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NRDC comments on CEC March 2016 staff report on computer and monitor efficiency standards

Additional submitted attachment is included below.

NRDC
NATURAL RESOURCES DEFENSE COUNCIL

NRDC Comments on CEC Staff Analysis of Computers, Computer Monitors, and Signage Displays

2015 Appliance Efficiency Pre-Rulemaking
Docket Number 14-AAER-2

May 23, 2016

Submitted by:
Pierre Delforge, Natural Resources Defense Council

On behalf of the Natural Resources Defense Council and our more than 380,000 members and online activists in California, we respectfully submit these comments on the California Energy Commission's (CEC) Appliance Efficiency Pre-Rulemaking Staff Report on Computers, Computer Monitors, and Signage Displays.

We strongly support CEC's initiative to develop energy efficiency standards for computers and displays. Computers and displays are responsible for roughly 3 percent of total electricity consumption in California. Realizing cost-effective energy savings in plug-in equipment, which represent approximately two thirds of building electricity use in California[1], is a critical strategy to help achieve the state's clean energy and carbon reduction goals.

CEC's proposed standards have the potential to reduce computer and display energy consumption by one third after stock turnover, saving 2.5 billion kilowatt-hours of electricity annually, equivalent to the consumption of all the households in the city of San Jose. This would also put $400 million back in Californians' pocketbooks from avoided electricity bills, and reduce carbon pollution by 780,000 tons CO2 annually.

We commend CEC for its leadership on appliance efficiency standards, and particularly on electronic products, a category whose energy use is growing rapidly and for which few standards already exist globally. CEC developed the first efficiency standards in the world for external power supplies, televisions, and products with rechargeable batteries. These standards were met more cost-effectively than expected, ahead of schedule, and with no negative impact on the market. In addition, the standards helped drive innovation and the new products not

111 Sutter Street
21st Floor
San Francisco, CA 94104
TEL 415 875-6100 FAX 415 875-6161

only save consumers energy but perform better than those produced before the standards went into effect. For example, televisions have larger screens, higher resolutions, and more features, yet are cheaper to buy and use less energy than before CEC adopted TV standards in 2009.

California has long provided leadership in energy efficiency standards to the country and the world. California is home to one in eight consumers in the nation, which means that CEC efficiency standards have far-reaching effects, driving energy efficiency improvement both within the state and outside of California. CEC standards can create de facto national standards, strongly influence potential federal standards, and even influence international markets. We expect that CEC's work on computers and displays will be similarly influential. For computers, CEC's work is especially timely given that the US Department of Energy standards development process is in its early stages.

CEC's staff proposal is a sound basis for computer efficiency standards, and **we urge CEC to finalize this rulemaking by the end of this year**. In order to finalize the proposal, some key details need to be refined in order for the standards to be effective and achieve expected benefits. We summarize these points below and refer to the attached joint California Investor-Owned Utilities (IOUs)-NRDC response for details.

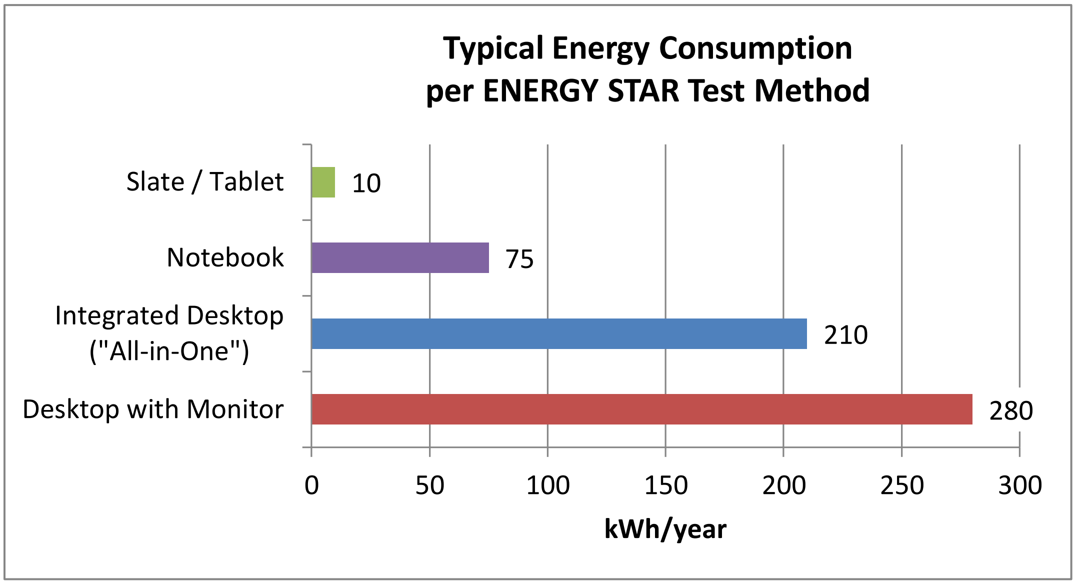
A. COMPUTERS

1. CEC's proposed computer standards are technically feasible and cost-effective

Computers present a large cost-effective savings opportunity: The typical home and office computers spend the majority of their time while turned on doing little or no work, such as when users are away from their desks, or even when users are typing or reading information, an activity which requires very little processing power. However, computers still draw much higher power than needed in these low-activity states. This is particular true with desktop computers that manufacturers often don't optimize for energy efficiency because they have access to unlimited energy from the wall outlet. Mobile computers, on the other hand, are designed to be efficient so as to last as long as possible when relying solely on battery power.

Figure 1 illustrates the typical energy consumption of different types of computers. Figure 1 shows energy consumption mostly in idle mode, when computers don't perform any work, per the ENERGY STAR test procedure. The large differences in energy consumption in idle mode are indicative of the respective typical levels of energy efficiency of these computer types.

Figure 1: Relative energy consumption of typical computers



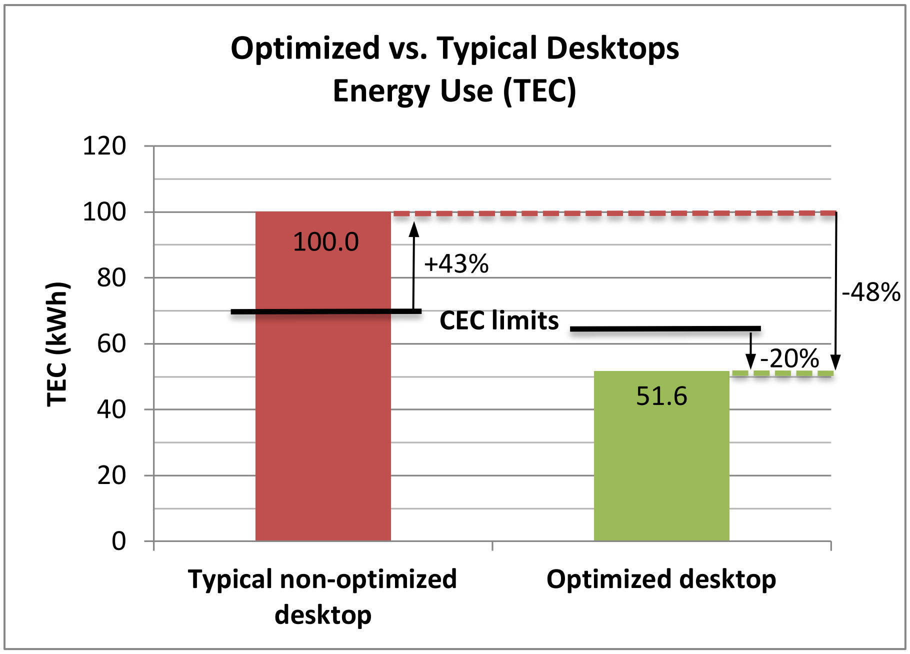
Energy efficiency standards are necessary to compensate for failure of market incentives to drive the adoption of cost-effective energy efficiency design best practices in computers, particularly desktops but also laptops.

We have demonstrated that CEC's proposed levels are technically feasible and cost-effective: NRDC and its partners carried out two projects to demonstrate the technical feasibility of CEC's proposed standards: 1) We developed a prototype relatively high-performance desktop computer that draws half the power of an equivalent, non-optimized computer in idle mode at little extra-cost; 2) We did a comparative tear-down of two commercially available all-in-one computers, a typical efficiency model and a high-efficiency model, to identify the strategies employed by the more efficient design.

i) High-efficiency desktop demonstration prototype

NRDC worked with electronics power-management firm Aggios and the California investor-owned utilities to optimize energy efficiency on a typical desktop computer. We were able to reduce idle power by half compared with an equivalent non-optimized machine, and beat CEC's proposed standards by 20 percent as shown in Figure 2.

Figure 2 – High-efficiency Desktop Demonstration Prototype



This was achieved using a combination of zero-cost strategies such as optimizing power management settings (getting the CPU to fully utilize its low-power states such as C8), and low-cost strategies such as selecting commonly available more efficient components (DDR4 memory, efficient motherboard and disk drive), as well as a prototype high-efficiency power supply developed by Power Integrations and ROHM Semiconductor from off-the-shelf components.

We did not have time to implement a hybrid solid state drive (SSD)-hard disk drive (HDD) solution that would power down the HDD after 5 minutes of inactivity, which would have yielded significant further savings.

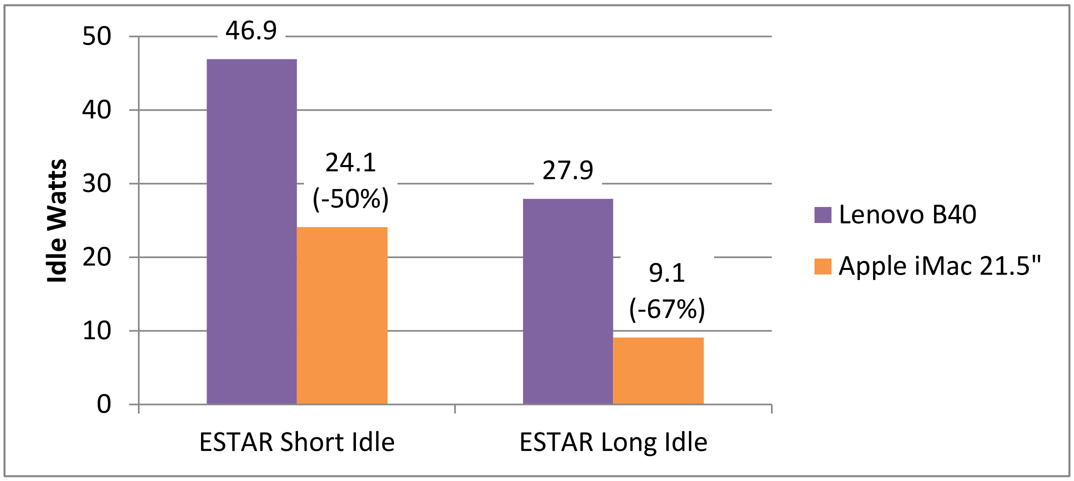
The optimized desktop added less than $10 to the purchase price of the machine (retail price of components without tax or shipping), saving five times that amount in lifetime operating costs. More details on this prototype are included in the IOU comments.

ii) Comparative tear-down of two all-in-one computers

We also performed a tear-down of two commercially available all-in-one computers to identify the strategies employed by the more efficient design. One computer was a typical efficiency model and the other a high-efficiency model. Both had comparable screen size and resolution and other performance characteristics.

The efficient model drew half the power of the other in short idle mode (display on) and a third the power in long idle mode (display off) as shown in Figure 3.

Figure 3 – Idle power of two all-in-one computers



Component-level measurements identified differences in power consumption as being caused by a combination of settings, software and hardware strategies including display auto-brightness control, a more efficient display, better processor power management, lower-power drives, more efficient motherboard, shorter sleep timers, and faster wake time from sleep, all while performing better relative to a computing performance benchmark.

The iMac is significantly more expensive than the Lenovo, and this may explain part of the efficiency difference in some components such as the display. However most of the efficiency improvement opportunities, such as settings tuning and software power management, could be implemented at little or no cost, and are therefore not constrained by price. Efficiency appears to be a small factor in the price difference between the models.

The detailed configurations, findings and methodology are available in the project report which is docketed separately and also available online.[2]

This comparison clearly shows that it is possible to cut idle power draw of commonly available computers by half or more, and that some computer models launched in 2014 can already achieve standards due to go into effect in 2018.

There are many cost-effective opportunities to reduce idle power in computers: The technology to cut computer power draw in idle mode exists and is already widely used in the market. To achieve CEC standards, manufacturers have a range of options:

[2] https://www.nrdc.org/sites/default/files/aggios-aio-report-20160429.pdf

a) **Optimize power management settings**: current CPUs offer very low-power idle modes, but those are often not fully enabled by manufacturers, as demonstrated by our all-in-one comparison projects where neither computer fully optimized CPU power management (such as package C-states). Motherboard ports often remain powered on even when nothing is plugged into them. Disks continue to spin even in long idle mode after 15 minutes of user inactivity.

b) **Select the more efficient components available on the market**: From display LED backlights, to DDR 4 memory, to hybrid SSD-HDD disks that spin the HDD down after 5 minutes of inactivity, to power supplies that maintain high-efficiency at idle load, there are many energy efficient components available on the market capable of cutting energy waste when a computer is idle at minimal extra-cost. CEC estimates $18 in added cost to achieve its proposal, our prototype added less than $10 to the system price while generating more than $50 in electric bill savings over the life of the computer. The rate of technology change in the computer industry is so rapid that these costs will likely be even lower by the time that the proposed standard comes into effect.

CEC's proposed standards are performance-based, leaving manufacturers the choice of using the combination of options that works best for them. This approach also fosters innovation by allowing industry to develop new, more cost-effective ways to comply.

The stringency of CEC's proposed standard is appropriate: While the standards are ambitious for some computer categories, particularly for mainstream desktops, ambition is justified because this category of products has typically not been optimized for energy efficiency. We have demonstrated the technical feasibility and cost-effectiveness of achieving the proposed efficiency levels <u>today</u>, which means that they will be definitely achievable 18 months from now by CEC's proposed effective date of January 2018.

Ambitious savings are key to achieving available energy savings: Setting standards that most computers on the market already meet would yield limited savings. These standards are an important opportunity to capture readily achievable energy savings. In an age where the existential threat of accelerating climate change requires us to dramatically reduce our GHG emissions, these standards present an important opportunity to do so using existing, readily available and affordable technology, while saving consumers and businesses money. It would be unfortunate not to take advantage of one of the cheapest, easiest and fastest opportunities to cut energy waste and accelerate our transition to clean and efficient energy use.

CEC's proposed standards are also far from the highest cost-effective energy savings possible, as demonstrated by our prototype which beats CEC's level by 20% by employing just a few of the available efficiency strategies for computers. CEC's proposed standards are particularly weak for notebooks where they yield little to no savings, and for integrated displays where the current proposal is far more lenient than warranted by current technology.

2. **<u>While CEC's proposal is sound, some key refinements are necessary to ensure the final standards are effective</u>**

a) Two tiers to maximize savings

NRDC's key priority for this rulemaking is to maximize cost-effective energy savings. While CEC's proposed levels are technically feasible today, we are open to a two-tier approach where a less ambitious tier 1 can be achieved early through easy-to-implement power settings optimizations and relatively minor software changes, and tier 2 gives industry more time to implement the engineering changes and the supply chain transition necessary to achieve CEC's proposed levels.

Tier 1 would guarantee early saving and tier 2 would maximize long-term saving while giving industry reasonable time to implement the most complex engineering and supply chain changes.

We believe 1/1/2019 is an appropriate timeframe for Tier 2 given that CEC's proposed levels are technically feasible and cost-effective today, 2 ½ years before this date. And tier 1 could go into effect on 1/1/2018. We do not propose specific Tier 1 levels, they would have to be discussed with stakeholders if this two-tier approach is considered.

b) Expandability adder

NRDC strongly supports CEC's proposal to give computers an adder based on their capacity to expand by accommodating additional graphics cards, HDDs, etc. This reflects the physical reality where more expandable computers draw more power in idle because of the power demand of expandability interfaces, and because of the lower efficiency of larger power supplies required to support this expandability. This approach ensures a longer shelf-life for the standards than the current ENERGY STAR 6 approach, and than any approach based on rapidly evolving technical specifications.

However, CEC should simplify this expandability score to make it more reliable (reducing the risk of errors), easier to enforce, and more durable as new types of expansion interfaces appear on the market during the life of the standards.

We urge CEC to consider the IOUs-NRDC proposed simplified expandability score and power supply size hybrid approach laid out in the IOU comments. This simplified approach can be adopted independently of stringency, it is a better, simpler, and more durable metric for minimum efficiency standards.

c) Some allowances and adders are far too generous and should be reduced.

CEC's proposed adders for all-in-one and notebook displays are inappropriate, especially for high-resolution screens where the adder can be several times the base allowance for the system. CEC's proposal would create a large loophole for all-in-ones and notebooks. We urge CEC to align the adders for integrated desktop displays with its proposed standards for standalone displays, with necessary adjustments for test luminance, and to set notebook display adders at the median of the ENERGY STAR dataset, as proposed in the IOU comments. This will ensure display adders are balanced and support effective standards for all-in-one and notebook computers.

CEC's proposed **disk adder** is also too high. It is based on ENERGY STAR v5 levels, set in 2008, and no longer representative of current technology. We urge CEC to set an appropriate disk adder as proposed in the IOU comments.

Nearly all mainstream **notebooks** already on the market can achieve CEC's proposed allowances, and therefore the proposed standards would yield no significant savings for notebooks. We urge CEC to consider the alternative proposal for notebooks laid out in the IOU comments. This balanced proposal would eliminate the least efficient half of notebooks currently on the market, achieving modest but important savings.

d) Power supply requirements

We strongly recommend that CEC sets 80-PLUS Bronze level efficiency requirements at 20% and 50% load, as well as power factor requirements at those load points.

CEC did not propose specific requirements for power supply efficiency, on the basis that the TEC requirements already provide a strong incentive for power supply efficiency at idle load. However, idle load efficiency as measured by the ENERGY STAR test procedure is not indicative of active mode efficiency. Active efficiency requirements remain critical to ensure real-world savings. Active mode efficiency requirements will ensure that manufacturers don't just design to the test but also to real-world energy savings.

The IOUs estimate that correcting desktop power factors to 0.9 in idle mode would save up to an additional 46 GWh/yr statewide (about 2 kWh/yr per desktop) on the consumer side of the meter, with additional savings on the utility side of the meter. While distribution-level savings cannot be counted as direct customer benefits, they add up and represent real energy losses, unnecessary generation capacity, and GHG emissions.

e) Test computers with brightness as shipped with minimum luminance

The ENERGY STAR test method of calibrating display brightness before testing is not representative of real-world energy use. It does not incentivize manufacturers to optimize display brightness settings on their computers, and it can result in a weakening of the standards by 20 percent or more as shown by our testing of two all-in-one computers.

111 Sutter Street
21st Floor
San Francisco, CA 94104
TEL 415 875-6100 FAX 415 875-6161

We urge CEC to adjust its test procedure so that displays are tested as shipped, with a minimum brightness level corresponding to the ENERGY STAR test brightness levels. The minimum will ensure that displays are not shipped with artificially low brightness levels.

This test procedure change will encourage manufacturers to optimize the display brightness of their products or ship them with auto-brightness control. This is a large energy saving opportunity which costs nothing.

f) Definitions

Precise definitions of products, features and components are critical to ensure there are no loopholes in the standards and that the standards are clear and enforceable. We generally agree with CEC's intended scope, but recommend some adjustments for clarity, as proposed in the IOU comments.

g) Duty Cycle / Mode Weightings

We urge CEC to only allow the conventional duty cycle in the TEC calculation. Allowing the network connectivity duty cycle from the ENERGY STAR specification is not appropriate for a regulatory program, because this duty cycle was meant as an incentive, and is not based on data. It could result in a loss of 10 percent of energy savings from the CEC standards.

3. Conclusion

The IOUs, NRDC and their partners have provided strong evidence that CEC's proposed standards are technologically feasible and cost-effective, from market analyses, to demonstration prototypes, measurement of the power draw of security and management features, and the comparison of typical and high-efficiency all-in-one computers.

Setting strong California standards for computers and monitors is important for many reasons at both state, national and international levels:

- It will save Californians money while leveraging some of the cheapest energy savings available to help achieve the state's energy and climate goals;
- It will benefit all Americans as the national market and even the international markets largely adopt California standards;
- It will provide U.S. DOE and the European Union a strong foundation to set their own standards;
- It will encourage EPA to set more stringent voluntary leadership standards, allowing consumers, businesses, and governments to further reduce their energy consumption and greenhouse gas footprints.

B. COMPUTER MONITORS

The energy use of computer monitors and signage displays is growing in California, driven by an increase in screen sizes, resolution (4K and higher resolutions), and the proliferation of multiple-display configurations in offices, and of signage displays in commercial and public spaces.

NRDC strongly supports CEC's proposed on mode power limits for monitors between 17 and 25 inches, and sleep and off mode levels. The data docketed by the IOUs throughout this rulemaking shows that these levels are technically feasible, cost-effective, and already achieved by a large share of the market.

We urge the CEC to consider the following adjustments to its proposal, in order to maximize cost-effective energy savings:

1) Coverage for models smaller than 17 inches diagonal

We urge CEC to include displays smaller than 17-inch in the scope of the standards. This is important to prevent a loophole where these manufacturers could use the cheapest and most inefficient components and designs in these products absent standards.

Industry expressed concerns that the market share of displays smaller than 20-inch is declining and does not support the investments necessary to improve their efficiency. We dispute this argument for several reasons:

a. The majority of small displays currently on the market already meet ENERGY STAR On mode levels according to the IOUs' analysis;
b. While the market share of small standalone displays is declining, these display sizes continue to be manufactured in large volumes for notebook computers. Notebook computer sales are expected to remain large enough in the foreseeable future to justify investments in efficiency in sub-20-inch display sizes.

2) More stringent levels for models larger than 25 inches diagonal

While CEC's proposal is appropriate and aligns well with ENERGY STAR for displays up to 29-inches in size, it provides much larger allowances than ENERGY STAR for larger sizes. We urge CEC to consider the IOU proposal to set an additional size bin with more stringent levels above 29 inches, as proposed in the IOU comments.

3) Smaller allowances for enhanced performance displays (EPDs)

We are concerned that CEC's revised EPD allowance is overly generous and will provide a loophole as EPDs gain ever-greater market share. We strongly support the IOUs recommendations to provide no EPD allowance for Type I (sRGB) EPDs as models currently widely available in the market demonstrate that they require no additional power.

We also recommend that CEC reduce the allowance for Type II (Adobe RGB) EPDs to 0.4, and then phase it out after 2 years, as there is strong evidence that display technology will provide cost-effective compliance pathways by then.

4) Test displays with brightness as shipped with minimum luminance

As with computer integrated displays, we urge CEC to adjust its test procedure for standalone displays so that they are tested as shipped, with a minimum brightness level corresponding to the ENERGY STAR test brightness levels.

We appreciate the opportunity to provide this input to the CEC, and thank CEC for its careful consideration of our comments.

Respectfully submitted,

Pierre Delforge
Director, High Tech Sector Energy Efficiency
Natural Resources Defense Council
111 Sutter St, 21st Floor
San Francisco, CA 94104
(415) 875-6100
pdelforge@nrdc.org