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NRDC Comments on CEC Computer and Displays Staff Report

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 29, 2015

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 to 4 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 2.7 billion kilowatt-hours of electricity annually, equivalent to the consumption of all the households in the city of San Jose. This would also put $430 million back in Californians' pocketbooks from avoided electricity bills, and reduce carbon pollution by one million 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 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 almost always outside of California. CEC standards can create de facto national standards, provide a floor for future national regulatory minimums 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.

Standards are necessary for computers and displays because there is a large and cost-effective potential for energy savings that is not being adopted voluntarily by the market. Contrary to mobile battery-powered products such as smart phones and tablets which have become extremely efficient due to market incentives to maximize battery life, desktop computers which have access to virtually unlimited power from the wall have not made as much progress. For example, a recent commercially available desktop computer (March 2015), was found to use a power supply which is only 55% efficient in idle mode, meaning that nearly half of the energy use of the computer is wasted in the power supply, when 80-percent efficient power supplies are broadly available and cost-effective. Other computers were found not to implement the energy-saving settings such as the low-power C7 processor states, that can significantly reduce idle power consumption with no impact on performance. These examples demonstrate the need for standards to ensure that cost-effective efficiency technologies available in the market today are implemented systematically, and consumers are not left to bear the consequences of unnecessarily high levels of energy waste.

The draft standards proposed in the staff report are a good start, and we urge CEC to strengthen them in several areas to make them more effective and achieve larger benefits. In addition to the attached joint NRDC-California Investor-Owned Utilities (IOU) response, we provide below a summary of the key points.

A. Computers

CEC's proposal consists of a base allowance with additional allowances (or adders) depending on the performance and functional capabilities of each computer, such as screen size. Like ENERGY STAR v6, the draft standards cover idle modes (short idle when the display is on, and long idle when the display is off), sleep mode and off mode, wrapped together into a single equation to derive the estimated annual Typical Energy Consumption (TEC).

1. Desktop Computer Base Allowance

CEC's draft standards for desktops are technologically feasible and cost-effective today. The Aggios computer optimization demonstration at the April 15, 2015 workshop showed that mainstream desktops can be optimized to meet proposed standards, with a combination of software configuration changes and cost-effective power supply replacement.

The base allowance for desktops is appropriate for current technology, but should be **reduced** to account for expected technology improvements by the effective date of January 2018. Computer technology is making rapid progress on energy efficiency, the current trend is expected to continue and should be taken into account when setting standards that do not go into effect until 2018.

2. Integrated Desktop Computer Base Allowance

Integrated desktop computers, or "All in Ones", are desktop computers with integrated displays. We support CEC's proposal to use same base allowance for integrated as for conventional desktops. While the total allowance is too high as explained in NRDC's April 15 workshop presentation, we found that this is largely due to overly generous adders. Once the display and memory adders are adjusted as proposed by advocates, the proposed base allowance is adequate for current technology. However it should be reduced to account for 2018 technology as with conventional desktops.

3. Notebook Computer Base Allowance

While notebooks are already more energy efficient than desktops, they represent roughly two thirds of computer sales, and their aggregate energy consumption is expected to surpass that of desktop computers over the next decade. Large energy saving opportunities remain as evidenced by the 2.5:1 difference in energy consumption between comparable notebooks currently on the market per NRDC's April 2015 workshop presentation. It is therefore critical that the standards set appropriate limits for notebook computers.

CEC's proposed base allowance for notebooks is significantly too high and undermines the effectiveness of the standards for notebooks. NRDC's workshop presentation showed that two mainstream notebook computers easily meet CEC's proposed limit today with out-of-the-box settings: the Apple MacBook Pro 13-inch with Retina display achieve **78%** lower Typical Energy Consumption (TEC) than CEC's proposed level, and the Dell Latitude E6440, 13-inch 24% lower despite using 2.5 times the annual energy of the MacBook Pro with an equivalent screen size and performance. Almost all notebooks on the market would meet the proposed levels by 2017.

This is due in part to the overly generous display adder, but even then, the base allowance is still significantly higher than necessary. Once the display adder is adjusted as proposed by advocates, **we recommend a base allowance of 19 kWh/y**, which corresponds to the median over the last 10 months (July 2014-April 2015) high-performance (I3 category) notebooks in the ENERGY STAR Qualified Product List (QPL), which is 24 kWh/y, discounted by 10 percent twice to account for the annual natural TEC reduction trend by 2017. The availability of hundreds of units that meet these levels across all price ranges demonstrates that they are technologically feasible and broadly available in the market today.

4. Thin Client Base Allowance

By definition thin client are computers with lower capabilities than desktop computers. For example, they typically have no rotational storage media (hard disk, optical disk). As such they should be able to meet lower limits than desktop computers. ENERGY STAR v6 sets different limits for thin clients and desktops. **We propose a specific thin client base allowance set at the desktop allowance minus the storage adder**, reflecting the fact that thin clients typically don't have permanent storage media and therefore don't need to include storage media power in the idle levels.

5. Display Adder

Display adders are necessary to account for the energy used by the display of integrated desktops and notebooks in short idle mode. However, the display adders proposed by CEC based on ENERGY STAR v6 are far higher than required by current display technology, and would result in ineffective standards for integrated desktop and notebook computers. **We propose revised display adders based on the real power needs of current display technology per the ENERGY STAR v6 QPL.**

In a TEC approach where excessive adders can give inefficient systems a free pass to comply, it is critical to get large adders right. This applies to display adders which are of the same order of magnitude as the base allowance for the system: an average of 53 vs 50 kWh for integrated desktops, 15 vs. 30 kWh for notebooks.

Our proposed display adder uses the same type of equation as EPA's ENERGY STAR v7 draft 2 specification. It takes into account screen size and resolution, allowing higher energy use for large displays and those with higher resolution.

6. Discrete Graphics Adder

We generally support CEC's proposal to provide no adders for discrete graphics, because most computers have integrated graphics (either on the main processor or on another motherboard-mounted component). They can switch from discrete to integrated graphics, through solutions such as graphics switching or hybrid graphics, which are already widely available in notebooks, and are becoming more common in desktops too. Graphics switching solutions appear to be very cost-effective, based on industry cost estimates. The energy consumption of integrated graphics is already part of the base allowance of the system.

We support the inclusion of discrete graphics adders for the small minority of computers that do not have integrated graphics and therefore cannot implement graphics switching. The advocates are conducting further testing to determine appropriate levels for these adders, and will docket a recommendation within the coming month or two.

As for displays, discrete graphics adders can be large, as large or larger than the base allowance for the system. As such, providing adders for discrete graphics when not needed would create a large unwarranted allowance for the rest of the system, and would allow many otherwise inefficient computers to comply, leaving substantial cost-effective energy savings on the table.

7. Memory Adder

CEC's proposal relies on ENERGY STAR v6 memory adders which are outdated (developed based on 2010 to 2012, i.e. 3 to 5 year-old data), inconsistent with the driving factors behind memory energy use, and most importantly, overly generous. For systems with 64 GB of memory, this allowance can amount to 50 kWh/y, equivalent to the base allowance for desktops, and higher than the base allowance for notebooks. And this large allowance does not correspond to real energy consumption in computer systems.

Advocates' research and testing indicates that a **per memory module (known as DIMM) approach** is a far better match for the real power impacts of memory than a per GB approach**. We propose a 2 kWh per DIMM adder from the second DIMM**, which correspond to tested DDR3 levels. We are currently testing DDR4 memory and may adjust this proposal accordingly.

8. Secondary Storage Adder

In its March 2015 staff proposal, CEC included a 26 kWh/y allowance for secondary storage drives. This allowance is unnecessary: primary storage drives need to remain active during idle mode to provide the operating system with quick access to critical files; however, secondary hard drives—which mainly exist to provide storage for extremely large files, media, or backups—can and should be spun down under short and long idle conditions through power management, and therefore do not warrant an allowance. Short and long idle modes, as defined by the ENERGY STAR v6 test procedure and IEC 62323 standard, have no applications loaded and no windows open, and therefore do not require access to secondary storage. **We therefore recommend that CEC do not include an allowance for secondary storage.**

9. Duty Cycle

In a TEC-based standard, as proposed by CEC based on ENERGY STAR v6, the duty cycle is important to ensure that mode weightings are reasonably representative of real-world energy consumption. CEC's proposed use of the ENERGY STAR v6 duty cycle is based on just two outdated studies and is not representative of real-world use. **We propose an updated duty cycle for desktop computers that better represents their real-world use**, as described in the joint NRDC-IOU response. In short the proposed duty cycle includes an average of 60 percent of on time instead of 50 percent in CEC's proposal per ENERGY STAR v6. This is a weighted average across consumer and business computers, and takes into account computers that are not configured to auto-power down and stay on 24/7, particularly in office settings as demonstrated by the recent study conducted by the California Plug Load Research Center in 2013 which found that office computers were on 77 percent of the time.

We also recommend CEC adjust computer energy consumption and savings estimates to include a "real-world adjustment factor" to account for the difference between real-world usage (with applications loaded, windows open and network activity) and the ENERGY STAR v6 test method short and long idle modes which were designed to produce simple and reproducible measurements and are not representative of computer real-world energy consumption (no applications loaded, no windows open).

These two duty cycle adjustments are important for two reasons:

1. To ensure that manufacturers design efforts are focused on the modes that have the largest impact in real-world use.
2. **To appropriately account for computer energy consumption, savings potential and cost-effectiveness of the standards.** As computers are becoming better able to scale power down when inactive, short and long idle modes are no longer a good proxy for real-world energy consumption. Relying on the ENERGY STAR test procedure to estimate computer energy consumption could lead to underestimating energy consumption by up to 40 percent, and savings and cost-effectiveness by up to 20 percent per IOU testing.

10. Power Supply Efficiency

Desktop computers frequently include an internal power supply that converts AC voltage to the various DC voltages used by desktop computers. As inefficient internal power supplies can be the largest source of energy waste in computers, and TEC requirements do not consistently address this issue, we strongly recommend that CEC include minimum efficiency requirements for internal power supplies, in addition to TEC requirements. **We propose 80-PLUS Gold levels with an additional test point at 10 percent of load and a corresponding minimum efficiency requirement of 84 percent.**

a. 80-PLUS Gold levels

While ENERGY STAR and the European Union's Ecodesign regulations include minimum power supply efficiency requirements, CEC's proposal does not. External power supplies are already subject to federal standards, resulting in a transformation of that market, whereas many internal power supplies in today's computers are still very inefficient, as evidenced by the 55 percent efficient power supply found by Aggios in a randomly selected mainstream commercial desktop computer.

Opponents of this requirement argue that power supply efficiency is only one of the pathways for meeting TEC requirements, and manufacturers should be given the flexibility to meet TEC requirements in whichever way they want. We agree with this general principle, but in this particular case, power supplies are a commodity component where 80-PLUS efficiency levels are cost-effective by themselves. Including specific requirements for power supplies would **maximize energy savings cost-effectively for the following reasons**:

1. **Ensure that power supply efficiency potential is realized irrespective of other efficiency improvements:** Not including a power supply efficiency requirement would allow products which achieve standards requirements levels through other means to continue to use inefficient power supplies despite the cost-effectiveness of high-efficiency power supplies.
2. **Guarantee savings in active mode:** CEC draft standards are appropriately focused on idle mode, and some of the potential compliance techniques such as graphics switching may not save as much or any energy in active mode. 80-PLUS guarantees energy savings in active mode.
3. **Extend savings from the standards over time:** As technology evolves, and it becomes easier to meet TEC levels through other means, power supply requirements will ensure that cost-effective savings from power supplies will continue to be captured.
4. **Transform the market**: A mandatory requirement for internal power supplies will increase demand and volume and drive down cost, eventually leading to efficient power supplies being available at little or no additional cost vs. today's inefficient models.

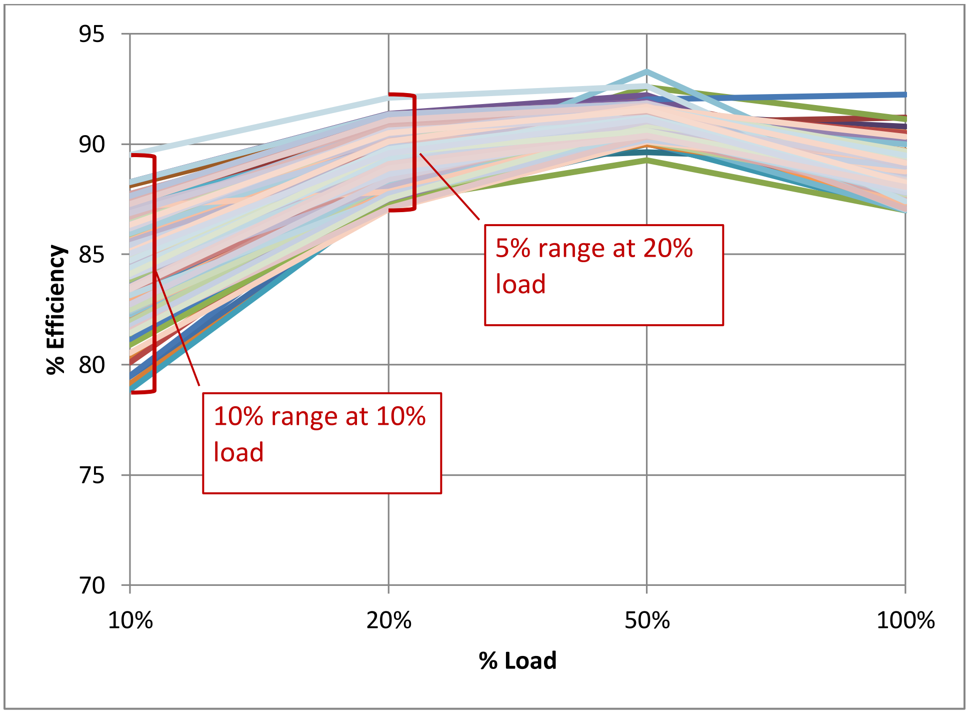
b. <u>10 Percent Load Efficiency Requirements</u>

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

The 80-PLUS standard test points of 20, 50 and 100 load focus on the active load range, and do not guarantee a decent efficiency below 20 percent. As modern computers, workstations and servers are becoming better able to scale power between idle and active mode, their idle load point has fallen below 20 percent and can be found anywhere between 5 and 15 percent for most computers. And even in active mode, computers are better able to dynamically ramp down their power use when not performing resource-intensive tasks. As a result, typical computers spend an increasing share of their time and energy in the 5-15% load range. As power supply efficiency drops dramatically below 20%, but some models drop much less than others, it is becoming increasingly important to ensure that computer power supplies are designed to be efficient at low load. 10 percent load is a proxy for the typical computer idle load range.

The 80-PLUS program has been testing all power supplies at the 10 percent load point since January 2012, despite this load point not being part of the 80-PLUS standard. The test data is available on the 80-PLUS website . An analysis of this data, as shown on Figure 1, indicates that the range of efficiencies is twice as large at 10 percent than at 20 percent load, confirming that the 10 percent load range is not consistently optimized.

Figure 1 – Efficiency Profiles of 80-PLUS GOLD Power Supplies



We recommend the CEC adopts efficiency requirements of 84 percent and 0.8 power factor at 10 percent load, in alignment with ENERGY STAR v6's power supply efficiency incentive allowance.

11. Power Management Requirements: Hibernate

In addition to ENERGY STAR's power management requirements (display off after 15 minutes or less and power down to low-power mode after 30 minutes or less), **CEC should require that computers transition to hibernate mode (known as ACPI S4 where ACPI used) after 4 hours or less in sleep mode.**

In sleep mode, computers continue to draw between 1 watt (notebooks) to 2 to 3 watts (desktops) or higher depending on the functionality provided in sleep mode, for as long as the computer is unused. In hibernate, this drops to 0.5 Watts. **A computer in hibernate instead of sleep mode for 12 hours per day would save 11 kWh/y for desktops (at 0.5 watts in hibernate vs. 3 watts in sleep.) and 3-4 kWh/y for notebooks (at 0.2 watts in hibernate vs. 1 watt in sleep).**

While sleep mode with a wake latency of 5 seconds or less is justified when the computer is used frequently (such as for a lunch break or when the user is away at a meeting), it is not justified when computers are unused for long periods of time, such as when people are away on vacation. Many notebooks are already configured by default to transition to hibernate automatically after several hours in sleep mode when on battery mode, because of battery life considerations. Desktops should do the same. The capability already exists in all or most computers today, it just needs to be implemented by default. Hibernate mode does not cause the loss of users' work as all content of the main memory is saved to non-volatile data storage, such as a hard drive, before entering the power mode.

In the 4/15/2015 workshop, industry argued that display off and auto-power down requirements may not be appropriate for some particular computer uses. NRDC is open to limited exemptions of power management requirements if these uses can be clearly and narrowly defined.

12. Occupancy Sensors and Auto-Brightness Control (ABC)

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

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

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

13. Definitions

CEC's definitions of the types of computers covered by the standards need to be refined to avoid any misinterpretations and ensure that they do not unintentionally open up loopholes in the standards. We propose updated and additional definitions with associated justifications in the attached joint NRDC-IOU response.

14. Registration Requirements

Computers are highly configurable, with thousands of possible configurations per product family. Registering all possible configurations is not practical. In the attached joint NRDC-IOU response, we propose an approach that attempts to provide a reasonable level of assurance that all configurations comply, while not imposing an undue administrative burden for manufacturers and CEC staff.

15. <u>Data Submittal Requirements</u>

The data submittal requirements could be enhanced by adding a few extra items as specified in the attached joint NRDC-IOU technical response. These would assist in any technical reviews or enforcement activities of computer energy efficiency for products sold on the California market.

B. Computer Monitors and Signage Displays

1. <u>Computer Monitors</u>

Computer monitors are a significant contributor to plug load energy use in California. They are increasingly used as second screens with notebooks, and in multiple screen setups with desktop computers. The growth in average monitor size and resolution is also offsetting some of the energy efficiency gains that have occurred from the transition to LED backlighting.

Major efficiency opportunities remain from a variety of technologies, including lighting (backlighting efficacy, panel transmittance, optical films, OLED, quantum dots), power management (default screen brightness, local dimming, automatic brightness control), and electronics (drive circuit, image circuit, and power supply unit).

A monitor can draw as much or more power than the computer it is attached to in on mode (20 to 50 watts for monitors in the 20 to 30-in size, compared to 5 to 15 watts for notebooks and 15 to 50 watts for desktops).

CEC's proposal is technologically feasible and cost effective using widely available technology options as demonstrated by the IOU comments.

NRDC therefore strongly recommends including enhanced performance displays (EPD) in the scope of this rulemaking. These displays provide have characteristics such as better contrast, resolution and color gamut, that are likely to become more common in mainstream computer monitors in the near future such as high resolution and accurate color reproduction. It is therefore critical to include them in the standards, potentially with a specific power allowance as appropriate.

2. <u>Signage Displays</u>

Signage displays are the television monitors found in retail or department stores, restaurants, museums, hotels, outdoor venues, airports, conference rooms, classrooms, etc. Sales are growing rapidly with a 10 percent annual growth rate projected through 2018. They are similar to large-screen TVs, however typically do not have a TV tuner, and are designed to operate 24/7, at higher brightness levels and to last longer.

Signage displays are larger, brighter and on for a longer period of time than computer monitors. In fact, the IOUs estimate that **the average signage display consumes 9 times as much energy as the average computer monitor.**

CEC's current proposal to cover signage displays as televisions using existing TV standards is not adequate. The TV standards were adopted in 2009 and are no longer appropriate for 2017 display technology.

We strongly support the IOU proposal for signage display levels. It is very cost effective with a **2:1 benefit to cost ratio** and would save Californians **260 GWh annually** after stock turnover.

In particular, **NRDC strongly recommends CEC also cover signage displays with a screen area larger than 1400 in sq**, which are currently unregulated. These large signage displays are becoming increasingly common, and use higher power than smaller ones due to their larger size. IOUs estimate that 1400+ sq in displays represent **14 percent of shipments, 30 percent of energy consumption and 21 percent of the savings potential**. It is therefore critical to include them in the standards.

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

Respectfully submitted,

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