Preliminary Draft Review: Proposed Tier I Requirements

Craig Hershberg, US EPA

History of Computer Specification

Version 1.0 Effective June 92 Expired Sept 95	• A desktop in sleep mode must use ≤ **30 W;** Integrated systems must use ≤ **60 W** • **Specified that a computer must go to "sleep" after a period of time *or* through user enabling**
Version 2.0 Effective Oct 95 Expired June 99	• A desktop in sleep mode must use ≤ **30 W;** Integrated systems must use ≤ **60 W** • **The computer must be shipped with power management functions that send the computer into sleep mode after 15 to 30 minutes** • **Manufacturers must incorporate wording to educate consumers about sleep mode** • **Computer must be able to send ENERGY STAR monitor into sleep mode**
Version 3.0 **Tier 1** Effective July 99 Expired July 00	• A desktop with a power supply rating ≤ **200 W** must use ≤ **30 W** in sleep mode; **power supply rating** > **200 W** must use no more than **15%** of the power supply rated value in sleep mode; Integrated computer systems must use < **45 W** in sleep mode • **Computers must have the ability to sleep when connected to a network** • **Computers must be able to "wake" when prompted by the network**

History (cont.)

Version 3.0
Tier 2
Effective July 2000
Not yet expired

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:

Rated Output Power of Power Supply	Power Allowance in Sleep Mode
≤ 200 W	≤ 15 W
> 200 W ≤ 300 W	≤ 20 W
> 300 W ≤ 350 W	≤ 25 W
> 350 W ≤ 400 W	≤ 30 W
> 400 W	10% of the Rated Output Power • 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

• 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

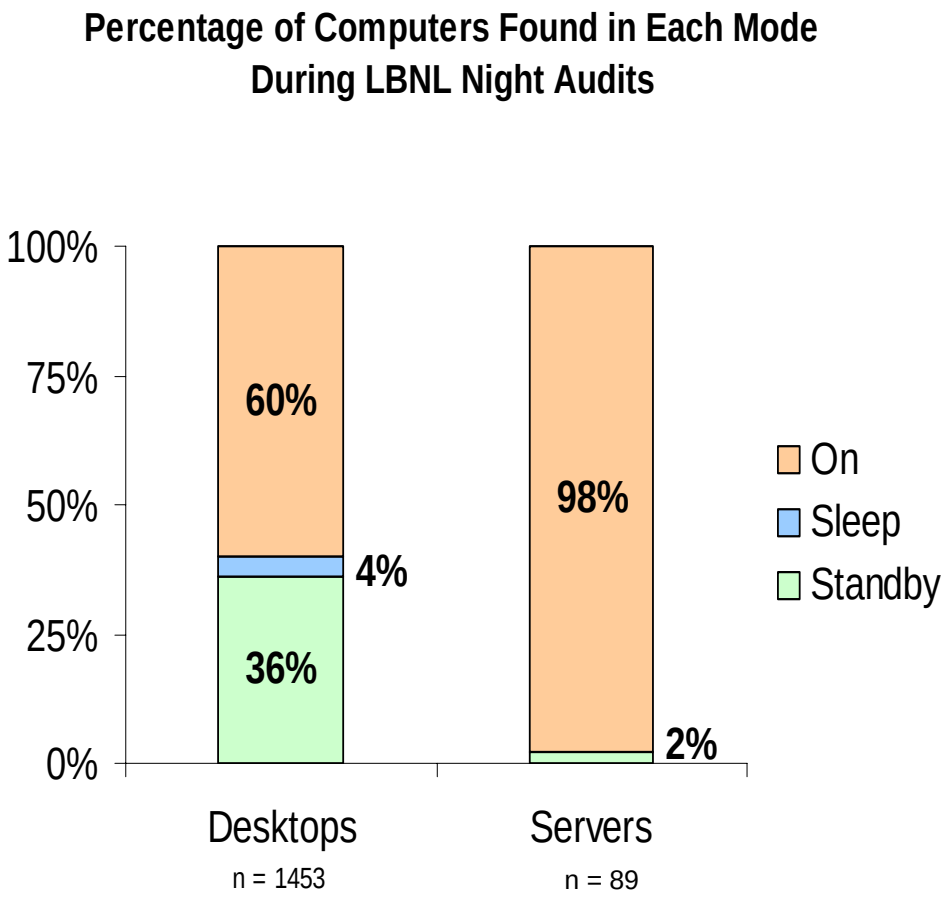
Paradigm Shift for ENERGY STAR Computers

	Old Approach	New Approach
Modes addressed	Sleep mode only	All modes
Certainty of savings	Depends on enabling rates & user behavior	Most savings automatic (hardware-driven)
Promotion & differentiation opportunities available	Label only	Label + utility incentives & marketing + preferential gov & corp procurement
Products covered	Desktops, workstations, laptops	+ Desktop-derived servers, thin clients, media PCs?

Why Revise the Specification?

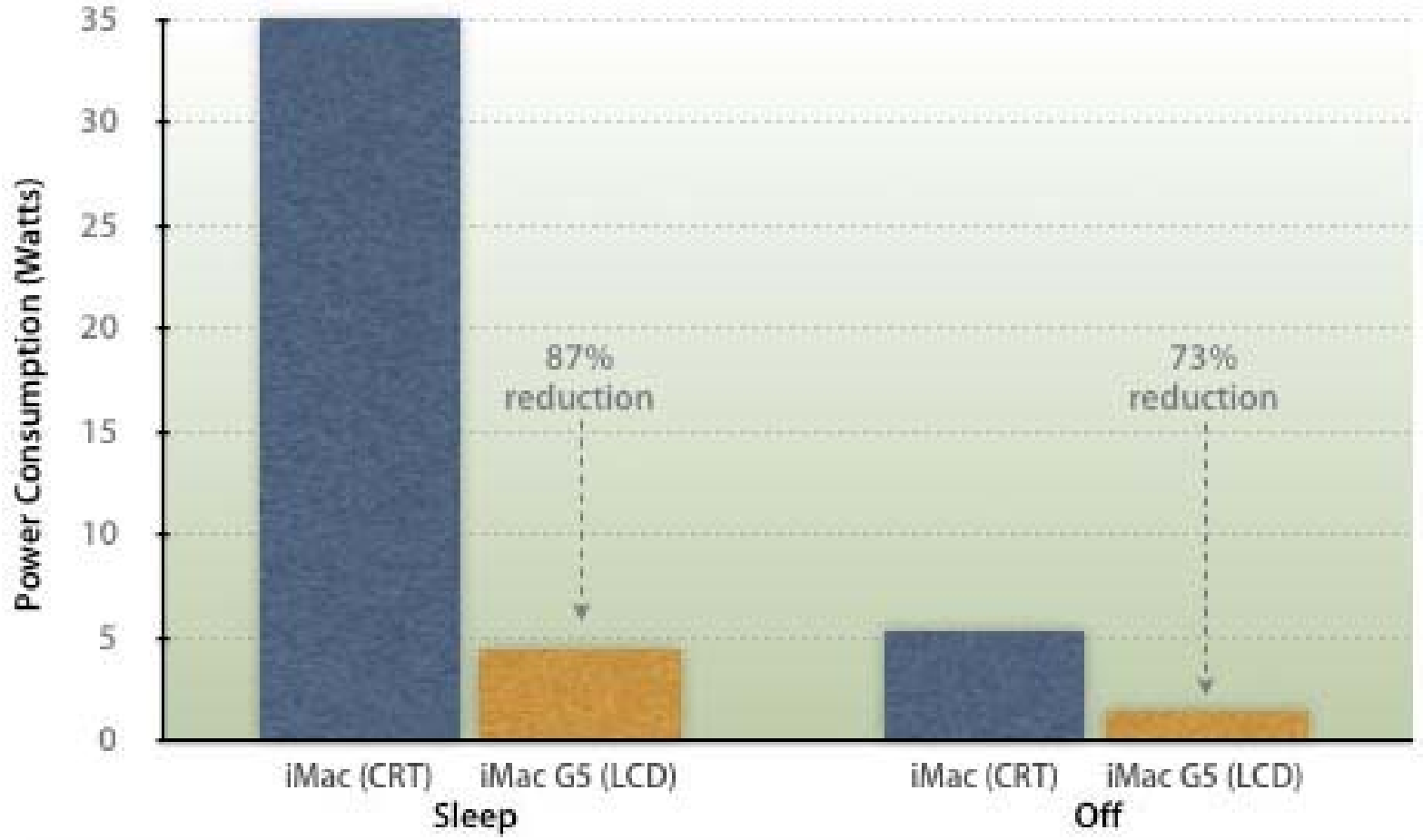
- Current specification only considers sleep mode, does not address “active mode”
- Largest opportunities for energy savings are when computers are turned on, which occurs during peak demand times
- Current label has about 98% market penetration, offering little differentiation for innovative, energy 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*.

Limited Additional Savings Potential: Sleep Mode



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

Total 3 year Cumulative National Energy Savings (millions kWh)	Total 3 year Cumulative National Carbon Dioxide Savings (million tons CO2)	Total 3 year Cumulative National Value of Electricity Saved per year (millions of dollars)	Equivalent Number of American Households Powered for One Year
5098	3.4	372.1	498,844

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?

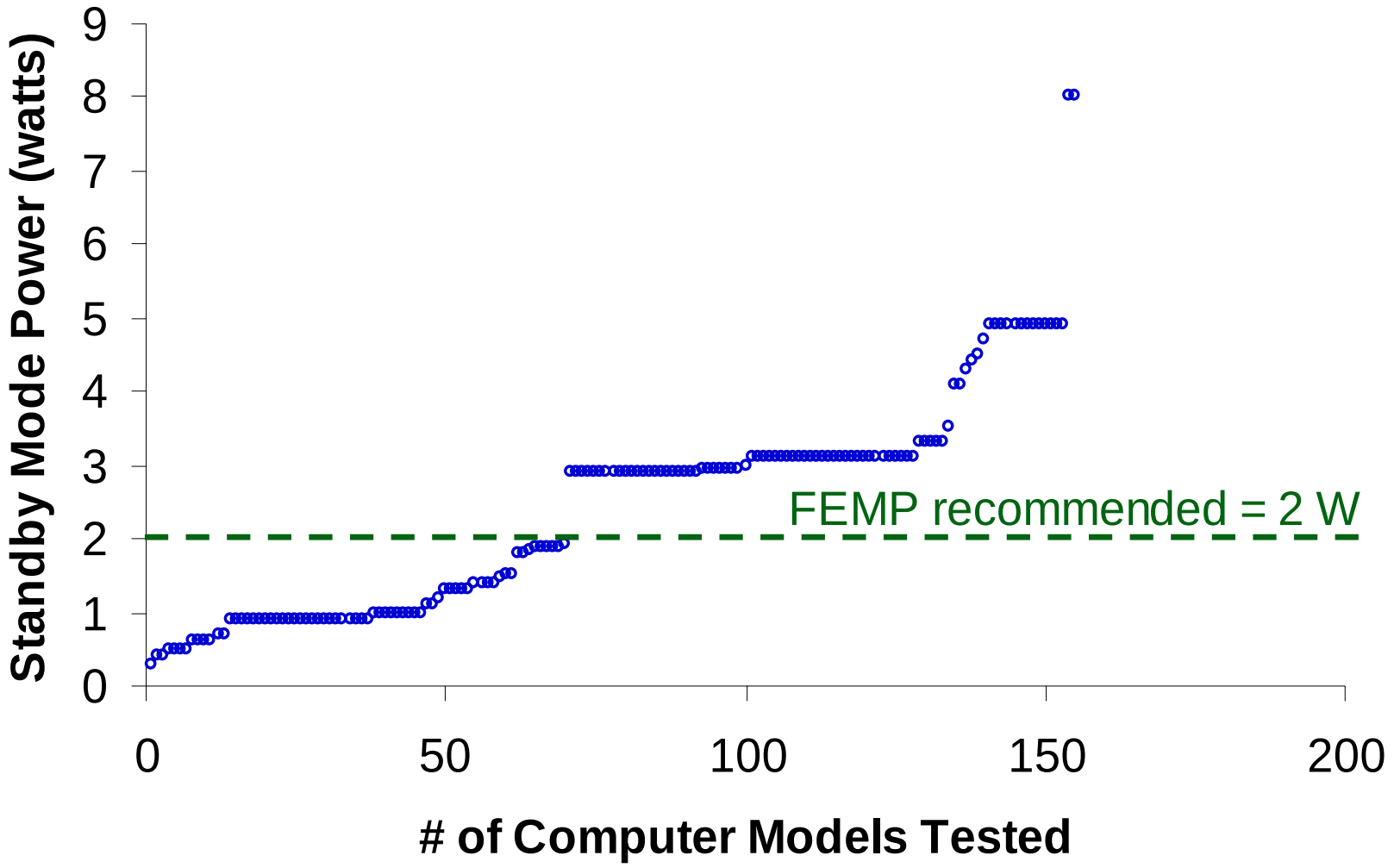
Standby Levels

Proposed Performance Requirements

- Desktops & workstations: ≤ 2 W
- Notebooks: ≤ 0.5 W
- Integrated Computers ≤ 3 W

- Follows FEMP standby recommendations
- Test Method: IEC 62301 (www.iec.ch)

Desktop Standby Levels Achievable Today



Questions/Discussion

- Are these levels reasonable/achievable?
- Others?

Sleep Mode Levels

Proposed Performance Requirements

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

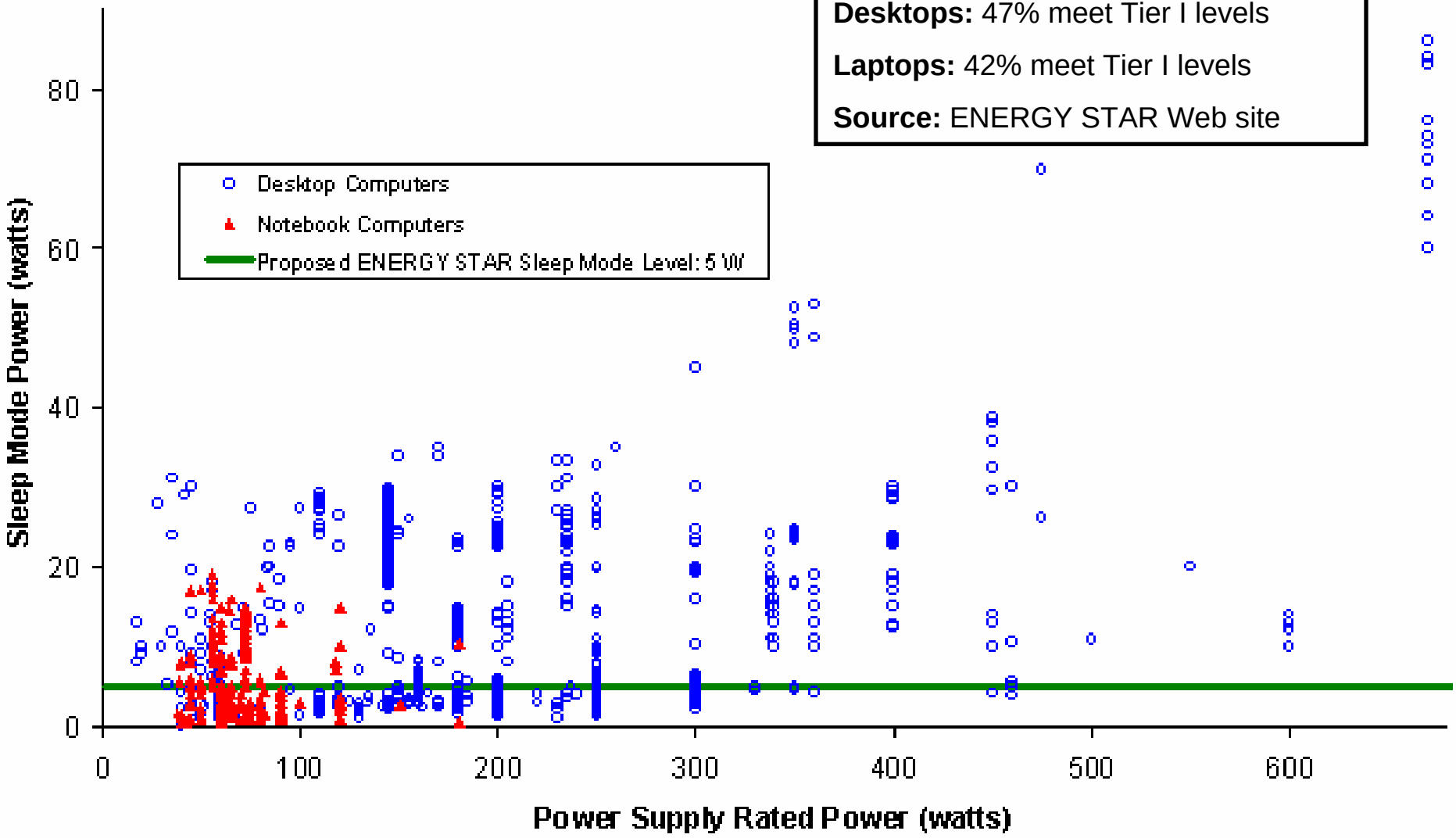
- Test Method: Existing ENERGY STAR (Version 3.0) computer test procedure

Sleep Mode Levels Achievable Today

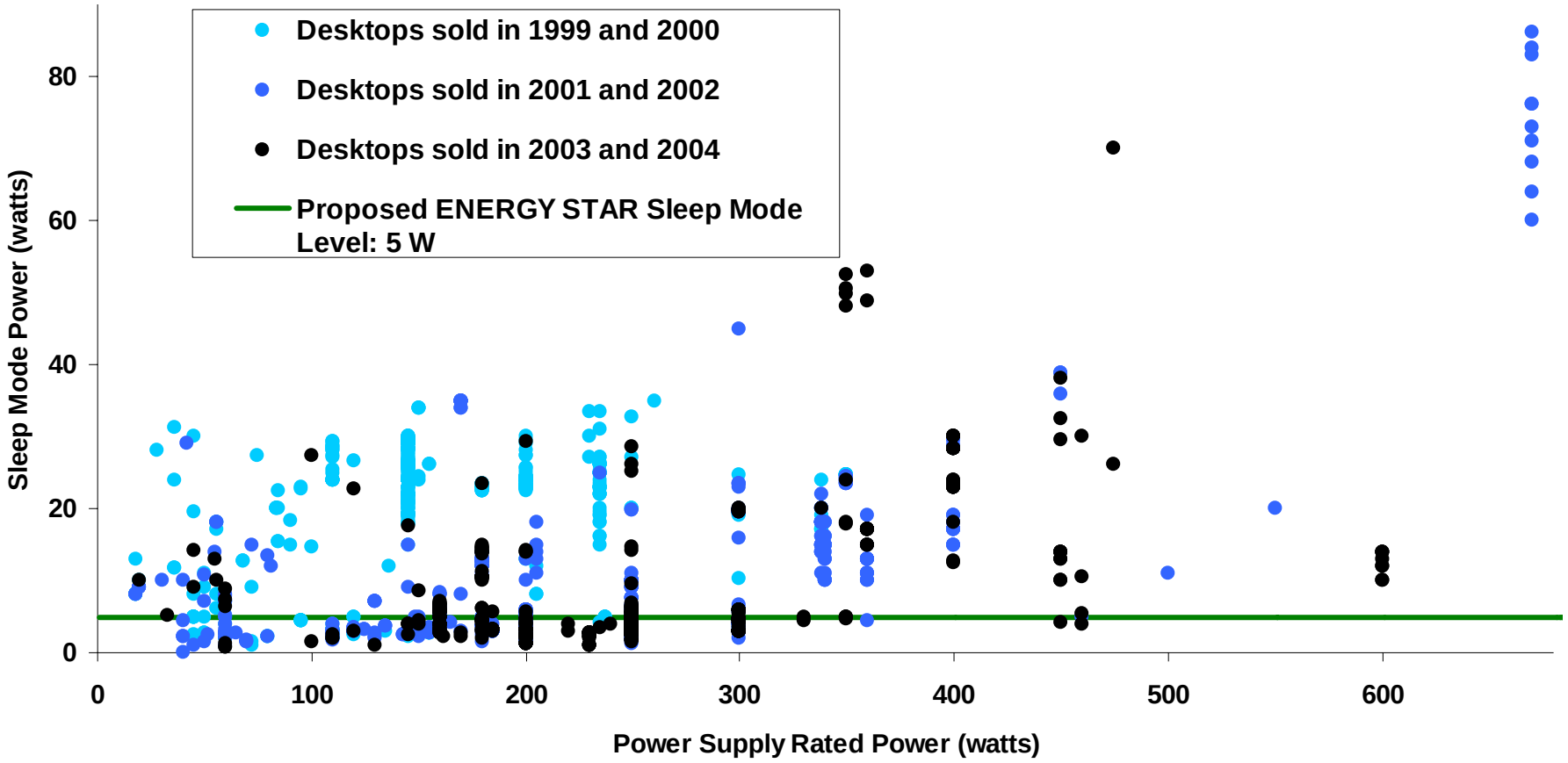
Desktops: 47% meet Tier I levels

Laptops: 42% meet Tier I levels

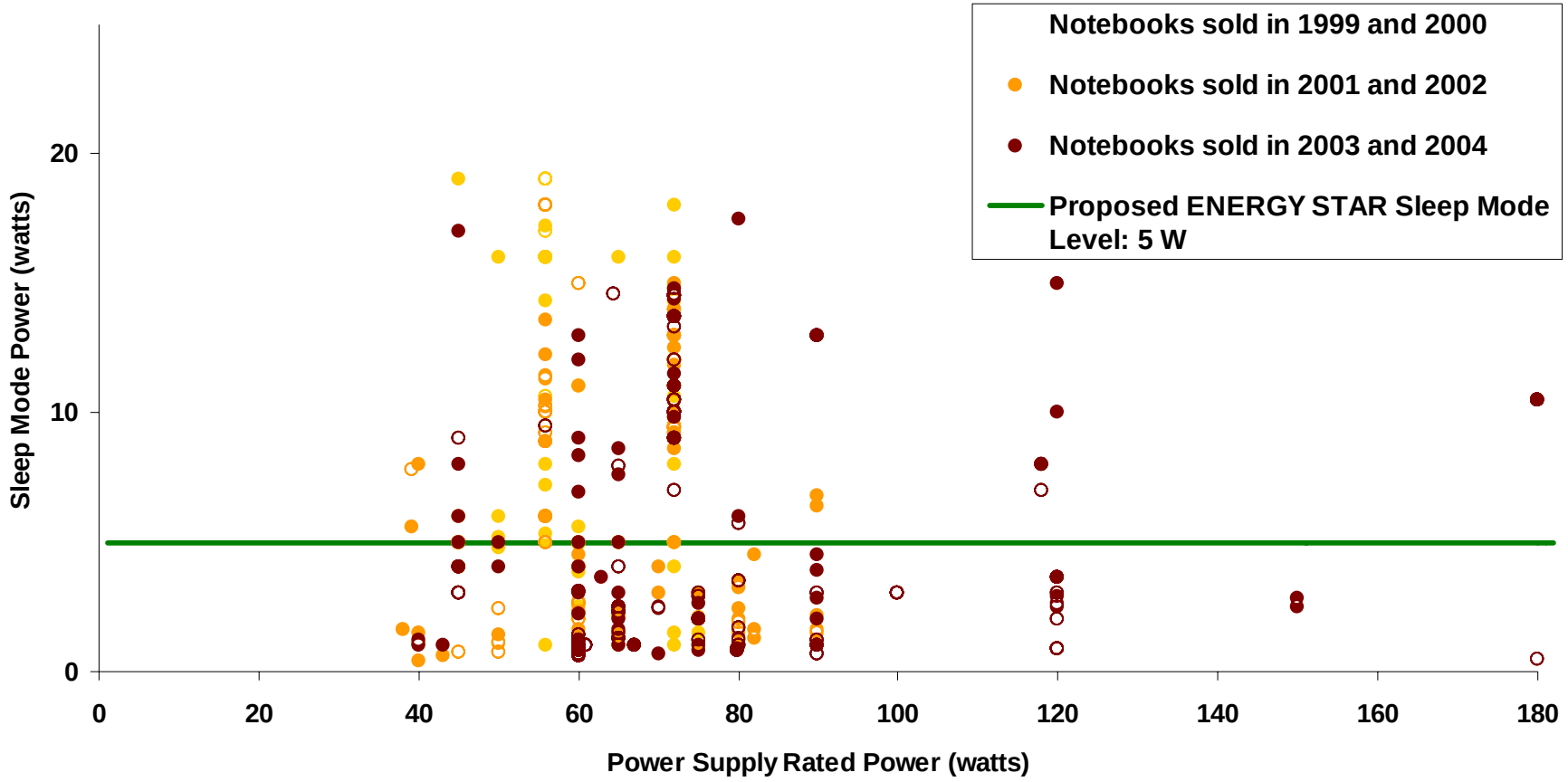
Source: ENERGY STAR Web site



Desktops: Sleep Levels Today



Notebooks: Sleep Levels Today



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.

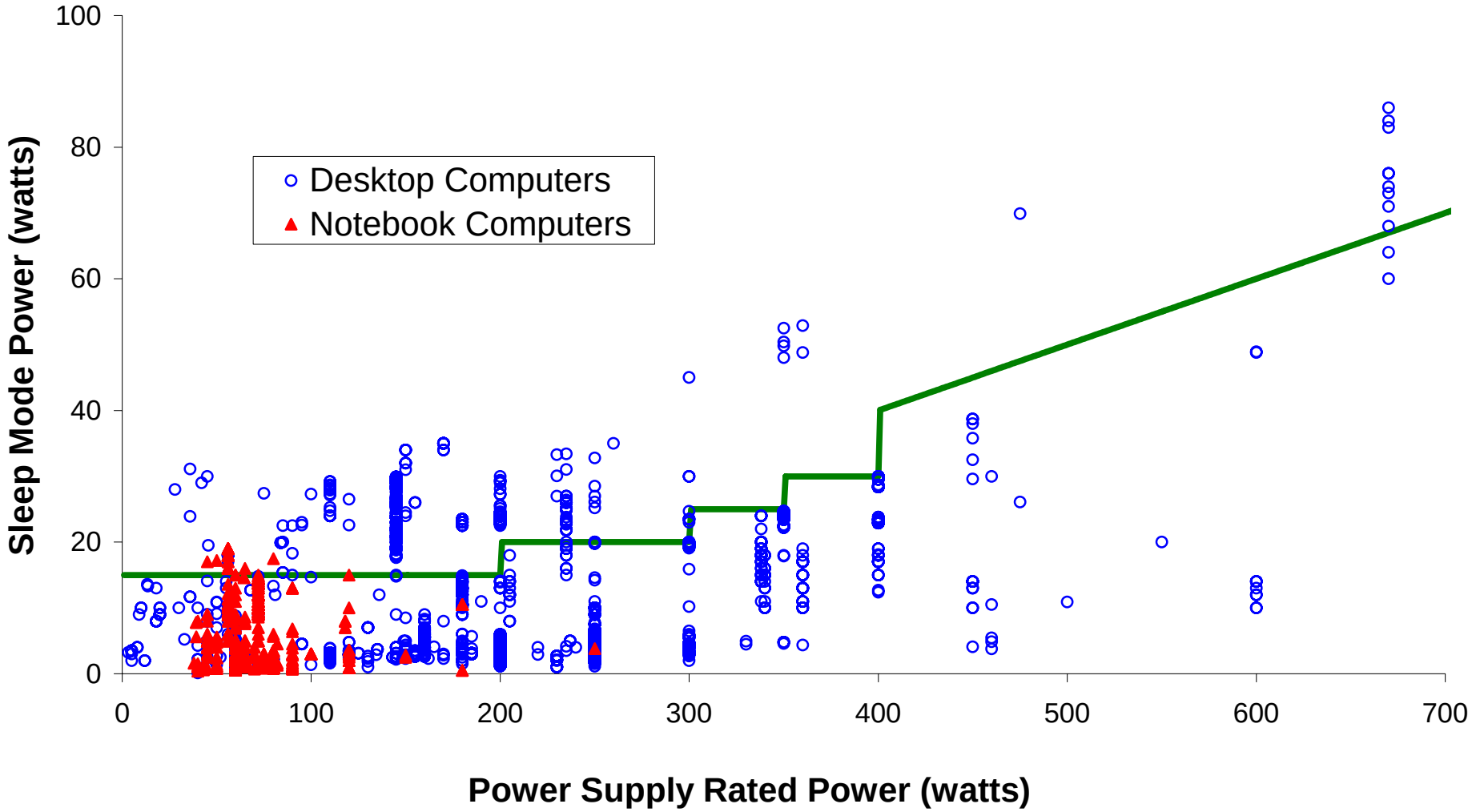
- Proposed New Requirement
  - Default must be within 15 minutes of user inactivity

Questions/Discussion

- Is the elimination of a sliding scale an issue?

Under Version 3.0

Rated Output Power of Power Supply	Allowance Sleep Mode Power
≤ 200 W	≤ 15 W
> 200 W ≤ 300 W	≤ 20 W
> 300 W ≤ 350 W	≤ 25 W
> 350 W ≤ 400 W	≤ 30 W
> 400 W	10% of the Rated Output Power


Sleep Mode Power (watts)
Power Supply Rated Power (watts)
Desktop Computers
Notebook Computers
0
20
40
60
80
100
0
100
200
300
400
500
600
700

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

Idle State Levels

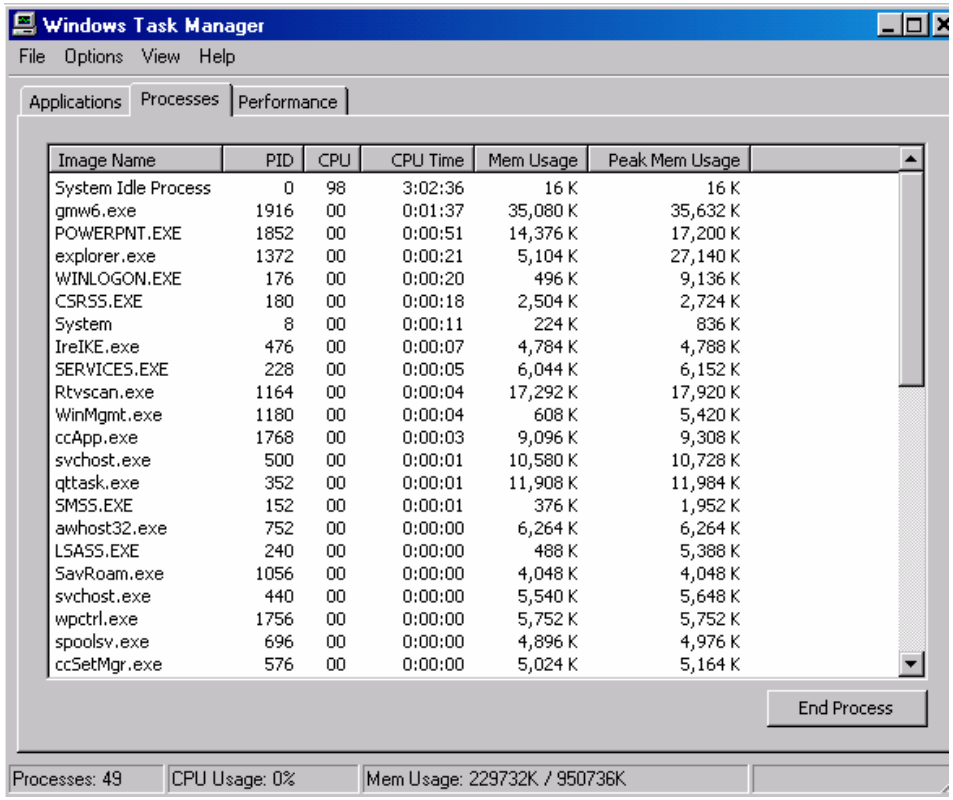
Proposed Performance Requirements

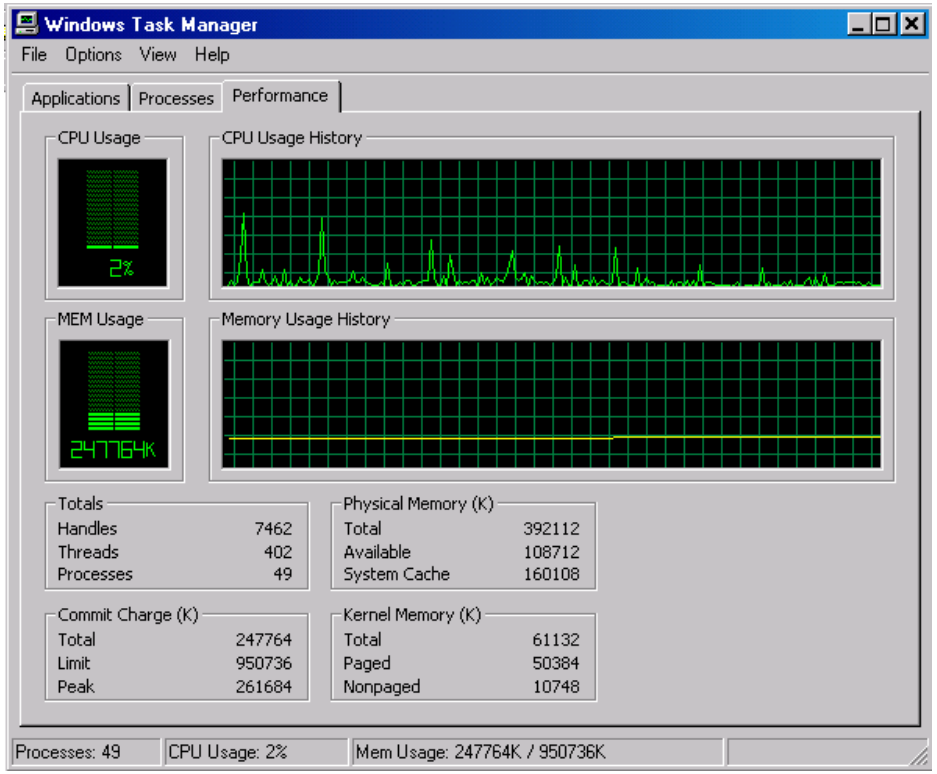
- Desktops: ≤ 50 to 60 W
- Notebooks: ≤ 15 W
- Integrated Computers: ≤ 52 to 62 W
  - Represents desktop idle level + 2 W monitor ENERGY STAR requirement
- Desktop Derived Servers/Workstations: ≤ 90 to 100

- Test Method: TBD
- More research needed

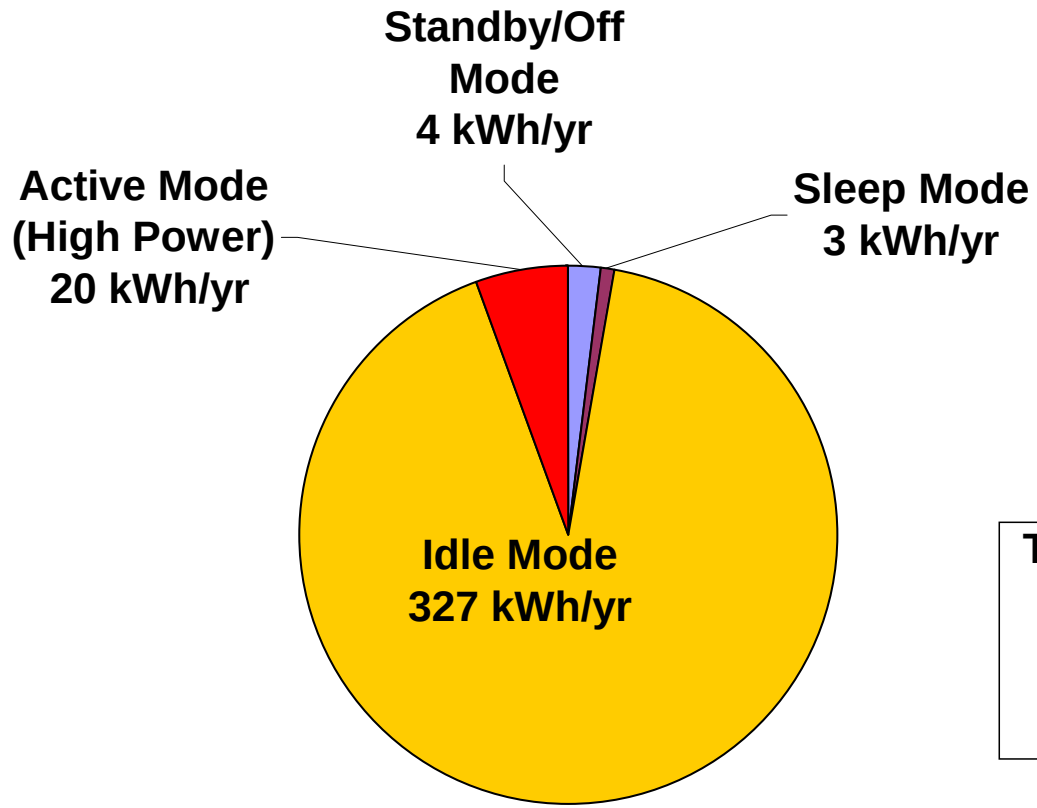
Idle State (cont.)

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)





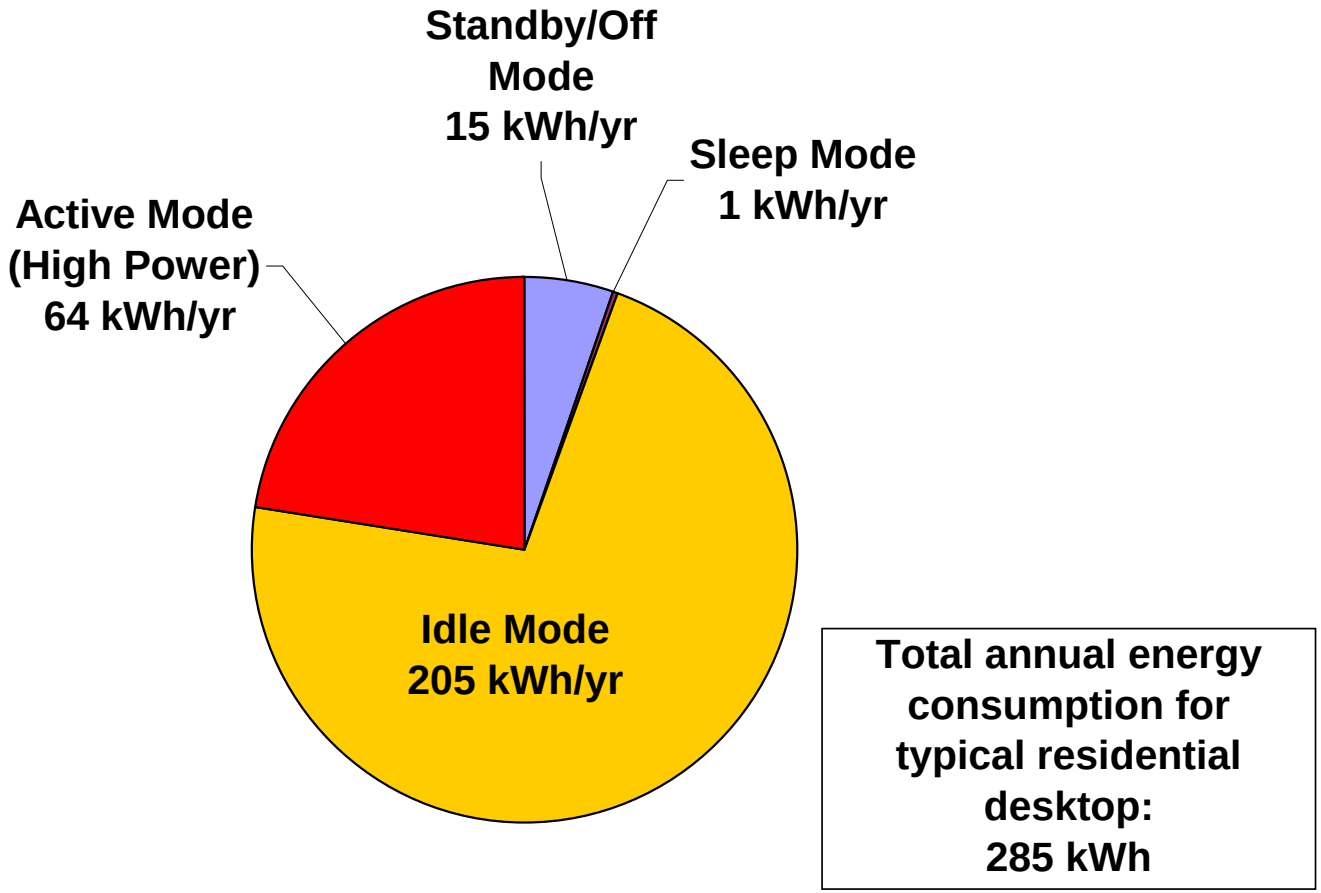
Idle State: Commercial Desktops



Total annual energy consumption for typical desktop: 354 kWh

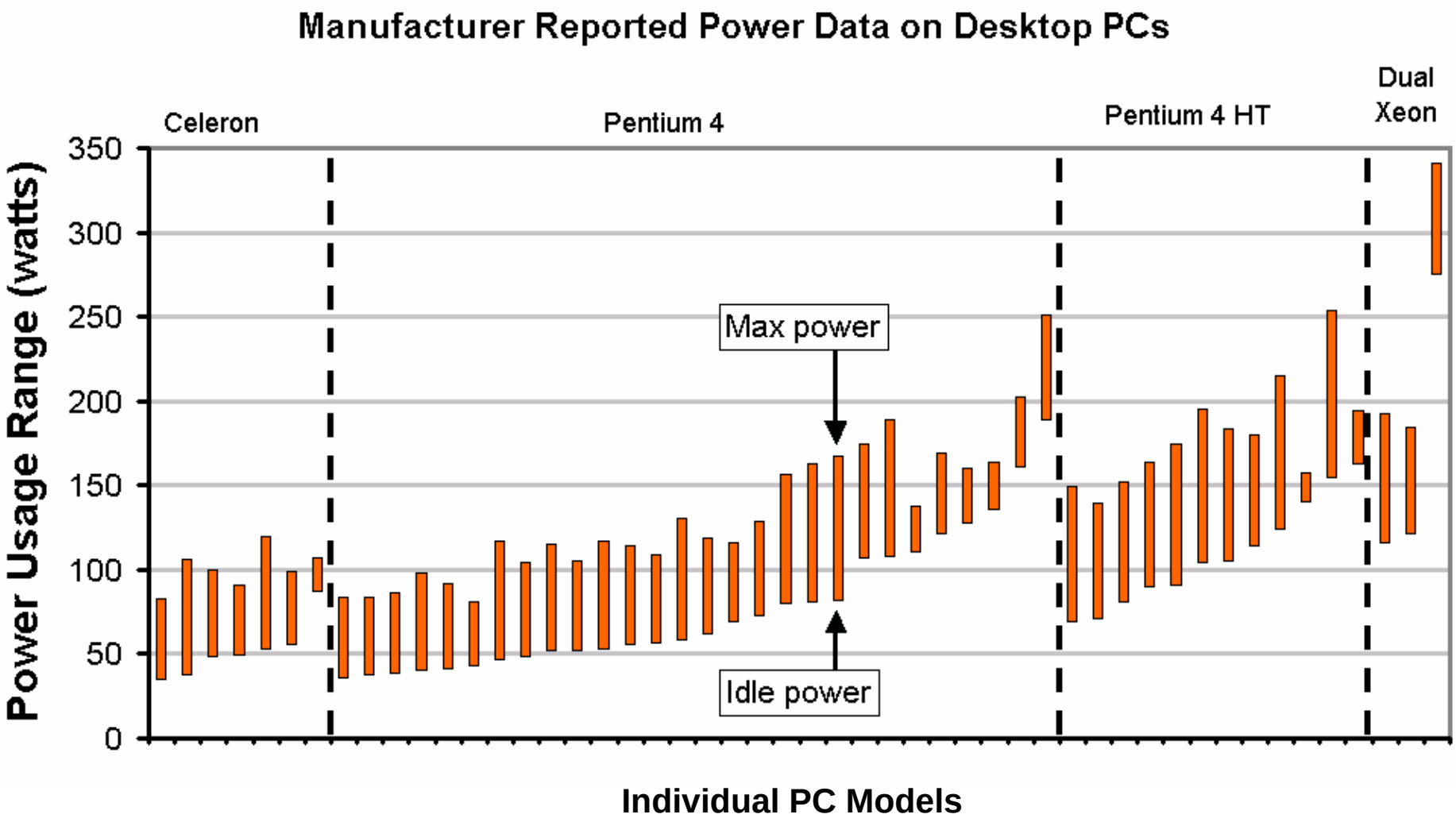
Idle State over 90% of total energy use in commercial desktops

Idle State: Residential Desktops

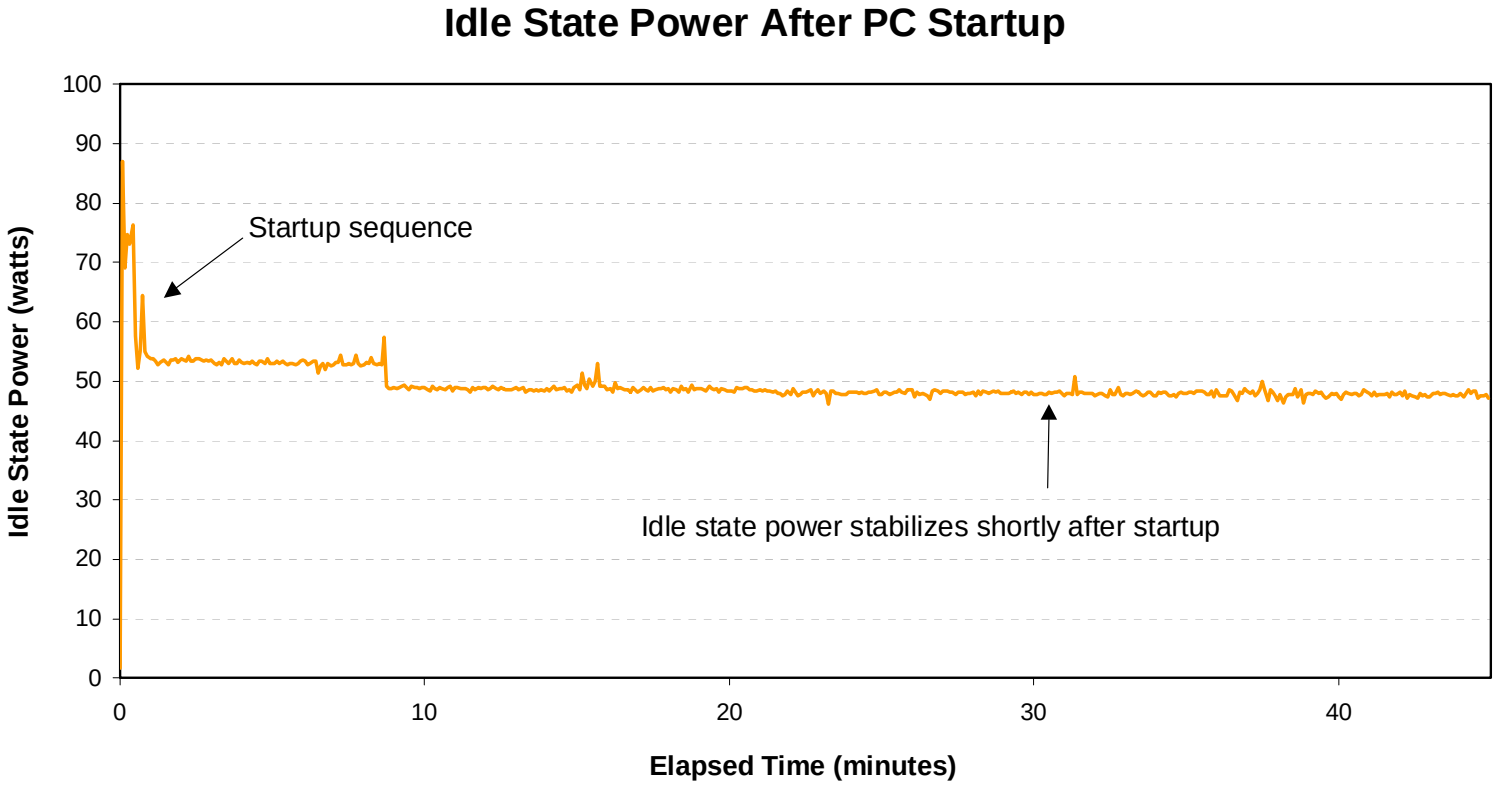


Idle State over 70% of total energy use in residential desktops

Idle Power Levels Achievable Today



Test Method Considerations



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?

External Power Supply (EPS)

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

Nameplate Output Power (P_{no})	Average Efficiency in Active Mode (expressed as decimal)
0 to ≤ 1 watt	≥ 0.49 * P_{no}
> 1 to ≤ 49 watts	≥ 0.09 * Ln (P_{no}) + 0.49
> 49 watts*	≥ 0.84

Nameplate Output Power (P_{no})	Maximum Power in No-Load
0 to < 10 watts	≤ 0.5 watts
≥ 10 to ≤ 250 watts*	≤ 0.75 watts (Tier I EPS spec) ≤ 0.5 watts (Tier II EPS spec)

* Most computers would fall in these categories

EPS: Calculating Active Power

- 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

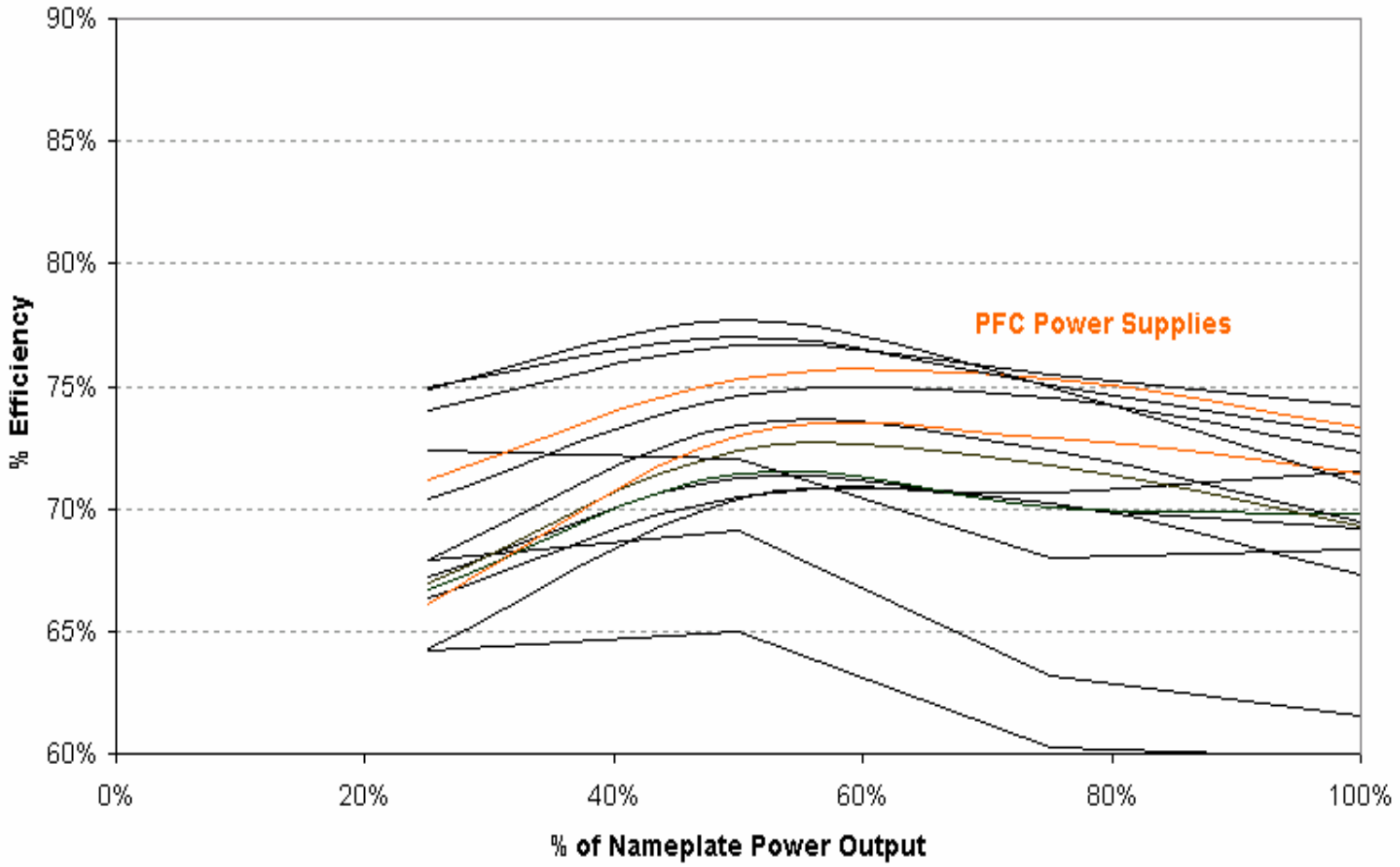
Internal Power Supply (IPS)

Proposed Performance Requirements

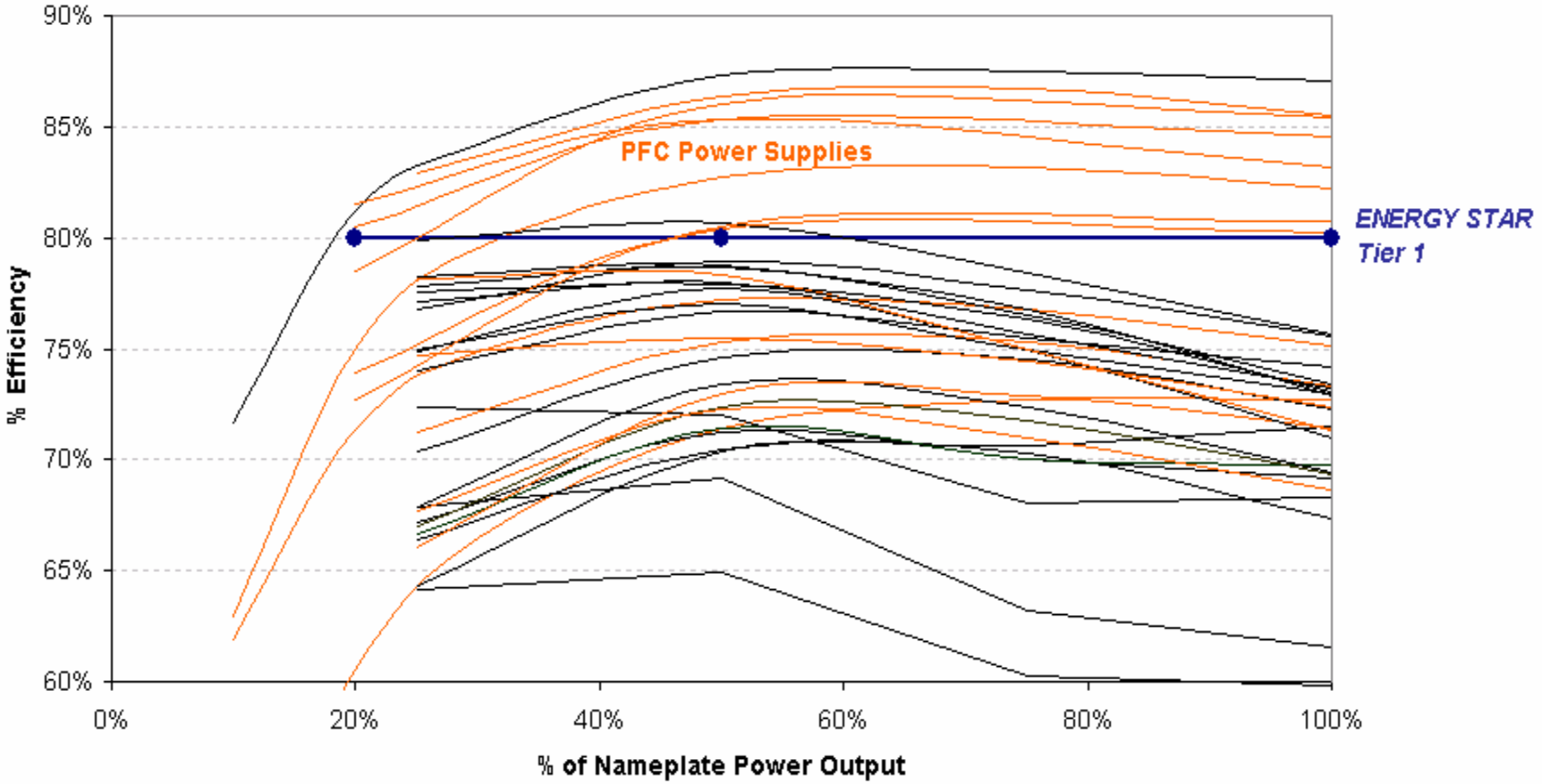
% Load	*20% Load*	*50% Load*	*100% Load*
Desktops, Workstations, Integrated Computers	80%	80%	80%

- Adapted from Intel's internal computer power supply design guide recommendations (www.formfactors.org)
- Test Method: Draft test procedure available at www.efficientpowersupplies.org

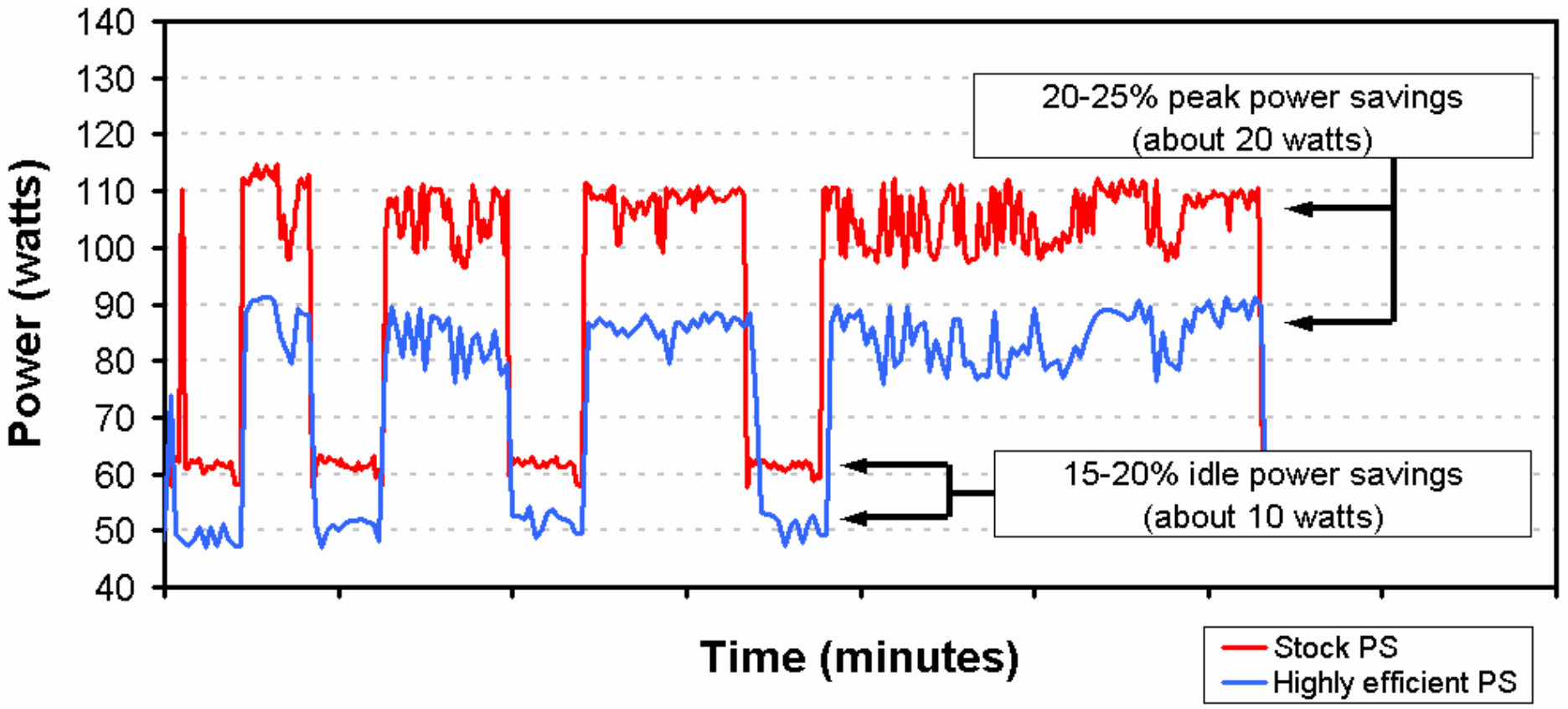
Desktop IPS Efficiencies Mid- 2004



Desktop IPS Efficiencies Today



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.

IPS Requirements (cont.)

Proposed Performance Requirements

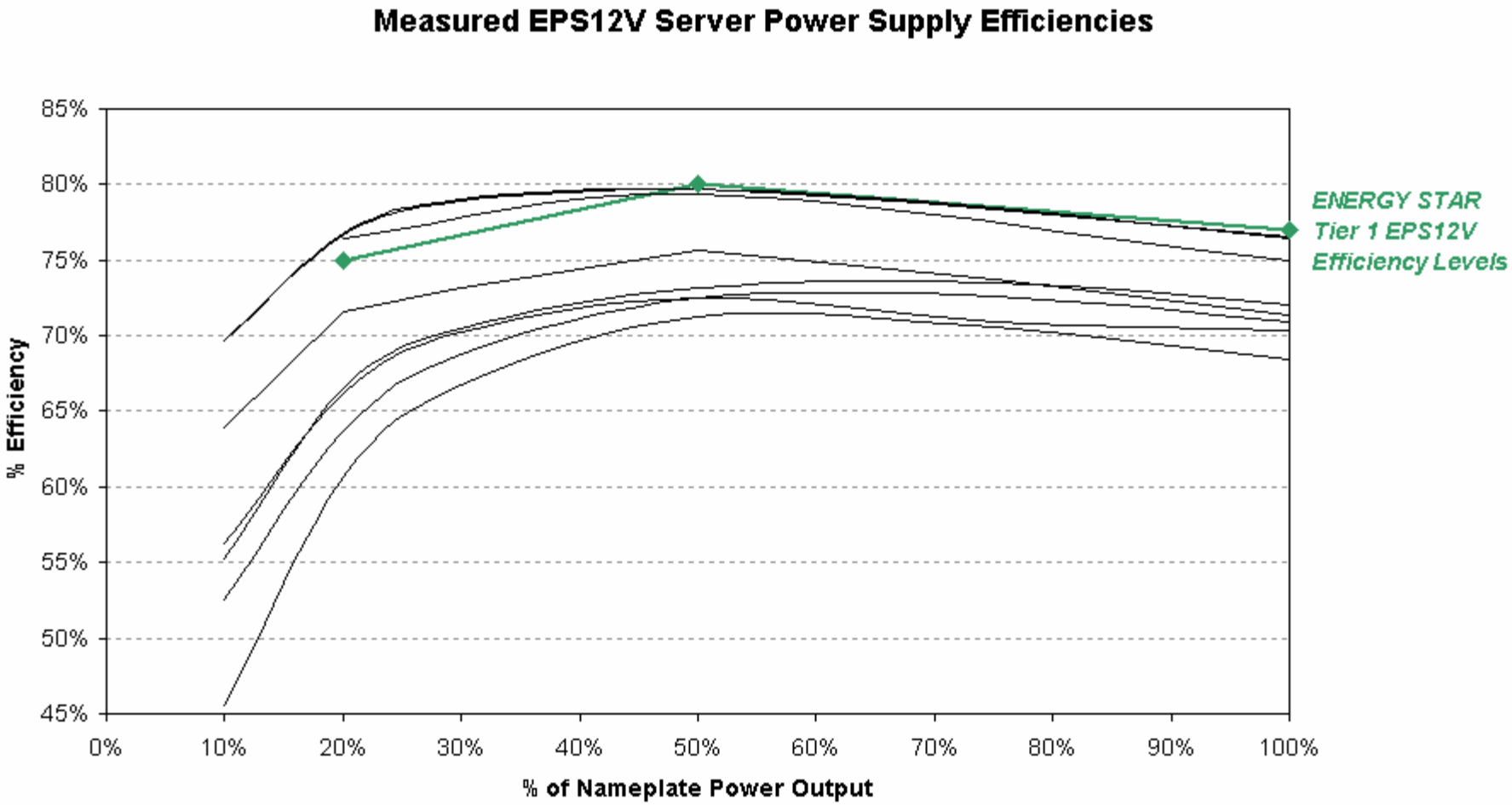
- Desktop Derived Servers

% Load	*20% Load*	*50% Load*	*100% Load*
EPS12V	75%	80%	77%

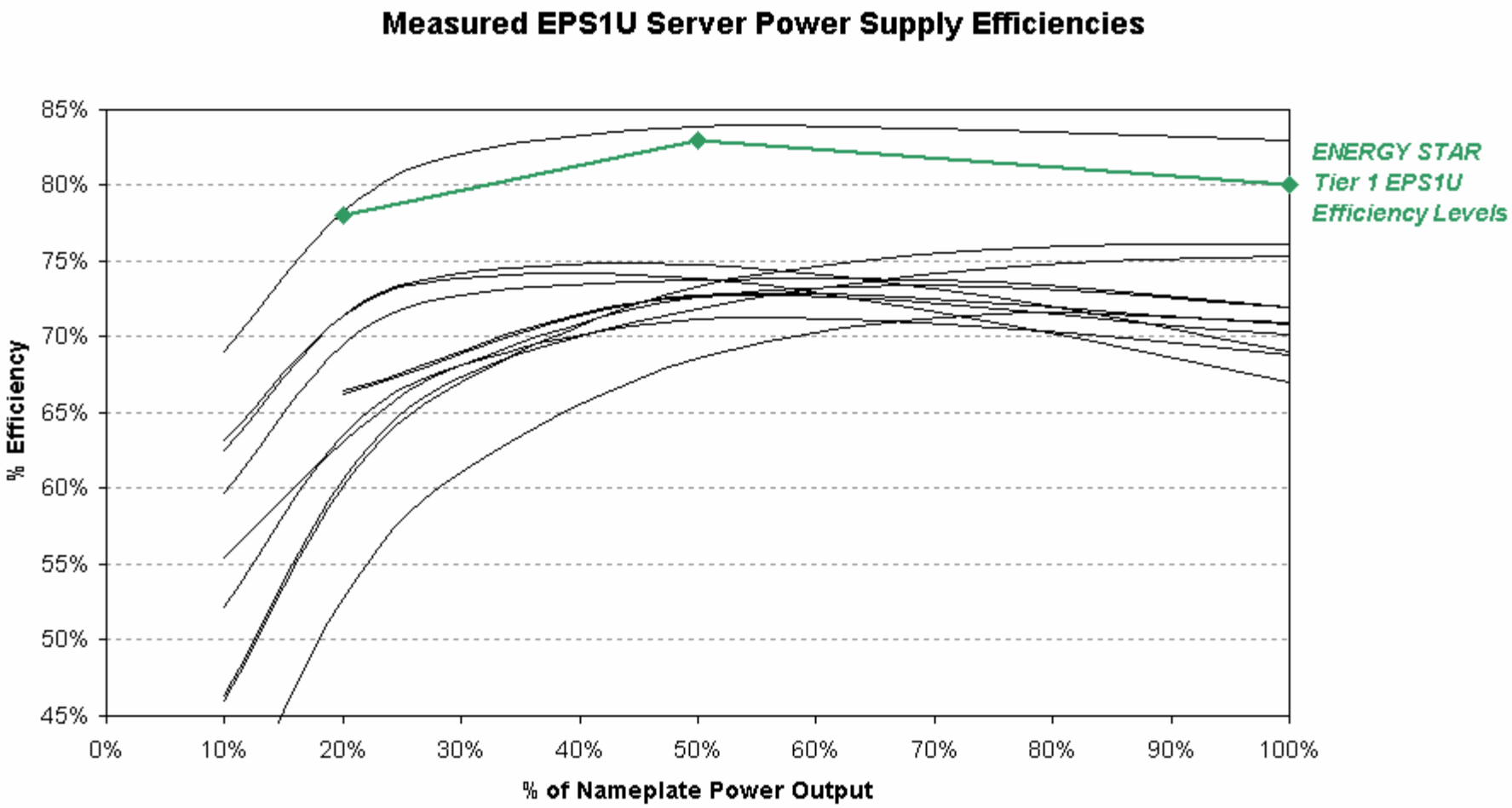
% Load	*20% Load*	*50% Load*	*100% Load*
EPS1U	78%	83%	80%

- Harmonized with proposed Server System Infrastructure (SSI) recommended levels
- Test Method: Draft test procedure available at www.efficientpowersupplies.org

EPS12V IPS Efficiency Levels Achievable Today



EPS1U IPS Efficiency Levels Achievable Today



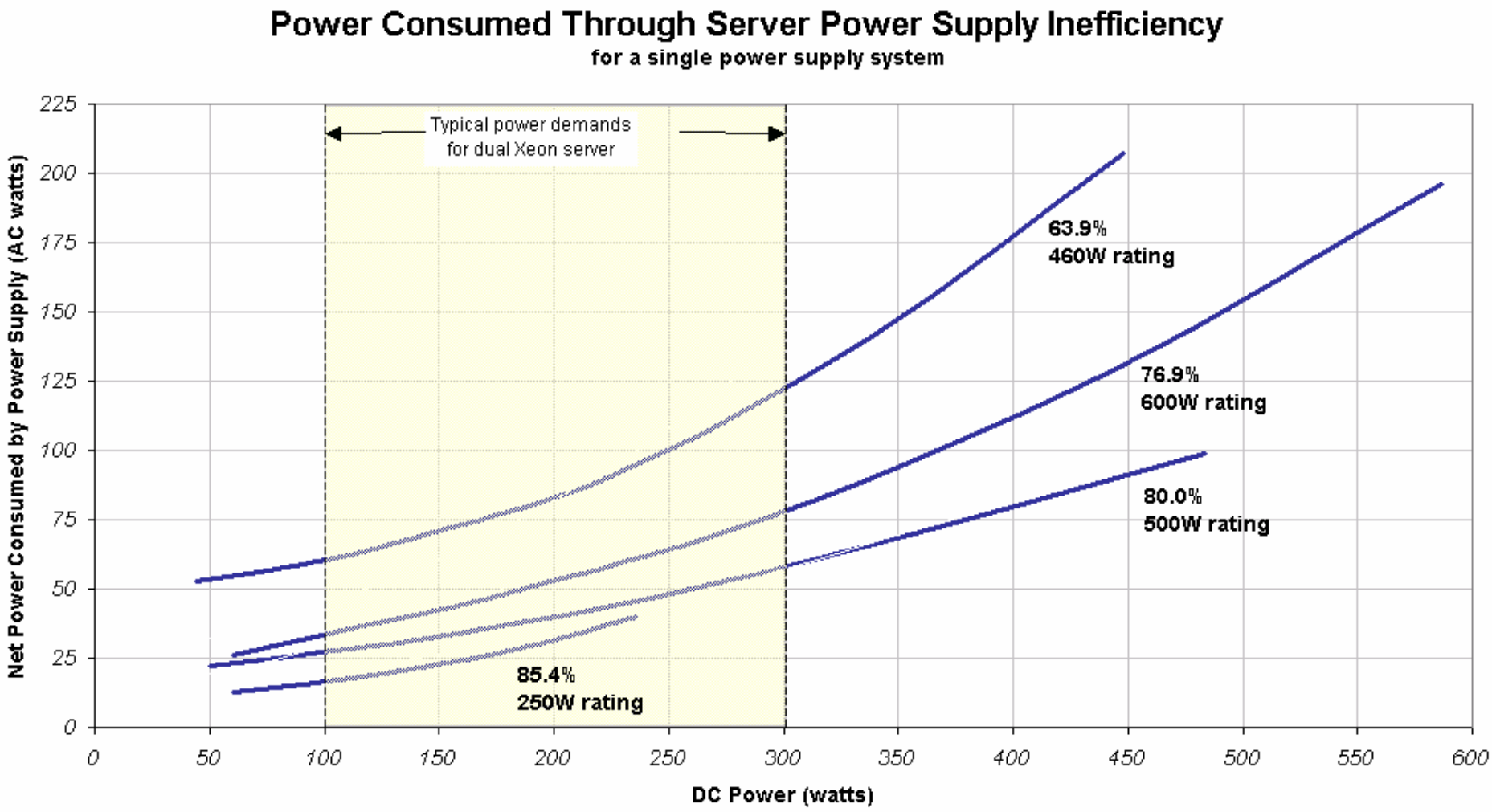
Questions

- Are these proposed levels achievable?
- Others?

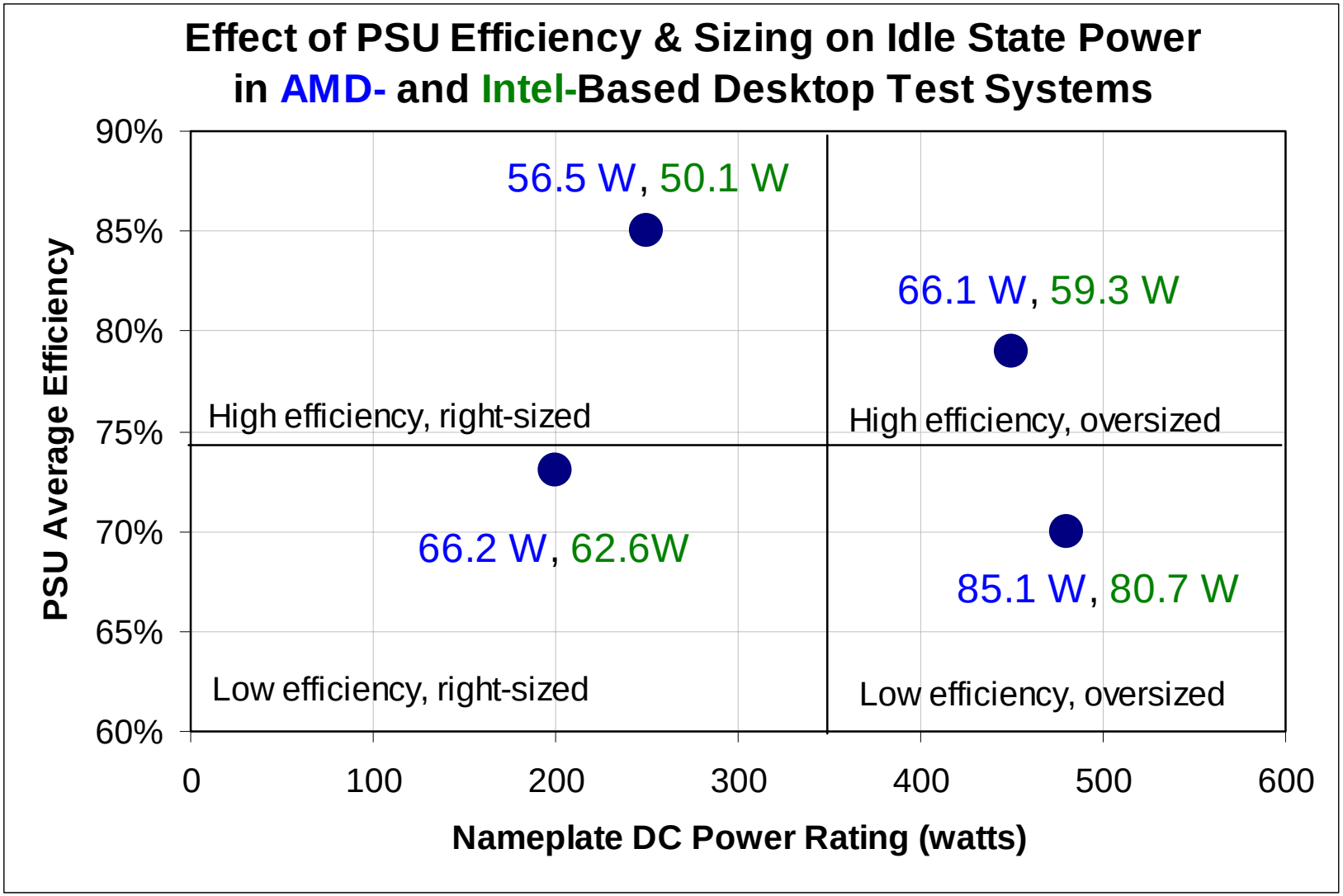
Addressing Power Supply Oversizing

- 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



Sizing (cont.)


Effect of PSU Efficiency & Sizing on Idle State Power
in AMD- and Intel-Based Desktop Test Systems
PSU Average Efficiency
90%
85%
80%
75%
70%
65%
60%
56.5 W, 50.1 W
66.1 W, 59.3 W
High efficiency, right-sized
High efficiency, oversized
66.2 W, 62.6W
85.1 W, 80.7 W
Low efficiency, right-sized
Low efficiency, oversized
0
100
200
300
400
500
600
Nameplate DC Power Rating (watts)

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

Tier I Effective Date

- 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

Product Labeling

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

Annual Shipment Data

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

Other PA Requirements

- 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?

- Craig Hershberg, US EPA
  Hershberg.craig@epa.gov
  (202) 343-9120