DOCKETED

Docket Number:	16-AAER-02
Project Title:	Appliance Efficiency Rulemaking for Computers, Computer Monitors, and Signage Displays
TN #:	214166
Document Title:	ITI - TechNet Comments on CEC Computers, Computer Monitors, and Signage Displays
Description:	N/A
Filer:	System
Organization:	ITI/TechNet
Submitter Role:	Public
Submission Date:	10/24/2016 4:51:49 PM
Docketed Date:	10/24/2016

Comment Received From: Alexandria McBride
Submitted On: 10/24/2016
Docket Number: 16-AAER-02

ITI -TechNet Comments on CEC Computers, Computer Monitors, and Signage Displays (Docket #16-AAER-02)

Additional submitted attachment is included below.

CEC Computers, Computer Monitors, and Signage Displays (Docket #16-AAER-02)

Appliance Efficiency Rulemaking

ITI/TechNet Comments on the Rulemaking
October 24, 2016

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1. INTRODUCTION

ITI and TechNet (also referred to hereafter as "industry") have been honored to participate in a constructive dialogue with CEC staff since the beginning of the Computers and Displays Standards Rulemaking in Spring 2012. Our collaborative and data-driven discussions have resulted in a historic rulemaking that achieves the highest energy efficiency standards possible without undermining the innovation powering California's economic engine. The standards proposed in this rulemaking are ambitious, but given the industry's history of creating increasingly energy-efficient technologies, we are certain that they are achievable. As stated during the October 10th Public Meeting, ITI and TechNet support the proposed standards, provided CEC staff's consideration of the comments contained herein.

The industry comments and recommendations below pertain to the CEC's Proposed Regulatory Language: Express Terms Computers Computer Monitors and Signage Displays and have been previously communicated to CEC staff in multiple discussions. We urge the CEC staff to review and address these industry recommendations in the final standard.

ITI and TechNet are committed to continued engagement with CEC and other stakeholders to drive further improvements to the rule, even after the rulemaking process is complete. As CEC plans for implementation of this rule, we strongly suggest that CEC provide clear, accurate and timely guidance to industry (and other stakeholders) as the standards come into effect. For example, a CEC announcement letter with corresponding webinars, guidance documents and FAQs should be released at least six months before the effective date to allow stakeholders to make critical adjustments to their business and/or manufacturing processes and ask technical questions to CEC staff. We are certainly open to providing further feedback on implementation as we approach that phase of the process.

We look forward to seeing the results of these discussions in the final CEC standard.

2. SUMMARY OF KEY BATTERY CHARGER SYSTEMS ISSUES

In preparation for the scheduled January 1, 2017 expansion of scope of the CEC Battery Charger Systems regulation (CEC-400-2012-011-CMF), industry identified substantive concerns about the inclusion of non-consumer small battery chargers and requested clarification from CEC. The expanded regulation qualifies many non-consumer products as battery chargers and battery charger systems, but for which there is no appropriate test procedure in place, and would restrict those products from sale in the State of California. The products of concern are non-consumer products with battery charger and battery charger systems that include rechargeable batteries as defined by the regulation but do not support primary function of the product when the AC power is not present. Examples of these products vary and include a majority of servers and storage controllers.

ITI worked closely with CEC staff to clarify the definition of what it means "to provide electrical energy to a product," and the definition stated in Section 1601(w)(7) fully clarifies CEC's intent and addresses industry concerns. ITI supports the CEC proposed language in Section 1601(w)(7) and strongly urges the CEC move forward with this definition before the Battery

Charger System regulation becomes effective on January 1, 2017.

3. SUMMARY OF KEY COMPUTERS ISSUES

Express Terms:

- **Definitions**

  - **Add-in card definition:** The problem is mainly with the last sentence of the CEC proposed definition *"It also does not include cards that split, physically extend, or convert a slot type"*. There are several examples of cards that do convert a slot (like PCIe to USB, PCIe to Ethernet slot, PCIe to SATA slots/RAID cards, etc.) which will have unique power delivery requirements and hence will need an adder. After understanding the CEC staff industry had proposed to include the term "riser cards" within the definition to ensure the concern is addressed. Including riser cards as part of the excluded items should ensure cards that split or physically extend slots are not used for Add-in card TEC adder.

    Industry proposed definition: *"Add-in card" means a removable device that can be installed in a computer PCI or other slot. Add-in card does not include hard-disks, system memory, riser cards or removable devices that are intended to operate outside of a computer chassis.* (Please refer to proposed changes to the regulatory language in section 6 of this document)

  - **High expandability Computer definition**: CEC did not separate the agreed system memory bandwidth and frame buffer bandwidth requirements. This creates confusion and ambiguity since the terms system memory bandwidth and frame buffer bandwidth have different definition and different proposed values. Further system memory bandwidth and frame buffer bandwidth have different equations to compute kWh capability allowance. Industry proposes to add two additional clauses, pertaining to systems memory bandwidth to the clauses (Please refer to proposed changes to the regulatory language in section 6 of this document)

    Schedule issue: Compliance for computers meeting the high expandability criteria (per definition) start January 1, 2018. However the dates for discrete graphics and power supply requirements built into the definition are on a different timeline ("before January 1, 2020" and "on or after January 1, 2020"). It is confusing and unnecessary to track these dates. This could inadvertently lead to potential non-compliance. Industry Proposal: Modify High expandability computer criteria (2) to remove the following language "If the computer is manufactured before January 1, 2020", and align with January 1, 2018 effective date, and modify (3) to change from "on or after Jan 1, 2020" to "on or after July 1, 2021" to align with computer Tier 2 dates. (Please refer to proposed changes to the regulatory language in section 6 and visual flow chart in Appendix A)

  - **Mobile workstation definition:** CEC did not separate the agreed system memory bandwidth and frame buffer bandwidth requirements. This creates confusion and

ambiguity since the terms system memory bandwidth and frame buffer bandwidth have different definition and different proposed values. Further system memory bandwidth and frame buffer bandwidth have different equations to compute kWh capability allowance. Industry proposes to edit an existing clause (3) under Mobile workstation definition. (Please refer to proposed changes to the regulatory language in section 6)

- **Workstation definition:** Industry appreciated the opportunity to with CEC and stakeholders to make substantive changes to workstation definition in ENERGY STAR Computers v6.1 specification. Industry is recommending a minor change to correct bandwidth unit of measure from 'Gigabytes/sec' to 'Giga transfers/sec' under workstation definition (3)(B). Please refer to proposed changes to the regulatory language in section 6 of this document.

- **Primary storage** (also addressed in CEC staff report page 46):

  Defining the largest drive as the Primary storage is not technically appropriate. The industry strongly requests CEC to take a second look at this issue and consider the industry feedback below:

  There are many times when the system designer and users will decide to install the key system files that are required for the primary operation of the system on a smaller drive and not the largest drive in the system. A quick search on the internet reveals several technical advisory articles that advise users to install their operating systems and related boot files on the faster drives (like SSDs) or smaller partitions and the data files are on the larger drive/ partition. This way of setting up a system gives certain advantages to the user. These include significantly speeding up the system and making it more responsive, without losing storage space; Protection – if the operating system is on a different installation and gets corrupt it won't damage data files.

  Removing the drive with the OS will make the system non-functional hence we need to define this drive as the primary one whereas removing the data drive (usually the larger one) will not cause such a problem. The issue is not about finding a loop hole in the system but strictly about user responsiveness/ experience criteria.

  Additionally, identifying the drive with the OS installed is a quick and easy check instead of looking at the capacity of each and every drive in the system and figuring out the largest one (2 drives might be ok but the time increases with increasing number of drives in the system) thus saving valuable time and resources for the system integrators.

  Industry recommendation: Industry proposes to define primary storage to be the one with OS installed (please refer to proposed changes to the regulatory language in section 6 in this document).

- **Test Methods for Specific Appliance (1604)**

  - **ENERGY STAR Equation 1 applicability:** Express terms incorrectly states in section 1604(v)(5)(B), "The total energy consumption of a computer shall be calculated using Equation 1 in Section 3 ENERGY STAR Program Requirements for Computers Eligibility Criteria Version 6.1 (Rev. March-2016)" The equation being referred to here[1], is applicable only for *TEC Calculations (E_{TEC}) for Desktop, Integrated Desktop, Thin Client and Notebook Computers*. It is not intended for other form factors like workstations, small-scale servers, mobile workstation and high expandability computer. There are several issues here:

    - There are separate ENERGY STAR TEC equations for small-scale servers, and workstations, while no TEC equations exist for mobile gaming systems, mobile workstations and high expandability computers.
    - CEC made changes to ENERGY STAR workstation definition in alignment with the industry and other stakeholders. US EPA has not established if there should be any changes to workstation TEC equation should EPA agree to adopt the new definition.
    - CEC modified ErP Lot 3 definition for mobile workstation and established new definitions for mobile gaming systems and high expandability computers. While mobile gaming system is to comply with integrated desktop criteria, mobile workstation and high expandability computer are not part of ENERGY STAR and hence there is no direct applicability to above referenced TEC equation, since these system usage profiles may be different from mainstream notebooks and desktops systems.
    - CEC is requiring power modes and TEC data gathering (Table X) for all computers in scope, whether or not there is conformity assessment requirement. As such the Equation 1 referenced above does not apply.

    Industry recommendation:

    - Industry proposes that data should only be collected when there is an actual compliance requirement. This will reduce unnecessary data collection burden. Further with this approach there will be minimal changes needed to section 1604 (v)(5)(B) (Please refer to proposed changes to the regulatory language in section 6 in this document).

    - Should CEC decide to collect modal power and TEC data for all computers, CEC will need to make reference to the correct TEC equations in ENERGY STAR sections 3.7 – 3.9, with additional guidance for form factors and equations not defined in the ENERGY STAR program.

- **Mode weightings (full capability vs. remote)**:
  - 1604 (v)(5)(B) allows for Conventional and Full Capability Duty Cycles

[1] ENERGY STAR Program Requirements – Product Specification for Computers (Eligibility Criteria Version 6.1)

- Industry has confirmed that not all OS and hardware suppliers support the Full Capability requirements.
  - Three major non-proprietary operating system manufacturers do not support Full Capability
  - Two of three of the major network interface chip manufacturers do not support Full Capability
- Industry believes OS and hardware suppliers do support the "remote wake" capability
- Industry recommendation: Allow use of "remote wake" mode weightings in place of "Full capability mode weightings". The proposed change would insure all computer manufacturers would have the option of choosing between either Conventional or Remote Wake mode weightings (please refer to proposed changes to the regulatory language in section 6 of this document)

- **Expandability score table**: Industry proposes to amend the expandability score Table V-1 to remove overlapping criteria and add new criteria for USB ports that can provide between 15 and up to 29 watts of power. (please refer to proposed changes to the regulatory language in section 6 of this document)

- **Expandability score table (NRDC Comments):** Please refer to Docket - Presentation - **NRDC**'s Comments on CEC's Proposed Computer Energy Efficiency Standards by Pierre Delforge - TN # 213957, specifically slide #4 USB standards, would like to call attention to the referenced ITI - Computer, Computer Monitors, and Electronic Displays by Chris Hankin, Information Technology Industry Council Comments: June Deep Dive Meeting, ITI/TechNet Computers Presentation -- Dell Corp – TN# 205339, specifically slide #9. Information related to PSU sizing referenced in NRDC presentation is out of context. The information provided was specifically related to manufacturer design requirements for determining the size of the power supply and does not take into account data provided by industry was in DC and associated losses when measuring AC total power required and correlation to the associated expandability score adders. The following information provides details on the associated power needs and losses that are needed by each USB port:

					Modal Weightings	Off 0.45	Sleep 0.05	Long Idle 0.15	Short Idle 0.35	
Item	**PSU Eff**	**DC Power (W)**	**DC/DC Eff**	**DC/DC Conversion losses (.94%EFF) (W)**	**AC Power (W)**	**Off (kWr)**	**Sleep (kWhr)**	**Long Idle (kWhr)**	**Short Idle (kWhr)**	**TEC (kWhr)**
USB Port 2.0 connectors	0.85	2.5	0.97	0.075	3.03	0	0	3.98	9.29	13.27
USB 3.x	0.85	4.5	0.98	0.09	5.40	0	0	7.10	16.56	23.65

In Docketed - Appliance Efficiency Rulemaking for Computers, Computer Monitors, and Signage Displays TN 213550 – pages 11-12, the adders provided via the Expandability Score for USB 2.0 & USB 3.x are as follows:

Table V-1

Interface Types and Scores for Expandability Score Calculation

Interface Type	Interface Score
USB 2.0 or less	5
USB 3.0 or 3.1 Gen 1	10

Comparing total AC power requirements to the Expandability Score does not provide

1. Unwarranted boost to the expandability score, nor
2. Unwarranted allowance for higher categories

In fact the expandability score adders under estimates the total power requirements needed to support USB ports of the covered computers.

Industry Recommendation: Industry is of the view that expandability score is a settled issue after months of engagement with the stakeholders and reaching a compromise. In fact the whole power savings model is built on the scores currently laid out, and further rehashing it will unravel months of work. There will be cases where industry may be disadvantaged, i.e. get lower score than what the power consumption could end up being (For Ex: USB PD between 60-99W gives us only 60 points). Industry recommends CEC leave the USB Expandability score adders as currently defined.

- **NRDC** presentation slide #5 states **High-expandability exemption** related to HBM (high-bandwidth memory) for discrete graphics cards as a potential loophole for models not achieving a high expandability score of greater than 690 points. The statement that 400GBs will be at mainstream, is unfounded. If mainstream as defined by NRDC is interpreted as highest volume sales, discrete graphics offered in the 2019 timeframe will probably start about 128GB/s in 2019 (4x GDDR5 8gbps).

- Further the comments that "High-bandwidth cards don't need an exemption, graphics adders are sufficient" are not supported by future market trends or data. The one energy data point that was cited to support this proposal does not align with the CEC testing methodology. NRDC computer presentation slide #6 identified the Radeon AMD R9 Fury X Reference drawing 5W at idle.This result will not be achieved using the test and duty cycle requirements in the CA. regulation. One possible explanation for the result is that testing was performed without a display or with the display turned off. Testing of this chip has found ~20W in a short idle test running Windows 7 and using a 1920x1080 monitor. Weighted idle power is above the Tier 1 adder for discrete graphics, when measured according to the test requirements of the CA. regulation

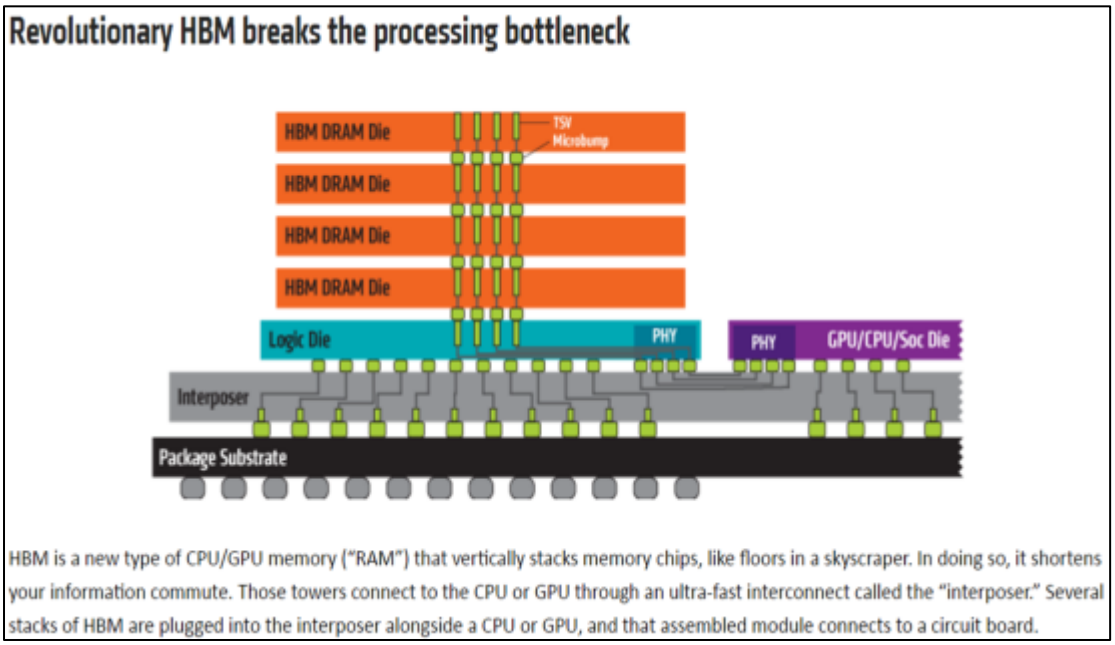
- **NRDC** computer presentation slide #5 states specifying a 600W power supply along with the Frame Buffer Bandwidth of the graphic card "would encourage power supply upsizing, increasing energy use".. The added costs to upsizing a power supply is not in the best interest of the industry or our customers. Also note that upsizing a power

supply also affects the efficiencies it will operate at. The lighter the loading the worst the efficiency will be, which affects the graphic cards and the whole system. The below information provided in earlier ITI/TechNet comments shows again the cost of going to different levels of certification, but it also shows the cost delta between a 300 and 460Watt power supply.

Efficiency Baseline APFC 68% Efficient	300 Watts OEM Cost/Consumer Cost	460 Watts OEM Cost/Consumer Cost	270 Watts OEM Cost/Consumer Cost
80+ Bronze	$2.35/$3.80	$3.65/$5.95	$2.55/$4.15
80+ Silver	$5.00/$8.15	$7.10/$11.55	$4.85/$7.90
80+ Gold	$9.15/14.90	$13.65/$22.20	$8.60/$14.00
80+ Platinum	Not available in multi output format	Not available in multi output format	Not available in multi output format

- The intent of the discrete graphics high expandability exemption is to exempt from TEC reporting a limited set of future desktop systems using very high end GPUs which present idle power design risks by using newer process nodes and newer features. Linking very high-end GPUs with a high-end power supply ensures the exemption is only for high-end systems. Exempting such systems will be the key for California to maintain its rate of innovations and to avoid a situation where California and its businesses become disadvantaged competitively should these systems be excluded from the California market. The frame buffer bandwidth limits found in the current CEC regulation Express Terms document represent and will continue to represent high-end 384-bit or higher GDDRx based graphics subsystems as well as HBM based solutions. The complexity of the HBM memory technology makes it difficult to build (3-dimensional, DRAM stacks, use silicon interposer, etc.) and its additional costs compared to other memory technologies will limit the HBM usage to the higher end of the spectrum. If the market and technology changes in regards to both cost and idle power consumption, these issues can be revisited.

An example of the complexity of the HBM structure[2] is shown below.



- Additionally, the assertion to drop adders for Tier II and change Tier I to with much higher threshold of 1,000 GB/s is unfounded. Industry provided CEC with proposed definitions for Gaming Systems that was not adopted for this rule making. Instead an Expandability Score approach was put forward by CEC and Industry agreed to this alternative approach to classify models that require additional power allowances. CEC has proposed power savings by mandating power management enablement, energy efficient Ethernet, and 80 PLUS Gold level energy efficient internal power supplies. The current proposed measures will provide significant benefits to Californians and do not require further modifications.

- NRDC presentation slide #7 – Computers: **256-bit memory interface**: Provide extra-expandability points to system memory only, not chip-integrated memory. Industry is of the view that It is unlikely HBM memory requirements will be mainstream in desktops.

Provision for aging of OS installation: Industry recommends to amend 1604 (G) to add the following sentence at the end of current provision, to allow 24 hour OS stabilization prior to start of power testing.
For purposes of providing data as required in Section 1606, desktop computers, thin clients, mobile gaming systems, notebook computers, and portable all-in-ones shall be tested by selecting the configuration that has the greatest allowable energy consumption as provided for in Section 1605.3(v)(5). If multiple configurations exist that meet this criteria, select the configuration that will yield the greatest annual energy consumption as

[2] Source: AMD

measured by the test procedure. *'Prior to testing, a covered computer is allowed to connect to the internet and have at least 24 hours to run software and driver updates with sleep disabled to allow for proper "aging" and OS stabilization'.*

Sleep Mode Measurement: Industry recommends that 1604 (5) (H) allow an alternate test method for long-idle and sleep-mode for computers that use alternate to ACPI S3 sleep mode.

Rationale: Computers that use alternate to ACPI S3 sleep typically remain in ACPI S0. However, the operating system reduces power to system components with control of each component separately. This reduces the overall power consumption of the system to levels similar to ACPI S3 sleep while allowing the system to have brief periods of activity to update applications and to respond to incoming Skype calls or IM requests. Systems with these alternate low-power modes are able to return to normal operation instantaneously. This allows the computer to have a behavior similar to long-idle while having power consumption similar to S3 sleep. This typically allows the computer manufacturer to set the default time-out for sleep to 10 or 15 minutes without an impact to the user's productivity.

The use of an alternative to ACPI S3 sleep mode poses another complication. As noted, the system can have brief periods of activity to update applications. These periods of activity only last a few seconds and may occur over varying periods depending on the configuration of the installed applications. Measuring the average power over 5 minutes can give varying results depending on whether one of these periods of activity occurs during that 5-minute period. This can lead to inconsistent measurements. Measuring the average power over 30 minutes will give more repeatable and accurate measurements of the power consumed in the alternate to ACPI S3 sleep mode. A shorter time period may be used if specified by the manufacturer.

Industry recommend amending 1604 (5) (H) with the following.

The sleep mode power measurement shall be tested in a modified manner from the test procedure described in IEC 62623:2012:

- <u>if the Unit Under Test (UUT) uses ACPI S3 sleep mode accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{sleep};</u>
- <u>if the UUT uses an alternative to ACPI S3 sleep mode, (e.g., low power long Idle, Modern Standby, etc.), then accumulate power values for 30 min and record the average (arithmetic mean) value observed during that 30 min period as P_{sleep}. A time period shorter than 30 min may be used if specified by the manufacturer. Such systems shall enter the alternative to ACPI S3 sleep mode directly from short idle without a period of long idle. The measured value shall be used for both sleep and long idle in the TEC calculations.</u>

This alternate test method will give a more accurate reading for the power consumed without changing the total time required for the test.

Power Factor- In Docketed - Appliance Efficiency Rulemaking for Computers, Computer Monitors, and Signage Displays TN 213550, page 13 in relation to Internal Power Supplies for computers: (l) The power factor of a computer and compliance with Table V-9 in Section 1605.3(v)(6) shall both be determined by the following test procedure: *Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies Revision 6.7 (March 1, 2014)*. In addition the median power factor during long-idle measurements shall be recorded in the test report.

Median power factor measurement during long-idle mode for Desktops and Integrated Desktops that utilize an internal power supply is not part of the Generalized Test Protocol. Power Supplies are tested as standalone equipment not attached/connected to the computer during testing of efficiency and/or power factor. Industry does not support median power factor testing and reporting as long-idle mode measurements are configuration dependent.

The requirements for measuring Power Factor for Small-scale Servers, High expandability Computers, and Workstations require 0.9 when measured at 50% load as well as 0.9 Power Factor at Full or 100% load. These covered categories are not subject to modal and/or TEC limits thus are not subject to testing for Long Idle mode nor testing and reporting power factor during Long Idle mode.

Collecting Power Factor data for both desktop computers and integrated desktops during Long Idle will not provide a foundation for future regulations. These computers will require new designs and behaviors to support lower power Long Idle mode to achieve the aggressive power reduction targets. As stated above in relation to Alternative sleep mode (non-ACPI-S3), computers implementing similar solutions will greatly reduce the loading on the internal power supply and more closely resemble loading similar to ACPI-S3 during Long Idle mode. Collecting power factor during long idle mode will vary greatly depending on the manufacturer's solution. In fact, the mode weightings (time spent in mode expressed as a percentage) for Long Idle is only 15% annually of the total 8760 hours. Industry strongly recommends CEC abandon the requirement for measuring and reporting power factor during Long Idle mode. If CEC deems it necessary to collect power factor data that is not covered by existing test procedures, industry recommends CEC identify a fixed loading point (% of the maximum output) of the covered internal power supply so that information collected is comparable, repeatable, and relevant.

Industry recommend amending 1604 (5) (l) with the following:

(l) The power factor and efficiency of products covered in Table V-9 in Section 1605.3(v)(6) shall both be determined by the following test procedure: *Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies Revision 6.7 (March 1, 2014)*.

- **State Standards for non-Federally regulated appliances(1605.3)**

Treatment of thin client without ACPI S3 or alternative sleep mode. There is an issue that was not addressed before. It has to do with the sale of 'Zero Thin Clients' class of products in California that do not support system sleep mode. Industry has observed in the ENERGY STAR Computers QPL data, that Zero thin clients[3] (that do not have an operating system local to the device) also do not support system sleep mode. While the thin clients with alternative to ACPI S3 sleep mode are addressed as part of Table V-6, the system without the OS are not addressed in the draft language.

- We would recommend thin client systems without an OS or a hard drive present, be exempt from system sleep mode (i.e. not required to comply with 1605.3(v)(5)(B) under power management section).
- For Thin Clients without ACPI S3 sleep mode or alternative to ACPI S3 sleep mode, power in long idle shall be used in place of power in sleep mode in the TEC equation. No sleep mode power limit is required for these thin clients. (Please refer to proposed changes to the regulatory language in section 6 of this document)

Alternative sleep mode power limits (memory scalar)

Industry reviewed the *Alternative Sleep Mode Power Limits* 1605.3 (V)(5) (Table V-6) in Express Terms and determined the memory capacity scaling factor of 0.03 or 30 mW/GB memory capacity is not adequate. Industry looked through memory supplier datasheets for DDR4 IDD power values (See table A below). Industry believes 45mW/GB is a more realistic approach over CEC's proposal of 30 mW/GB of memory capacity. Not knowing where DDR5 power will land in the future – at this point it is safe to assume it's no better than DDR4. We also looked at the spec sheet from Hynix as well and the numbers are in line to what is shown below.

Industry Recommendation: Change scaling factor in Table V-6 from 0.03 to 0.045 for all computer types (3 line items) consistent with the analysis below. (Please refer to proposed changes to the regulatory language in section 6 of this document)

DC Power:
16 GB Hynix Normal temp: 0.672 W (DC)

32 GB Hynix Normal temp: 1.327 W (DC)

[3] Example of Zero client "OS's"

1. Citrix ICA, Microsoft RDP, VMWare Horizon and a Firefox web browser, and

2. PCoIP that is not an OS but is firmware installed in the system that brings up a login box to connect the Zero Client to a server.

1.327 W - 0.672 W = 0.7W/16GB = 43.75 mW/GB (DC)

Assuming AC/DC conversion is 80% = 54.7mW/GB (this is even higher than what is below)

Table A

	AC Watts/GB (80% AC-> DC efficiency)			Comments
DDR Capacity (GB)	**Vendor A**	**Vendor A**	**Vendor B**	
8	0.048	0.048	0.039	
16	0.042	**0.045**	0.043	NB Scalar (> 8GB)
32	0.04	0.043	0.04	
64	0.039	0.039	0.04	DT/AIO Scalar (> 32 GB)

- **System memory bandwidth requirements (Table V-8):**

  Industry had proposed to amend 'Majority of system memory capacity….' in Table V-8 (3) to include a lower bandwidth bound of 17GB/s to ensure that the majority of system memory has sufficient bandwidth to drive the display. (Please refer to proposed changes to the regulatory language in section 6 of this document).

- ## Filing by Manufacturers (1606 – Table X)

  - Industry strongly suggests CEC require Model Name & Model Number be mandatory reporting requirements for covered computers and displays. Model Name & Model Number are needed to differentiate between covered computers and displays.
  - CEC currently requires this information for covered Battery Chargers. This information is crucial in properly identifying specific covered products. Below is an example of a covered Small Battery Charger: http://www.appliances.energy.ca.gov/QuickSearch.aspx

Column1	Manufacturer Name	Brand Name	Model Number	Consumer Product Model	Product Type	Battery Chemistry
24647	Dell, Inc.	DELL	Dell Latitude 12 Rugged Extreme	P18T	Notebook Computer	Lithium Ion

  - CEC must include Internal Power Supplies "size" similar to information reported for models using External Power Supplies: AC Adapter Size (watts) (notebook computers only) so that models meeting High Expandability Score by either

    - A power supply of 600 watts or greater and a discrete graphics with a frame buffer bandwidth of 400 gigabytes per second (GB/s) or greater or integrated graphics with a system memory bandwidth of ≥ 434 GB/s; and/or

- A power supply of 600 watts or greater and a discrete graphics with frame buffer bandwidth of 600 gigabytes per second (GB/s) or greater or integrated graphics with a system memory bandwidth of ≥ 634 GB/s can be properly ascertained.

- **Schedule alignment:**

  - **Enhanced performance (EP) display dates**: EP Tier 1 and Tier 2 requirements are aligned with computer monitor effective dates (Table V-8). However, the same EP requirements apply to integrated desktop computers that have different effective dates. This date misalignment is confusing and unworkable for computers.
    EP Industry Proposal: Modify Table V-8 to align EP requirements dates with computers effective dates respectively (Tier 1: Jan 1, 2019, and Tier 2: July 1, 2021). Please refer to proposed changes to the regulatory language in section 6 of this document.

  - **High expandability computer (dGfx dates alignment)**: Already addressed above under definition

Staff Report Final Analysis:

- **Cost Effectiveness (Table 7, Page 44)**
  - Industry is of the position that the component cost estimates are significantly underestimated. Industry had already provided its component cost estimates based on 3rd party quotes, in earlier submissions to California Energy Commission.

- **Add-in cards (Page 47):** The add-in card allowance is incorrectly stated in watts instead of kWh, while the separation should also be in kWh. The transmission rate should be gigabits/sec (Gb/s) and not Gigabytes/sec (GB/s). These corrections are necessary for consistency**.**

4 SUMMARY OF KEY DISPLAYS ISSUES :

- **State Standards for non-Federally regulated appliances(1605.3)**
  - **Treatment of display adders - 1605.3 (E)**
    'Manufacturers shall apply no more than one applicable adder from Table V-5 to determine the maximum on-mode wattage.'

    Industry Concerns:
    - During all of the Industry's presentations and feedback, for Monitors and Computers alike, we have emphasized that in cases an allowance is needed, such an allowance be additive to any other additional power needs.
    - The concept of the adders for allowances was a compromise to the original request by the industry to have the product "out of scope" instead.
    - On the Computers Regulation, it is understood and accepted by CEC that Industry will get capability based adders for attributes like system memory, discrete GPU, additional storage, add-in cards, etc.
    - The same situation exists for Monitors, where the individual allowances should be additive, if a product incorporates more than one of the capabilities for which an adder has been identified (not accounted for in the base "ON" mode limit)
    - For reference, other Monitor related regulations like ENERGY STAR[4] also incorporate the concept of adding allowances to the "ON Power" as capability is added to the baseline monitor definition.

3.3.3 For all Monitors, Calculated TEC (ETEC) in kWh shall be less than or equal the calculation of Maximum TEC (ETEC_MAX) with the applicable allowances and adjustments (applied at most once) per Equation 2.

Equation 2: Total Energy Consumption Requirement for Monitors

$$E_{TEC} \leq (E_{TEC\_MAX} + E_{EP} + E_{ABC} + E_N + E_{OS} + E_T) \times eff_{AC\_DC}$$

Where:

– *ETEC is TEC in kWh calculated per Equation 1;*
– *ETEC_MAX is the Maximum TEC requirement in kWh calculated per Table 1;*
– *EEP is the enhanced performance display allowance in kWh per Section 3.3.4;*
– *EABC is the Automatic Brightness Control allowance in kWh per Equation 4;*
– *EN is the Full Network Connectivity allowance in kWh per Table 3;*
– *EOS is the Occupancy Sensor allowance in kWh per Table 4;*

[4] ENERGY STAR® Program Requirements Product Specification for Display, Eligibility Criteria Version 7.0 Rev. May-2016

– *ET is the Touch Technology allowance in kWh per Equation 5; and eff AC_DC is the standard adjustment for ac-dc power conversion losses that occur at the device powering the Display, and is 1.0 for Ac-powered Displays and 0.85 for Displays with Standard dc.*

Industry proposed amendments to regulatory language and Table V-4 and V-5 are attached to Appendix A of this document. To resolve the identified issue, an additional "Category" column has been added to explicitly indicate which adders can be applied only once.

- **Industry comments on Testing, Certification & Marking Requirements for non-regulated products:**

  Section 1605.**3 (v) (4) (F) requires that certain products not required to comply with the performance requirements in 1605.3 (v) (4) be subject to comply with the test procedures in section 1604 (v)(4), the certification requirements in section 1606, and the marking requirements in section 1607.**

  - During the webinar on October 10th, 2016, the commission indicated this requirement was placed to gather and collect data about market penetration of these devices. While industry understands the need to collect data, the proposal as it stands represents a huge burden to manufacturers of products that may not increase the market penetration at a considerable rate and therefore represent an insignificant impact to the grid.

  - Medical monitors that are classified for use as medical devices by the United States Food and Drug Administration represent a small fraction of a percent of all monitors on the market today based on data from Display Search and sales data provided by a manufacturer. These products are sold through special medical sales channels for the medical industry at prices starting in the thousands of dollars. Due to the specific applications of these products in Radiology, Mammography, and Surgical operations these devices are subject more rigorous and precise calibrations to DICOM gray scale standard display function (GSDF) for matched performance with endoscopic cameras. Performance in the gray scale as compared to performance in the color spectrum is of vital importance for detection and display of pathological disorders. Any proposed reduction in power consumption in the on-mode for these devices would require a reduction in display luminance. Reductions in luminance impact performance in the gray scale rendering these devices incapable. Industry believes these ***professional*** devices may never be candidates for energy efficiency regulations.

  - KVM/KMM monitors are not marketed as consumer products but are intended for use in data centers. KVM/KMM does not include a stand mechanism to use on a desk surface or in an office environment. To access and activate the KVM/KMM, an individual must have security access to the data center. The server rack must be opened, and the tray extended for the KVM/KMM to exit sleep mode.

  - Although KVM/KMM monitors are available for purchase by consumers, costs range from $800 to $6,000. They are targeted for use in data centers to allow a single console to manage multiple servers. KVM/KMM save power by reducing the number of keyboards, monitors, and mice needed to administer servers and save time by allowing access to multiple servers from a single console.

- As an alternative to testing, certification, and marking requirements; industry proposes continued dialogue with the commission to provide product sales on yearly basis. We request these dialogs start in the near future and outside this rulemaking. Once industry and the commission define a formal process, the data collection process will be carried out. The sales data will assist the commission achieve its intended goal to monitor market penetration while removing the unnecessary burden to manufacturers.

- To ensure this proposal by industry is applied in other sections of this document, industry also asks the commission to revise Table X and remove KVMs, KMMs, and Very High Performance from the list of permissible answer.

5 FUTURE TECHNOLOGIES PETITIONS

During the last year of discussions with the CEC and other stakeholders, we have often speculated on how to best "future-proof" the standards. For industry, this has in particular involved the desire to make sure that as yet unknown future technologies – for instance, not yet invented but needed cyber-security protections -- are not unintentionally hampered or prevented from entering the California marketplace.

In the "Future Technologies" section (page 49) of the Final Staff Analysis, the CEC staff have offered the observation that for such technologies – ones "that did not exist at the time of the adoption hearing for the regulation" – any person may petition the Commission "to request a rulemaking hearing under Section 1221 of Title 20 to consider adding an interface score (for calculating expandability) or functionality adder." The Staff Report also helpfully notes that the Commission has a process to handle trade secrets or confidential business information that could be used in conjunction with such petitions.

As industry stated at the October 10th Public Meeting, we strongly support this intended use of the Section 1221 petition process for future technologies, except in one important aspect. The Staff Analysis seems to contemplate business as usual, but the existing petition process could dampen, stall or even inhibit future innovation from occurring in California. Our discussions have emphasized the importance of expeditious consideration for these future technologies all the while allowing these technologies to continue to advance and be available for California consumers, business and government entities.

ITI/TechNet Request: Industry requests that the CEC Executive Director take steps to ensure expedition, committing to a process of no more than 6 months for future technologies petitions.

ITI/TechNet Request.

Industry requests that the CEC Executive Director take steps to ensure expedition, committing to a process of no more than 6 months for future technologies petitions.

6 INDUSTRY RECOMMENDATION ON REGULATORY LANGUAGE

COMPUTERS

Description	Page	Current Language	Proposed Language
1602 Definitions	3	"Add-in card" means a removable device that can be installed in a computer PCI or other slot. Add-in card does not include hard-disks, system memory, or removable devices that are intended to operate outside of a computer chassis. It also does not include cards that split, physically extend, or convert a slot type .	"Add-in card" means a removable device that can be installed in a computer PCI or other slot. Add-in card does not include hard-disks, system memory, riser cards or removable devices that are intended to operate outside of a computer chassis. ~~It also does not include cards that split, physically extend, or convert a slot type .~~

Description	Page	Current Language	Proposed Language
1602 Definitions	4	"High expandability computer" means a computer with any of the following: (1) An expandability score of more than 690; (2) If the computer is manufactured before January 1, 2020, a power supply of 600 watts or greater and a discrete graphics with a frame buffer bandwidth of 400 gigabytes per second (GB/s) or greater; or (3) If the computer is manufactured on or after January 1, 2020, a power supply of 600 watts or greater and a discrete graphics with frame buffer bandwidth of 600 gigabytes per second (GB/s) or greater.	"High expandability computer" means a computer with any of the following: (1) An expandability score of more than 690; or (2) ~~If the computer is manufactured before January 1, 2020, a~~ A power supply of 600 watts or greater and a discrete graphics with a frame buffer bandwidth of 400 gigabytes per second (GB/s) or greater starting January 1, 2018; or (3) A power supply of 600W or greater and a system memory bandwidth of ≥ 434 GB/s starting January 1, 2018; or (4) ~~If the computer is manufactured on or after January 1, 2020, a~~ A power supply of 600 watts or greater and a discrete graphics with frame buffer bandwidth of 600 gigabytes per second (GB/s) or greater, starting July 1, 2021; or (5) A power supply of 600W or greater and a system memory bandwidth of ≥ 634 GB/s starting July 1, 2021
	5	"Mobile workstation "……. (3) Has at least one integrated or discrete graphic processing unit with frame buffer bandwidth of 134 gigabytes per second or greater ;	"Mobile workstation "……. (3) Has at least one integrated GPU meeting the minimum system memory bandwidth of ≥ 134 GB/sec or discrete GPU(s) providing a frame buffer bandwidth ≥ 96 GB/sec per GPU. ~~Has at least one integrated or discrete graphic processing unit with frame buffer bandwidth of 134 gigabytes per second or greater~~ ;

Description	Page	Current Language	Proposed Language
1602 Definitions	6	"Primary storage" means the largest capacity non-volatile storage device present in the system	"Primary storage" means the ~~largest capacity~~ non-volatile storage device with the operating system installed ~~present~~ in the system
1602 Definitions	8	"Workstation" means…….. (3)…… B) Supports 4 or more lanes of PCI-express, other than discrete graphics, connected to accessory expansion slots or ports where each lane has a bandwidth of 8 gigabytes per second (GB/s) or more.	"Workstation" means…….. (3)…… B) Supports 4 or more lanes of PCI-express, other than discrete graphics, connected to accessory expansion slots or ports where each lane has a bandwidth of ~~8 gigabytes per second (GB/s)~~ 8 giga transfers per second (GT/s)or more.
1604 Test Methods for specific appliances (computers)	11	1604(v)(5)(B) The total energy consumption of a computer shall be calculated using Equation 1 in Section 3 ENERGY STAR Program Requirements for Computers Eligibility Criteria Version 6.1 (Rev. March-2016)	1604(v)(5)(B) The total energy consumption of a computer shall be calculated using appropriate equations in sections 3.7-3.9 of ~~Equation 1 in Section 3~~ ENERGY STAR Program Requirements for Computers Eligibility Criteria Version 6.1 (Rev. March-2016) *Note: Per earlier industry explanation, CEC will need to provide additional guidance for form factors and equations not defined in the ENERGY STAR program.*

Description	Page	Current Language	Proposed Language
1604 Test Methods for specific appliances (computers)	11	1604(v)(50(B) 1. '…. unless they meet the criteria to use "full capability" mode weightings, below.' 2. In order to use the "full capability" mode weighting a computer shall have the following features enabled as shipped: i. Maintain Ethernet (IEEE 802.3-2015) or wireless (IEEE 802.11-2012) network addresses and network connection capability while in ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep mode; ii. Resume from ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep mode upon request from outside the local network; and iii. Support advertising host services and network name while in ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep mode.	1604(v)(50(B) 1. '…. unless they meet the criteria to use ~~"full capability"~~ "remote wake" mode weightings, below.' 2. In order to use the ~~"full capability"~~ "remote wake" mode weighting a computer shall have the following features enabled as shipped: ii. Maintain Ethernet (IEEE 802.3-2015) or wireless (IEEE 802.11-2012) network addresses and network connection capability while in ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep mode ; and iii. ~~Resume from ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep mode upon request from outside the local network;~~ While in ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep, the system is capable of remotely waking upon request from outside the local network. ~~and~~ ~~iv. Support advertising host services and network name while in ACPI System Level S3 Sleep Mode or an alternative to ACPI S3 sleep mode.~~
1604 Test Methods for specific appliances (computers)	11	Table V-1 (Interface Type and Scores for Expandability Scores Calculations)	Please Refer to Industry proposed amendments in Appendix A of this document

Description	Page	Current Language	Proposed Language
1604 Test Methods for specific appliances (computers)	13	1604(G) For purposes of providing data as required in Section 1606, desktop computers, thin clients, mobile gaming systems, notebook computers, and portable all-in-ones shall be tested by selecting the configuration that has the greatest allowable energy consumption as provided for in Section 1605.3(v)(5). If multiple configurations exist that meet this criteria, select the configuration that will yield the greatest annual energy consumption as measured by the test procedure.	1604(G) For purposes of providing data as required in Section 1606, desktop computers, thin clients, mobile gaming systems, notebook computers, and portable all-in-ones shall be tested by selecting the configuration that has the greatest allowable energy consumption as provided for in Section 1605.3(v)(5). If multiple configurations exist that meet this criteria, select the configuration that will yield the greatest annual energy consumption as measured by the test procedure. Prior to testing, a covered computer is allowed to connect to the internet and have at least 24 hours to run software and driver updates with sleep disabled to allow for proper "aging" and OS stabilization.
1604 Test Methods for specific appliances (computers)	13	1604(H) The sleep mode power measurement shall be tested in a modified manner from the test procedure described in IEC 62623: 2012. Instead of measuring power after manually entering sleep mode, the power measurement shall begin no sooner than 30 minutes and no later than 31 minutes of user inactivity on the unit under test. This measurement shall follow the long-idle test without altering the unit under test.	1604(H) The sleep mode power measurement shall be tested in a modified manner from the test procedure described in IEC 62623:2012: - if the Unit Under Test (UUT) uses ACPI S3 sleep mode accumulate power values for 5 min and record the average (arithmetic mean) value observed during that 5 min period as P_{sleep}; - if the UUT uses an alternative to ACPI S3 sleep mode, (e.g., low power long Idle, Modern Standby, etc.), then accumulate power values for 30 min and record the average (arithmetic mean) value observed during that 30 min period as P_{sleep}. A time period shorter than 30 min may be used if specified by the manufacturer. Such systems shall enter the alternative to ACPI S3 sleep mode directly from short idle without a period of long idle. - The measured value shall be used or both sleep and long idle in the TEC calculations.

Description	Page	Current Language	Proposed Language
1604 Test Methods for specific appliances (computers)	13	1604(l) The power factor of a computer and compliance with Table V-9 in Section 1605.3(v)(6) shall both be determined by the following test procedure: *Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies* Revision 6.7 (March 1, 2014). In addition the median power factor during long-idle measurements shall be recorded in the test report.	1604(l) (l) The power factor and efficiency of products covered in Table V-9 in Section 1605.3(v)(6) shall both be determined by the following test procedure: *Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies Revision 6.7 (March 1, 2014)*. ~~In addition the median power factor during long-idle measurements shall be recorded in the test report.~~
1605.3 State Standards for Non-Federally Regulated Appliances	19	1605.3 (v)(5)(C) If the model is shipped at the purchaser's request with either a limited capability operating system or without an operating system , the model is not required to comply with Section 1605.3(v)(5)(B).	*Note:1605.3 (v)(5)(C) does not include Thin Clients exemption from 1605.3 (v)(5)(B), for systems with a limited capability operating system or internal storage. Industry proposes the following addition to 1605.3 (v)(5)(C) to help clarify the Total Energy Consumption (TEC) procedure and avoid confusion* If the model is shipped at the purchaser's request with either a limited capability operating system or without an operating system or without internal storage, the model is not required to comply with Section 1605.3(v)(5)(B). Further the model may substitute the power in long idle mode with power in sleep mode in Typical Energy Consumption (TEC) equation, when calculating TEC.

Description	Page	Current Language	Proposed Language
1605.3 State Standards for Non-Federally Regulated Appliances	19	Table V-6 (Alternative Sleep Mode Power Limits) Maximum Power Consumption (watts) 10+ 0.03*C…… 5 + 0.03*C …….. 2.5 + 0.03*C…….. ********** 1605.3 (v)(5) (A) Comply with Table V-7; and	Table V-6 (Alternative Sleep Mode Power Limits) Maximum Power Consumption (watts) 10+ ~~0.03~~ 0.045*C…… 5 + ~~0.03~~ 0.045*C …….. 2.5 + ~~0.03~~ 0.045*C…….. ********** 1605.3 (v)(5)(A) did not address Table V-8 (adders) (A) Comply with Table V-7 and Table V-8; and
1605.3 State Standards for Non-Federally Regulated Appliances	21	1605.3 – Table V-8 On or after July 1, 2019; EP=0.3…… On or after January 1, 2021; EP =0.2…….	1605.3 – Table V-8 (modify to align with computers Tier 1 & Tier 2) On or after ~~July 1, 2019~~ January 1, 2019; EP=0.3…… On or after ~~January 1, 2021~~ July 1, 2021; EP =0.2…….
1605.3 State Standards for Non-Federally Regulated Appliances	22	Table V-8 High bandwidth system memory… This adder does not apply …. 3) Majority of system memory capacity (in gigabytes) has bandwidth has a bandwidth less than 134 GB/s…	Table V-8 High bandwidth system memory… This adder does not apply …. 3) Majority of system memory capacity (in gigabytes) has bandwidth greater than 17GB/s but ~~has~~ less than 134 GB/s…..
1605.3 State Standards for Non-Federally Regulated Appliances	23	1605.3 – Table V-9 (Header) Power Supply Requirements for Small-scale Servers, High expandability Computers, Mobile Workstations, and Workstations	1605.3 – Table V-9 (Remove Mobile Workstations from Header) Power Supply Requirements for Small-scale Servers, High expandability Computers, ~~Mobile Workstations~~, and Workstations

Description	Page	Current Language	Proposed Language
1606 Filing by manufacturers : Listing of Appliance in the Database (Computers)	24-26	Table X Data Submittal Requirements	
		Total Battery Capacity (watt-hours) (notebook computers only)	Total rated battery capacity (watt-hours) (notebook computers only)[5]
		Power supply Meets Table V-9 or Level VI	Power supply Meets Table V-9 or Level VI (only required as 'True' for Small-scale servers, high expandability computers, mobile workstations, and workstations. Small-scale servers, high expandability computers, mobile workstations, and workstations)[6]
		Wired Ethernet or Fiber Card with a transmit rate of 10 GB/s or greater	Wired Ethernet or Fiber Card with a transmit rate of 10 Gb/s or greater[7]
		Motherboard model number	~~Motherboard model number~~ (DELETE)[8]
		None	Product model number (ADD)[9]
		None	Product model name (ADD)[10]
		None	Alternative to ACPI S3 sleep mode test method used (Yes/No) (Add)[10]

[5] Reason: Removes ambiguity, unclear if its rated or measured battery capacity

[6] Reason: The power supply efficiency is not a requirement for Desktop Computer, Mobile Gaming System , Thin Client, Notebook Computers and portable all-in-one

[7] Reason: It should be 10 Gigabit per second Ethernet instead of 10 Gigabyte per second Ethernet

[8] Reason: Irrelevant information - does not provide meaningful information; adds additional burden to manufacturers. Motherboard model numbers might vary for the same product family.

[9] Reason: This will be the unique identifier that identifies the product family

[10] Reason: This will be the name that identifies the product family

DISPLAYS

Description	Page	Current Language	Proposed Language
1605.3 State Standards for Non-Federally Regulated Appliances	17-10	Table V-4 Table V-5	Table V-4 (see proposed amendments in Appendix A) Table V-5 (see proposed amendments in Appendix A)
1606 Filing by manufacturers : Listing of Appliance in the Database (computers)	24-26	Table X Computer Monitor, EPD sRGB, EPD Adobe RGB, OLED, Gaming Monitor w/ Incremental Hardware, Gaming Monitor w/o Incremental hardware, "Keyboard, Video, Mouse,""Keyboard, Mouse, Monitor," Very High Performance	Computer Monitor, EPD sRGB, EPD Adobe RGB, OLED, Gaming Monitor w/ Incremental Hardware, Gaming Monitor w/o Incremental hardware, ~~"Keyboard,Video,Mouse,""Keyboard,Mouse,Monitor," Very High Performance~~

[10] Reason: This identifies the alternative test method used for measuring long-idle and sleep-mode power.

APPENDIX A (Supporting Data)

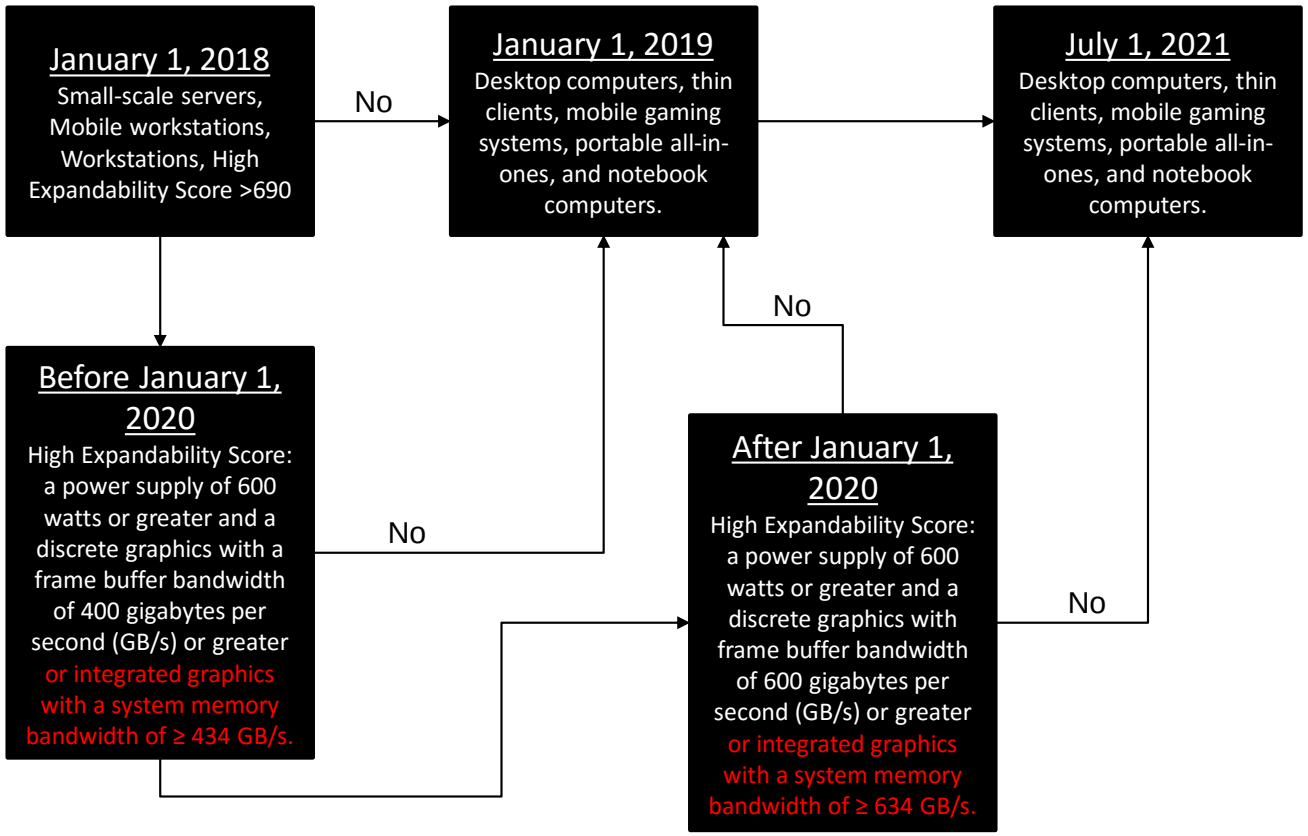
Table V-1 (Proposed Amendments)

Interface Type and Scores for Expandability Scores Calculations

Interface Type	**Interface Score**
USB 2.0 or less	5
USB 3.0 or 3.1 Gen 1	10
USB 3.1 Gen 2	15
USB ports that can provide 100 or more watts of power	100
USB ports that can provide between 60 and up to ~~100~~ 99 watts of power	60
USB ports that can provide between 30 and up to ~~60~~ 59 watts of power	30
USB ports that can provide between 15 and up to 29 watts of power	15
Unconnected USB 2.0 motherboard header	10 per header
Unconnected USB 3.0 or 3.1 Gen 1 motherboard header	20 per header
PCI slot other than PCIe x16 (only count mechanical slots)	25
PCIe x16 or higher (only count mechanical slots)	75
Thunderbolt 2.0 or less	20
Thunderbolt 3.0 or greater	100
M.2 (except key M)	10
IDE, SATA, eSATA	15
M.2 key M, SATA express, U.2	25
Integrated liquid cooling	50
CPU Support for 4-channels of memory or a 256 bit or greater memory interface	100

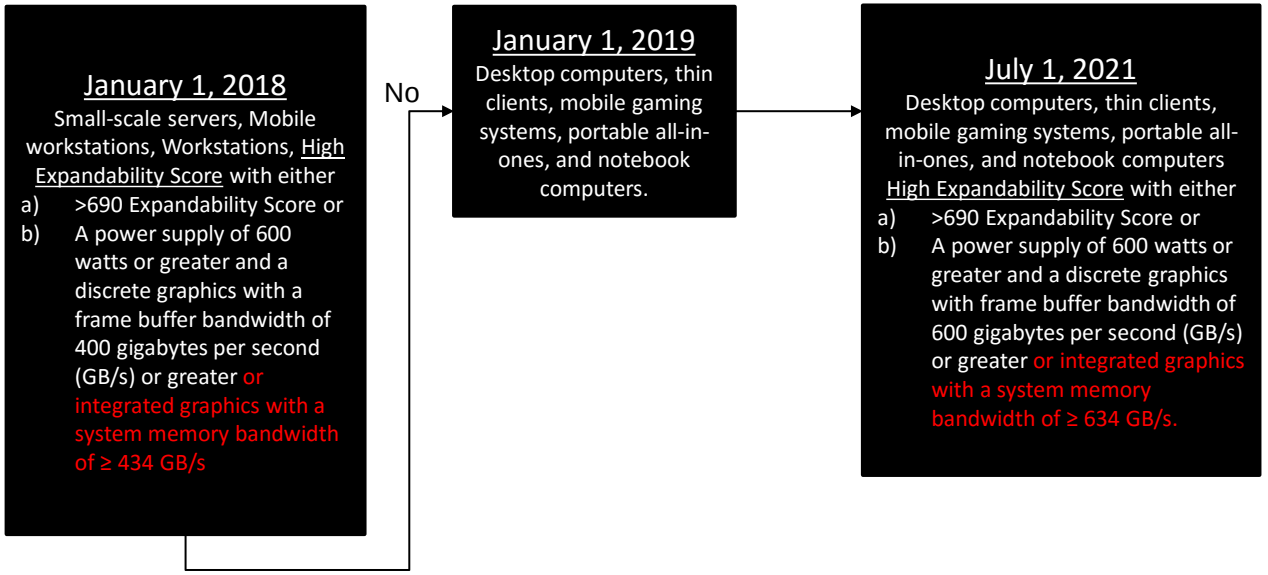
TechNet ITI

Current Effective Dates



TechNet ITI

Industry Proposed Effective Date Alignment



DisplaySearch data for consumer displays

DisplaySearch data (CA is 12% of US)	2016 WW	2019 WW	2016 US	2019 US	2016 CA	% of Total	2019 CA	% of Total
Number of monitors projected to be sold	129,217,000	120,005,000	23,924,000	23,484,000	2,870,880	100%	2,818,080	100.0%
Number of monitors, size 17" or smaller	2,109,000	425,000	99,000	84,000	11,880	0.4%	10,080	0.4%
Number of monitors, size 18.5"	11,194,000	7,684,000	1,314,000	689,000	157,680	5.5%	82,680	2.9%
Number of monitors, size 19.x"	13,848,000	10,450,000	2,172,000	2,200,000	260,640	9.1%	264,000	9.4%
Number of monitors, size 20" or smaller	36,044,000	24,075,000	5,473,000	4,146,000	656,760	22.9%	497,520	17.7%
Number of monitors, size 27" or larger	16,299,000	20,682,000	3,770,000	4,678,000	452,400	15.8%	561,360	19.9%
Number of monitors, size 30" or larger	4,444,000	5,358,000	295,000	385,000	35,400	1.2%	46,200	1.6%
Number of monitors QHD resolution (2560*1440) (3.6MPix)	4,093,000	5,770,000	1,194,000	1,564,000	143,280	5.0%	187,680	6.7%
Number of monitors UHD resolution (3840*2160) (8.2MPix)	4,468,000	7,474,000	1,501,000	2,179,000	180,120	6.3%	261,480	9.3%
UHD - 27" and larger	3,038,240	4,708,620	1,020,680	1,372,770	122,482	4.3%	164,732	5.8%
UHD - smaller than 27"	1,429,760	2,765,380	480,320	806,230	57,638	2.0%	96,748	3.4%
Number of monitors larger than UHD (>8.3MPix)	125,000	318,000	34,000	83,000	4,080	0.1%	9,960	0.4%
Number of monitors smaller than HD (<1.1MPix)	3,153,000	9,942,000	657,000	965,000	78,840	2.7%	115,800	4.1%
Number of monitors that meet ">99% of sRGB"	10,200,000	11,730,000	2,295,000	3,061,000	275,400	9.6%	367,320	13.0%
Number of monitors that meet ">99% of AdobeRGB"	3,100,000	3,565,000	697,500	930,487	83,700	2.9%	111,658	4.0%
Number of touch enabled monitors	610,000	701,500	137,250	183,096	16,470	0.6%	21,972	0.8%

Medical Devices sales are similar to those demonstrated for monitors smaller than 17 inches. Percentages of medical devices reported (0.4%) in the entire United States.

E. Manufacturers shall apply ~~no more than one~~ the applicable adder(s) from Table V-5 to determine the maximum ON-mode wattage. Only one adder can be applied from each category

Table V-5
List of Potentia~~lly Applicable adders~~ Allowances to the "ON" limits specified in Table V-4

Category	***Computer Monitor Type***	***Models manufactured on or after July 1,2019, and before January 1, 2021***	***Models manufactured on or after January 1,2021***
E.P.Ds.	Enhanced Performance Display with a color gamut support of 32.9% of CIELUV or greater (99%or more of defined sRGB colors)	30% "ON Power" Allowance	20% "ON Power" Allowance
	Enhanced Performance Display with a color gamut support of 38.4% of CIELUV or greater (99%or more of defined AdobeRGB colors)	75% "ON Power" Allowance	60% "ON Power" Allowance
Gaming	Gaming Monitors without incremental hardware-based assistance	30% "ON Power" Allowance	20% "ON Power" Allowance
	Gaming Monitors with incremental hardware-based assistance	35% "ON Power" Allowance	35% "ON Power" Allowance
OLED	OLED monitor	30% "ON Power" Allowance	20% "ON Power" Allowance
Curved	Curved monitor	30% "ON Power" Allowance	20% "ON Power" Allowance
Touch	Touch monitors	1W "ON Power" Allowance	1W "ON Power" Allowance

Example: a Curved gaming monitor with hardware assistance would receive both the 30% and the 35% adders, for a total ON Power allowance of an additional 65%.

Corrections on Table V-5 to match changes to Table V-4

Table V-4 (Power Consumption Standards for Computer Monitors)

	Diagonal Screen Size (d) in Inches	Maximum Computer Monitor On Mode Power Consumption in Watts
Resolution ≤ 5 MP	17”≤d≤20”	[(6.0*r) + (0.025*A) + 3.7] + applicable adder(s) in Table V-5
	20”<d<23”	[(4.2*r) + (0.02*A) + 2.2] + applicable adder(s) in Table V-5
	23”≤d<25”	[(4.2*r) + (0.04*A) – 2.4] + applicable adder(s) in Table V-5
	25”≤d<30”	[(4.2*r) + (0.07*A) – 10.2] + applicable adder(s) in Table V-5
	30”≤d≤61”	[(6.0*r) + (0.1*A) – 14.5] + applicable adder(s) in Table V-5
Resolution > 5.0 MP	17”≤d≤20”	[25 + (0.025*A) +3.7] + applicable adder(s) in Table V-5
	20”<d<23”	[25 + (0.02*A) +2.2] + applicable adder(s) in Table V-5
	23”≤d<25”	[25 + (0.04*A) – 2.4] + applicable adder(s) in Table V-5
	25”≤d<30”	[25 + (0.07*A) – 10.2] + applicable adder(s) in Table V-5
	30”≤d≤61”	[25 + (0.1*A) – 14.5] + applicable adder(s) in Table V-5