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May 6, 2015

Mr. Christopher Hankin
Information Technology Industry Council
1101 K Street NW, Suite 610
Washington, DC 20005

Dear Mr. Hankin:

We would like to thank the Information Technology Industry Council (ITI) and its members for participating in the Energy Commission's April 15, 2015 workshop on efficiency standards for computers and displays. We appreciate ITI's constructive participation on this rulemaking through the feedback and presentations provided at the workshop.

During the workshop, ITI commented that the Energy Commission needed to make available the data and information used to analyze and propose the draft standards. The Energy Commission is dedicated to providing a transparent process and opportunities for stakeholder input in our energy efficiency standards, and includes references to the underlying data for computers and displays in footnotes throughout the draft staff report. All of this information is publicly available online for stakeholder consideration.

Nonetheless, staff provides the additional attached guidance to help stakeholders find and understand the resources that the Energy Commission used to develop its report. The primary data concerns expressed at the workshop fell into three categories: product performance, cost, and technology. Attachment A discusses computer data for these three categories, and Attachment B discusses display data.

To give stakeholders time to take advantage of this additional guidance, Energy Commission staff will also extend the comment period to May 29, 2015 at 4:00 pm. We look forward to your continued involvement in our energy efficiency proceeding.

Sincerely,

Dave Ashuckian P.E., Deputy Director
Efficiency Division

Attachment A: Computer Data

1. Product Performance Data

Energy Commission staff primarily reviewed ENERGYSTAR certified computer data and configurations. Staff reviewed certified models dating back to the ENERGYSTAR v.3 specification for computers to look at overall trends and market momentum. As stated on page 22 of the staff report, staff used ENERGYSTAR 5.2 data to determine two key numbers: unit baseline and unit energy savings. The final ENERGYSTAR 5.2 dataset is available in its entirety at: http://www.energystar.gov/sites/default/files/asset/document/Computers_v5_Historical_QPL.xlsx . This qualified product list (QPL) contains the power consumption, model numbers, and other relevant details. Energy Commission staff considered each configuration of a model as a separate listing. For example, if model XYZ had a listing for category A, B, C, and D, the listing was broken down into four listings, one for each category.

To calculate the baseline unit energy consumption, an equal weighting was applied to each listing, essentially translating to the average of the QPL annual energy use listing for a form factor.

To calculate the energy savings under the proposed regulations, the energy consumption for products that did not comply were altered to a level where they would exactly comply. The energy consumption for products that met or exceeded the proposed regulations was unchanged. Staff illustrated this methodology in the slide presentation on April 15, 2015 on slide 31 (available here: http://docketpublic.energy.ca.gov/PublicDocuments/14-AAER-02/TN204227_20150416T150956_Computers_presentation.pdf) and mentioned it on page 22 of the staff report.

Energy Commission staff took a slightly different approach for workstations and small-scale servers in how the baseline units were transformed to "compliant" units. In this case the individual power consumption figures, reported in the ENERGYSTAR 5.2 QPL, were modified by an assumed improvement in power conversion efficiency consistent with the upgrade from an 80 plus certified power supply to an 80 plus gold level power supply. For sleep- and off-mode power, the baseline efficiency was 78% and was improved to 82%. For idle mode power, the baseline efficiency was 80% and was improved to 87%. These differences were determined using the 80 plus program's certification requirements and data, both of which are available here: http://www.plugloadsolutions.com/80pluspowersupplies.aspx The measured power levels were translated by using the following equation: $P_{improved} = P_{measured} \times \frac{Percent\ Efficiency\ Baseline}{Percent\ Efficiency\ Improved}$. The resulting power levels were multiplied by the

ENERGYSTAR duty cycles to generate annual energy usage of improved units, and then calculate energy savings.

Collaborative Labeling and Appliance Standards Program's (CLASP) market study, submitted to the Energy Commission and referenced on page 14 of the staff report, provides evidence that the ENERGYSTAR 5.2 QPL and the levels of performance contained within it are representative of the general computer marketplace. The study is available, as referenced on page 14 of the staff report, docketed, and posted on the CEC website, as well as CLASP's own website at: http://www.clasponline.org/en/Resources/Resources/PublicationLibrary/2014/Data-on-China-Computer-Market-Reveals.aspx .

Additional savings from energy efficient Ethernet and power management settings were not calculated and were assumed not to add cost to products.

2. Cost Data

The Energy Commission compares incremental costs to average unit energy savings, to determine cost-effectiveness of the proposed standards. Staff derived average unit energy savings as described above. Incremental costs and methodology depend on the form factor and relevant requirements described below.

To determine the incremental costs for notebooks, staff looked at both hardware and software approaches to reducing energy consumption. The wide array of device states and power management protocols allows currently available notebooks to comply. For notebooks that do not comply, the marginal improvement needed is generally very small. This is also reflected in the energy savings, which are estimated to be small relative to desktops. The incremental costs of $1 for notebooks are discussed on pages 21 and 22 of the staff report, which cites pages C-27 and C-28 of the October 27, 2014 comment letter from the investor-owned utilities (IOUs) and NRDC, available at : http://www.energy.ca.gov/appliances/2014-AAER-01/prerulemaking/documents/comments_12-AAER-2A/California_IOUs_Standards_Proposal_Addendum_Computers_2014-10-27_TN-73899.pdf. The incremental costs were derived by diluting extra engineering costs amongst unit sales. The software/firmware revision approach is expected to yield the small incremental savings necessary to meet the standard.

The desktop incremental costs build from this laptop incremental cost. The estimated engineering and design work was doubled to represent the larger gap between non-compliant desktop computers and the proposed regulation. The incremental cost incorporates current trends in desktop parts and device protocols. Desktop processors have incorporated many of the power management and efficiency features that were only separately available in notebook processors. Similar trends are apparent in optical drives, hard drives, and graphics cards. The incremental cost does not characterize major part swapping, such as those described in comments by ITI and the IOUs.

Instead, it characterizes clever design and implementation of features that are available and expected to be common in 2018 (the effective date.) The combination of this design effort along with technology advancement is characterized in slides 14 through 22 of the computer presentation as well as pages 21 and 54-57 of the draft staff report.

Small-scale server and workstation incremental costs are based on upgrading an 80 plus certified power supply to an 80 plus gold power supply, as described in the staff report on page 19 and in the workshop presentation on slide 32. Staff reviewed three sources of cost information when looking at the incremental cost of the 80 plus power supply: ITI's May 9, 2013 comment letter, Greentech Leadership Group's May 9, 2013 comment letter, and the CA IOU's August 6, 2013 comment letter, all available in the Commission's docket. From this information, staff arrived at an incremental cost of $13.00, which is the highest cost estimate provided by the IOUs. The IOU estimate is based upon isupply BOM data and DOE markup methodologies. (See IOU August 6, 2013 comment letter, p. 35). ITI's incremental costs show higher incremental costs than estimated by the IOUs ($14.00-25.50), but these were based on a less efficient baseline unit at 68% efficiency. (See ITI May 9, 2013 comment letter, p. 19.) Although this incremental cost is higher, the proposed standard would also result in a significant increase in incremental savings, as the baseline unit used for staff's analysis had 80% efficiency.

3. Technology Data

Notebooks already to a large extent comply with the proposed standards. Staff believes in most cases the 1-3 kWh/yr that many models need to shed to gain compliance is achievable through more aggressive implementation of existing power management (firmware/software changes). While there are other pathways that cost significantly more money, staff assumes that manufacturers will choose the lowest compliance cost pathway.

Staff did not estimate incremental costs for incorporating "laptop-like" efficient devices in desktops. That is because using laptop parts to comply with the desktop standards is unnecessary given the advances in device power management that exist in the latest products on the market. The latest processors and associated chipsets for desktops already incorporate much of the idle device power management features that exist in laptops. These are reviewed and discussed in the staff report and presentation. The technologies that are being incorporated are standard in the latest devices, and certainly should be widely proliferated by 2018. However, realizing idle power savings is more difficult in desktops than in laptops because desktops have a larger array of customization and configurations. Thus, more effort will be necessary to ensure that the system, as a whole, is utilizing these features.

Staff determined that devices have these capabilities by analyzing system power in a "bottom up" approach. Each desktop sub-system, as identified in the ITI July 9, 2013 comment, was reviewed relative to current technology. The updated levels were determined using documentation regarding SATA protocols and device specification sheets and confirmed by product review websites that test performance. Tom's Hardware is an example of one such site. The findings are summarized in Appendix A of the staff report.

Attachment B: Display Data

1. Product Performance Data

Staff's proposal is based on an analysis of existing ENERGYSTAR data as well information and data provided by the IOUs in their standards proposals, which are available in the rulemaking docket at: http://www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/12-AAER-2A_Consumer_Electronics. Energy Commission staff utilized test data in the IOUs' CASE Report and Technical Report, available at the link above.

The report outlines power consumption and configuration of each pair of tested models across three of the most popular sizes sold today: 19", 22", and 27". For each pair, two models were selected to represent the range of energy efficiency of displays currently on the market. To further represent the display market, the IOU team selected models from six different major manufacturers. Details on the tested models are explained in Section 3 of the IOUs' Technical Report and summarized in Table 3.1 (pasted below).

Table 3.1 Features of Units Tested

Test Unit Description	Representative	Efficient	Representative	Efficient	Representative	Efficient
Test Unit ID	D19-1	D19-2	D22-1	D22-2	D27-1	D27-2
Diagonal Viewable Screen Size	18.5	18.5	21.5	21.5	27	27
Contrast Ratio	10,000:1	Not Listed	1000:1	1000:1	3,000:1	1000:1
Response Time (ms)	5	5	8	5	8	7
Power Supply	Internal	Internal	External	Internal	External	Internal
Panel Type	TN	TN	IPS	TN	TN	IPS
Weight (kg)	2.8	2	2.5	3.8	6.1	5.3
Video Ports	VGA	VGA	DVI, VGA	DVI, VGA, HDMI	DVI, VGA, DisplayPort	DVI, VGA, HDMI
Reported Brightness (cd/m^2)	200	250	250	250	300	270
Horizontal Viewing Angle (deg)	90	170	178	170	170	178
Vertical Viewing Angle (deg)	50	160	178	160	160	178
Network Ports	None	None	None	None	None	None
Backlight	CCFL Edge (top and bottom)	LED Edge (bottom)	LED Edge (bottom)	LED Edge (side)	LED Edge (bottom)	Led Edge (side)
ABC	No	No	No	No	Yes	No
Power scaling mode	Yes	Yes	Yes	Yes	No	Yes
ENERGY STAR Reported Power (W)	13.6	11.7	23.1	14.6	29.3	20.0

The test methodology used by the IOUs to develop their comment was also explained in detail in Section 3 of the Technical Report on page 8. Detailed results of the testing are outlined in Section 4 of the Technical Report on pages 11-30.

2. Cost Data

Chapter 14 of the staff report discusses the energy savings and cost analysis. Staff analysis is based on the data and information from IOUs' Technical Report in Section 3.5 on page 11. The IOUs used cost information from DisplaySearch, which is an industry-accepted resource available for purchase or subscription. In addition, staff investigated the cost of compliant monitors available on online retailers to confirm that the IOU incremental cost estimates reflect current retail prices.

Staff also relied on the incremental cost analysis outlined in Section 5 of the IOUs' Technical Report and summarized in Figures 5.2, 5.3, and 5.5 on pages 34, 35, and 40 respectively.

3. Technology Data

Staff discusses the technical feasibility of display improvements on pages 38 to 40 of the draft staff report. Manufacturers can use various technology options to improve the efficiency of computer monitors to comply with the proposed standards. Table 4 in the staff report specifically shows a number of options that manufacturers can use to comply with the proposed standard, including improving the back light unit efficiency by using high efficacy LEDs; optimizing use of light by using combinations of films and reflective polarizers; using panels that have greater transmittance, using color filters, including 80-88 percent efficient power supplies that would reduce the power conversion losses; or managing power with automatic brightness control sensor technologies.

Staff has also analyzed the IOUs' response to the Energy Commission's invitation for standards proposals, available at: http://www.energy.ca.gov/appliances/2013rulemaking/documents/proposals/12-AAER-2A_Consumer_Electronics/California_IOUs_Response_to_the_Invitation_for_Standards_Proposals_for_Electronic_Displays_2013-07-29_TN-71760.pdf. Staff evaluated and used information from the IOUs' standards proposal for electronic displays on pages 34-37 and pages 55-62.

Staff also considered the technologies outlined in the IOU's Technical Report in Table 5.4, which highlighted multiple pathways for a model (that would otherwise not be able to meet the proposed level) to meet the proposed level for each screen size tested (19", 22", 27"). Table 5.4 is pasted below:

Table 5.4 Descriptions of Cost-Effective Strategies

Diagonal Screen Size	Representative Display (Measured)	Cost Effective Strategy 1	Cost Effective Strategy 2	Cost Effective Strategy 3	Cost Effective Strategy 4
19"	On Mode: 20.01W PSU: 80% Reflective Polarizer: None Lamp Efficacy (CCFL): 47lm/W Screen Brightness: 255 nits Global Dimming: None ABC: None	On Mode: 5.9W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 110lm/W Screen Brightness: 200 nits Global Dimming: Yes ABC: Yes	On Mode: 9.44W PSU: 88% Reflective Polarizer: None Lamp Efficacy (LED): 110lm/W Screen Brightness: 255 nits Global Dimming: Yes ABC: None	On Mode: 9.16W PSU: 88% Reflective Polarizer: None Lamp Efficacy (LED): 110lm/W Screen Brightness: 200 nits Global Dimming: None ABC: None	On Mode: 8.55W PSU: 83% Reflective Polarizer: Yes Lamp Efficacy (LED): 125lm/W Screen Brightness: 255 nits Global Dimming: None ABC: None
22"	On Mode: 29.42W PSU: 87% Reflective Polarizer: None Lamp Efficacy (LED): 105lm/W Screen Brightness: 275 nits Global Dimming: Not enabled by default ABC: None	On Mode: 13.78W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 110lm/W Screen Brightness: 200 nits Global Dimming: Enabled by default ABC: Yes	On Mode: 14.34W PSU: 87% Reflective Polarizer: None Lamp Efficacy (LED): 110lm/W Screen Brightness: 241 nits Global Dimming: Enabled by default ABC: None	On Mode: 13.33W PSU: 87% Reflective Polarizer: Yes Lamp Efficacy (LED): 105lm/W Screen Brightness: 241 nits Global Dimming: Enabled by default ABC: None	On Mode: 14.73W PSU: 87% Reflective Polarizer: None Lamp Efficacy (LED): 125lm/W Screen Brightness: 241 nits Global Dimming: Not enabled by default ABC: None
27"	On Mode: 38.38W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 87lm/W Screen Brightness: 400 nits Global Dimming: None ABC: None	On Mode: 17.25W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 110lm/W Screen Brightness: 170 nits* Global Dimming: Yes ABC: None Improved TFT (low)	On Mode: 20.04W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 107lm/W Screen Brightness: 170 nits Global Dimming: None ABC: Yes	On Mode: 19.36W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 110lm/W Screen Brightness: 170 nits Global Dimming: Yes ABC: None	On Mode: 19.62W PSU: 88% Reflective Polarizer: Yes Lamp Efficacy (LED): 107lm/W Screen Brightness: 170 nits Global Dimming: Yes ABC: None