DOCKETED

Docket Number:	14-AAER-02
Project Title:	Computer, Computer Monitors, and Electronic Displays
TN #:	204227
Document Title:	Computers Presentation
Description:	N/A
Filer:	Harinder Singh
Organization:	CEC/ Ken Rider
Submitter Role:	Energy Commission
Submission Date:	4/16/2015 3:09:58 PM
Docketed Date:	4/16/2015

Staff Workshop
Draft Computer Standards

Art Rosenfeld Hearing Room

April 15, 2015

Ken Rider
Appliances and Existing Buildings Office
Efficiency Division

Presentation Agenda

- Background
- Energy Use of Computers
- Efficiency of Computers
- Proposed Regulations
- Energy Savings
- Other Benefits
- Timeline and Comments

History of the Pre-Rulemaking

- September 30, 2011: Comments received suggesting products for further efficiency improvements.
- March 14, 2012: An Order Instituting Rulemaking was issued that included computer and display products.
- March 25, 2013: Energy Commission invites stakeholders to participate and share data and information.
- June 13, 2013: Energy Commission invites stakeholders for proposals to reduce energy consumption in computers and displays.
- March 12, 2015: Energy Commission releases draft staff report for computers and displays.

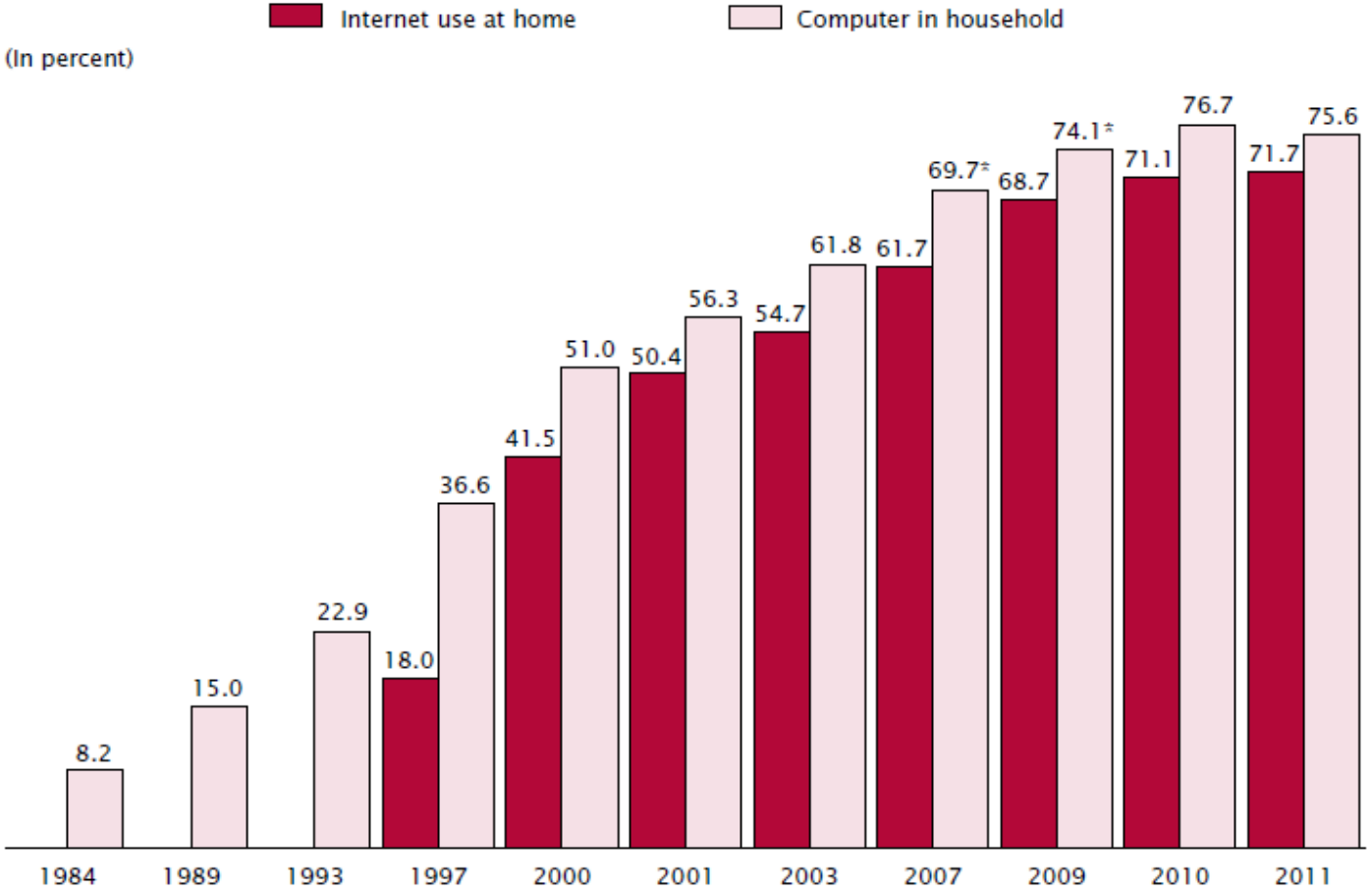
Product Focus

Residential and Commercial:

- Desktops (including thin-clients and integrated desktops)
- Notebooks
- Small-Scale Servers
- Workstations

Figure 1.

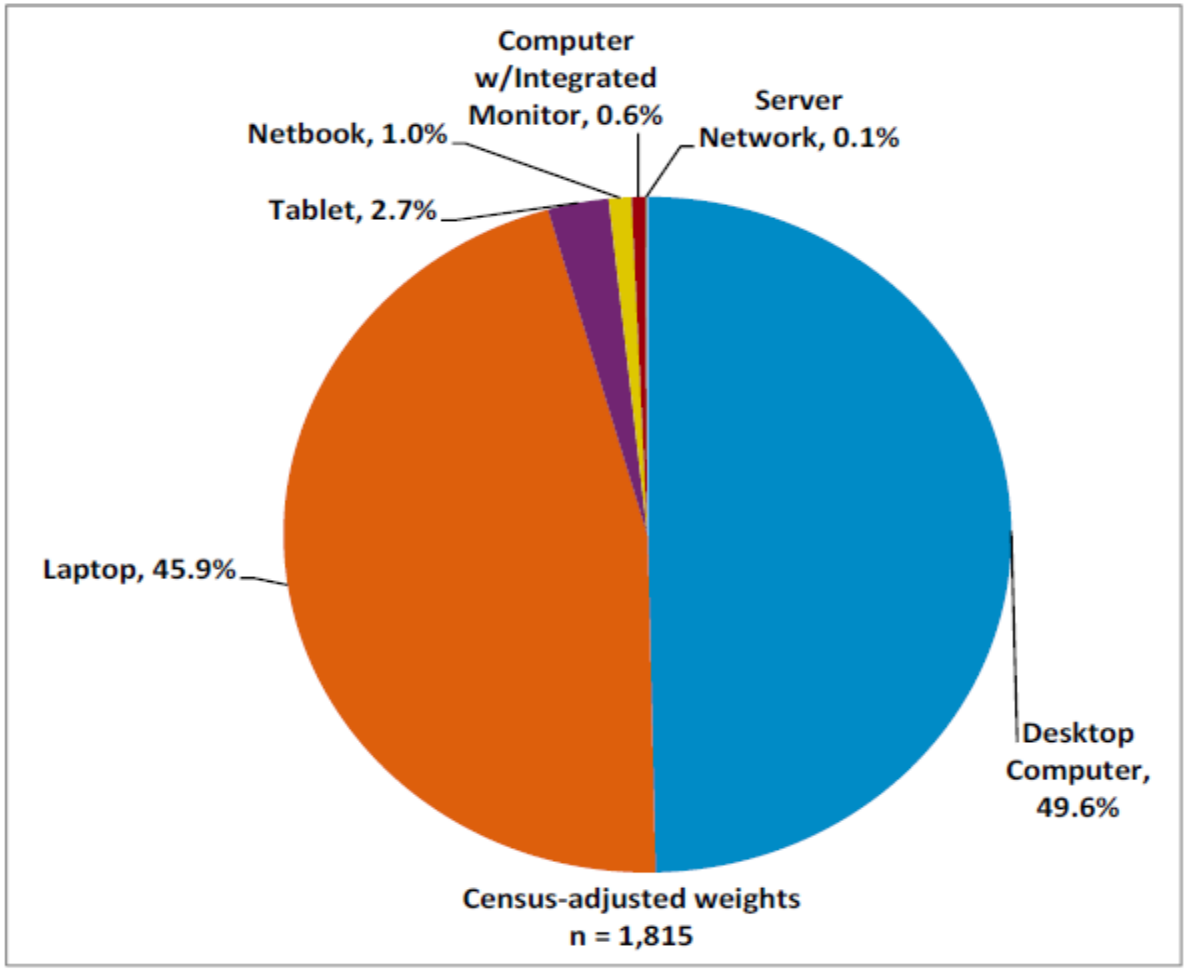
Household Computer and Internet Use: 1984–2011



*Note: In 2007 and 2009 the Census Bureau did not ask about computer ownership. The estimates presented here for 2007 and 2009 reflect estimates made based on the ratio of computer ownership to Internet use in 2003 and 2010, respectively.
Source: U.S. Census Bureau, Current Population Survey, selected years.

Source: "Computer and Internet Use in the United States," U.S. Census Bureau, May 2013.

Figure 31: Distribution of the Type of Most Used PC, using Census-adjusted Weights



Source: "Residential On-site Study: California Lighting and Appliance Saturation Study (CLASS 2012)," California Public Utilities Commission, November 24, 2014 page 4-146.

Modes of Operation

Mode Name		Measured?	Description
Off	HIGHER POWER	Yes	Also known as “soft-off” the computer is shutdown.
Sleep		Yes	The computer has manually or automatically entered a low power state, the CPU is no longer active.
Short-idle		Yes	The computer is on and active, but has not been used for 5 minutes and only background programs are running.
Long-idle		Yes	The computer is on and active, but has not been used for 15 minutes, the screen has shut-off.
Active		No	The computer is on and active and currently in use.

Importance of Idle modes

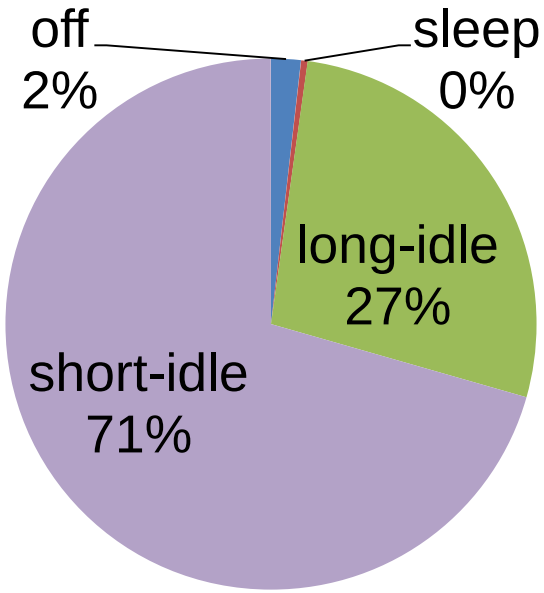
Computers spend a significant time in idle modes.

Energy Star's duty cycle assumes that conventional desktops are on, and in idle mode for 50% of the time. Similarly, notebooks are on, and in idle mode for 40% of the time.

Energy consumption in other modes, such as sleep and off, are minimal.

Example Desktop

For example a desktop with a long-idle of 45 watts, short-idle of 50 watts, sleep of 2 watts, and an off mode of 1 watt would have the following energy use profile under ENERGY STAR assumptions:



Significant Amount of Statewide Use

Studies submitted in the pre-rulemaking record estimate between 2.5% and 4.4% of residential electricity consumption is from computers.

Computer energy consumption in commercial spaces are concentrated in office and educational spaces where they can make up over 10% of a building's energy use.

The majority of computer electricity consumption is in desktops.

Industry Progress

Computer and component manufacturers have recently made progress in offering cost-effective, high performance, energy efficient equipment.

Innovations in laptop computers have led to power consumption levels that are 3-4 times less than are commonly found in desktops.

Desktop components are increasingly incorporating low power idle states, and industry standards and protocols are enabling their consistent use in system design.

Sleep mode power is already very low.

Power Supply Efficiency

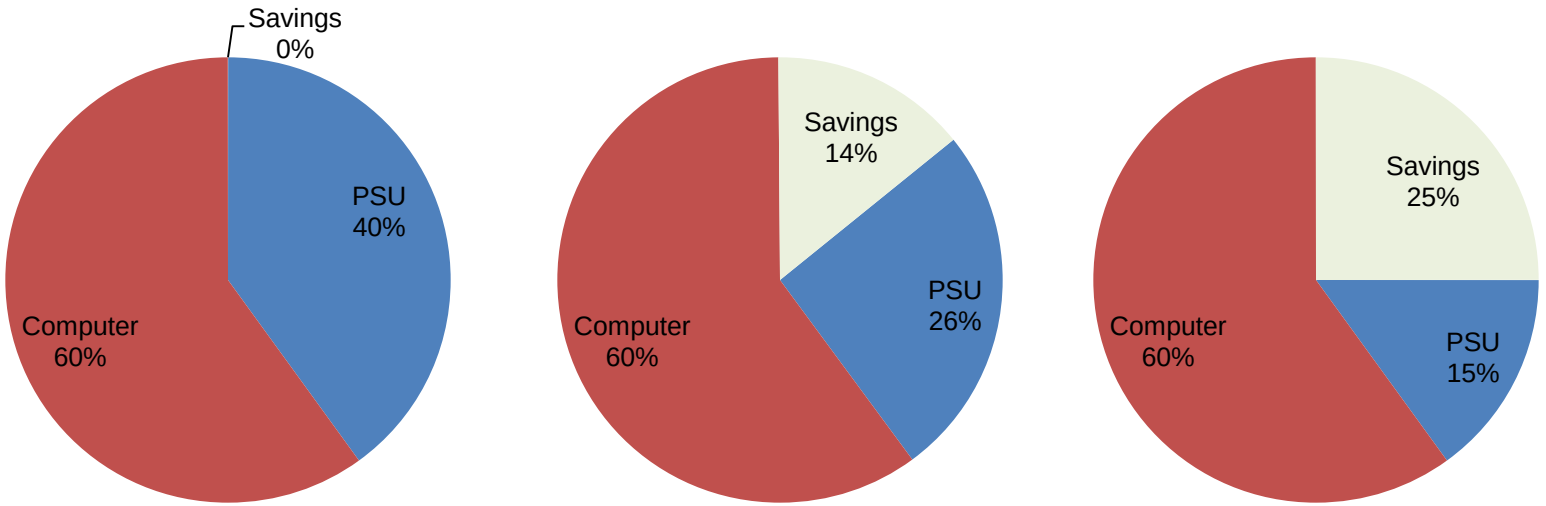
80 Plus program, run by Ecova's plug-load solutions, has led to market transparency and identification of efficiency in power supplies. Focuses on 100, 50, and 20 percent output efficiencies.

First 80 plus product was certified in 2005, today there are over 5,000 certified models. Large momentum in both the bronze and gold categories have resulted in significant price reductions for these more efficient supplies.

US DOE requirements for external power supplies will increase minimum efficiency to 88% and decrease no load losses to a maximum of 0.210 watts on February 10, 2016.

Low Output Power Supply Efficiencies

Idle power levels in proposed standards are below 20% of most power supply outputs and not measured in the 80 plus program. The power supply can be the dominate idle power consumption.



60% 70% 80%

Power Supply Efficiency

Processor Efficiency

New processors are more efficient per executed instruction and are scalable.

Lower power working states, known as “C-states,” are implemented in CPUs that allow them to be progressively less consumptive the more idle a computer becomes.

These low power states allow processors to scale well to workload and reach consumption levels of 1 watt.

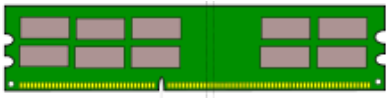
Sleep-like new states such as S0i1 and S0i3.

Internal Storage

Large performance variation in idle states. From 0.05 watts to 7 watts.

Improvements to SATA standard including power managements states for both the controller and attached devices.

Even lower power states such as “device sleep” allow for mW power draws in idle in the single digits.

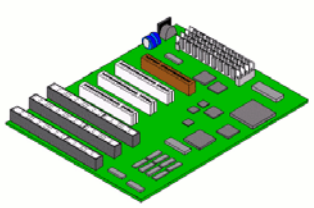


Memory

Lower voltage memory reduces power draw. Transition to DDR4 leads to lower supply voltage.

Advanced management of memory can allow for power reductions.

Idle state can be entered similar to sleep state when processes have reached minimal states.

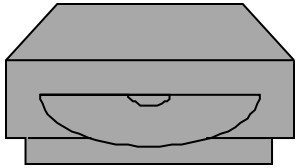


Motherboards

Motherboards contain an array of controllers, chips, and voltage regulators.

Desktop motherboards often have controllers and devices that are never in use from unused expansion slots or onboard devices.

Coordination of device states, incorporation of the latest interface standards, and disabling unused devices will reduce power consumption.



Optical Drives

Optical drives (CD/DVD/BD players) idle power draw vary significantly by model.

SATA 3.1 supports zero power optical drive power.

Operating system implements power reduction when drive is not in use.

Cooling

Active cooling elements such as fans are necessary under significant loads to keep devices within their thermal tolerances.

Low idle power levels can instead rely on passive cooling and still meet tolerances.

Reducing fan power further reduces idle mode consumption and also reduces the audible noise from the computer, both which are preferable to consumers.

Graphics Acceleration

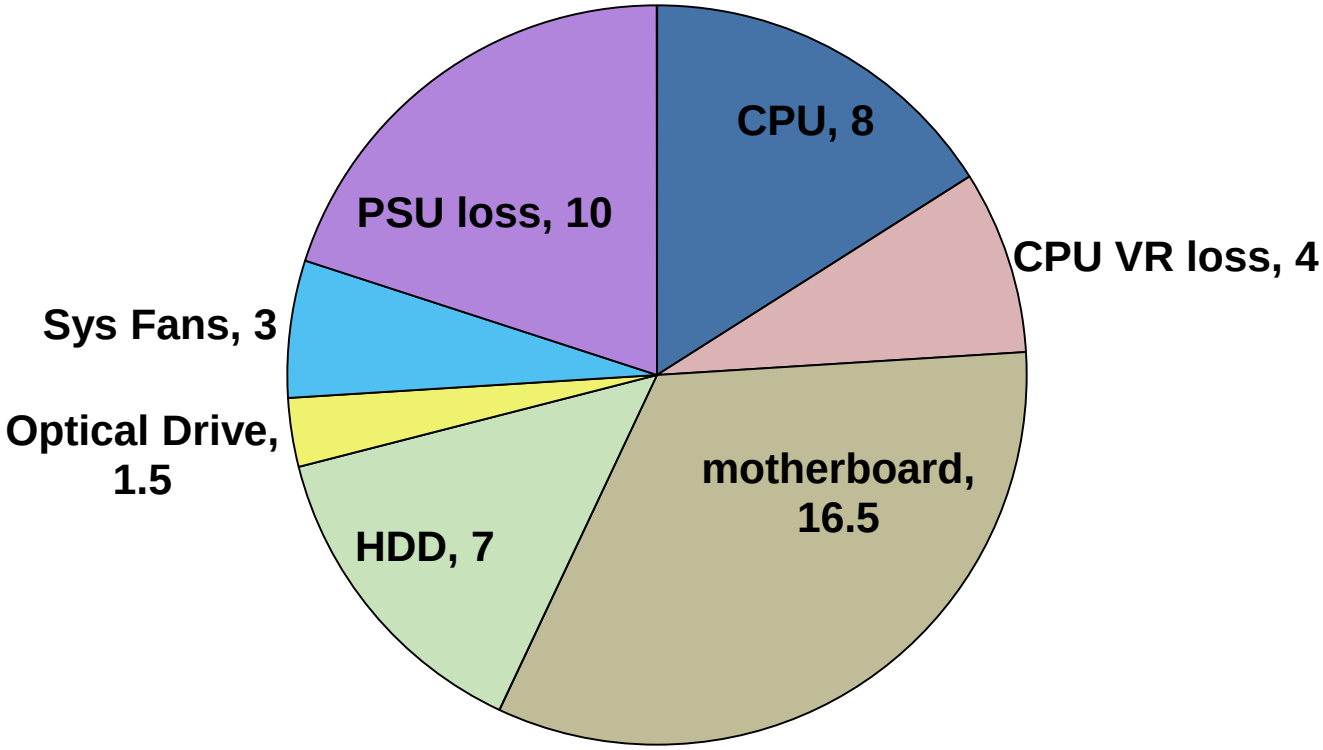
Lowest idle powers are found in some of the most powerful graphics cards.

Acceleration is not necessary in long-idle, where the screen is off.

3D acceleration is not necessary in short-idle mode, workload and therefore power levels should be very low.

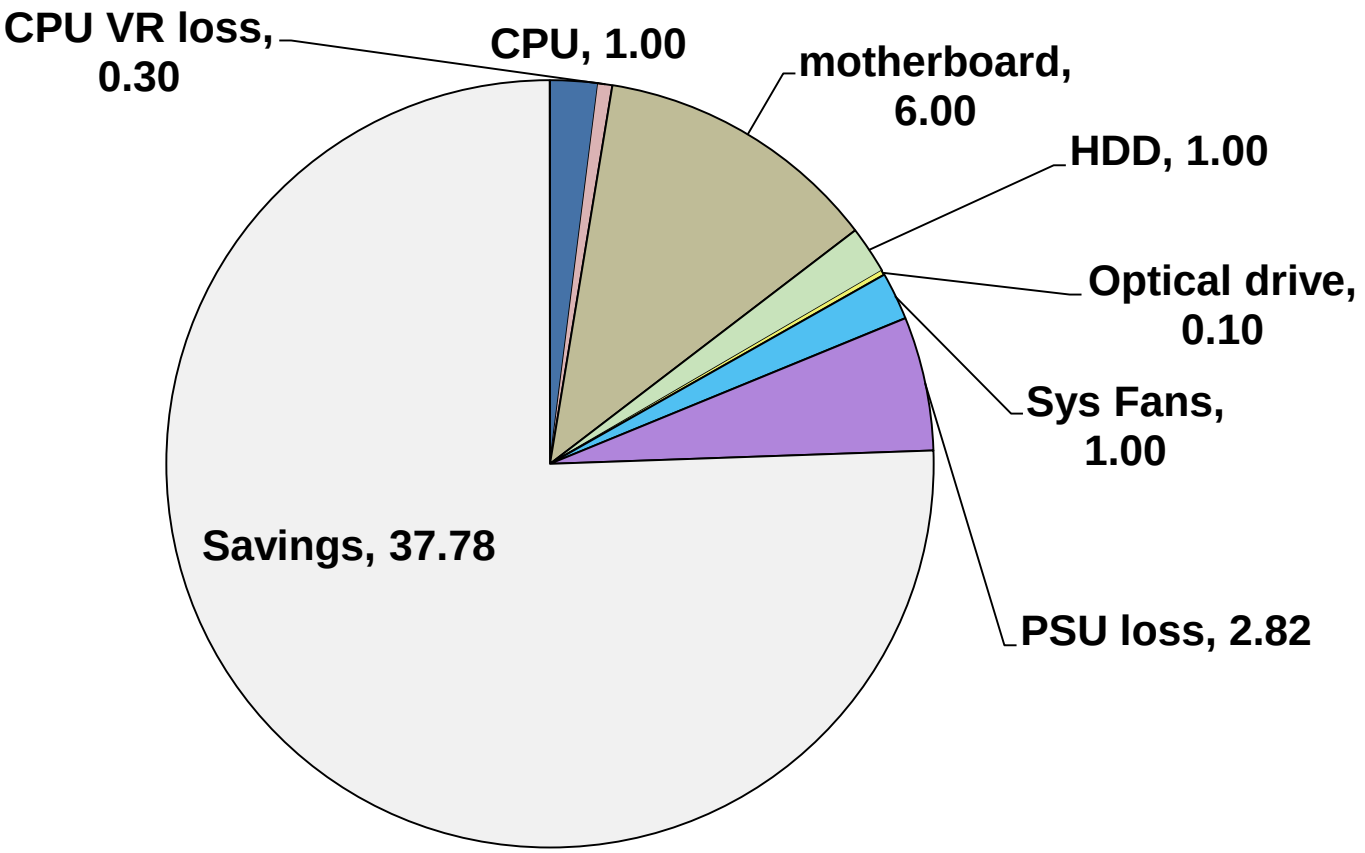
Graphic switching and new designs allow computers to avoid the large overhead of powerful discrete graphics cards.

Desktop Typical Idle Power (watts)



Total Power: 50 Watts

Potential Idle Power (watts)



Total Power: 12.2 Watts

Evaluation of Potential Standards

Proposals were evaluated from stakeholders.

Staff also investigated existing international standards for computers by: US EPA, China, European Union, and Australia.

Three primary goals of the draft standards:
1) maximize energy savings
2) harmonize with existing standards
3) incorporating stakeholder comments and feedback

Scope (Section 1601)

The scope of the regulations is defined by section 1601, and is further refined by the definitions in section 1602.

In Scope	Not In Scope
Desktop Computers	Tablets
Notebook Computers	Game Consoles
Small-Scale Servers	Handheld gaming devices
Workstations	Servers other than small-scale servers
Thin-Client Computers	Industrial process controllers

Definitions (Section 1602)

- The initial set of definitions were taken from the ENERGYSTAR Specification Version 6.1.
- The definitions used in the standards describe product types, modes of operation, and design capabilities.
- Small modifications were made to the definitions to reduce the language to necessity.

Test Procedure (Section 1604)

The proposed test procedures are contained in section 1604 of the proposed regulations. Staff proposes to utilize the "ENERGY STAR Test Method for Computers, Rev. August 2014" and make use of the ENERGY STAR Specification version 6.1 for annual energy use calculations.

Performance Requirements (Section 1605.3)

All computers are required to put transition displays into sleep mode after 15 minutes or less of user inactivity.

All computers are required to transition into a sleep mode after 30 minutes or less of user inactivity. Small-scale servers are an exception, and do not have to transition to a sleep mode.

Small-scale servers and workstations must be manufactured with an 80 plus Gold level power supply and energy efficient ethernet.

Notebooks, Desktops, and thin-clients must meet energy consumption targets.

Performance Requirements

Computer Type	Maximum total energy consumption on or after January 1, 2017.	Maximum total energy consumption on or after January 1, 2018.
Desktops and Thin-Clients	none	50 kWh/yr + applicable adders in Table V-4.
Notebook	30 kWh/yr + applicable adders in Table V-4.	30 kWh/yr + applicable adders in Table V-4.

Table V-4
Energy Consumption Adders

Function	Desktop and Thin-Client Adder (kWh/yr)	Notebook Adder (kWh/yr)
Memory (per GB RAM)	0.8	0.8
Energy Efficient Ethernet	8.76 × 0.2 × (0.15 + 0.35)	8.76 × 0.2 × (0.10 + 0.30)
Storage	26	2.6
Integrated Display Where: "r" is the megapixel resolution of the display "A" is the viewable screen area in square inches EP = 0 for standard displays EP = 0.3 for enhanced displays less than 27 inches in diagonal length EP = 0.75 for enhanced displays of 27 inches or greater in diagonal length	8.76 × 0.35 × (1+EP) × (4×r + 0.05×A)	8.76 × 0.30 × (1+EP) × (2×r + 0.02×A)

Reporting Requirements (Section 1606)

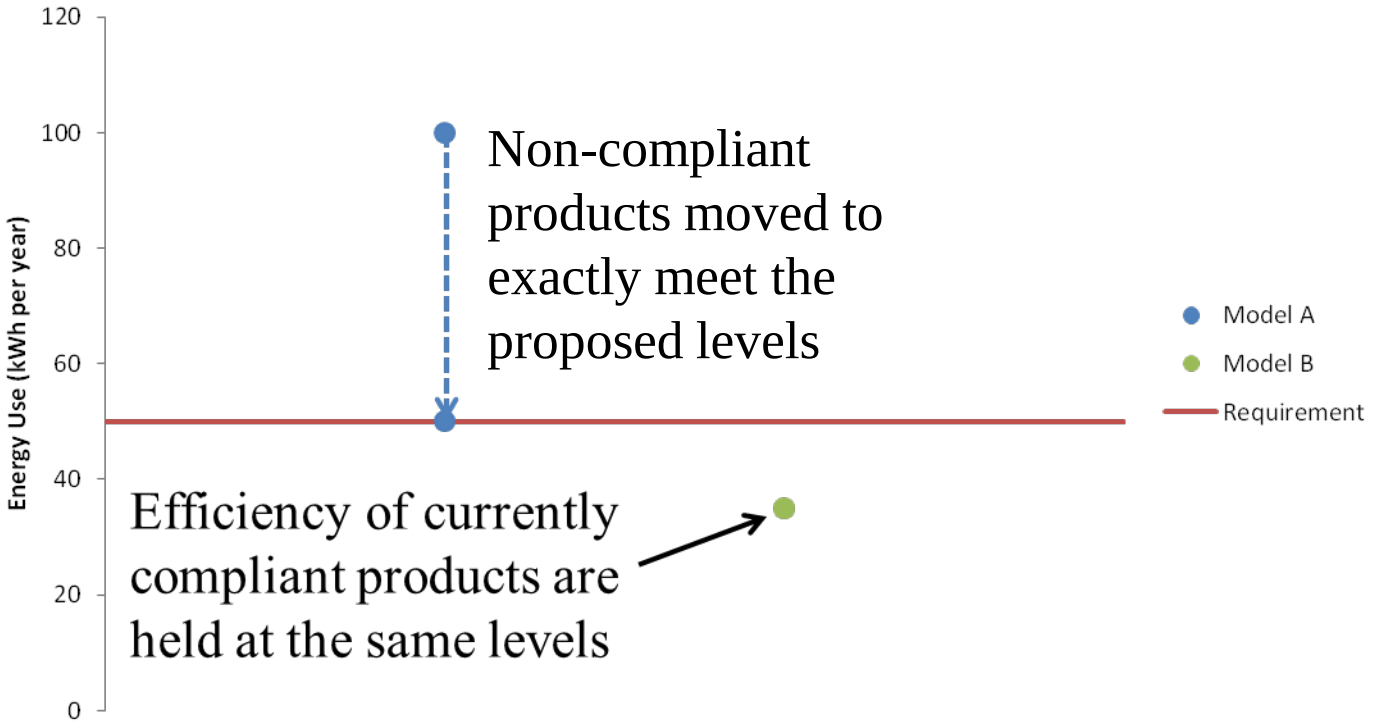
Products manufactured on or after the effective dates must certify their compliance with the standards with the Energy Commission.

The data collected is the minimum necessary to determine compliance and identify the product.

Staff does not propose any specific labeling or marking requirements. However, there are general requirements that the model number, manufacturer, and date of manufacture be permanently and legibly placed on the product.

Savings Methodology for Notebooks and Desktops

The average unit energy savings is established by comparing performance data to the proposed limits.



Savings Methodology for Workstations and Small-Scale Servers

The energy savings in workstations and small-scale servers was calculated by evaluating the effects of 80 PLUS Gold level power supply against a baseline of a basic 80 PLUS power supply.

Staff adjusted wattages accordingly and then calculated annual energy use.

Example: A workstation with an idle power of 180 watts baseline would now have a power of 180 x (0.8/0.87) or 165.5 watts.

Energy Savings and Cost Effectiveness

Product Type	Average Energy Use – Baseline (kWh/yr)	Average Energy Use – Compliant (kWh/yr)	Design Life (yr)	Life Cycle Savings (kWh/yr)	Life Cycle Savings ($)	Incremental Cost ($)
Desktop	143.2	56.8	5	432	$69.12	$2.00
Notebook	33.4	29.8	4	14.4	$2.30	$1.00
Small-Scale Server	302.0	278.0	5	120	$19.20	$13.00
Workstation	469.3	431.9	5	187	$29.92	$13.00

Statewide Energy Savings

Product Type	Unit Savings (kWh/yr)	Unit Sales (million)	Unit Stock (million)	1 Year Sales Savings (GWh/yr)	Stock Savings (GWh/yr)
Desktop	86.4	2.9	23.4	250.6	2,021.8
Notebook	3.6	5.2	21.0	18.7	75.6
Small-Scale Server	24.0	0.06	0.3	1.44	7.2
Workstation	37.4	0.15	0.53	5.61	19.8
Total	-	8.31	45.23	276.35	2,117.2

Other Benefits

Energy savings translate to lower utility bills and operating costs. 2,117 GWh per year translates to $339.9 million dollars in reduced electricity costs.

The reduced electricity consumption also leads to lower green-house gas emissions from lowered demand in power plants. Staff estimates that emissions will be lowered by 0.634 million metric tons of CO_2 equivalents.

Timeline and Comments

Comments are due on May 15, 2015. Comments will be reviewed to determine necessary revisions to the report or process.

The Energy Commission will accept comments by "e-docketing" at http://www.energy.ca.gov/appliances/2014-AAER-2/prerulemaking/.

Or by mail at:

California Energy Commission
Dockets Office, MS-4
Re: Docket No. 14-AAER-2
1516 Ninth Street
Sacramento, CA 95814-5512

Contact information

Ken Rider

Ken.Rider@energy.ca.gov

(916) 654-5006