cost-effectiveness calculations to account for real-world computer usage, by increasing both the estimated time in idle

modes and the energy consumption when in idle. The result is an increase in both per-unit and statewide savings from the standards not currently calculated, and potentially justifies an even more stringent standard.

7. **Power Supplies:** The CASE Team continues to recommend the cost-effective 80 PLUS Gold requirement for desktop internal power supplies, an efficiency requirement at 10% load, and power factor requirements at all loads.
8. **Power management:** The CASE Team recommends that computers transition to hibernate mode after 4 hours or less in sleep mode, and also a requirement for proximity sensors & auto brightness control.
9. **Definitions & Data Submittal Requirements:** The CASE Team recommends several modifications and additions to the definitions and reporting requirements for Title 20 Table X to ensure optimal compliance for the products covered by the proposal.

2 Typical Energy Consumption (TEC) Base Allowances

2.1 Desktops

The Aggios desktop optimization project, funded by NRDC and building off the notebook research funded by the IOUs (2014), demonstrated at the April 15th workshop, exemplifies that mainstream desktops can be optimized to meet proposed standards, with a combination of software configuration changes and cost-effective power supply replacement. The proposed desktop base allowances are appropriate for current technology, but **should be reduced** to account for expected technology improvements by effective date 2018. Computer technology is making progress on energy efficiency, with the current trend expected to continue and should be taken into account when setting standards for 2018. Given the potential software improvement opportunities and adjustments based on historical trends of annual ENERGY STAR level improvement of roughly 10% as highlighted by ITI/Technet in their April 15th, 2015 workshop presentation (2015) and an effective date of 2018, we propose a TEC base allowance of **36 kwh/yr** (50 kWh/yr with 10% improvement compounded over three years).

Performance categories should only be necessary if some types of computers cannot meet CEC levels. The CASE Team is currently working to determine this with fully-featured, high-performance machines and will submit investigation results in June.

2.2 Notebooks

CEC proposed limits for notebooks are far too generous and should be re-assessed. Notebook products now represent a majority of the mainstream computer market and should be scrutinized carefully for efficiency improvement potential.

As reported in its recent letter to Information Technology Industry Council, the CEC's analysis for determining standards was based on the highest performing products from the ENERGY STAR 5.2 QPL, which dates back to 2008-2012, and is now an outdated dataset. For example, the CLASP (2014) research of 2013 data showed that roughly 57% of notebooks on the market would meet ENERGY STAR Version 6 levels, and additional IOU research conducted in 2014 on available products determined that the market for ENERGY STAR Version 6 notebooks is likely already quite high, as purchasing a non-ENERGY STAR qualifying product from leading OEMs proved challenging. With further analysis of the May 2015 ENERGY STAR 6.1 QPL (2015) including subtraction of the estimated display and memory energy consumption from these products, the CASE Team suggests that CEC should reconsider its analysis and modify the proposed allowances. See Table 2.1 below for details. Roughly 75% of all notebooks made available in 2014 would meet the CEC proposed base allowance. **We recommend a base allowance of 19 kWh/y,** which corresponds to the median over the last 10 months (July 2014-April 2015) high-performance (I3 category) units in the ENERGY STAR Qualified Product List (QPL) (2015), which is 24 kWh/y, discounted by 10 percent twice to account for the annual natural TEC reduction trend by 2017.

In addition to the compliance pathways and incremental cost discussed previous in the CASE Report (CA IOUs 2013) and Addendum (CA IOUs 2014), preliminary analysis of retail price data collected in February 2015 suggests that there is little to no statistical significance between price and efficiency for notebooks, as highlighted by the two products with similar performance, I2, notebooks, presented by the IOUs at the April 15th workshop. The CASE Team is finalizing its analysis and will be sharing the results by the end of June.

Table 2.1: ENERGY STAR 6.1 QPL Analysis - Typical Energy Consumption for Notebooks (kWh/yr)

	Category 0	Category I1	Category I2	Category I3	Overall
	# of Entries	# of Entries	# of Entries	# of Entries	# of Entries
(All)	111	1,679	727	714	3,280
(2014-1st Half)	74	1,480	643	647	2,844
(2014-2nd Half)	5	122	36	27	190
(2015-1st Half)	32	77	48	40	197
	Top 75% (TEC)	Top 75% (TEC)	Top 75% (TEC)	Top 75% (TEC)	Top 75% (TEC)
(All)	12.4	27.5	26.8	35.7	29.9
(2014-1st Half)	12.0	27.9	28.9	36.5	32.2
(2014-2nd Half)	12.4	7.6	24.6	27.5	25.6
(2015-1st Half)	14.0	N/A	18.3	35.9	24.5
	Top 50% (TEC)	Top 50% (TEC)	Top 50% (TEC)	Top 50% (TEC)	Top 50% (TEC)
(All)	10.9	11.0	19.2	27.7	22.7
(2014-1st Half)	8.7	21.0	21.4	30.6	25.4
(2014-2nd Half)	10.9	7.0	18.2	23.0	19.7
(2015-1st Half)	14.0	N/A	13.1	24.5	18.1
	Top 25% (TEC)	Top 25% (TEC)	Top 25% (TEC)	Top 25% (TEC)	Top 25% (TEC)
(All)	3.6	7.0	13.9	22.2	16.4
(2014-1st Half)	4.2	11.4	15.9	23.6	18.5
(2014-2nd Half)	3.6	6.5	13.8	19.3	14.4
(2015-1st Half)	14.0	N/A	10.3	20.2	11.5
	Top 10% (TEC)	Top 10% (TEC)	Top 10% (TEC)	Top 10% (TEC)	Top 10% (TEC)
(All)	2.2	5.5	8.9	17.8	10.8
(2014-1st Half)	2.2	6.8	9.7	20.3	12.2
(2014-2nd Half)	2.7	5.8	9.0	16.5	11.0
(2015-1st Half)	14.0	N/A	8.5	13.6	9.2

2.3 Thin clients

By definition thin clients are computers with lower capabilities than desktop computers. For example, they typically have no rotational storage media (hard disk, optical disk), as highlighted in more detail in the thin client definitions, Section 8.5.2. As such they should be able to meet lower limits than desktop computers. ENERGY STAR v6.1 sets different limits for thin clients and desktops. We propose that a specific thin client limit be set at 20 kWh/yr, the desktop level minus the roughly 16 kWh/yr of TEC required by 3.5" magnetic hard drives in desktop computers.[1] This reflects the fact that thin clients do not have a HDD and therefore do not need to include disk power in the idle levels.

3 Adders

While we support the principle of functional allowances (a.k.a. adders) to cover features and performance capabilities that cannot be powered down in idle mode, like the display in short idle, adder amounts should be set to what is necessary using best-practice cost-effective technologies, and should only apply to features or performance capabilities that cannot be power down in idle mode. CEC's proposal aligns with ENERGY STAR v6, providing four adders —displays, discrete graphics cards, memory and storage—and we recommend adjustments to all four.

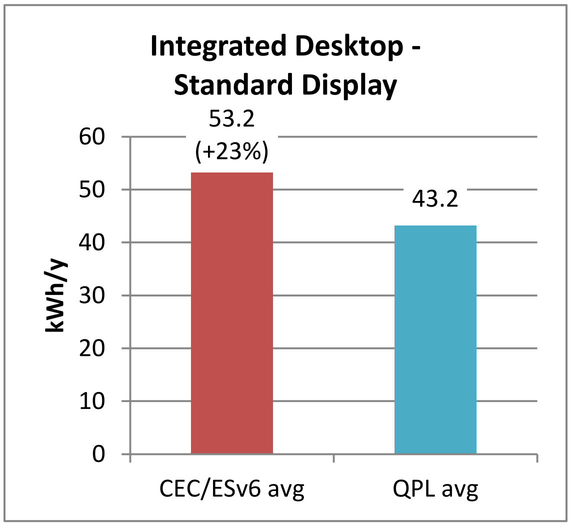
3.1 Display Adders

The display adders proposed by CEC based on ENERGY STAR v6 are far higher than required by current display technology and would result in ineffective standards for integrated desktop and notebook computers. We propose revised display adders based on the real power needs of current display technology per the ENERGY STAR v6.1 QPL.

Display adders are necessary to account for the energy used by the display of integrated desktops and notebooks in short idle mode. However the ENERGY STAR v6 display adders used in CEC's proposal are far higher than the difference between short and long idle in the QPL. That difference is a conservative proxy for display power since it can include the power of other components than the display.

Figure 3.1 shows that CEC proposed adders, based on ENERGY STAR v6, are on average 23% higher than the difference between short and long idle in the QPL for integrated desktops, and 59% higher for notebooks.

[1] Based on an analysis of hard drive idle power consumption data from Tom's Hardware, available at: http://www.tomshardware.com/charts/hdd-charts-2013/-26-Power-Requirement-at-Idle,2917.html



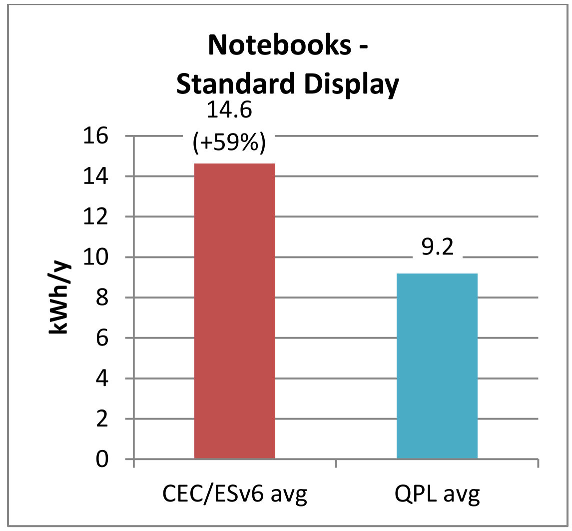


Figure 3.1: Average Display Allowances Across QPL for May 2014 - April 2015 Models - Standard Display

These differences have a huge impact on the effectiveness of the standards, because display allowances are of the same order of magnitude as the base allowance for the system: 53 vs 50 kWh for integrated desktops, 15 vs. 30 for notebooks. In a TEC approach where excessive adders can give inefficient systems a free pass to comply, it is critical to pay attention to adders like displays so that the overall cost-effective and feasible energy savings are optimized.

3.1.1 Proposal for Display Adders

We propose revised display adders that are closer to the real needs of recent computers in the ENERGY STAR QPL. Our proposal is approximately 15% lower than the average difference between short and long idle power in the QPL for computers registered with ENERGY STAR from May 2014 to April 2015 (in order to represent the latest technology, which will be mainstream by 2017 / 2018). We have chosen a value that is lower than the average, because the difference between short and long idle can include more than just display power. For example, it could also include power savings from placing the disk and other components in lower power modes in long than short idle.

Our proposal uses a hyperbolic tangent equation, similar to that proposed in ENERGY STAR display spec Version 7 draft 2:

Computer type	Display allowance (kWh/year)
Integrated desktops	8.76 x 0.35 x (1+EP) x (0.5 x r + 16 x Tanh (0.004 x (A-55) + 0.25) + 0.3)
Notebooks	8.76 x 0.3 x (0.25 x r + 8.5 x Tanh (0.003 x (A-70) + 0.22) + 0.3)

Where:

- r = Screen resolution in megapixels
- A = Viewable screen area in in^2
- EP = 0.15 for enhanced performance displays of any size

Figure 3.2 shows how these proposed levels compare with ENERGY STAR v6.1 and with the QPL on average.

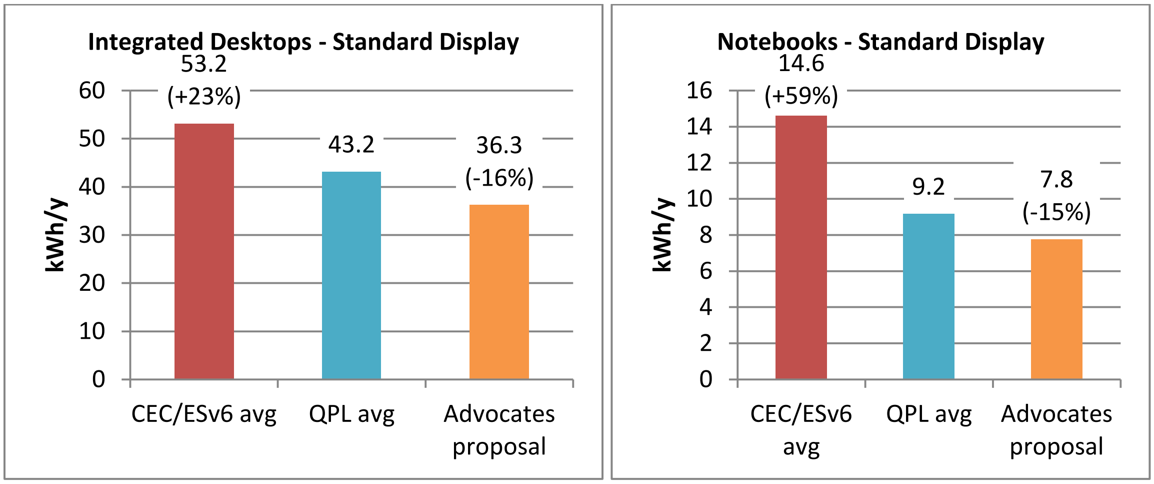


Figure 3.2: Comparison of Average Display Adder Proposal vs. CEC/ENERGY STAR v6.1 and QPL (May 14-April 15) – Standard Display

Our proposed levels yield "pass rates" of 21% of the QPL for integrated desktops (54% for enhanced performance displays, or EPDs), and 29% for notebooks (44% for EPDs) as shown in Table 3.1. The substantial number of units achieving these levels demonstrates their technical feasibility and broad availability in the market today. Note that these are not real pass-rates, we're using conservative estimates of display power.

Table 3.1: Number of QPL models with Short-Long idle delta lower than proposed display adder, percentage of products of total that meet the proposed levels.

	Standard Display	EPD
Integrated Desktops	40 (21%)	11 (54%)
Notebooks	163 (29%)	9 (44%)

The proposed equations have been developed to allow units to meet the proposed levels across the spectrum of screen size and resolutions as shown by Figures 3.3 through 3.6. These figures compare the ENERGY STAR Version 6 display allowances and CASE Team proposed levels to the measured values of the difference between short and long idle, across screen area and resolution.

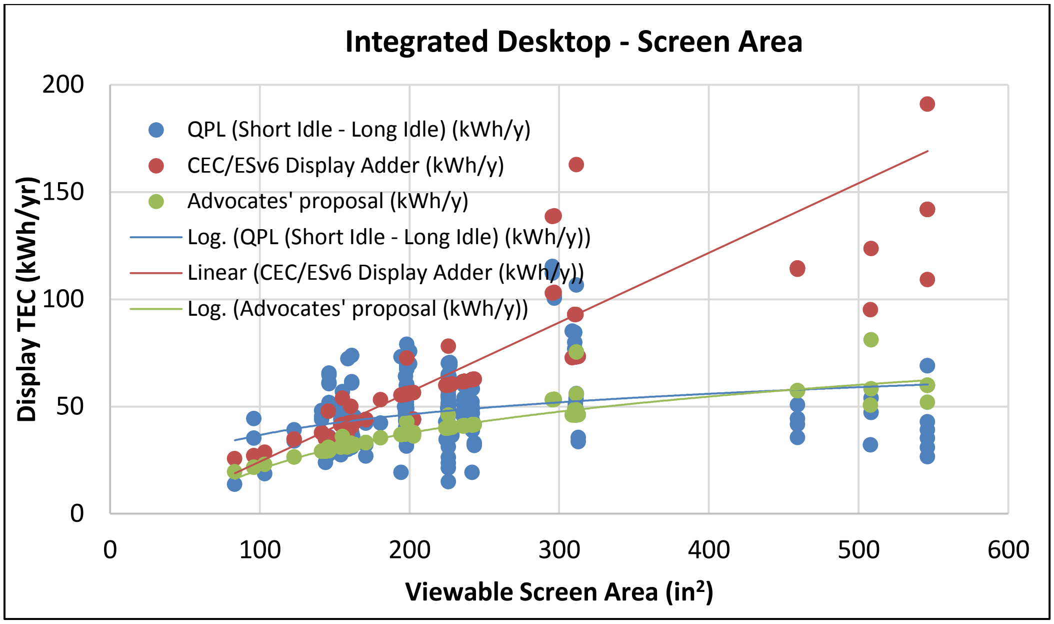


Figure 3.3: Comparison of ENERGY STAR Version 6.1 Display Allowances and QPL-Reported Short-Long Idle Difference across Screen Area.

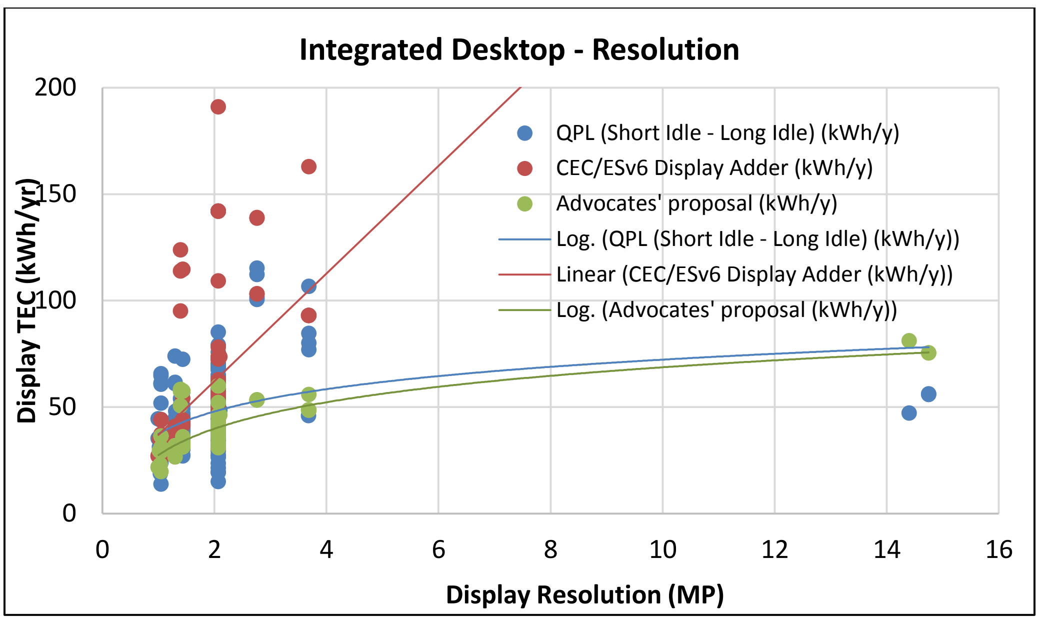


Figure 3.4: Comparison of ENERGY STAR Version 6.1 Display Allowances and QPL-Reported Short-Long Idle Difference across Resolution.

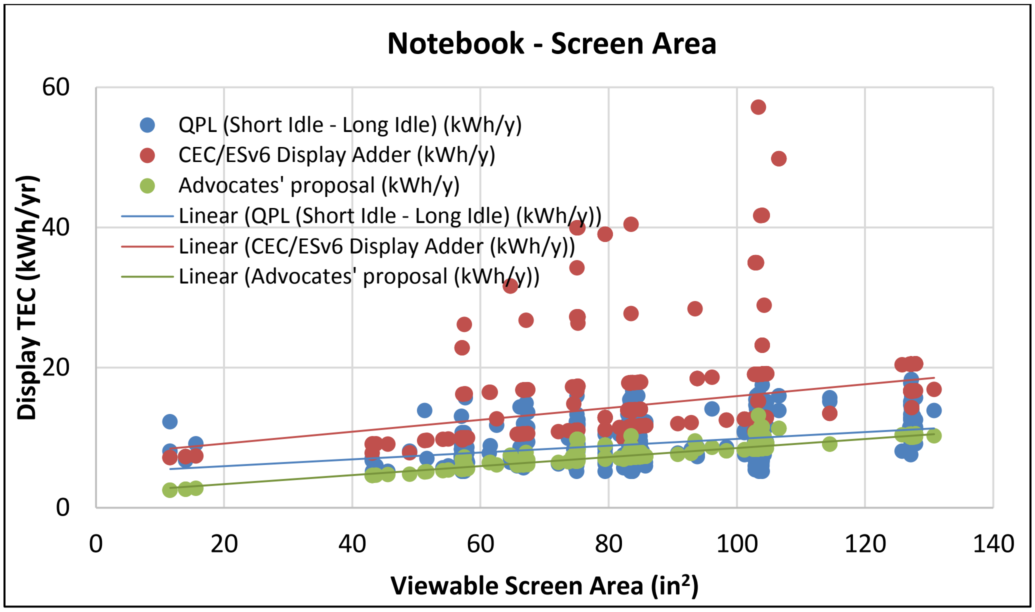


Figure 3.5: Comparison of ENERGY STAR Version 6.1 Display Allowances and QPL-Reported Short-Long Idle Difference across Screen Area.

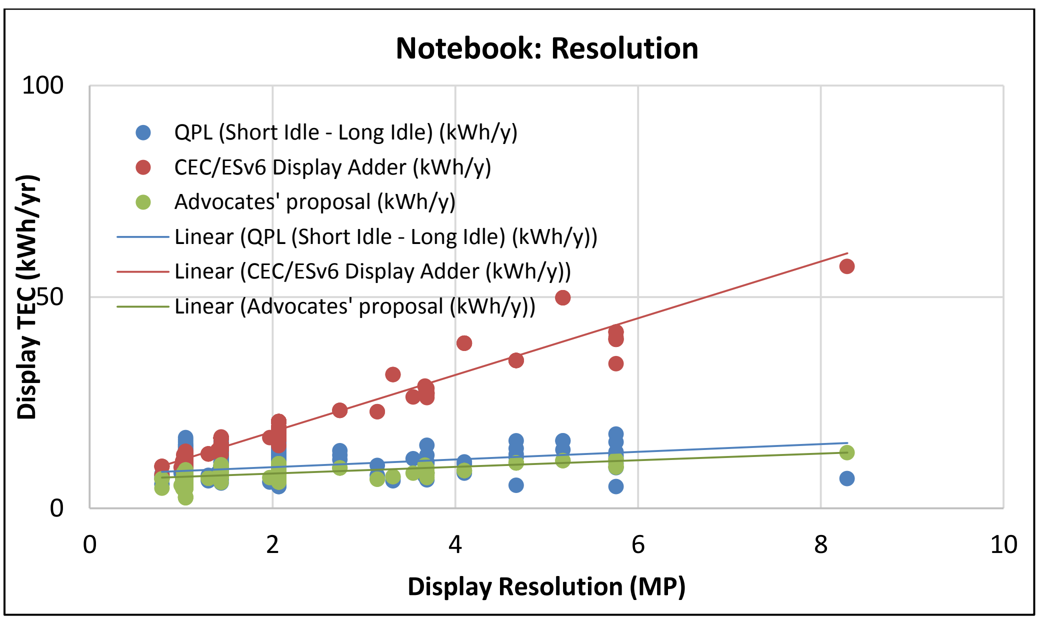


Figure 3.6: Comparison of ENERGY STAR Version 6.1 Display Allowances and QPL-Reported Short-Long Idle Difference across Resolution.

Enhanced performance displays (EPDs): Our proposal does not include a scaling factor for EPDs for notebooks because the QPL shows that the resolution factor in our proposed equations gives EPDs a sufficient allowance as it is.

3.2 Discrete Graphics

The CASE team generally supports the March 2015 staff proposal in establishing no functional adders for computer systems containing discrete graphics processing units (dGfxs). Discrete graphics continue to make efficiency gains, integrated graphics serve mainstream graphics needs very efficiently, and for users requiring higher performance, switchable graphics are able to eliminate the energy impacts of discrete graphics cards during altogether short and long idle, all of which obviates the need for an adder in most systems. Only a small portion of desktop systems may require discrete graphics adders in cases where platforms do not support integrated graphics.

Below, we provide relevant trends and data that support CEC's proposal as well as considerations for modifications to the proposal to more comprehensively treat the diverse graphics configurations available on the market. Our comments here are specifically directed at desktop computers, although discrete graphics adders for notebooks and integrated desktops are also unnecessary for similar reasons.

3.2.1 Continued Discrete GPU Efficiency Improvements

GPU manufacturers have dramatically improved the efficiency of their products in the past half-decade. Until 2011, many discrete GPU products consumed as much energy as a desktop computer itself. Today, thanks to process improvements and enhanced power management, even the highest specification cards have power demands less than 10 W (DC) during idle modes (Tom's Hardware, 2015). The CASE team, along with CLASP and NRDC, has developed a dataset of discrete GPU power measurements since 2011 (35 dGfx in all) and have observed a step decrease in energy consumption. Figure 3.7 illustrates the incremental TEC impacts of a broad sampling of dGfx, displayed as a function of frame buffer bandwidth (FBB) in GB/s (a proxy for overall card performance and graphics throughput). The chart also displays the FBB limits of each ECMA performance category. In 2011, a typical G4 dGfx contributed an additional 102 kWh/yr to a desktop's TEC, but now only adds 35 kWh/yr, a 66% decline.

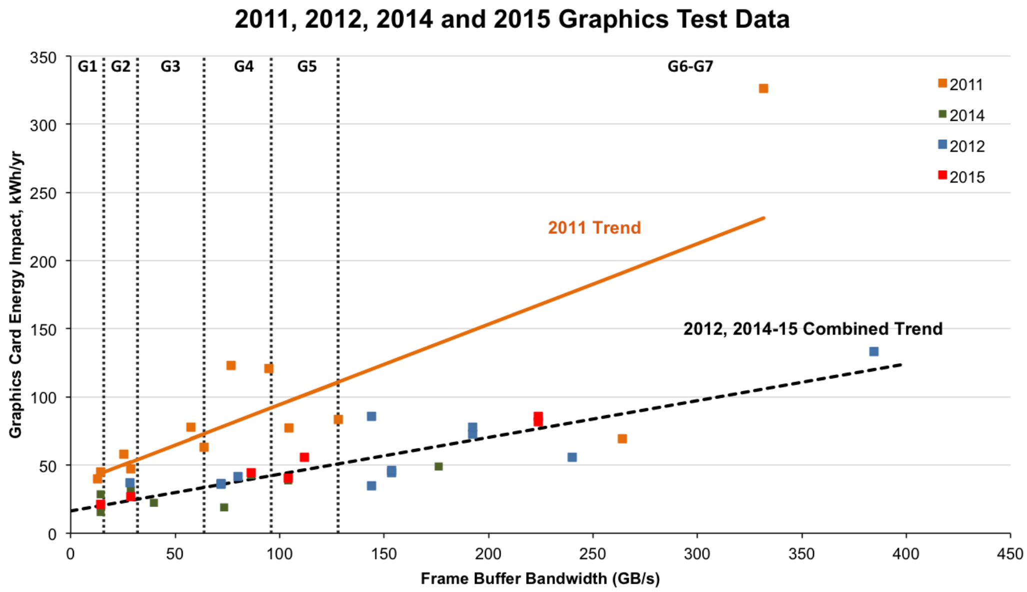


Figure 3.7: IOU, NRDC and CLASP measurements of dGfx, 2011 - 2015

3.2.2 Integrated DGfx Adequately Address Mainstream Graphics

As currently implemented, even today's most efficient dGfxs require some additional energy consumption in idle. New technologies and trends, however, suggest that in the vast majority of cases, future discrete GPUs will not warrant a TEC allowance. For example, both Intel and AMD have moved to integrate relatively high-performance GPUs into their processors. Intel's Core processors have included integrated GPUs since 2010, and AMD's "Accelerated Processing Units" (APUs) have existed since 2012. Both organizations tout the performance and capability of integrated graphics products to address the graphics needs of mainstream customers, even for certain gaming applications.[2]

An analysis of the advertised performance characteristics of current integrated GPUs suggests that these products are currently capable of addressing graphics needs in ECMA categories up to G4. Most products are currently equivalent to G2 discrete GPUs based on their supported memory bandwidth. Several products in AMD's A-series APU line are equivalent to G3. The memory bandwidth of current integrated GPUs is limited by system memory, which is shared between the processor and GPU; however, recent product announcements from Intel state that the company's next generation of integrated GPUs—namely Iris Pro 5200 and 6200—will include an additional 128 MB of dedicated onboard graphics memory, bringing FBB values well into the G4 range.[3]

Integrated GPUs already appear in the vast majority of desktops and can perform at levels equivalent to low-end G1 through G3 discrete cards. Discrete graphics are, therefore, not the most

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[2] See descriptions from Intel (http://www.intel.com/content/www/us/en/architecture-and-technology/hd-graphics/hd-graphics-video.html) and AMD (http://www.amd.com/en-us/innovations/software-technologies/technologies-gaming/apu).

[3] Approximately 75 GB/s using system memory and dedicated graphics memory.

energy efficient way to deliver G1-G3 graphics performance, so providing discrete graphics adders for G1-G3 products is not justified.

3.2.3 Switchable/Hybrid Graphics Key to Mitigating Discrete GPU Impact

Manufacturers may wish to incorporate discrete graphics for enhanced performance in advanced business PCs or higher end home PCs focused on gaming and media. In such systems, graphics adders are still unnecessary as long as the system contains an integrated GPU, as the vast majority of systems do. Graphics switching—sometimes referred to as hybrid or dual graphics—can then be used to disable the discrete graphics card in short and long idle mode when there are no applications loaded and no windows open, and the system is therefore not handling advanced rendering or video processing workloads.

Graphics switching is already widely available for mobile dGfx products and some desktop products as well. NVIDIA's Optimus technology allows mobile dGfxs to be powered off under certain scenarios (i.e. during idle modes or while performing less graphics-intensive tasks such as browsing the Web). Similarly, AMD's "Radeon Dual Graphics" technology provides switchable graphics capability for several existing pairings of APUs and discrete GPUs on both mobile and desktop platforms. IOU measurements confirm that AMD's technology can dramatically lower the impact of discrete GPUs when enabled (see Figure 3.8), although the configuration tested was not able to completely power down the discrete GPU.

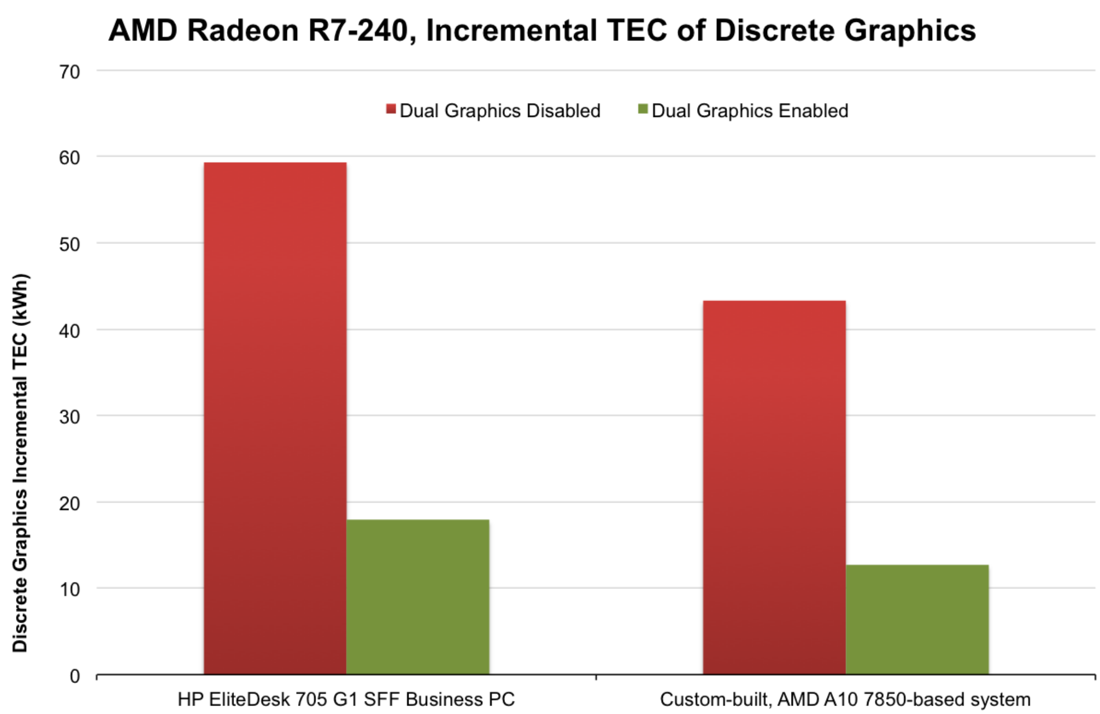

Figure 3.8: Measurements of Radeon Dual Graphics incremental TEC impacts compared to baseline systems without discrete graphics

Third parties have also begun developing vendor-agnostic desktop graphics switching solutions that can be used on a wide range of GPUs. Both Fujitsu and Asus have recently partnered with software manufacturer LucidLogix to incorporate Lucid's "VirtuWatt" graphics switching technology into certain desktop products. Fujitsu's implementation is branded as "Virtu Green" and is available in select CELSIUS workstations and ESPRIMO desktops.[4] Asus has more recently incorporated VirtuWatt on gaming PCs to enable an "Eco Energy Mode" with low idle power.[5] VirtuWatt is a combination software/hardware solution. Software is used to "virtualize" GPUs, route requests to the appropriate graphics component, and channel output signals to a single port (usually the motherboard's display port). A power microcontroller is incorporated into the motherboard or the card itself to power manage the discrete GPU (see Figure 3.9 below).

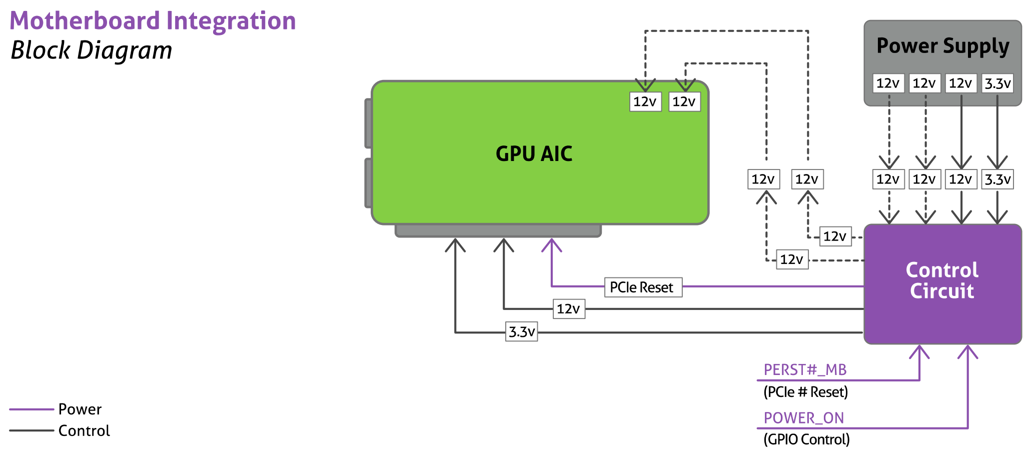

Figure 3.9: VirtuWatt motherboard integration. Discrete graphics card (green) is power managed by control circuit (purple). Source: LucidLogix, 2015

Regarding the costs of graphics switching, we know that many current NVIDIA and AMD products already support this technology (particularly in the mobile space) and that desktop OEMs are voluntarily implementing third-party solutions from vendors like LucidLogix that involve software changes and the addition of a simple and inexpensive microcontroller to the motherboard.[6] At the April 15, 2015 staff workshop on CEC's draft staff proposal, Dell Inc. indicated that the addition of graphics switching capabilities would incur a $5 incremental cost at retail. This figure establishes a conservative basis for cost effectiveness. At a $5 incremental cost, a $0.16/kWh cost of electricity, and a 5-year product lifetime, graphics switching would need to save only 6.25 kWh/yr for consumers to incur no net costs over the product life. As Figure 3.7 shows, these savings are readily achievable and economically justifiable for any discrete GPU in our Even the lowest power

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[4] A description of Fujitsu's collaboration with LucidLogix:http://www.businesswire.com/news/home/20120809005092/en/Lucid-Virtu-Enables-'0-Watt'-Graphics-Functionality-Selected#.VWTimWBJZTY.

[5] A description of Asus' implementation of VirtuWatt technology: http://www.techpowerup.com/201666/lucid-and-asus-announce-desktop-pc-power-optimization.html.

[6] Power microcontrollers, such as those used in battery charge management, can be purchased at volume for less than $1, according to data available on electronics parts supplier DigiKey.com. Even at large retail markups (e.g. 300%), this translates into incremental retail costs of less than $5.

discrete GPUs in our dataset would generate highly cost-effective savings, with benefit-cost ratios in excess of 2.5. The benefit-cost ratio for certain higher powered G7 GPUs could exceed 13.

CEC should maintain its current no-adders position for dGfx and encourage further adoption of this sensible and highly cost-effective technology.

3.2.4 Considerations for Discrete Graphics Only Systems

The CASE Team supports the staff proposal of no additional graphics adders for systems that contain an integrated GPU. We recommend that the CEC clarify that integrated dGfx are either part of the system's main processor or another motherboard-mounted component.

There are also a limited number of desktop platforms today that rely solely on discrete graphics. Intel's Haswell Extreme processors are one such example. Although uncommon in mainstream desktops, such processors can be found in OEM high-end gaming PCs like the Alienware Area 51. As these systems rely solely on high-performance discrete GPUs to drive any connected displays, some additional TEC allowance may be applicable, pending further analysis. The CASE Team continues to conduct measurements on current generation dGfx and will be publishing a technical report with additional findings to be docketed at a later date.

3.3 Memory

In its March 2015 proposal, CEC included a functional adder for memory of 0.8 kWh/yr per GB of installed physical memory based on the ENERGY STAR v6.1 computer specification. This adder is outdated, is inconsistent with the driving factors behind memory energy use, and most importantly, grants overly conservative and unwarranted allowances for memory.

ENERGY STAR developed its original adder using data gathered during the 2010-2012 timeframe, but the memory landscape has since evolved. Today's computers use DDR3 DRAM, whereas ENERGY STAR's dataset was gathered at a time when less efficient DDR2 technology was still available. Furthermore, computer memory is expected to begin transitioning to newer, more efficient DDR4 technology, which draws less power when in an active mode and has improved support for power management when in lower power modes.

Even compared to today's designs using DDR3 memory, the staff proposal is too conservative for establishing an energy efficiency standard. The CASE Team has identified computer models on the ENERGY STAR QPL with identical model numbers and equivalent (or occasionally higher performance) processors, but differing amounts of physical memory, allowing for a comparison of real memory TEC impacts. As Figure 3.10 shows, the total amount of installed physical memory is a relatively poor indicator of energy use and, therefore, should not be used as a basis for granting functional allowances.[7] Furthermore, the proposed 0.8 kWh/yr per GB value is overly conservative and can grant over 50 kWh/yr of additional TEC to high-end systems (twice that amount as 16 GB DIMMs become available, enabling 128 GB memory installs in high-performance systems).

[7] In two isolated instances, manufacturers reported *lower* measured TEC despite a higher memory configuration. We acknowledge that such results are counterintuitive but include the data to illustrate our point that installed memory capacity does not necessarily correlate to energy use.

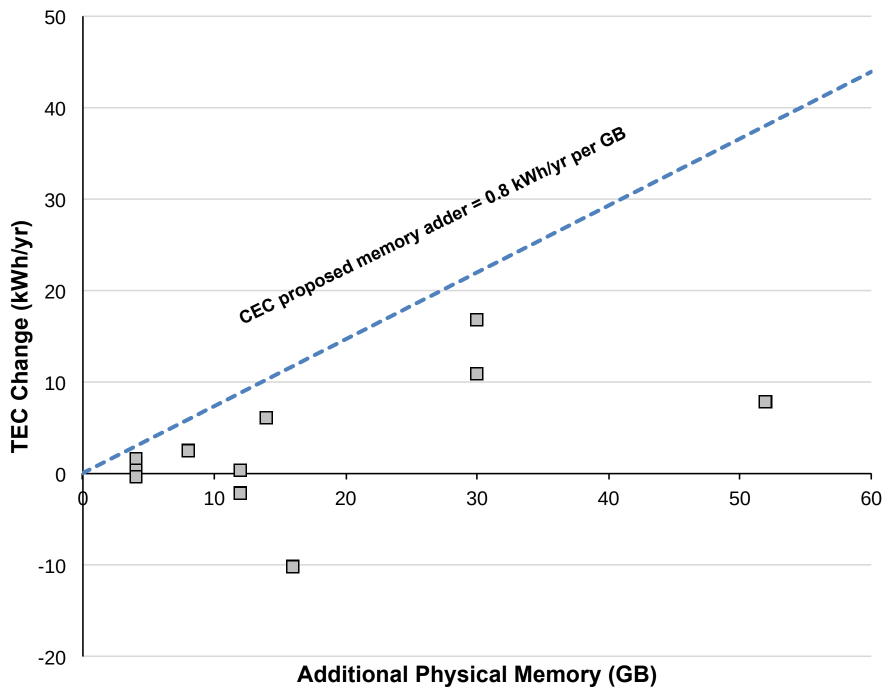

Figure 3.10: Incremental TEC consumed by desktop computers with additional installed memory. Source: ENERGY STAR qualifying products list, 2015

Recent testing conducted by Aggios suggests that the incremental power consumed by memory tends to scale more closely with the number of populated dual inline memory module (DIMM) slots on the motherboard than with overall capacity. Aggios' testing also shows that memory typically consumes about 1.3 to 2.2 kWh/yr per installed DIMM, based on today's DDR3 technology.

The CASE Team proposes an alternative memory adder informed by Aggios' testing and our current understanding of memory energy usage. Our proposal grants no adder for the first DIMM installed in the system (its energy use is covered by the base TEC allowance), but provides a 2 kWh/yr adder for each additional installed DIMM. Mathematically expressed, this is

$$\text{TEC}_{\text{memory}} = 2 * (n_{\text{DIMM}} - 1)\ \text{kWh/yr},$$

where n_{DIMM} is the total number of installed DIMMs. In systems where physical memory is, for some reason, completely integrated onto the motherboard or otherwise not user-serviceable, this adder would not apply.

3.4 Secondary Storage

In its March 2015 Staff Report, CEC included a 26 kWh/yr allowance for secondary storage drives. The CASE Team sees this allowance unnecessary. Primary storage drives need to remain active during idle mode to provide the operating system with quick access to critical files; however, secondary hard drives—which mainly exist to provide storage for extremely large files, media, or backups—can generally be spun down under short and long idle conditions through power management. Short and long idle modes, as defined by the ENERGY STAR v6.1 test procedure and IEC 62323 standard, have no applications loaded and no windows open, and therefore do not require access to secondary storage.

Operating systems used in some of today's computers already support separate power management of secondary drives. For over a decade, Mac OS-based systems have come equipped with a low-level, command-line utility to manage secondary drives.[8] A similar tool is available for Linux systems as a third-party add-on.[9] The various versions of the Windows operating system currently do not natively support separate power management for secondary drives; however, the basic power management infrastructure is already in place and has enabled the development of a variety of third-party utilities for secondary drive power management on Windows.[10] Implementing power management of secondary drives is, thus, a matter of upgrading existing software capabilities to more easily expose power management settings for individual drives and ensure that drives are appropriately power-managed by default.

The CASE Team recommends that the CEC grant no additional power allowances for secondary drives, encouraging manufacturers to make power management for these drives standard on all systems instead. This will involve implementing software changes, either by the computer manufacturers themselves or by operating system developers. In addition, we recommend that CEC clearly define secondary storage to align with ENERGY STAR's definition of "additional internal storage," specifically: "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."

In order to ensure that manufacturers are allowed to count the impacts of secondary drive power management when qualifying systems, we also recommend that CEC clarify language in the referenced ENERGY STAR v6.1 test procedure and IEC 62323 standard. The ENERGY STAR v6.1 test procedure refers to IEC 62623, Ed.1.0, 2012-10 for details concerning testing of short and long idle power demands. The IEC standard states that during short idle power mode testing, "long idle power management features should not have engaged (for example, HDD (if available) is spinning and the EUT is prevented from entering sleep mode)". The IEC standard does not describe how secondary storage devices should be configured during short idle power mode testing under ENERGY STAR v6.1. It does, however, address secondary storage devices in ENERGY STAR v5.2-compliant *long* idle measurement procedures, in which it allows as-shipped power management on secondary drives to be enabled during long idle testing[11]. The CASE team recommends that similar language be used to encourage power management of short idle modes enabled as shipped.

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[8] "pmset", short for "power management settings", has been a part of Mac OS X since 2002.

[9] "hdparm" is an open-source utility for Linux hard drive power management.

[10] Third-party Windows utilities include revoSleep, Drive Power Manager, and Hard Disk Sentinel.

[11] The IEC standard states for "ENERGY STAR v5.2-compliant long idle" that "If more than one internal hard drive is installed as shipped, the non-primary, internal hard drive(s) may be tested with hard drive power management enabled as shipped".

Thus, CEC should clarify test procedure language so that additional drives may be spun down in short idle, using similar language to the IEC 62623 language for ENERGY STAR v5.2-compliant long idle.

Finally, in the event that CEC maintains this adder, it needs to tighten potentially ambiguous language that currently does not specify whether to apply the adder only *once* (per ENERGY STAR v6.1) or for *each* secondary storage drive. The CASE team recommends that this adder need only be applied once, as per ENERGY STAR, and because there is no reason to have multiple drives active in short and idle modes.

4 Adjustment to Cost-effectiveness Analysis

4.1 Duty Cycle

4.1.1 Network Connectivity

The CASE Team recommends that CEC should require a single conventional duty cycle for determining TEC. ENERGY STAR's network connectivity mode weightings are meant to provide an incentive for manufacturers to implement network connectivity in sleep modes. However there is no evidence that network connectivity in sleep mode actually reduces computer on time. These numbers are therefore arbitrary, and may under-represent active modes, weakening the standards. This could significantly reduce energy savings over the life of the standard, particularly if network connectivity in sleep mode becomes widely available. In the absence of evidence of the benefits of network connectivity, it would be prudent, and simpler, to treat all computers equally and use a single duty cycle.

4.1.1 Estimates for Cost-effectiveness

The CASE Team continues to recommend that CEC utilizes the revised duty cycle for desktops proposed by the IOUs in determining energy savings estimates and cost-effectiveness rather than adopt the ENERGY STAR Version 6.1 duty cycle, which is based on just two, outdated studies; it does not consider several additional studies of computer duty cycle. The IOUs compiled these numerous studies and proposed a more representative duty cycle in their most recent submission at the end of 2014 (CA IOUs 2014). Moreover, inclusion of the most recent and only California-focused study conducted by the California Plug Load Research Center in 2013 further supports the recommendation for desktops, which in the non-residential sector are in non-sleep or off modes 77% of the time. Based on a residential and non-residential weighted average by sample size (each study assigned a value of 1-10, rather than absolute sample size) we recommend the revised mode weighting for conventional desktops below in Table 4.1.

Table 4.1: Estimated Duty Cycle for Each Form Factor

Mode	Conventional Desktops, Integrated Desktops and Thin Clients	Notebooks	Workstations	Small-scale Servers
Off	30%	25%	35%	0%
Sleep	10%	35%	10%	0%
Long Idle	20%	10%	15%	100%
Short Idle	40%	30%	40%	0%

4.2 Real-World Adjustment Factor

The CASE Team proposes that CEC utilize our latest published $TEC_{adjustment}$ factors (Figure 4.1) with a 50% weighting when applying them to energy savings and cost effectiveness estimates.

The CASE Team has been examining the impacts of real-world usage on computer energy use since mid-2014 and have generally found that ENERGY STAR-reported TEC values need to be adjusted to determine actual energy use in the field. We provided initial results of this research as part of our October 2014 CASE report addendum (CA IOUs 2014). Our most recent analysis shows that computers can consume anywhere from 15 to 40% more energy under real-world conditions compared to ENERGY STAR-reported TEC (see Figure 4.1), not including the duty cycle adjustment discussed above. As discussed in earlier comments, such adjustments for field usage could increase energy savings for the same cost, and therefore increase cost effectiveness for the proposed standard. We recommended CEC use a TEC adjustment factor in its analyses. Specifically, we recommend adopting the adjustments presented in Figure 4.1 with a 50% weighting. Accordingly, this would mean an adjustment of 7.25% for desktops, 12.5% for integrated desktops, and 20.5% for notebooks.

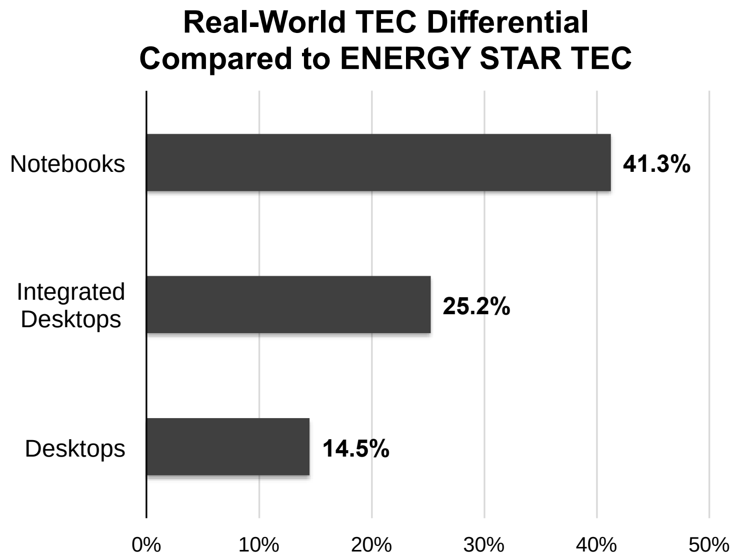

Figure 4.1: Percent increase in TEC under real-world test conditions compared to ENERGY STAR measured TEC

While some of the energy-using components in a system (e.g. hard drives, optical drives, network interfaces) demand about the same amount of power whether the system is under short idle conditions or intense workloads, other system components—CPUs, GPUs, power supplies and memory, for example—will be driven harder and consume more power under real-world loading.

To illustrate the concept, consider the energy savings calculations below between a base system (B) and efficient system (E). Each system's energy budget consists of "scalable" and "fixed" portions. Real-world workloads only exercise the power-scalable pieces of hardware, so in the energy savings calculation, the $TEC_{adjustment}$ only multiplies the scalable part of the energy budget:

$$TEC_{B,real\ world} = TEC_{B,scalable} * TEC_{adjustment} + TEC_{B,fixed}$$

$$TEC_{E,real\ world} = TEC_{E,scalable} * TEC_{adjustment} + TEC_{E,fixed}$$

$$TEC_{savings,real\ world} = TEC_{B,real\ world} - TEC_{E,real\ world}$$

$$= (TEC_{B,scalable} - TEC_{E,scalable}) * TEC_{adjustment} + TEC_{B,fixed} - TEC_{E,fixed}$$

The $TEC_{adjustment}$ should only apply to a portion of the energy savings, but which portion and how much? Our technical team has established two basic criteria for applying this factor. Energy savings measures that 1) provide meaningful savings in idle and active modes and 2) are power-proportional (generate larger savings as the system's workload and power increase) are applicable. Figure 4.2 illustrates a number of promising energy-savings strategies for computers and maps them by mode and power proportionality. Measures highlighted in green are considered applicable. Measures highlighted in red either do not apply to idle/active modes or provide fixed savings.

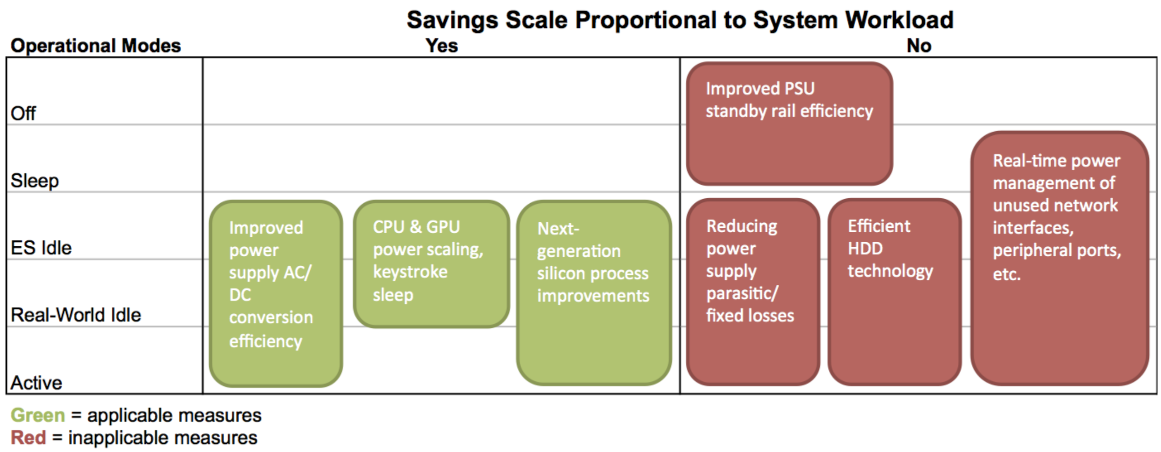

Figure 4.2: Matrix of computer energy efficiency measures and applicability to $TEC_{adjustment}$ multiplier

The energy savings from several compliance strategies are likely to be increased when taking real-world usage into account. Improving AC/DC power supply efficiency remains a promising, cost-effective compliance path, and associated savings will increase if systems are more heavily loaded. Similarly, die shrinkage and continued refinements to silicon components will continue to reduce power demand at a variety of load points. Implementation of low-latency, device-level power management—sometimes referred to as "keystroke sleep"—will also help to lower power demand across a range of CPU and GPU load conditions.

We cannot anticipate the exact paths that manufacturers will pursue to comply with the standard, but we assume that at least 50% of the savings generated by the standard will be derived from a combination of the strategies highlighted in green. The CASE Team therefore proposes that CEC utilize our latest published $TEC_{adjustment}$ factors (Figure 4.1) with a 50% weighting when applying them to energy savings and cost effectiveness estimates.

5 Power supply efficiency requirements

5.1 Desktops, integrated desktops and thin clients

We strongly recommend that CEC include efficiency requirements for internal power supplies, in addition to TEC requirements. We propose 80-PLUS Gold levels with additional 10 percent load efficiency requirements of 84 percent.

5.1.1 80-PLUS Gold levels

CEC's proposal does not include power supply efficiency requirements, contrary to ENERGY STAR and EU Ecodesign. External power supplies are already subject to federal standards, resulting in a transformation of the market, whereas many internal power supplies in today's computers are still very inefficient.

Opponents of this requirement argue that power supply efficiency is only one of the pathways for meeting TEC requirements, and manufacturers should be given the flexibility to meet TEC requirements in whichever way they want. We agree with this generally, however not having a power supply efficiency requirement would still leave opportunity for additional cost-effective savings. Moreover, having the requirement guarantees energy savings in active mode; CEC draft standards are appropriately focused on idle mode, and some of the potential compliance techniques such as graphics switching may not save as much or any energy in active mode.

We propose 80-PLUS Gold based on break-even cost-effectiveness analysis utilizing data provided by Information Technology Industry Council (ITI) in response to the Invitation to Participate (2013) and the April 15th, 2015 computers workshop (2015). The assumptions and results are highlighted below in Table 5.1.

In summary, ITI reports an incremental cost of $12.15 for improving PSU efficiency between the market baseline of 68% to 80 PLUS gold, for a 300 Watt PSU, which we estimate to be typical size. Assuming $.16 per kWh and a 5-year design life, the amount of energy savings needed for the customers to incur no additional cost is 15 kWh/yr. The conversion efficiency of the baseline and efficient computer systems is defined as:

$$\eta_{base} = \frac{E_{DC}}{E_{AC,base}} \text{ and } \eta_{eff} = \frac{E_{DC}}{E_{AC,eff}}.$$

Since only the power supply is being replaced, the DC power budget on the systems, E_{DC}, is the same in both cases. The AC energy consumption of the more efficient system can then be written as:

$$E_{AC,eff} = E_{AC,base} \frac{\eta_{base}}{\eta_{new}}.$$

The energy saved by replacing the power supply is then:

$$E_{saved} = E_{base}(1 - \frac{\eta_{base}}{\eta_{new}}).$$

Using this conversion, the energy used by the base system needs to be greater than 70 kWh/yr. A typical desktop computer today uses about 190 kWh/yr accounting for real-world energy use (both real-world adjustment factor and duty cycle modifications), with about 95% of this energy used in idle/active modes that would be impacted by improved power supply efficiency. We recommend using this value for the baseline since the savings would be achieved as one compliance pathway, however if assuming the power supply savings is accounted for after the TEC requirement is in place, the energy consumption would be 70 kWh/yr. Regardless of the scenario used, the CASE Team proposal would be cost-effective, with **benefit-cost ratios ranging from 1.04-2.58** using 2013 cost estimates. When using experience curves and anticipating the costs by the effective date of 2018, the benefit-cost ratio could be higher. Break-even cost-effectiveness values for 80-PLUS Silver and Bronze are also provided for reference.

Table 5.1: Incremental Cost of Efficiency PSUs

PSU Efficiency Improvement	Values	Source
68% to 80 PLUS Bronze	$ 5.18	ITI Response to CASE proposal, July 29, 2013
68% to 80 PLUS Silver	$ 10.35	
68% to 80 PLUS Gold	$ 12.15	
68% to 80 PLUS Platinum	$ 16.88	
Assumptions		
$/kwh	$ 0.16	CEC Staff Report 2015
Design Life	5	CEC Staff Report 2015
Real World Energy Use Factor	0.35	Calculated based on CASE Team proposed Real-World Adjustment Factor and revised duty cycle
Idle mode only adjustment	0.95	Based on ENERGY STAR QPL 2015 % of Sleep and Off Mode relative to TEC
Breakeven TEC savings per year		
68% to 80 PLUS Gold	15.19	Calculated using above incremental cost, $/kWh and design life
68% to 80 PLUS Silver	12.94	
68% to 80 PLUS Bronze	6.48	
Breakeven TEC		
68% to 80 PLUS Gold	70	Calculated, using efficiency at 20% Load
68% to 80 PLUS Silver	65	
68% to 80 PLUS Bronze	38	
Desktop TEC Comparison		
Current Avg. TEC Baseline	180	Calculated using 140 kwh/yr (ITI presentation, April 15, 2015), Real World Energy Use Factor, and idle mode only adjustment
Current Avg. TEC CEC Proposal	72	Calculated
Proposed Base Allowance	50	CEC Staff Report 2015
Proposed Memory Adder	6	CEC Staff Report 2015, assumed 8 GB.
Benefit Cost Ratio		
68% to 80 PLUS Gold – Baseline	2.58	Calculated
68% to 80 PLUS Gold – CEC Proposal	1.04	

5.1.2 10 Percent Load Efficiency Requirements

In addition to 80-PLUS we strongly recommend that CEC includes efficiency requirements of 84 percent at 10 percent load for desktops, workstations and small-scale servers.

10 percent load is a proxy for the idle load range. As computers, workstations and servers are becoming better able to scale power between idle and active mode, their idle load point has fallen below 20 percent and can be found anywhere between 5 and 15 percent for most computers. And even in active mode, computers are better able to dynamically ramp down their power demand when not performing resource-intensive tasks. As a result, typical computers spend an increasing share of their time in the 5-15% load range.

Unfortunately, the 80-PLUS standard test points of 20, 50 and 100 load focus on the active load range, and do not guarantee a decent efficiency below 20 percent. An 80-PLUS power supply with poor efficiency at the idle load point, would significantly impact overall system efficiency.

In fact, the 80-PLUS program has been testing all power supplies at the 10 percent load point since January 2012, despite this load point not being part of the 80-PLUS standard. The test data is available on the 80-PLUS website[12]. An analysis of this data on Figure 5.1 shows that the range of efficiencies is twice as large at 10 percent than at 20 percent load, confirming that the 10 percent load range is not consistently optimized.

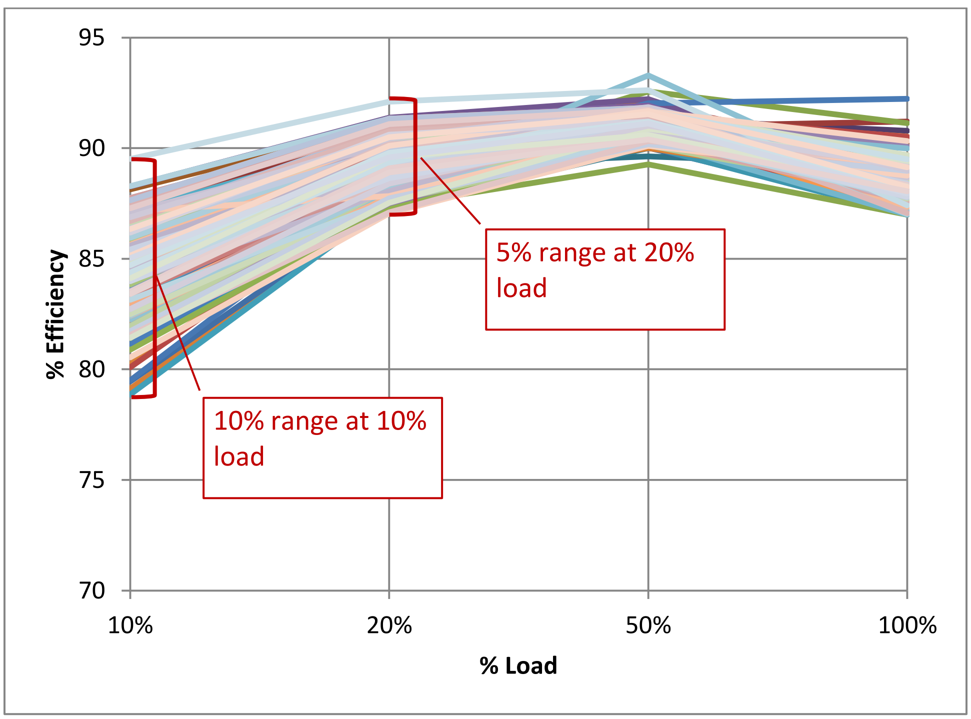

Figure 5.1: Efficiency Profiles of 80-PLUS GOLD Power Supplies

[12] http://www.plugloadsolutions.com/80pluspowersupplies.aspx

We recommend the CEC adopts efficiency requirements of 84 percent for 80-PLUS Gold, in alignment with ENERGY STAR v6.1's power supply efficiency incentive allowance.

This requirement does not significantly add to the test burden for manufacturers, since the 10 percent load test can be performed using the same test setup and equipment as other load points, adding negligible time and cost to the 80-PLUS testing.

6 Power management requirements: Hibernate

In addition to ENERGY STAR's basic power management requirements (display off after 15 minutes and power down to low-power mode after 30 minutes), CEC should require that computers transition to hibernate mode after 4 hours or less in sleep mode.

In sleep mode, computers continue to draw between 1 watt (notebooks) to 2 to 3 watts (desktops) for as long as the computer is unused. This could last days, or weeks. While sleep mode with a latency of 5 seconds or less is justified when the computer is used frequently (such as for a lunch break), it is not justified when computers are unused for long periods of time, such as over the weekend or when people are away on vacation. Many notebooks are already configured by default to transition to hibernate automatically after several hours in sleep mode, because of battery life considerations. Desktops should do the same. The capability already exists in all computers today, it just needs to be implemented by default.

In the April 15th 2015 workshop, stakeholders conveyed that display off and auto-power down requirements may not be appropriate for some particular computer uses. The CASE Team is supportive of limited exemptions of power management requirements if these uses can be clearly and narrowly defined.

7 Proximity sensors and auto-brightness control (ABC)

In addition to time-based power management, there is an opportunity for CEC to require power management based on the presence of the user in proximity of the computer and ambient lighting levels:

Proximity-based power management: require occupancy sensors on notebooks and integrated desktops so that when no one is in the room, there is no need for the display to be on and other computer features ready to respond within a millisecond. This is an opportunity to transition the computer into long idle mode, including switching off the display, and engaging other long idle power management strategies such as powering down the disk and other components.

Auto-brightness control: this capability is already available in most notebooks because of battery use reasons. It should be implemented in integrated desktops and enabled by default in both notebooks and desktops.

8 Product Definitions and Information Provision

8.1 Summary

CEC's definitions of the types of computers covered by the standards need to be revised to avoid any misinterpretations and ensure that they do not unintentionally open up loopholes in the standards. This section provides proposed changes to the definitions with associated justifications.

8.2 Definitions

8.2.1 Computer – General Definition

We propose a minor adjustment in the general definition of "computer" to avoid any misinterpretation, and make additional comments that set the stage for changes to other definitions and additions of new definitions.

Proposed definition

"Computer" *means a desktop computer, notebook computer, small-scale server, workstation, or thin-client computer.* <u>*For the purposes of these standards,*</u> *tablets, game consoles, handheld gaming devices, computer servers (other than small-scale servers), and industrial process controllers* <u>*are not considered to be computers*</u>*.*

Comments

The "computer" definition explicitly excludes some types of computers such as tablets and game consoles. These products need to be defined elsewhere in the draft regulatory language, to ensure that there is no opportunity for products intended to be in scope to side step computer standards by being marketed as excluded products.

Certain types of notebook computers could be defined as "tablets" where they have detachable keyboards. Such products are sometimes referred to as 2-in-1 or hybrid notebooks in that they can support both a touch and traditional keyboard-mouse interface.

More energy intensive products such as "Portable-all-in-ones" (which are in effect a large tablet designed to perform the duties of an integrated desktop computer) could also fall outside of the scope of the standards if defined as a "tablet" by manufacturers.

The delineation between gaming desktop computers and game consoles is no longer clear cut in the market place. Many gaming desktop computers are being squarely marketed at the traditional game console marketplace but at the same time retaining their ability to support desktop computer functionality. Given this blurring it is necessary to define game consoles as an excluded category of product.

A definition for "Hand held gaming devices" is also needed because these products could fall under the definition of "notebook computers".

"Small scale servers" are very similar devices to desktop computers. Products that would otherwise be marketed as "desktop computers" could therefore be sold as "small scale servers" and side step the standards. As such a definition for "Small scale servers" should be added to the standards.

8.2.2 Desktop Computer

Proposed definition

"Desktop computer" *means a computer that is not designed for portability and is 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 desktop computer includes computers that may be sold with a display integrated into the unit or that is meant to be powered through the power supply of the desktop computer.*~~

Justification

Desktop computers and Integrated Desktop Computers are normally defined separately so that clear distinctions can be made between the different product types. While this has the benefit of simplicity, this is problematic for the use of the ENERGY STAR test procedure which explicitly calls out "Integrated Desktop Computers". We recommend that CEC separates the definitions into "desktop computer" and "integrated desktop computer" to ensure that the ENERGY STAR test procedure can be referenced directly without having to add clarifying comments in the standards.

8.2.3 Integrated Desktop Computer

Proposed definition

"Integrated desktop computer" *means a type of 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 physically 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.*

8.2.4 Notebook Computer

Proposed definition

"Notebook computer" *means a computer designed specifically for portability and to be operated for extended periods both with and without a direct connection to an alternating current (AC) power source. Notebook computers include an integrated display, with a viewable diagonal screen size of at least 9 inches, and are always sold with a non-detachable or detachable physical keyboard. Notebook computers are typically designed to provide similar functionality to Desktop computers, including operation of software similar in functionality as that used in Desktop computers.*

Justification

The draft CEC definition for notebook computers appears to be a modified version of the ENERGY STAR v6.1 definition. The ENERGY STAR definition also includes a note concerning the functionality levels found in notebook computers: *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.* Omitting the ENERGY STAR note on the notebook definition could result in a larger number of product types, such as e.g. phones with integrated keyboards, calculators, personal digital assistants

(PDAs), meeting the draft CEC definition and therefore being unintentionally covered by the standards. We recommend that CEC include additional text on the functionality levels expected in notebook computers.

The EU Ecodesign Regulation on computers and computer servers (EC/617/2013) also includes additional limiting factors on the size of the integrated display (9 inches) to limit the likelihood of unintentionally covering products that are similar to notebook computers.

The CEC definition also states that notebook computers are "*always sold with a mechanical keyboard (using physical, movable keys)*". Whilst touch keyboards have not made a significant market impact yet there is no guarantee that during the life of the standards that they would not become more popular and hence provide a loophole to the standards.

8.2.5 Thin Client

Proposed definition

"Thin client" *means an independently powered computer that relies on a connection to remote computing resources (for example, a computer server or a remote workstation) to obtain primary functionality. Main computing functions (for example, 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 (for example, on a desk) and not for portability.*

Justification

Rotational media means Hard Disk Drive (HDD), which does not cover Solid State Drives (SDD). Even when considering SSDs, the absence of permanent storage media is a common, but not a defining criterion for this category. Some thin clients could include local storage media, and still rely on a connection to remote computing resources to obtain primary functionality. In addition, a storage media criterion could encourage the inclusion of HDDs or SDDs so that thin clients are either defined as desktop computers or excluded from the scope of the standards. The definition works without this criterion, we therefore recommend removing it.

8.2.6 Mobile Thin Client

Proposed definition

"Mobile Thin Client" *means 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 these standards.*

Justification

Within the current CEC draft "mobile thin clients" would be treated as a "thin client" and allowed the same allowance as an "integrated desktop computer" rather than the lower allowance for a "notebook computer". Given that mobile thin clients are more similar to notebook computers (and are treated as notebook computers in both ENERGY STAR v6.1 and the EU Ecodesign Regulation on computers) the CEC should define this product type separately.

8.2.7 Enhanced Performance Display Definition

Proposed definition

"Enhanced Performance Display" *means a display with a contrast ratio of at least 60:1 measured at a horizontal viewing angle of at least 85° from the perpendicular, with or without a screen cover glass and a native resolution greater than or equal to 2.3 megapixels (MP), and with a Color Gamut of sRGB or greater as defined by IEC 61966-21. Alternate color spaces are allowable as long as 99% or more of defined sRGB colors are supported.*

Justification

CEC's draft standards do not include a definition for "Enhanced Performance Display". While we are proposing that enhanced performance displays receive no specific allowance based on the QPL data, if they were to receive an allowance, a definition of enhanced performance display would be required in order to ensure that the appropriate adder is given to integrated displays. The US EPA is currently updating the definition of "Enhanced Performance Display" within the forthcoming ENERGY STAR v7 specification for displays after stakeholders commented that the previous definition was not sufficiently robust to differentiate very high specification displays which likely required more power to function. We recommend that CEC adopt the new ENERGY STAR draft definition.

8.2.8 Portable All-In-One Definition

Proposed definition

"Portable all-in-one" *means a computer device designed for limited 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 a 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, but is primarily powered by connection to the AC mains.

Justification

Within ENERGY STAR v6.1, portable all-in-ones with a diagonal display size greater than 17.4 inches considered Integrated Desktop Computers, and those with a diagonal display size equal to or smaller than 17.4 inches considered a "slate/tablet". The EU Ecodesign Regulation on computers (617/2013) treats these products as notebook computers.

We recommend that CEC defines "portable all-in-one" per the ENERGY STAR definition (requiring a diagonal display size greater than 17.4 inches), and treats them as integrated desktop computers.

8.2.9 Slate/Tablet Definition

There are a number of types of computer that are excluded from the scope of the CEC Standards, but no definitions are currently listed for these product types. Providing definitions for excluded products types helps to ensure that products in scope are not confused with products out of scope. We recommend the following definitions:

Proposed definition

"Slate/Tablet" means a type of computer that includes an integrated touch-sensitive display with a diagonal size greater than 6.5 inches and less than 17.4 inches, and does not have a permanently attached physical keyboard.

8.2.10 Game Console Definition

Proposed definition

*"**Game Console**" - a computing device whose primary function is to play video games. Game consoles share many of the hardware architecture features and components found in general personal computers (e.g. central processing unit(s), system memory, video architecture, optical drives and/or hard drives or other forms of internal memory). In addition, game consoles have the following attributes:*

- *Utilise either dedicated handheld or other interactive controllers designed to enable game playing (rather than the mouse and keyboard used by personal computers); and*
- *Are equipped with audio visual outputs for use with external televisions as the primary display; and*
- *Use dedicated console operating systems (rather than using a conventional PC operating system); and*
- *May include other secondary features such as optical disk player, digital video and picture viewing, digital music playback, etc.; and*
- *Are designed to be powered through connection to an alternating current (AC) main power source via either an internal or external power supply unit; and*

8.2.11 Handheld Gaming Device Definition

Proposed definition

*"**Handheld gaming device**" means a product whose primary function is to play video games with an integrated display as the primary game-play display, and which primarily operates on an integrated battery or other portable power source rather than via a direct connection to an AC power source.*

8.2.12 Computer Server Definition

Proposed definition

***"Computer server"** means a computer that hosts services and manages networked resources for client devices (e.g. desktop computers, notebook computers, thin clients, wireless devices, PDAs, IP telephones, other computer servers, or other network devices). A computer server is sold through enterprise and commercial channels for use in data centers and office/corporate environments. A computer server is primarily accessed via network connections, versus directly-connected user input devices such as a keyboard or mouse. For purposes of this specification, a computer server must meet all of the following criteria:*

A. is marketed and sold as a Computer Server;

B. is designed for and listed as supporting one or more computer server operating systems (OS) and/or hypervisors;

C. is targeted to run user-installed applications typically, but not exclusively, enterprise in nature;

D. provides support for error-correcting code (ECC) and/or buffered memory, including both buffered dual in-line memory modules (DIMMs) and buffered on board (BOB) configurations.

E. is packaged and sold with one or more ac-dc or dc-dc power supplies; and

F. is designed such that all processors have access to shared system memory and are visible to a single OS or hypervisor.

8.2.13 Industrial Process Controllers Definition

Proposed definition

*"**Industrial process controllers**" means a computing device that is primarily designed for use in industrial applications such as controlling industrial processes and are designed to withstand industrial environments through technical features such as enhanced dust proofing.*

9 Data Submittal Requirements

The data submittal requirements could be enhanced by adding a few extra items (as proposed in red in the Title 20 Table X below). These would assist in any technical reviews or enforcement activities of computer energy efficiency for products sold on the California market.

The CEC should also provide definitions for some of the items in the data submittal table where these are not provided elsewhere in the document. For example, definitions for the different classes of GPUs would be required to inform both users and manufacturers.

Section 1606 of Title 20 - Table X

	Appliance	*Required Information*	*Permissible Answers*
V	Computers	Computer Type	Desktop, Integrated Desktop, Notebook, Small-Scale Server, Workstation, Thin-Client, Portable All-in-Ones, Mobile Thin Clients.
		Manufacturer	
		Model Name	
		Model Number	
		Operating System	
		CPU Name	
		Base Core Frequency (gigahertz)	
		Number of Physical ~~Execution~~ Cores	
		Amount of RAM (gigabytes)	
		Number of RAM modules	
		Discrete Graphics	None, G1, G2, G3, G4, G5, G6, G7, G8+
		Switchable graphics functionality	Yes, No
		Switchable graphics enabled during testing	Yes, No

		Does the computer have an integrated display?	Yes, No
		Diagonal screen size (inches)	
		Viewable screen area (square inches)	
		Resolution (megapixels)	
		Enhanced Performance Display	Yes, No
		Length of time of user inactivity before entering sleep (minutes)	
		Length of time of user inactivity before placing display into sleep (minutes)	
		Energy Efficient Ethernet Capability	Yes, No
		Internal PSU efficiency	10 %, 20 %, 50 % and 100 % of rated output power
		External PSU efficiency	
		Off mode power (watts)	
		Sleep mode power (watts)	
		Long-idle power (watts)	
		Short-idle power (watts)	
		Total Annual Energy Consumption (kilowatt hours per year)	

References

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