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ITI/TechNet Comments on Displays

Additional submitted attachment is included below.

CEC Final Draft Staff Report for Displays (Docket #14-AAER-2)

Appliance Efficiency Pre-Rulemaking

ITI/TechNet Comments on CEC Staff Report

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1. Introduction.

At the April 26th Workshop, ITI and TechNet (also referred to hereafter as "industry"), reflected on the very active consultations that had been held since last spring's Workshop, to include the two shareholder face-to-face meetings and fairly constant communications with CEC staff and other key shareholders. These consultations resulted in agreements with fellow stakeholders in some areas, and clarified facts in other areas. While this progress was limited, as stated at the April 26th Workshop, we were surprised that it was not more adequately reflected in the Final Staff Draft.

As we also stated at the Workshop, industry sees the Final Staff Draft as not technically feasible, nor cost effective, and asserts that its promulgation as-is would significantly limit choices for Californians and more generally dis-serve their best interests.

ITI and TechNet have pledged to continue to engage constructively with the CEC and key stakeholders to get this important rule making right. As we noted at the Workshop, if we are to achieve the agreed goal of a technically feasible, cost effective Final Rule by year's end, then much collaboration and significant changes are requisite.

In this regard, we appreciate the constructive dialogue that occurred during the Workshop, and the intense consultations that have occurred since then. Needed progress is being made. Some of this progress is reflected in these written comments.

As stated both at the Workshop, and in various consultations since, the Final Staff Draft's proposed 1/1/18 effective date is not tenable, and would greatly dis-serve California's citizens and businesses. A Final Rule can and should advance the State's climate and energy efficiency goals while also not reducing Californian's access to promising future technologies, choice in technology purchases, nor California's future competitiveness. This is not possible with a 1/1/18 effective date, nor without other needed adjustments.

2. Overall Impact to manufacturers and CA customers

Despite display manufacturers having provided substantial data and information (including product demonstrations), the CA CEC Final Draft Staff Report proposed power consumption requirements that were more stringent and problematic than the First Draft Staff Report. And if the final display requirements are unchanged, will pose significant impacts to manufacturers and California customers who purchase Computer Display and Signage Display products.

The Final Staff Draft requirements are 30% more stringent than voluntary ENERGY STAR® Ver. 7.0 display program requirements (effective July 1, 2016).

Problems with the Final Staff Draft include: Scope, definitions, test methods, On, Sleep, and Off Mode limits, On Mode Adder for Enhanced Performance Displays (EPDs), mandatory luminance shipment requirement, and lack of additional tolerance for displays that are shipped with additional features/functionality that cannot be turned off for compliance testing.

Additionally, while the Final Staff Draft includes an On Mode "Adder" that applies to power consumption in On Mode for Enhanced Performance Displays, the tolerance specified is insufficient.

Details on the current compliance rate and manufacturers' forecast for compliance in the future are provided below.

Compliance rate for all sizes / types displays currently on market – 19%

– Above overall compliance rate includes a portion of displays that have been redesigned to comply with ENERGY STAR Ver. 7.0 (Effective 1 July 2016)

– Compliance rate for standard resolution displays (Less than 5.0 MP) - 20%

– Compliance rate for enhanced performance displays (Greater than 5.0 MP) - 29%

Forecast compliance rate for Computer Monitors and Enhanced Performance Displays that will be sold in future:

– Jan. 1, 2018 – Overall compliance rate should improve from 40% – 50%

– In January 2019 - Overall compliance rate should improve to 50%

– In January 2020 - Overall compliance rate should improve to 58%

– In January 2021 - Overall compliance rate should improve to 66%

(Note: Many Computer Monitors and Enhanced Performance Displays are unable to comply with multiple requirements (On, Sleep, and Off Mode limits).)

The Final Staff Draft requires On Mode power consumption reductions ranging from 4.8 W to 10.2 W to comply; not 3W~5W reduction CEC analysis indicates as being required to comply.

Manufacturers cannot justify additional cost to redesign lower cost, smaller sized displays (< 20" diagonally). Suppliers will not invest in the smaller sized displays given declining market share, additional costs to comply.

Impact smaller sized displays (< 20" diagonally):

– Compliance rate for smaller sized displays currently on market - ~14%
– Forecast compliance rate for smaller sized displays on market 1 Jan. 2018 and later - unknown (given declining market share, investment, additional costs to comply)
– Availability of smaller sized displays will diminish when CEC display efficiency requirements enter into force - 1 January 2018

(Note: Many Enhanced Performance Displays already incorporate the most energy efficient technologies available today.)

Impact customers using Enhanced Performance Displays (EPD):

– Compliance rate for EPDs with > 5.0MP resolution currently on market ~ 29%

– Forecast compliance for EPDs with > 5.0 MP resolution on market in Jan. 1, 2018 - 50%

– Additional research with suppliers is required given that CEC did not use industry's recommended adders for EPDs

Customers impacted by CEC's latest regulatory proposal include customers in government, commercial and consumer market segments who require the enhanced performance of these

specialized, higher cost, lower shipment volume displays. Examples of customers who purchase these types of enhanced performance displays include:

Scientists, engineers, medical professions (not certified as medical devices), graphics designers, motion picture animators, and others involved in technical activities including but not limited to CAD/CAM designers, scientific, economic, and financial forecasting/modeling, aerospace, defense, virtual reality, etc.

(Note: Shipment volumes for these specialized Enhanced Performance Displays are less than 5% of the total US market for Computer Monitors / Displays.)

Impact of latest proposed 0.5 W Sleep, 0.3 W Off mode power consumption limits:

Approximately 15% of displays that are currently on market are unable to comply with CECs proposed Sleep and Off mode limits. And for these modes, there are not as many design solutions available to reduce power consumption in these modes to the levels proposed by CEC. Additional detail on this problem is provided later in this document.

It is also important to understand that for displays including additional features / functionality beyond displaying content, these types of displays will not be able to comply with the Sleep and Off Mode limits. Unable to comply even if the limits proposed by industry - 1.0 W Sleep and 0.5 W Off Modes are adopted. Therefore, for displays configured with additional features and functionality (beyond basic display capability that cannot be turned off for testing in the Sleep / Off Modes), an additional solution is required. Industry has recommended either exempting these types of displays (preferred), or providing additional tolerance or "adders" beyond the 1.0 W Sleep and 0.5 W Off Modes recommended by industry.

The solution to address this situation, also needs to include provision for additional features / functionality incorporated into Computer Monitors / Displays in the future.

3. Lack of technical solutions to bridge gap by 1/1/18.

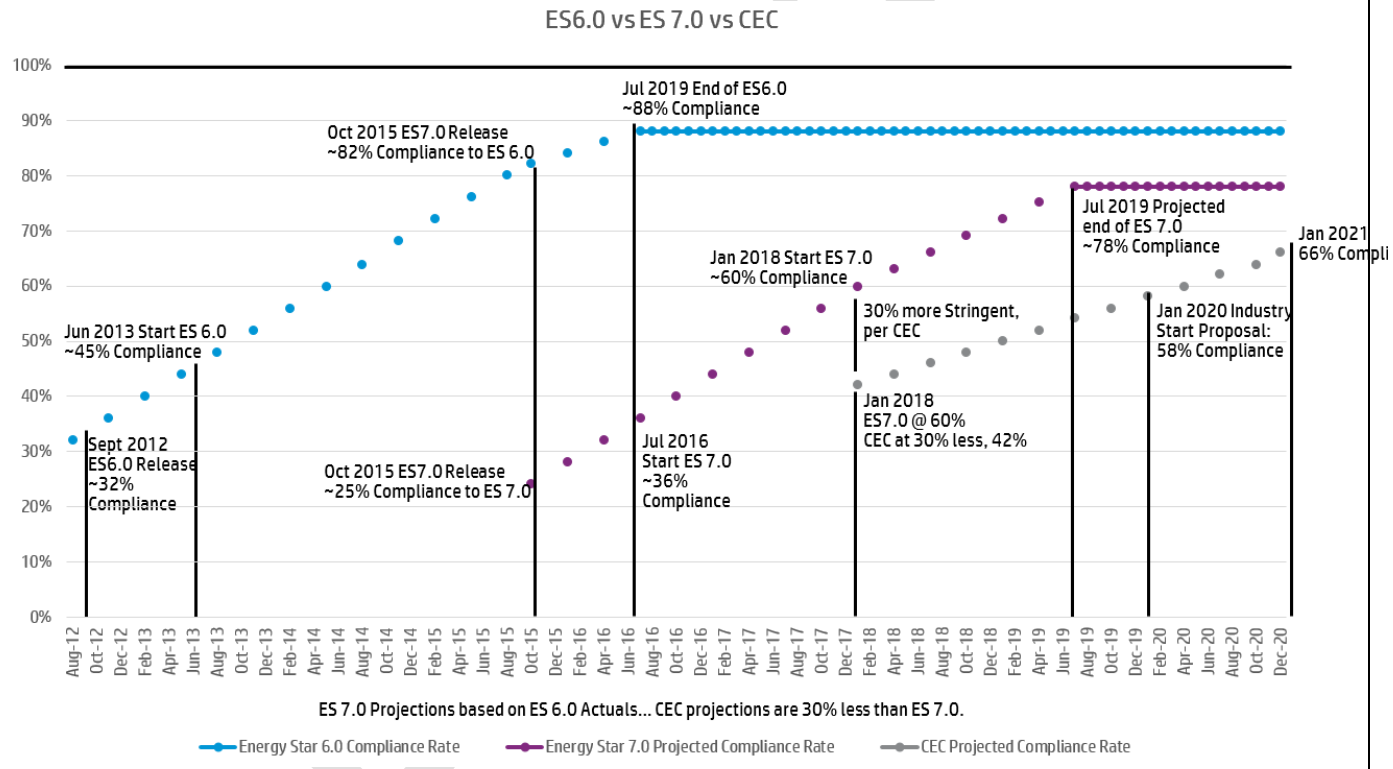
Industry understands and supports CEC's goals to reduce plug loads. However, industry must continue serving its California customers and does not have solutions to comply with the Final Staff Draft's by January 1, 2018 (and later as well). A summary of concerns related to CEC's "Final Draft" Display regulations are outlined below. Additional technical and cost details are provided later in this document.

- For smaller, low cost Computer Monitors measuring < 20" diagonal size, display and panel manufacturers will not continue to invest in this declining market. Customers in California who need these low cost computer monitors, will simply no longer have access to these products.
- For "mainstream" Computer Monitors and Enhanced Performance Displays (EPDs) measuring > 20" diagonal size, manufacturers need more relaxed specifications and more time to comply, to continue serving customers in California who need these products.

Challenges related to the proposed On Mode limits for Computer Monitors:

- Computer Monitor and panel manufacturers are already implementing design changes to enable some displays to achieve certification to ENERGY STAR Ver. 7.0 Display Program Requirements.
  - For many of these displays, there are not additional "design levers" available to comply with the CEC's proposed On Mode limits, that are 30% more restrictive than exclusive ENERGY STAR Version 7.0 specification limits.
  - Examples include Enhanced films (often in addition to standard prism films), more efficient LED backlights, and power supplies.
- Sleep and Off Mode Computer Monitors and Enhanced Performance Displays (EPDs):
  - Even fewer technical solutions to comply with CEC's proposed 0.5 W Sleep and 0.3 W Off Mode limits.

4. Fundamentals, Details, and Industry Proposals.



For Monitors 20" and lower…

Projected monitor sales for these sizes show declines thru 2024. 17" Size will likely not be sold beyond 2020 and 18.5" will likely not be sold in significant volume beyond 2022.

Proposal is to split the first segmentation into two:

- Keep 17" and under Displays out of scope
- Significantly relax the On Mode limit for the 17" to 20" Display segment
- Relax the On Mode limit for the 20" to 23" Display segment

A proposal for the 17" to 20" Displays where the goal is to relax the limits so that about 80% of the products can be compliant is provided below.

We are collecting information on existing products what are non-compliant as well as those that are compliant to ENERGY STAR V6.0 and are projected to be compliant to ENERGY STAR V7.0.

As mentioned before, these smaller sized Displays are the ones for which the panel manufacturers is not willing to invest on future/better technologies.

Industry sold 15" monitors thru about 2015, eventually most got delisted for ENERGY STAR V6.0. Most Industry members no longer sell a 15" sized Display. This is a size where volumes were projected to decrease YoY, and where no new-investments were committed.

At this time we are seeing a similar fate for the 17" and 18.5" Display sizes. Some of these were able to meet ENERGY STAR V6.0, but will get de-listed for ENERGY STAR V7.0 and there are no further improvement plans for these Displays, other than maybe a small increase on LED efficiency, but not enough to make them compliant.

By a July 1, 2019 effective date for CEC compliance, we see the 19.x" and 20" sized Displays reaching their last technology improvements, and few further improvements for the next 5 years.

Proposal (for a July 1, 2019 Compliance start date):

d ≤ 17" Out of Scope
17" < d ≤ 20.0" (4.2*r) + (0.02*A) + 6.2 (Industry Proposes a +4W allowance for 20" and less)
20" < d < 23.0" (4.2*r) + (0.02*A) + 5.1 (Industry Proposes a +2.9W allowance for larger than 20")

Panel Size	Native Resolution	Current ON Power	ES 6.0 Limit ON Power	ES 7.0 Limit ON Power	CEC Final Max ON Power	Percent Reduction Needed	Final Max ON Power Proposal	Additional Percent Reduction Needed Estimate
(in.)		(W) (Ave)	(W)	(W) (Est)	(W)		(W)	
17	1440*900	14.95	14.74	7.14	10.26	31% (4.69W)	13.56	Out of Scope
17	1280*1024	15.50	15.10	9.82	10.54	32% (4.96W)	13.84	Out of Scope
18.5	1366x768	13.45	13.65	10.46	9.53	29% (3.92W)	12.83	5% (0.62W)
19	1280x1024	14.77	15.95	13.59	11.22	24% (3.55W)	14.52	2% (0.25W)
19.5	1600x900	14.96	16.38	12.86	11.43	20%	14.73	2% (0.25W)

[redacted]						(2.83W)	

Regarding the proposed ON limits for Mainstream displays (20" to 27")

We did not spend much time discussing this Display size segment, but it is acknowledged that it is the area where we have most flexibility to try to make additional improvements. For these "mainstream" Display models, a combination of more efficient LEDs, addition of enhancement films, and even a new TFT cell design for improved transmissivity are options we can work with our supply base. Industry did not consider power supply efficiency improvements, as Displays are at about 85~89% efficiency today, as part of being DOE 2016 compliant on Displays with an external power supply.

The biggest challenge display manufacturers face is to get implementation of improvements at the same time across many suppliers, as we would need multiple sources of the "better" components, since the mainstream segment is also the high-volume segment.

And this is where Industry would like to call to your attention that we still need either some relief in the form of higher power allowances. Based on actual historical data, on average, we have been able to make efficiency improvements of about 7~10% YoY. The projection thru 2024 is that the YoY improvement will start to decline, as some tools utilized (like addition of enhancement films) are a "one time" improvement. Also, continued increase in LED efficiency will tapper out, to the point that further improvement is not necessarily cost effective.

As an example, if Industry uses a 10% improvement expectation YoY, this will require the supply base about 3 years to accomplish from the date of Regulation release (say Q4 2016) to have a collective/system-wide 30% improvement increase for each monitor size. Then the Industry needs about 1 year to take these optimized components and incorporate them into a new monitor design.

	20"	21.5"	23"	24"	27"
	1600*900	1920*1080	1920*1080	1920*1080	1920*1080
E.S. 6.0 limit	16.5W	21.1W	22W	24.1W	29W
CEC proposed	11.7W	14.9W	15.4W	16.7W	20.3W
Delta	4.8W	6.2W	6.6W	7.4W	8.7W
% Reduction	29%	29%	30%	31%	30%

That would put us at September 2020, as the earliest compliance date proposal, to have about 78% of the mainstream monitors meet the CEC regulation. Even with a July 1, 2019, compliance date, we need certain allowances.

For Touch monitors

The main concern from Industry is the likely use case. Today, when a system (PC + monitor) is in Sleep mode, the user expectation is that a touch on the keyboard or a movement on the

mouse, will initiate the system "Return from Sleep" event. A touch monitor uses the USB interface connected to the PC, to provide the PC with "touch information".

The Use case scenario of concern for the Touch monitor solutions, is that the End User will expect to "touch" the monitor to initiate the "Return from Sleep" event. For this to happen, the touch related electronics, and a portion of the USB interface must remain "awake" on the monitor, in order to capture that "touch" event, forward it to the PC, and have the PC wake-up the whole system.

Industry agrees with the proposed "1 Watt" for the "ON" power consumption allowance.

Proposal (for a July 1, 2019 Compliance start date):
An Allowance of 1W in both ON, Sleep and OFF mode, for a touch monitor solution.

Regarding OLED monitors.

Currently, there is the misconception at the CEC that OLED monitors will be more power efficient than current LED monitors. This confusion may be based on the fact that there are some televisions incorrectly categorized as OLED televisions in the CEC database when in fact they are LED televisions. Here is a brief explanation of the technology, how it compares to TVs, and why we could end up with solutions that consume more power.

It is correct that OLED solutions do not have a backlight that is constantly producing a light output. For OLEDs, similar to old CRTs, each sub-pixel is independently exited. If exited, the sub-pixel turns on and emits light output in the color it is designed for. A key difference between LCD panels and OLED panels is that only one thin film transistor is required for each pixel in LCD panels whereas OLED panels require two thin film transistors per pixel. One thin film transistor is required for picture scan and another for adjustments in pixel degradation.

So,
If I am displaying a black image on an OLED monitor, my power consumption for the panel assembly itself will be close to 0W (not counting the power for the electronics that must remain on to operate other panel related functions). In comparison, the power consumption to display that same black image on an LED monitor may be 20~30W, since its backlight is ON regardless.

Now,
Lets say that I want to display a white image on an OLED monitor. In this case, every single sub-pixel is turned ON and consumes power. The Power consumption can easily be 40~50W. In comparison, the power consumption to display that same white image on an LED monitor may still be around 20~30W. In this case, the OLED solution consumes more power.

What happens with TVs,

> On TVs, you rarely see static images; you rarely see images that are too bright. On average, a lot of the motion picture content and biased to the darker settings. Under these conditions we would assume, that on average, an OLED TV will consume equal or less power than an LED TV, and likely present a nicer image. However, readily available data indicates that OLED TVs consume on average more power than LCD LED TVs.

In contrast, on a regular monitor, you will mostly see static images. You will mostly see bright images, with white backgrounds (background of your excel spreadsheet, word document, power

point slides are all normally white). If print average ink rates are any indication, less than 10% of the viewed image is non-white. So, statistically, we will consume more power on OLED monitors.

What happens on Smart phones? The largest use of OLED so far has been on smart phones. So what is being done there, to preserve battery life? The biggest change is a user interface that is opposite to the traditional computer monitor user interface. On smart phones, where possible, your background is black (or dark), and the letters (content) are white. That maximizes the number of sub-pixels that are either OFF (do not consume power), or are in an off-black shade (consuming some power), and you have a minimum of white/bright sub-pixels (which consume the most power). In addition, smart phones are equipped with power management capabilities that are not applicable on computer monitors. Smart phones remain inactive most of the time allowing users to select a relatively short time (in seconds) to turn off the display and preserve battery energy. Computer monitors are intended to be operated while on, and to power down when inactive for long periods of time (via computer power management capabilities) or when a signal from a computer is not detected.

Working within the Industry:
Microsoft is not yet fully on board to re-design the whole Windows OS with the alternate user interface concepts discussed above. The rest of the software industry developing Apps for use in monitors would also need to create alternate user interfaces that would optimize its use on an OLED environment. It should be noted that there are other technical issues for OLED that they will also need to address, to make it a viable technology for computer monitors (for example, static images today cause image burn-in. While this is not a big issue for TVs where images are mostly in motion, this is a big concern for monitors where a lot of the workspace is static.

Proposal (for a July 1, 2019 Compliance start date):

- Make OLED monitors “Out of Scope” of the Regulation, or
- Give OLED monitors the same power allowance as to AdobeRGB monitors, regardless of resolution

The goal is to make sure OLED product development is not curtailed in CA because of this regulation.

Regarding Panel LED Efficiency options:

For a given point in time, we have a variety of LED efficiencies: we can consider a range of 60 to 120 Lumen/W; there is the standard “white LED” solution for the bulk of BLU designs; they typically meet a 72% of NTSC for color gamut, are in the 70~90 Lumen/W efficiency rating, and are used as a string on one edge of the panel; and, the number of LEDs used will affect uniformity, brightness levels, and thermals.

Then, there are the specialized LED solutions for high color gamut panels (sRGB and/or AdobeRGB), which in general are less efficient and are much higher in cost.

There is a concern with assurance of supply for the more efficient LEDs as those currently have less than 10% of the overall market-share; a slow increase in demand will assure steady supply.

For the same size panel solution, we can forecast a 7~10% energy efficiency year-over-year improvement at roughly the same cost target. That is, the LED today that outputs 60Lm/W can output 65Lm/W in about a year, for the same price…

Regarding Enhancement Film options:

Monitors 20" and under are considered "budget" or "Opening Price point" monitors. The top three requirements for this segment are "cost", "cost", "cost". The Industry cannot afford to add any type of enhancement films.

Monitors above 20", are considered "Value" centric monitors: most of the solutions have less than "Full HD" resolution (1920*1080); for those that have a Full HD (1920*1080) resolution, they are considered "Mainstream." Few monitors HD (1368*768) and below use any kind of enhancement films.

Some Full HD monitors can afford these films, especially as we move from TN, to VA or IPS type technologies.

The problem is that those solutions already designed with enhancement films, are far away from meeting the CEC requirements. For the larger monitors, usually QHD or larger resolution, almost all solutions already include these enhancement films. The enhancement films are a "one time" improvement to the overall efficiency equation for the Monitor. And a net cost adder to the overall solution.

Regarding Power Supply Efficiencies:

Monitors are already efficient; therefore this is not a design lever available for Monitors. Power Supply efficiency:

- Most ES6.0 products at "Class V" (87% or better)
- Most ES7.0 products upgraded to "Class VI" (88% or better)

Reaching point of diminishing returns… Will be hard to get an additional 1~2% improvement:

- Large Design/Qualification cycle (1.5~2 years);
- IOU's analysis outdated and no longer relevant;
- DOE will help drive future improvements.

Regarding the Re-Design of the Basic TFT Pixel Cell Architecture:

Goal is to improve the transmissivity of the cell. Industry is pursuing this with all panel makers, but it is a significant cost impact to them. We will likely see some examples of these improvements on Curved Monitors and High-End 4K+ Next Gen Monitors. These are small incremental improvements that come at a high cost:

- New masks needed; each mask over $1M NRE; 4~7 masks needed per size, per panel maker, per technology;
- Long design cycle (1.5~2 years) by the Panel maker, before the Manufacturer starts its own design cycle;
- So far, one panel maker proposing doing this for the 1H2018 cycle, however Industry needs more than one committed panel maker;
- Monitor OEM design cycle starts after panel maker completes its R&D effort.

It should be noted that once non-recurring engineering (NRE) is amortized, Industry drives the supply base for similar cost structures. It should also be noted that this effort does not improve Power Consumption in Sleep or OFF modes.

5. Test Methods.

As discussed, if we will continue to pursue a single Power Limit for "ON", "Sleep" and OFF" for the CEC Regulation, then it is best to also follow the ENERGY STAR V6 test methods, as the ENERGY STAR V7 test methods are targeted for TEC measurements and averaging.

Narrative from CEC:

> **ES7.0:**
> "Version 7.0 sets new power consumption requirements in terms of total energy consumption, which allows manufacturers flexibility to balance power consumption in ON mode and Sleep mode."
>
> **Test Procedure:**
> "To measure the energy consumption of computer monitors, staff recommends using the ENERGY STAR test method, published in September 2015, and associated with ENERGY STAR Product Specification for Displays Version 7.0"
> "(5) The test method for computer monitors is ENERGY STAR Test Method for Determining Displays Energy Use Rev. Sep-2015, attached to the Version 7.0 Displays Product Specification."
>
> **Computer Monitors:**
> "Energy Commission staff proposes computer monitor standards to establish maximum ON-mode requirements based on screen area and resolution. This approach is similar to the ENERGY STAR Version 6.0 specification for on-mode power requirements. Furthermore, staff proposes maximum power for sleep mode (PSLEEP_MAX) and off mode (POFF_MAX).

ENERGY STAR V6.0 Test Procedure is set for Modal/Fixed limits. We instrument the monitor and make discrete Power measurements. ENEGY STAR V7.0 Test Procedure requires continuous Power measurements over a 10 minute test time, using different source inputs. The goal to average ON power under different likely User conditions. Further, by specifying a Max TEC, ENERGY STAR V7.0 allows Monitor OEMs to trade off ON power with Sleep power.

If CEC will set a specific ON, Sleep and OFF limits (as it is similarly done in ES6.0), then the "Test Procedure" should also follow ENERGY STAR V6.0, with any adjustments the CEC deems necessary. The ENERGY STAR V7.0 Test Procedure allows the OEM to adjust/vary ON, Sleep and OFF limits so that it meets an overall TEC target. That is, the ON, Sleep and OFF limits are not specific; OEM instead needs to meet the Max TEC allowed.

The current CEC Power Consumption Limits and the Specified Test Procedure are in conflict with each other.

6. Data and Analysis used in the Final Staff Draft.

For Monitors 5MPix and Higher…

Industry noticed that on the final draft there was a change on the formulas for monitors with more than 5MPix of resolution. Our feedback is that these monitors (4K, 5K, future 8K monitors) are the ones where we introduce "the best of everything" already:

- They all have the brightness enhancement films;
- and the very best LEDs (the one thing to note is that in some cases, when targeting sRGB and AdobeRGB color gamuts, the LEDs are very accurate, but also not as efficient);
- Our power supplies are already over 85% efficient;
- And frankly, in this segment, performance is king -- it will be difficult to compromise in order to save some power.

But as mentioned, here we already have most of the high-end components to make an overall efficient product. We are not going to get many more incremental power savings in the short term, other than further improvements in LED efficiency, which we previously reported as a possible 10% improvement YoY for the mainstream LED solutions, and perhaps 5% Y0Y on the better ones.

Here is an example of the effect of the formula change:

Originally (previous draft proposal), a 23.8" 4K sRGB monitor (this is the high volume model, as is the most affordable 4K monitor you can get), using the following formula, the ON limit was 42.12W

(4.2*r) + (0.04*A) -2.4 (34.82+9.7-2.4)

With the new formula, the ON limit is 28.29W

(21) + (0.04*A) -2.4 (21+9.7-2.4)

One sample current offering (HP Z24s) is 44.17W in the ON mode, meets ES6.0 and will get de-listed for ES7.0 in July. At this time we see no feasible means to lower anywhere close to 28.29W, so it will need to be removed from the CA market.

Even if we add the 10% sRGB allowance we would be at 31.12W ON limit. The main message is that CA risks removing from the market the new innovations, the top-of the line product, which is already very efficient, using premium components. Further, this is a segment of low volumes, but with potential to grow.

Industry Proposal (for a July 1, 2019 Compliance start date):

Remove the alternate formulas for monitors with resolution > 5MPix
And adjust the allowances to:

- 35% power allowance for >99% sRGB displays;
- 75% power allowance for >99% AdobeRGB displays

Regarding the new proposal for Sleep and OFF limits

While we understand that the CEC is trying to set the same limits as the proposed EuP Lot 5 limits, we would like to share the same arguments we have detailed in EMEA, and which we are still hopeful of getting adjusted before that regulation is final.

For a regulation that will dictate if a product can be sold or not on a given geography, it is of high risk to potentially remove from the market a product for missing the last 0.1W or 0.2W of power in OFF mode.

By lowering the limit from 0.5W to 0.3W, the EU (and CA) will potentially save $0.16/Yr in energy costs

Watts saved **0.5W to 0.3W Average**	Hours Sleep Residential (1 yr)	Hours Sleep Commercial (1 yr)	Average use (1 yr)
0.2	4453	5043	4887
W*Hrs	890.6	1008.6	977.4
Electricity cost ($/KW)	$0.160	$0.160	$0.160
1Yr savings	**$0.14**	**$0.16**	**$0.16**

So the potential for 16c savings per year per monitor should be compared to the risk of not having the monitor available for sale at all in the EU (or CA), because we would reach for example, only 0.35W or 0.4W.

There are other factors that may impact OFF mode for monitors in the future: we are currently projecting that the market will demand many monitors support the newly released USB Type-C interface, and that the monitor have the ability to provide up to 100W of power to other devices, like a NB, tablet, printer, etc.

This means that our average monitor which today had a 30~50W power supply, will in the next few years have a 130~150W power supply.

In Sleep and OFF mode, these larger capacity power supplies still generate some power from leakage current, and the amount is proportional to the total capacity of the power supply.

In the absence of additional hard data, and until all inefficiencies are understood, we recommend that for a regulation that will determine if a product is sold in CA, that the original Sleep and OFF limits be used.

Proposal (for a July 1, 2019 Compliance start date):

- 1W limit for Sleep modes
- 0.5W limit for OFF modes

7. Definitions and Scope.

Computer Monitors. The current definition of a computer monitor requires some edits to clearly capture products and their intended use. The definition should read:

"Computer monitor" means an analog or digital device of size greater or equal 12 inches and less than or equal to 30 inches, with pixel density greater than 5000 pixels per square inch, and that is designed primarily for the display of computer generated signals, intended for one person to view in desk based environments, and not marketed for use as a television. A computer monitor does not include:

1. Displays with integrated or replaceable batteries designed to support primary operation without AC mains

or external DC power, or device mobility (e.g., electronic readers, battery-operated digital picture frames); and

2. Computer monitors classified by the United States Food and Drug Administration for use as medical devices

Signage Displays. The current definition of signage displays is too broad. The definition requires edits in order to separate signage displays and computer monitors. The definition should read:

"Signage Display" means an analog or digital device of size greater than 30 inches designed primarily for the display of computer generated signals intended for multiple people to view in non-desk environments, and not marketed for use as a television.

Monitors larger than 30":

We are currently assuming that monitors above 30" are Out of Scope, as shown in table V-3, and that this will NOT CHANGE. There is no data to substantiate that computer monitors larger than 30 inches need to be regulated under the computer monitor regulation.

Table V-3 Maximum Power Requirements by Modes- Computer Monitors

Diagonal Screen Size in Inches (d)	On Mode in Watts (P_{ON_MOX})	Sleep Mode in Watts (P_{SLEEP_MAX})	Off Mode in Watts (P_{OFF_MAX})
Resolutions Less Than or Equal to 5.0 MP			
17"≤d<23"	(4.2*r) + (0.02*A) +2.2	0.5	0.3
23"≤d<25"	(4.2*r) + (0.04*A) - 2.4	0.5	0.3
25"≤d≤30	(4.2*r) + (0.07*A) - 10.2	0.5	0.3

Industry has not done any new evaluations of impact to Compliance for solutions larger than 30". Industry also continues to believe that the percent of Product that is larger than 30" is small, and is where new innovations may occur, so it is the segment where we would have most unknowns, as we try to propose regulatory language that would future-proof monitor designs.

Monitors higher than 8MPix:

Monitors with resolutions higher than 4K (equal or higher than 3840*2160) should be **"Out of Scope."** There is not much data that the Industry can provide that projects the evolution of panel designs and use thru 2024 on the high resolution segment; we just know that these will be

the innovative, high-end, high-performance solutions done as a technology statement and proof points of what is doable.

It is difficult at this time to propose Regulatory language and limits, which will not curtail the development of the next generation of monitors, which by nature will initially anyhow be very small volumes.

Monitors with High Dynamic Range (HDR):

Monitors supporting the new HDR standards should be **"Out of Scope."** It is difficult at this time to propose Regulatory language and limits, which will not curtail the development of the new generation of HDR monitors, which by nature will initially anyhow be very small volumes, especially given the projected panel cost premiums.

8. Analysis of Power Reduction Needed (20"-27" Displays.

Industry believes the average monitor power reduction needed to meet the Final Staff Draft's mandate is:

- 7W for the 20" ~ 27" range, without the more restrictive formulas for monitors above 5MP

Staff's analysis of the ENERGY STAR data shows that only about 14 percent of the current models would meet the Final Staff Draft's proposed more stringent standards.

The CEC has stated these "monitors would only need to reduce their power consumption by 3 to 5 watts to comply". Industry analysis shows that the range of 4.8W-8.7W is required to comply with the CEC standard. The average reduction would require ~ 6.98W improvement or an average 31% increase in efficiency in order to comply.

9. Cost Assessment – CA Savings.

CEC increased Design Life to 6.6 years in the Final Staff Draft, whereas in last spring's Staff Draft the estimate was 6 years. Why?

Industry's analysis of the CEC proposed cost increase of $5.00 as referenced Table 21: Life-Cycle Costs and Benefits per Unit for Qualifying Products (page 81) is not aligned with current industry's cost projections for each unique product type, category and/or screen size.

As presented on April 26, material Cost data is an average, and is only representative of the cost to the Display Manufacturer. The price increase to the End User is much higher, and dependent on the mark-ups each manufacturer incurs within the supply chain and does reflect the final price to the customer.

Cost Estimates for LEDs (Prices seen by End User are much higher):

- For panels smaller than 24", we estimate an average a cost up of $3.50~$5.00 for each 10% efficiency improvement
- For panels larger than 24", the average cost is $5.50~$10.00 for each 10% improvement in efficiency.
- For the same size solution, we can also see a 10% energy efficiency year-over-year at roughly the same cost target.

Industry calculates savings of: $ 7.33 (3W Avg. savings) up to $12.04 (5W Avg. savings). This is not aligned with the $29.30 savings estimate reported by CEC.

Any solution to achieve the proposed limits must be available from multiple vendors/suppliers for each hardware component.

The more stringent design limits must take into account manufacturing variabilities that dictate designs be more efficient to ensure compliance is maintained, which ultimately increases cost for each component.

We strongly recommend CEC work closely with industry so that the true costs of compliance to the regulation is accurately represented in the cost analysis.

10. Data on Display Shipments.

Industry estimates reflect the sale of 2.9M a year in the state of California (based on IDC data), versus the 3.6 M estimate by the CEC.

Displays under 20”
The market for Displays under 20” continues to decline in volumes.

- These are “Opening Price Point (OPP)” SKUs that cannot afford the higher-end technology
- Percentage-wise they require a lot of power reduction compared to more mainstream SKUs
- Removing these from the CA market would be a significant business impact

Industry estimates 20” will be 10% of the installed base by 2019, and decreasing each year as Panel makers not investing on these “decreasing volume” business.

17” cell design has not changed in 5+ years… No more investments in 18.5”, there are no realistic options to increase BOM cost with either films or better LEDs.

Industry research shows prices from $89 to $119 price points from researching multiple OEMs – Web prices. These models are priced for cost sensitive and for economically challenged consumers.

Displays over 30”
Industry estimates monitors over 30” are low volume. All of the analysis by industry and CEC have focused on monitors 30” and below. Industry does not support the inclusion of monitors greater than 30” as these should not be in scope of the current rule making process as they have not been included in the CEC or Industry analysis.

Industry concerns display shipment requirements

New technologies are being introduced that require additional power allowances. Examples include new standards and connectivity (DP, USB type C etc.) cameras, docking, and USB HUB (4 ports), wireless, Thunderbolt, etc. and yet to be defined features / functionality likely developed in the future.

The Final Staff Draft's requirements do not include any "adders" for additional features/functionality other than for "touch".

Industry recommends turning off these features/functionality during testing for compliance with the CEC appliance efficiency regulations.

Industry requests a provision that allows manufacturers to ship these features / functionality enabled despite being turned off for testing. Disabling these features upon shipment would drive dissatisfaction among both retailers and customers.

Industry continues to request that displays with these features / functionality be removed from scope of the regulation, or appropriate additional tolerance be provided.

Monitor with network capabilities e.g. Wi-Fi, RJ45 etc. require additional power allowances. Option to address these features include power allowances for the various modes or the ability to disable network features during the test process.

CEC has specified all monitors ship at 200 nits

- There is no precedent for this type of restriction in any other WW regulation
- There is no precedent on California's own TV Regulation
    - For Competitive reasons
    - For Product placement/Positioning
    - For Cost Differentiation

The OEM must be allowed to ship each monitor at the performance settings that fit best with the offering. Industry agrees to set the "test configuration" at 200 nits, for uniform test reporting.

Manufacturers should not be unfairly burdened with an "As Shipped" fixed luminance. These settings are determined based upon customer inputs and is directly related to positive customer experience.

Industry has reviewed California Energy Commissions TV and it does not specify a particular brightness setting and industry requested CEC allow Computer Displays be allowed to follow the same guidelines.

Industry request CEC add language to clarify the "as shipped" configuration will not consume the same amount of power of the "as tested" configuration. CEC has verbally communicated that additional features can be turned off during the test process, while also stating those features could be enabled when shipped to customers in the state of California.

Industry supports CEC position for turning off additional features and/or functions of the displays. This is different from the ENERGY STAR 7.0 Displays test procedure that stipulates testing must be conducted with active connections to the ports.

Industry request CEC language clearly state their test procedure "supersedes" the instructions as specified in the ENERGY STAR 7.0 test procedure.

11. Industry Recommendations for Certain Low-volume Products.

Gaming Monitors (if not excluded from scope). If a monitor fulfills either one of the following requirements, industry recommends it be defined as a gaming monitor:

1. The monitor (and it's panel) support variable refresh rate ranging from 48Hz~76Hz (for 60Hz panel), 48Hz~145Hz (for 144Hz panel)
2. The monitor can support variable V-Sync such as G-Sync/FreeSync

Gaming monitors require additional power allowances to support the above features.

Below are two Dell Gaming Monitor examples that do not comply to ENERGY STAR 7.0 Displays power allowances and that support 48Hz~145Hz with G-Sync function:

1. S2417DG – 33W
2. S2716DG – 47W

Gaming monitor energy proposal:

ETEC <= (Etec_max + EEP + EABC + EN + EOS + EPC) X Effac_dc X + Etec (gaming)

Curved Monitors (if not excluded from scope). Follow ENERGY STAR® 7.0 definition and measurements procedures
B) Operational Modes:

6) Screen Area: The visible area of the Display that produces images.

Note: Screen Area is calculated by multiplying the viewable image width by the viewable image height. **For curved screens, measure the width and height along the arc of the Display**.

3.3.4 For Monitors meeting the enhanced performance display (EPD) requirements below, only one of the following Table 2 allowances shall be used in Equation 2:

i. Contrast ratio of at least 60:1 measured at a horizontal viewing angle of at least 85° from the perpendicular on a flat screen **and at least 83° from the perpendicular on a curved screen**, with or without a screen cover glass;

It's critical to include the arc of the Display so these are not unfairly burdened.

Curved Monitor energy proposal:
Etec <= (Etec_max + EEP + EABC + EN + EOS + EPC) X Effac_dc
Where EPC refers to the panel curvature
Formula for Epc = Etec_max X (1/PC)*1000
PC = panel curvature. – specify by panel suppliers.
Where EPC refers to the panel curvature
Formula for Epc = Etec_max X (1/PC)*1000

Keyboard, Video, Mouse (KVM) or Keyboard Mouse Monitor (KMM). KVM or KMM type products should be exempt from scope of the Computer Display / Signage Display Appliance Efficiency regulations.

KVM/KMM typical usage is significantly different from that of standard displays as they are located in secure (restricted access) areas of a data center and are in sleep mode for long periods of time. KVM/KMM are not marketed as consumer products but are intended for use in data centers.

KVM/KMM save power by reducing the number of IO devices needed to administer servers and save time by allowing access to multiple servers from a single console.

The benefits provided by KVM/KMM include saving space by allowing 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.

Medical Monitors. Industry recommends CEC amend the current language as it pertains to Medial Monitors and prefers the following language:

- Products that are classified by the United States Food and Drug Administration for use as medical devices.

FDA allows medical devices to have power management capabilities and/or a Standby mode. The language suggested aligns with the product description in Chapter 10 of the CEC final draft. Industry requests CEC remove reference to power management for displays classified as Medical devices if not explicitly excluded from scope.

12. Industry Recommendations for Enhanced Performance Displays.

Additional allowance related to resolution is necessary. The Final Staff Draft's is insufficient. Manufacturers need greater than 10% for sRGB and 70% for Adobe.

Without appropriate adders for specialized, high performance, low unit shipment volume displays, commercial users will be unable to purchase displays providing the functionality and performance needed. There may even be negative economic impacts to the State of CA if the power consumption limits or adders for EPDs remain as CEC has proposed.

Industry recommends a 35% power allowance for on mode for SRGB and 75% for Adobe.

Additionally, industry opposes the CEC formula for EPDs with > 5 MP: Industry recommends removing the second formula from the regulatory language.