Preliminary Draft Review: Proposed Tier I Requirements

Craig Hershberg, US EPA
### History of Computer Specification

<table>
<thead>
<tr>
<th>Version 1.0</th>
<th>Effective June 92</th>
<th>Expired Sept 95</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A desktop in sleep mode must use $\leq 30, \text{W}$; Integrated systems must use $\leq 60, \text{W}$</td>
<td>Specified that a computer must go to “sleep” after a period of time or through user enabling</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version 2.0</th>
<th>Effective Oct 95</th>
<th>Expired June 99</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A desktop in sleep mode must use $\leq 30, \text{W}$; Integrated systems must use $\leq 60, \text{W}$</td>
<td>The computer must be shipped with power management functions that send the computer into sleep mode after 15 to 30 minutes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Manufacturers must incorporate wording to educate consumers about sleep mode</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Computer must be able to send ENERGY STAR monitor into sleep mode</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Version 3.0</th>
<th>Tier 1</th>
<th>Effective July 99</th>
<th>Expired July 00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A desktop with a power supply rating $\leq 200, \text{W}$ must use $\leq 30, \text{W}$ in sleep mode; power supply rating $&gt; 200, \text{W}$ must use no more than 15% of the power supply rated value in sleep mode; Integrated computer systems must use $&lt; 45, \text{W}$ in sleep mode</td>
<td>Computers must have the ability to sleep when connected to a network</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Computers must be able to “wake” when prompted by the network</td>
</tr>
</tbody>
</table>
A desktop that is not intended to be used in a network environment or requires minimal hardware power to maintain that connection has the following use requirement in sleep mode:

<table>
<thead>
<tr>
<th>Rated Output Power of Power Supply</th>
<th>Power Allowance in Sleep Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 200 W</td>
<td>≤ 15 W</td>
</tr>
<tr>
<td>&gt; 200 W ≤ 300 W</td>
<td>≤ 20 W</td>
</tr>
<tr>
<td>&gt; 300 W ≤ 350 W</td>
<td>≤ 25 W</td>
</tr>
<tr>
<td>&gt; 350 W ≤ 400 W</td>
<td>≤ 30 W</td>
</tr>
<tr>
<td>&gt; 400 W</td>
<td>10% of the Rated Output Power</td>
</tr>
</tbody>
</table>

• A desktop that is intended to be used in a network environment and requires the processor and/or memory for maintaining that connection cannot consume more than 15% of its power supply rated output power when in sleep mode
• Integrated computers systems must use < 35 W in sleep mode
## Paradigm Shift for ENERGY
### STAR Computers

<table>
<thead>
<tr>
<th></th>
<th>Old Approach</th>
<th>New Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Modes addressed</strong></td>
<td>Sleep mode only</td>
<td>All modes</td>
</tr>
<tr>
<td><strong>Certainty of savings</strong></td>
<td>Depends on enabling rates &amp; user behavior</td>
<td>Most savings automatic (hardware-driven)</td>
</tr>
<tr>
<td><strong>Promotion &amp; differentiation opportunities available</strong></td>
<td>Label only</td>
<td>Label + utility incentives &amp; marketing + preferential gov &amp; corp procurement</td>
</tr>
<tr>
<td><strong>Products covered</strong></td>
<td>Desktops, workstations, laptops</td>
<td>+ Desktop-derived servers, thin clients, media PCs?</td>
</tr>
</tbody>
</table>
Why Revise the Specification?

- Current specification only considers sleep mode, does not address “active mode”
- Largest opportunities for energy savings are when computers are turned on, which occurs during peak demand times
- Current label has about 98% market penetration, offering little differentiation for innovative, energy efficient models
- Address low enabling rates
Good Work Already Underway: Sleep and Standby Modes

- Sleep enabling rates lower than expected.
- Need technology improvements that automatically save energy in all modes, rather than only relying on users to enable low power modes.
- Sleep and standby power levels are already low in many Energy Star specs. Further reductions can have diminishing returns. (i.e. 0.5 w to 0.3 w for ext. power supplies = 1 kwh/yr savings).
- People who buy labeled products expect them to use less energy when in use and overall, not just when they are not operating.

Percentage of Computers Found in Each Mode During LBNL Night Audits

- Desktops: n = 1453
  - On: 60%
  - Sleep: 4%
  - Standby: 36%
- Servers: n = 89
  - On: 98%
  - Sleep: 2%
Limited Additional Savings Potential: Sleep Mode

- 87% reduction
- 73% reduction
Growing Interest by Government and Corporate Procurement Officers

- Most have already specified ENERGY STAR levels for sleep mode and FEMP levels for standby – opportunity to save more with active
- Most already required to minimize lifecycle cost but no means for doing so until active data became available
- Availability of utility incentives can offset much of the incremental costs they would face in many facilities
- Power factor is a growing problem – Social Security Administration already imposed a 15% THD max for its computer purchases due to power quality problems experienced at its facilities
Importance of Reducing Desktop and Server Power Consumption

• IT equipment consumes $8 billion of electricity every year (100 billion kWh)*

• For the next two decades, electricity consumption for office equipment (3.2% annually) will grow over twice as fast as electricity as a whole (1.4% annually)*
  – The most rapid increase in energy demand is predicted for electricity used in computers – DOE 2004 Annual Energy Outlook with Projections to 2025

• Computers are a growing chunk of the opportunities left for saving energy

• Reducing power saves money, reduces heat and noise, and improves reliability

• It’s cheaper and better for the environment to save energy in computers than generate it in power plants

*Source: IT Professional “IT and the $8 Billion Electric Bill”, November/December 2004
## Potential Savings of Proposed Preliminary Draft Levels

<table>
<thead>
<tr>
<th>Total 3 year Cumulative National Energy Savings (millions kWh)</th>
<th>Total 3 year Cumulative National Carbon Dioxide Savings (million tons CO2)</th>
<th>Total 3 year Cumulative National Value of Electricity Saved per year (millions of dollars)</th>
<th>Equivalent Number of American Households Powered for One Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>5098</td>
<td>3.4</td>
<td>372.1</td>
<td>498,844</td>
</tr>
</tbody>
</table>
Elements of the Preliminary Draft Specification

• Section 1: **Definitions**
• Section 2: **Performance Specification and Test Procedure**
• Section 3: **Additional Requirements**
• Section 4: **Effective Date**
• Section 5: **Programmatic Changes from MOU to PA**
• Section 6: **Tier II/Phase II**
  – Fixing the network problem
  – System energy efficiency
Product Categories/Definitions

- Product categories covered:
  - Desktops
  - Notebooks
  - Integrated Computers
  - Workstations
  - Desktop Derived Servers

- Operational Modes: Active, Idle, Sleep, Standby
Definitions/Categories

• Classify hardware and software distinctions between desktops, workstations, and servers – needed since workstations and servers are allowed higher power limits
  – Definition needed for workstation

• New category/definitions needed for:
  – Entertainment and/or Media PCs?
  – Thin clients and/or X terminals?

• Consider splitting servers and workstations into 1-processor and 2-processor subcategories with different power limits

• Change “standby” mode to “off” mode?
Definitions (cont.)

- **Server definition**
  - A computer that primarily provides services to other devices on the network rather than to an individual interactive user. For purposes of this specification, this includes the following desktop derived, non-redundant type servers: EPS12V and the EPS1U. Both are derived largely from desktop computer designs, but have slightly different form factors and may often have multiple processors, different operating systems, and larger data storage capabilities.

- **Idle Mode definition**
  - A subset of active mode, this is the mode in which the operating system and other software have completed loading, the machine is not asleep and no activity, including peripheral or network, requiring CPU processing time is occurring.
Questions/Discussion

• Are these terms adequately defined?
• Are there any additional definitions and/or product types that should be included?
• Others?
Standby Levels

Proposed Performance Requirements

- Desktops & workstations: $\leq 2$ W
- Notebooks: $\leq 0.5$ W
- Integrated Computers $\leq 3$ W

- Follows FEMP standby recommendations
- Test Method: IEC 62301 (www.iec.ch)
Desktop Standby Levels Achievable Today

FEMP recommended = 2 W
Questions/Discussion

- Are these levels reasonable/achievable?
- Others?
Sleep Mode Levels

Proposed Performance Requirements

- Desktops, notebooks, workstations: \( \leq 5 \) W
- Integrated computers: \( \leq 7 \) W
  - Represents: 5 W desktop + Tier II ENERGY STAR Monitor sleep level of 2 W

- Test Method: Existing ENERGY STAR (Version 3.0) computer test procedure
Sleep Mode Levels Achievable Today

**Desktops:** 47% meet Tier I levels

**Laptops:** 42% meet Tier I levels

**Source:** ENERGY STAR Web site
Desktops: Sleep Levels Today

- Desktops sold in 1999 and 2000
- Desktops sold in 2001 and 2002
- Desktops sold in 2003 and 2004
- Proposed ENERGY STAR Sleep Mode Level: 5 W
Notebooks: Sleep Levels Today

Notebooks sold in 1999 and 2000
- Notebooks sold in 2001 and 2002
- Notebooks sold in 2003 and 2004
- Proposed ENERGY STAR Sleep Mode Level: 5 W
Sleep Mode Default

• Existing Requirement
  – Partner shall set the computer’s default to activate the monitor’s sleep mode within 30 minutes of user inactivity.

• Proposed New Requirement
  – Default must be within 15 minutes of user inactivity
Questions/Discussion

• Is the elimination of a sliding scale an issue?

<table>
<thead>
<tr>
<th>Under Version 3.0</th>
<th>Rated Output Power of Power Supply</th>
<th>Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allowance</td>
<td>≤ 200 W</td>
<td>≤ 15 W</td>
</tr>
<tr>
<td>Sleep Mode</td>
<td>&gt; 200 W ≤ 300 W</td>
<td>≤ 20 W</td>
</tr>
<tr>
<td></td>
<td>&gt; 300 W ≤ 350 W</td>
<td>≤ 25 W</td>
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</tr>
<tr>
<td></td>
<td>&gt; 400 W</td>
<td>10% of the Rated Output Power</td>
</tr>
</tbody>
</table>
Questions/Discussion

• All computer models must be able to transition from the sleep mode to full active state in no less than X seconds.
  – How much time would it take the computer to return to full active mode and how could we measure it?
  – “Instant available PC”

• Notebooks vs. desktops: different specifications, separate market evaluations needed?
Active Mode

• Comprises over 90% of annual energy use in typical residential and commercial desktops

• Active Mode requirements presented in two parts:
  – Idle State Requirements
  – Power Supply Requirements: External and Internal
Proposed Performance Requirements

• Desktops: \( \leq 50 \text{ to } 60 \text{ W} \)
• Notebooks: \( \leq 15 \text{ W} \)
• Integrated Computers: \( \leq 52 \text{ to } 62 \text{ W} \)
  – Represents desktop idle level + 2 W monitor ENERGY STAR requirement
• Desktop Derived Servers/Workstations: \( \leq 90 \text{ to } 100 \text{ W} \)

• Test Method: TBD
• More research needed
Idle State (cont.)

Screen shots illustrate Windows 2000 reporting of various operating parameters: System Idle Processes (3 hours and 2 minutes out of 3 hours and 6 minutes total) and CPU Utilization (2% in idle)
Idle State: Commercial Desktops

Total annual energy consumption for typical desktop: 354 kWh

Idle Mode: 327 kWh/yr
Active Mode (High Power): 20 kWh/yr
Sleep Mode: 3 kWh/yr
Standby/Off Mode: 4 kWh/yr

Idle State over 90% of total energy use in commercial desktops
Idle State: Residential Desktops

Idle State over 70% of total energy use in residential desktops

Total annual energy consumption for typical residential desktop: 285 kWh
Idle Power Levels Achievable Today

Manufacturer Reported Power Data on Desktop PCs

<table>
<thead>
<tr>
<th>Power Usage Range (watts)</th>
<th>Celeron</th>
<th>Pentium 4</th>
<th>Pentium 4 HT</th>
<th>Dual Xeon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max power</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Idle power</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Individual PC Models
Test Method Considerations

Idle State Power After PC Startup

- Startup sequence
- Idle state power stabilizes shortly after startup
Key Strategies for Reducing Idle Power

- Improve power supply efficiency
- Size power supply properly
- Use more efficient processor and enabling software
- Use more efficient memory
- Improve cooling technology
Questions

- Are the proposed levels for idle state achievable?
- Preliminary thoughts regarding a method to test and measure idle power?
Proposed Performance Requirement

- Notebooks and other Computers with an External Power Supply must meet ENERGY STAR External Single Voltage Ac-Ac and Ac-Dc Power Supply specification
## EPS Specification Overview

<table>
<thead>
<tr>
<th>Nameplate Output Power ($P_{no}$)</th>
<th>Average Efficiency in Active Mode (expressed as decimal)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to ≤ 1 watt</td>
<td>≥ 0.49 * $P_{no}$</td>
</tr>
<tr>
<td>&gt; 1 to ≤ 49 watts</td>
<td>≥ 0.09 * Ln ($P_{no}$) + 0.49</td>
</tr>
<tr>
<td>&gt; 49 watts*</td>
<td>≥ 0.84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nameplate Output Power ($P_{no}$)</th>
<th>Maximum Power in No-Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to &lt; 10 watts</td>
<td>≤ 0.5 watts</td>
</tr>
<tr>
<td>≥ 10 to ≤ 250 watts*</td>
<td>≤ 0.75 watts (Tier I EPS spec)</td>
</tr>
<tr>
<td></td>
<td>≤ 0.5 watts (Tier II EPS spec)</td>
</tr>
</tbody>
</table>

* Most computers would fall in these categories
• Calculate the model’s single **average Active Mode efficiency value by testing at 100%, 75%, 50%, and 25% of rated current** output and then use the average of these four values.

• Based on the model’s nameplate output power, select the appropriate equation from the appropriate table and calculate the minimum average efficiency.

• Compare the model’s actual average efficiency to the minimum average efficiency required by ENERGY STAR. If actual average efficiency is greater than or equal to the minimum average efficiency, the model has satisfied ENERGY STAR’s Active Mode requirement.

• Web site: [www.energystar.gov/powersupplies](http://www.energystar.gov/powersupplies)
Internal Power Supply (IPS)

Proposed Performance Requirements

<table>
<thead>
<tr>
<th>% Load</th>
<th>20% Load</th>
<th>50% Load</th>
<th>100% Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desktops, Workstations,</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Integrated Computers</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Adapted from Intel’s internal computer power supply design guide recommendations ([www.formfactors.org](http://www.formfactors.org))
- Test Method: Draft test procedure available at [www.efficientpowersupplies.org](http://www.efficientpowersupplies.org)
Desktop IPS Efficiencies Today

![Graph showing energy efficiency of desktop IPS power supplies. The graph compares various models against the ENERGY STAR Tier 1 standard. The x-axis represents the percentage of nameplate power output, and the y-axis represents efficiency. The graph includes curves for different models, with some exceeding the 80% efficiency threshold at low power levels, indicative of PFC power supplies.]
Power Supply Efficiency Helps Achieve Idle Mode Savings

Note: power measured while 2.66 Ghz Pentium 4 Media PC was running PCMark 2004 benchmarking software. No changes made to processor, memory, video card, or fans to reduce idle state power use.
### Proposed Performance Requirements

- **Desktop Derived Servers**

<table>
<thead>
<tr>
<th>% Load</th>
<th>20% Load</th>
<th>50% Load</th>
<th>100% Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS12V</td>
<td>75%</td>
<td>80%</td>
<td>77%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>% Load</th>
<th>20% Load</th>
<th>50% Load</th>
<th>100% Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>EPS1U</td>
<td>78%</td>
<td>83%</td>
<td>80%</td>
</tr>
</tbody>
</table>

- Harmonized with proposed Server System Infrastructure (SSI) recommended levels
- Test Method: Draft test procedure available at [www.efficientpowersupplies.org](http://www.efficientpowersupplies.org)
EPS12V IPS Efficiency Levels Achievable Today

Measured EPS12V Server Power Supply Efficiencies

% of Nameplate Power Output vs. % Efficiency

ENERGY STAR Tier 1 EPS12V Efficiency Levels
EPS1U IPS Efficiency Levels Achievable Today

Measured EPS1U Server Power Supply Efficiencies

- ENERGY STAR Tier 1 EPS1U Efficiency Levels
Questions

• Are these proposed levels achievable?
• Others?
• Most desktops today sold with significantly oversized power supplies
  – Commonly sold with 300 to 450 W power supplies, sometimes 600 W

• Larger power supplies more likely to run at lower, less efficient loads most of the time
  – Efficiency tends to increase with load
  – Example: Desktop requiring 40 W in idle:
    • 200 W IPS – 20% of total load (80% eff)
    • 500 W IPS – 8% of total load (50% eff)
Power Supply Sizing

Power Consumed Through Server Power Supply Inefficiency

for a single power supply system

- Typical power demands for dual Xeon server
- 85.4% 250W rating
- 63.9% 460W rating
- 76.9% 600W rating
- 80.0% 500W rating

DC Power (watts)

Net Power Consumed by Power Supply (AC watts)
Sizing (cont.)

Effect of PSU Efficiency & Sizing on Idle State Power in AMD- and Intel-Based Desktop Test Systems

- High efficiency, right-sized: 56.5 W, 50.1 W
- High efficiency, oversized: 66.1 W, 59.3 W
- Low efficiency, right-sized: 66.2 W, 62.6 W
- Low efficiency, oversized: 85.1 W, 80.7 W
Additional Tier I Requirements
User Interface Recommendations

• Proposed Requirement:
  – Although not mandatory, manufacturers are strongly recommended to design products in accordance with the Power Control User Interface Standard — IEEE 1621

• IEEE 1621 covers terms, symbols, colors

• Requirement already in ENERGY STAR Monitor (Version 4.0) and Draft Imaging specification

• **Benefits:** Consistent and clear user interface should increase enabling rates, energy savings, and user satisfaction with power management.
Key Elements of IEEE 1621

- 3 Basic Power States: On, Sleep, Off ...
- ... with standard colors: Green, Amber, Off
- Key symbols: ⚡ Power; ⏰ Sleep
- Sleep Metaphor (“wake up”)
- “Hibernate” a form of Off

Comments on merit of interface consistency — *not* on content of standard
• Date in which manufacturers may begin labeling models under the new specification
• Proposed: January 1, 2007
• EPA’s goal is to finalize Tier I by the end of 2005, which would allow manufacturers at least one year to redesign and retest products, if necessary
Transition from MOU to PA

• In 2000, EPA developed a new streamlined Partnership Agreement (PA)
• Starting in 2001, EPA/DOE began transitioning partners to the new PA as specifications were revised
• Most product categories are now completely transitioned to the PA – computers are next
• Partnership Agreement: 3 sections
  – Commitment Form
  – Partner Commitments
  – Eligibility Criteria (aka specification)
Partner Commitments

Three Standard Commitments:

• Annual submission of product information

• Clear display of the ENERGY STAR on products, on product packaging, in product literature, and on company Web site

• Annual submission of ENERGY STAR unit shipment data
Annual Submission of Product Information

**Goal:** to ensure qualified product information provided on the Web site is current

- Qualifying products do not need to be retested if the specification has not changed
- Submit list of products that continue to qualify
- Report products that have been discontinued year round
Goals:

• To ensure that participating manufacturers get recognition for their efforts
• To increase awareness of ENERGY STAR among consumers
• To make it easy for specifiers, purchasers, distributors, and/or others to identify energy-efficient models
• To maintain the integrity of the ENERGY STAR brand by ensuring that the symbol is visible in the marketplace
Goal: to determine market penetration of ENERGY STAR; determine program success and if changes are needed

• EPA will work with partners to determine data collection format
• Data can be masked and/or aggregated
• Data may be provided by a third party or trade association on behalf of its members
Grandfathering Not Allowed

- All products, including models qualified under Version 3.0, with a date of manufacture on or after the proposed [January 1, 2007] effective date, must meet the new Version 4.0 requirements to remain ENERGY STAR

- Date of manufacture: date (e.g., month and year) of which the unit is considered completely assembled

- EPA gives manufacturers 1 year transition period to qualify new products which allows time for older products to filter through marketplace
Tier I Next Steps

• EPA will take into consideration comments and suggestions made today and develop a Draft 1 specification for stakeholder review
  – All stakeholders are encouraged to provide written comments as well
  – Comments and discussion notes will be posted to the ENERGY STAR Product Development Web site at www.energystar.gov/productdevelopment
Questions?

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  (202) 343-9120