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CEC COMPUTER EFFICIENCY STANDARDS

APRIL 15, 2015

Computers and displays are responsible for 4-5% of electricity use in California

Computers, monitors, displays energy use in California

CEC Staff Proposal	8,282 GWh/y
EIA - Miscellaneous Electric Loads - 2013[1]	12,125 GWh/y

4-5 power plants

Actual energy use could be even higher, when adjusted for real-usage[2]

Desktop	+ 15%
Integrated Desktop	+ 25%
Notebook	+ 40%

4-5 MMT CO2/y

$1.5-2 billion/y

1. http://www.eia.gov/analysis/studies/demand/miscelectric/pdf/miscelectric.pdf
2. CA IOUs, Real World Adjustment Factor, Oct 2014 CASE report addendum, Docket #12-AAER-2A

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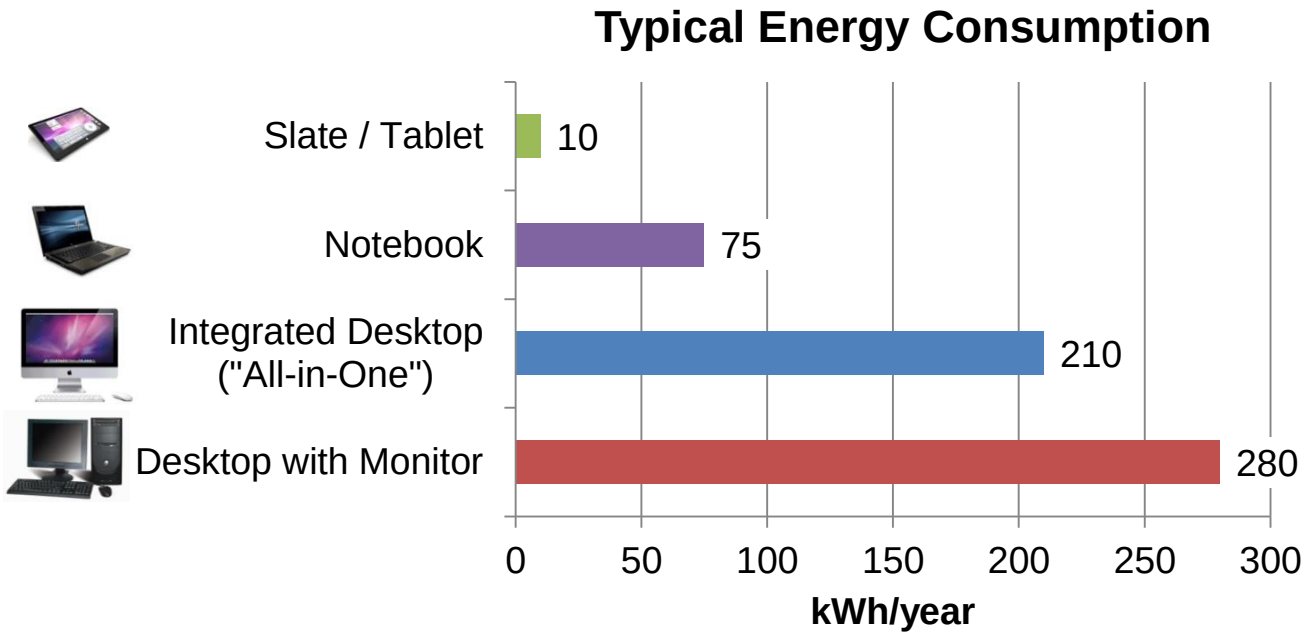
LARGE ENERGY SAVING POTENTIAL WITH EXISTING TECHNOLOGY

Large efficiency gap between computer form factors

Battery-powered devices of similar capabilities and price have radically lower power use



Source: Fraunhofer 2014, plus real-world adjustment factor.

Much progress made on low-power technology since previous standards

Recent efficiency technology	ENERGY STAR v6, EU Ecodesign Tier 1 (2010-2012 computers)
• Low-power processor states (C6/C7)	• Not available
• Motherboard switches off inactive components	• Components remain on throughout idle mode
• Peripheral interface PCIe L1.2 sub-state	• Not available
• Graphics switching on desktop (switch to integrated gfx for low-intensity gfx tasks)	• Notebooks only
• Right-sized and efficient power supplies	• Minimum efficiency requirements, but many still oversized
• “Keystroke sleep” (real-time power management)	• 15-min power management

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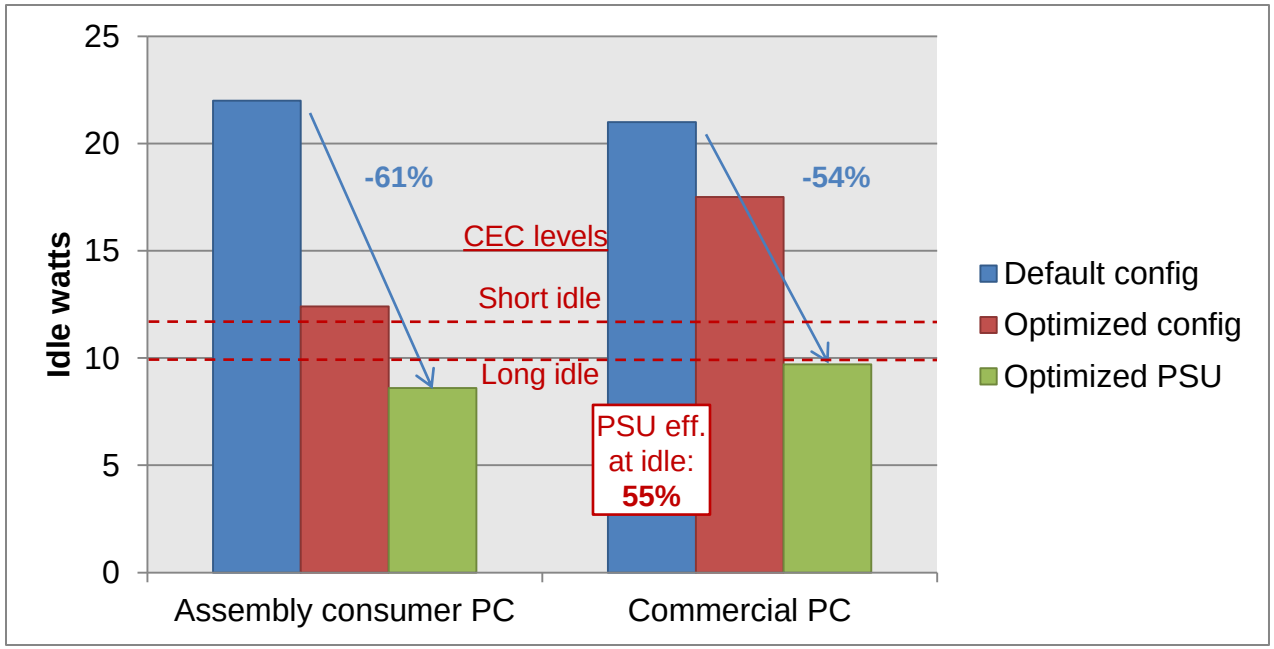
Today's mainstream desktops capable of achieving CEC proposal with minor changes

Aggios demonstration project:



- Reduced power by **54-61%** from out-of-the-box configuration
- Through power management software, BIOS and OS configuration changes, and inexpensive power supply upgrade
- No impact on latency or performance

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Integrated Desktops: significant energy saving potential beyond current CEC proposal

Apple iMac 21.5-inch	HP EliteOne 800 G1 21.5-inch Non-Touch AiO PC	CEC proposed limit[1]	ENERGY STAR limit[1,2]
			
Annual TEC: 73 kWh	Annual TEC: 113 kWh	Annual TEC: 100-125 kWh	Annual TEC: 205-230 kWh

iMac 22% lower than proposed CEC limit,
HP EliteOne 10% lower, without optimizations

(1) HP model has higher adders than the iMac
(2) Both computers in ENERGY STAR I3 performance category, and have same screen size

Notebooks: very large energy saving potential beyond current CEC proposal

Apple MacBook Pro 13-inch with Retina Display	Dell Latitude E6440, 13-inch	ENERGY STAR limit[1,2]	CEC proposed limit[2]
			
Annual TEC: 15.5 kWh	Annual TEC: 42.2 kWh	Annual TEC: 50-65 kWh	Annual TEC: 55-72 kWh

MacBook Pro **78% lower** than proposed CEC limit

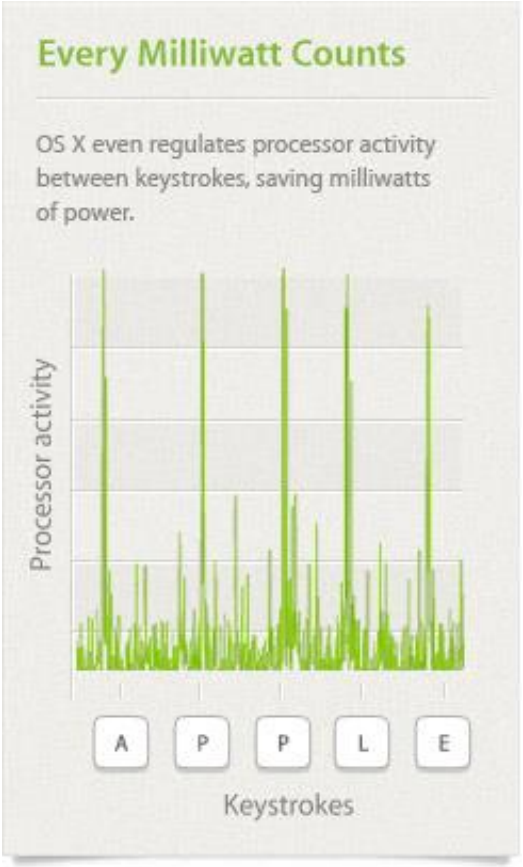
(1) Both laptops in ENERGY STAR I2 performance category, and have same screen size
(2) MacBook Pro has higher adder due to higher resolution screen

Real-time power management: sleep between keystrokes

Smartphone- and tablet-like power management:

- Apple's MacBook Pro manages power at millisecond level
- Goes to low-power "sleep mode" between keystrokes

➢ Demonstrates technical feasibility of much lower levels for notebooks



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CEC's proposal is generally sound, technically feasible, very cost-effective

- ✓ **Large energy saving opportunity**: 1-2 power plants, $430 million, 1-2 million tons CO2 in CA (much more nationally and globally)
- ✓ **Performance-based**: flexibility for industry to achieve levels
- ✓ **Idle mode only**: no impact on new features or performance in active mode

NRDC is committed to working with all stakeholders to make the standards work for all parties.