Results of Field and Lab Testing of PCs
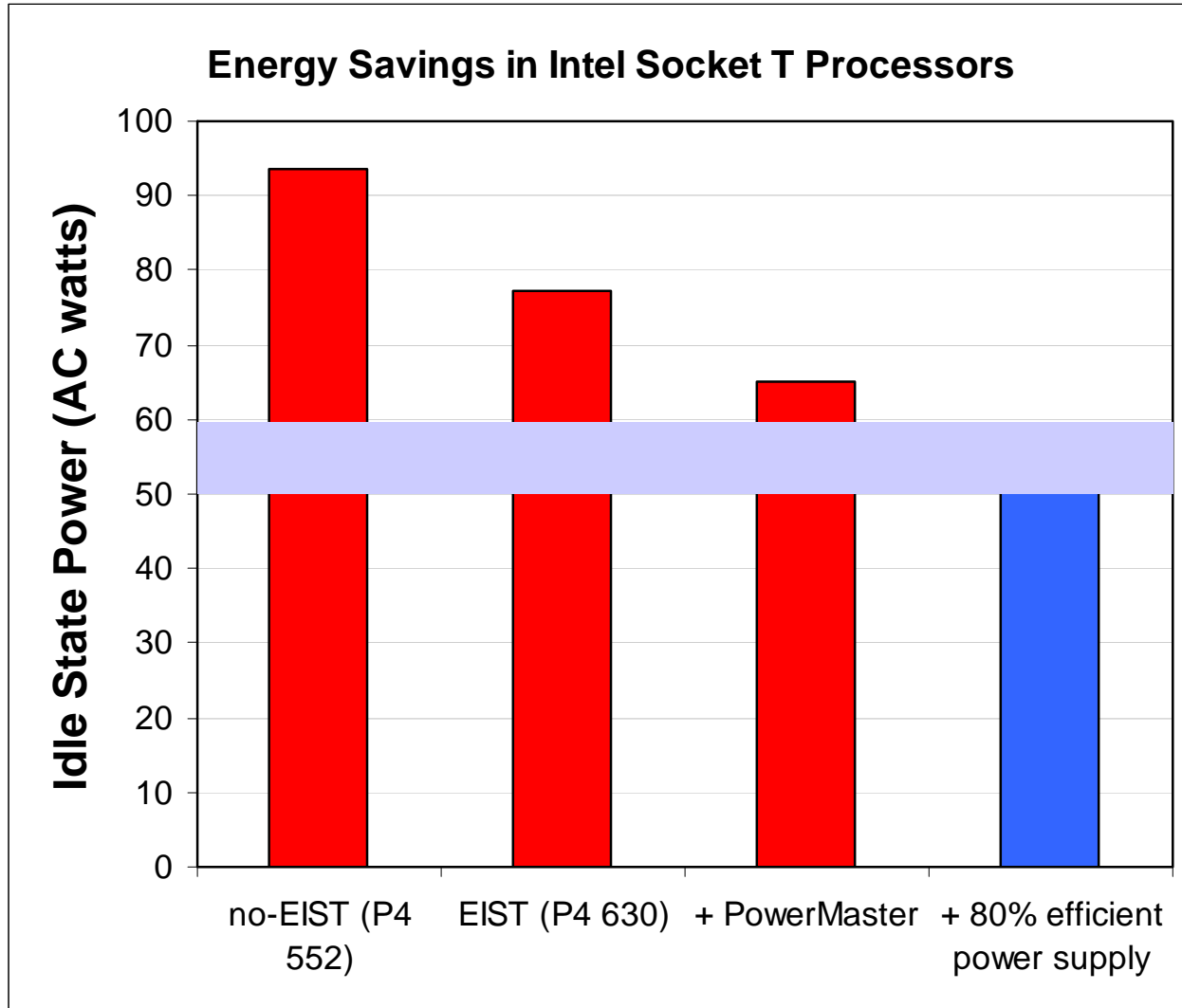
Presentation at Energy Star stakeholder meeting

June 21, 2005

Chris Calwell

Ecos Consulting

EIST, PowerMaster and Efficient PS

Energy Savings in Intel Socket T Processors

Idle State Power (AC watts)

Category	Value
no-EIST (P4 552)	~93
EIST (P4 630)	~77
+ PowerMaster	~65
+ 80% efficient power supply	~50

Base system: 1024 MB DDRI, on-board video, 80 GB SATA HD, DVD/CD-RW

Future: PowerMaster II

- Expected to launch late 2005
- Dynamic scaling of:
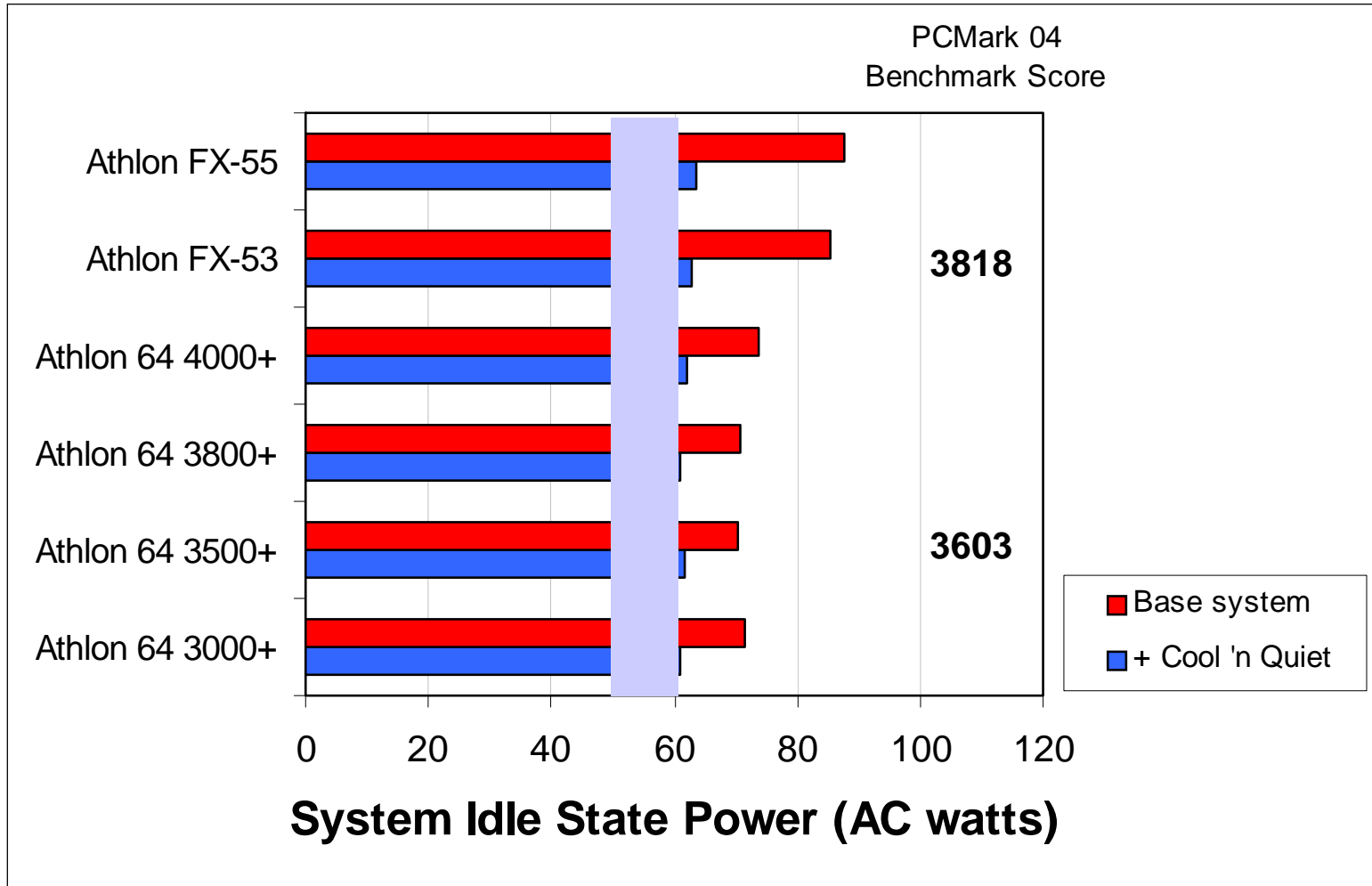 - Frequency (through FSB)
  - Voltage

- Used to ease cooling loads as AOpen moves to smaller form factor designs

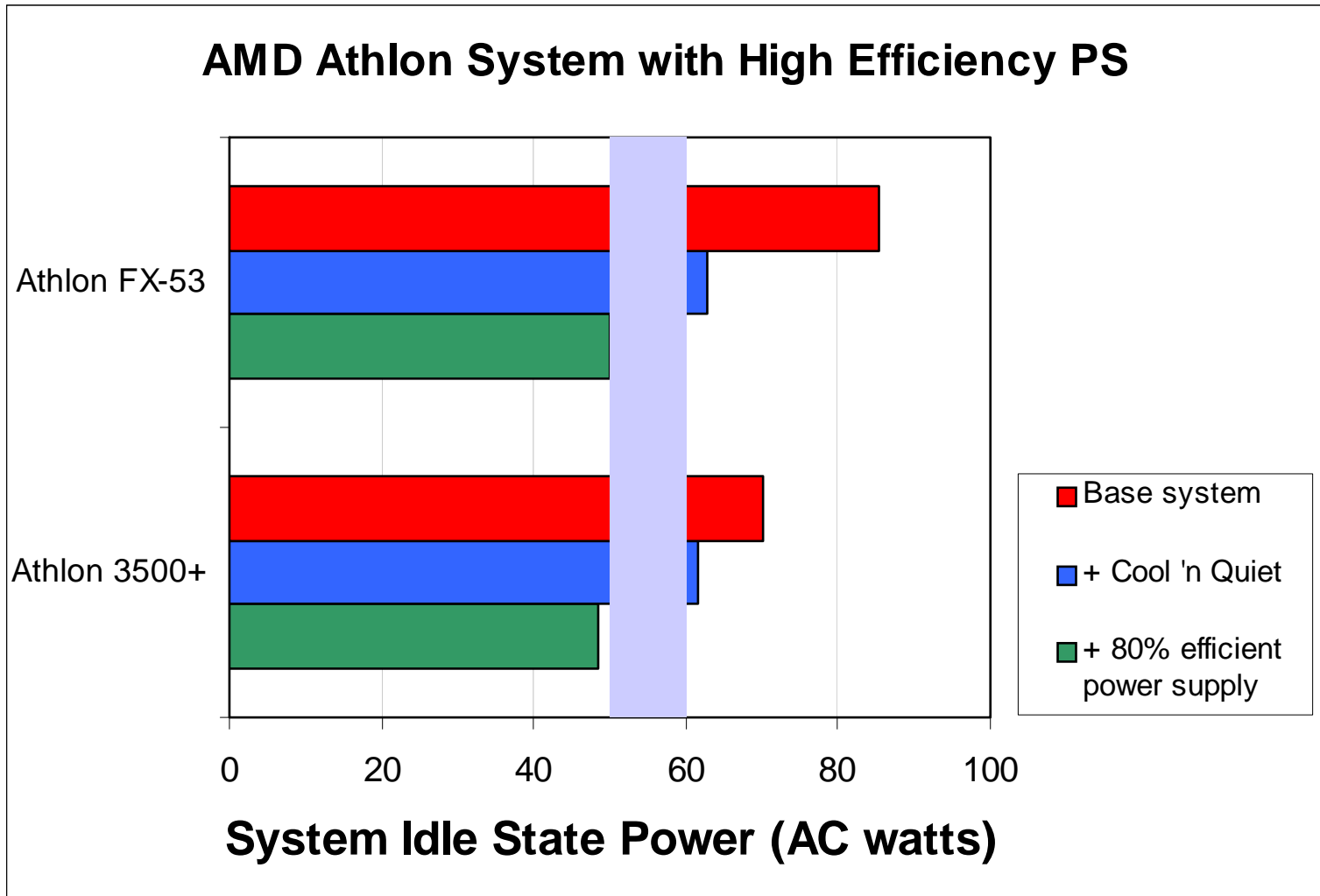# AMD Socket 939 System

- Cool 'n Quiet capable

AMD Systems Close to Meeting Proposed Spec with Conventional Power Supplies

PCMark 04
Benchmark Score

Athlon FX-55

Athlon FX-53   **3818**

Athlon 64 4000+

Athlon 64 3800+

Athlon 64 3500+   **3603**

Athlon 64 3000+

■ Base system
□ + Cool 'n Quiet

0   20   40   60   80   100   120

System Idle State Power (AC watts)

Base system: 1024 MB DDRI, nVIDIA GeFORCE 4 MX 440 video card, 80 GB HD, DVD/CD-RW, stock power supply

With 80% efficient power supply, <u>all</u> Athlon systems we tested pass

AMD Athlon System with High Efficiency PS

System Idle State Power (AC watts)

Legend:
- Base system
- + Cool 'n Quiet
- + 80% efficient power supply

Base system: 1024 MB DDRI, nVIDIA GeFORCE 4 MX 440 video card, 80 GB HD, DVD/CD-RW

Pentium M System

- Low voltage, 1.8 GHz Pentium M on desktop motherboard

- Accepts lower power DDRII memory

- Prior testing indicated big energy savings potential, while preserving adaptability of desktop form factor
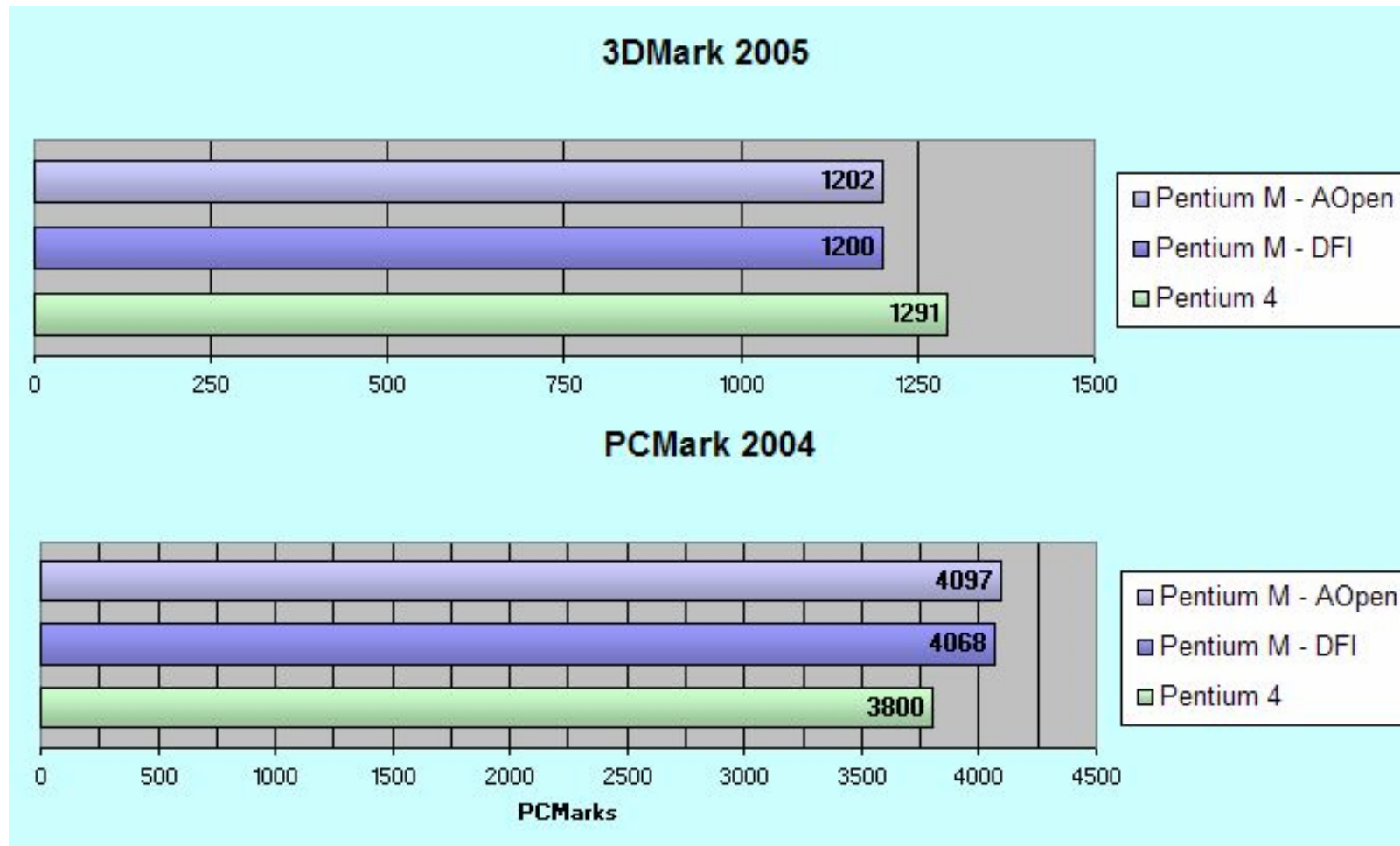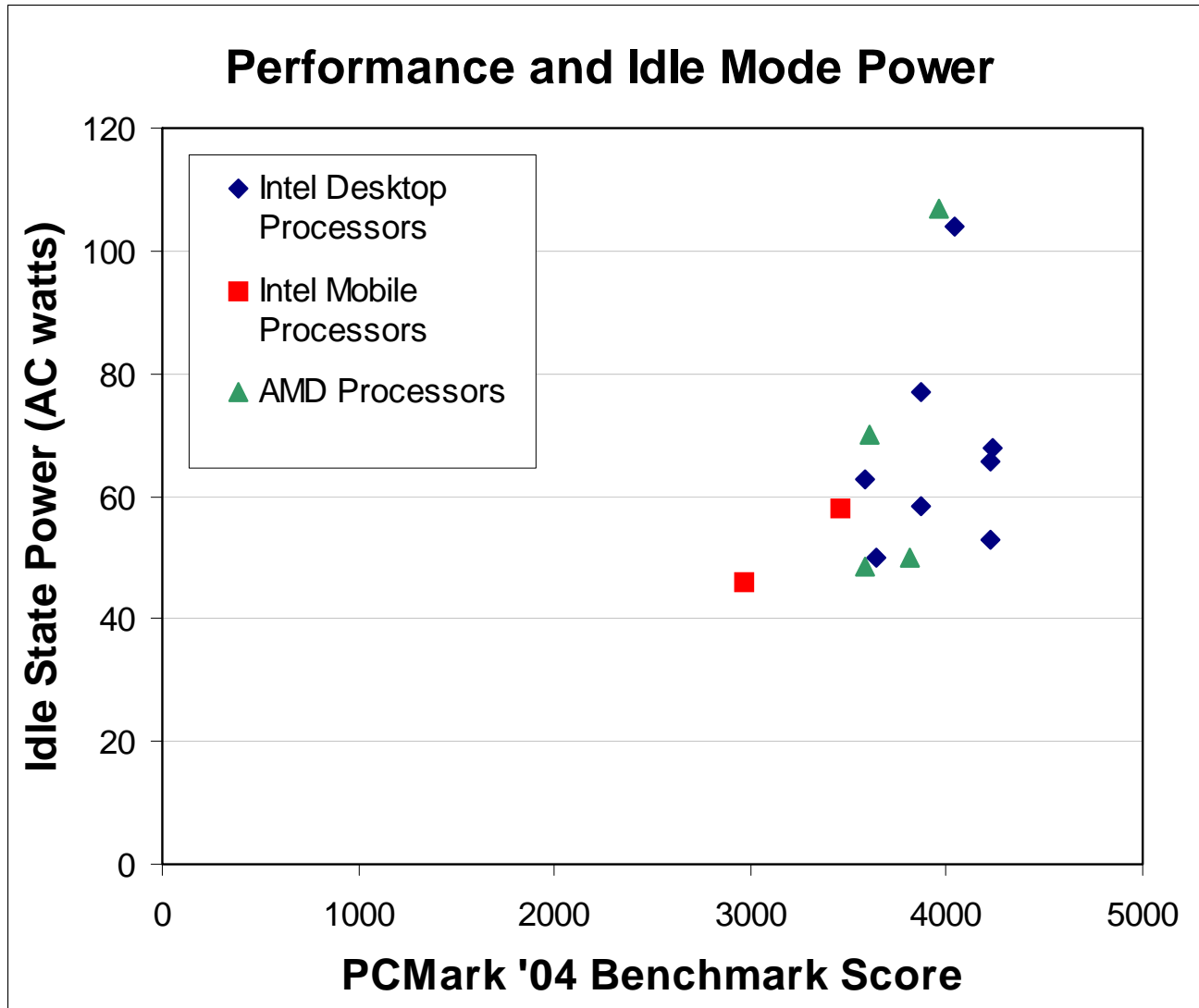
Lowest idle power yet…

Pentium M System Configurations
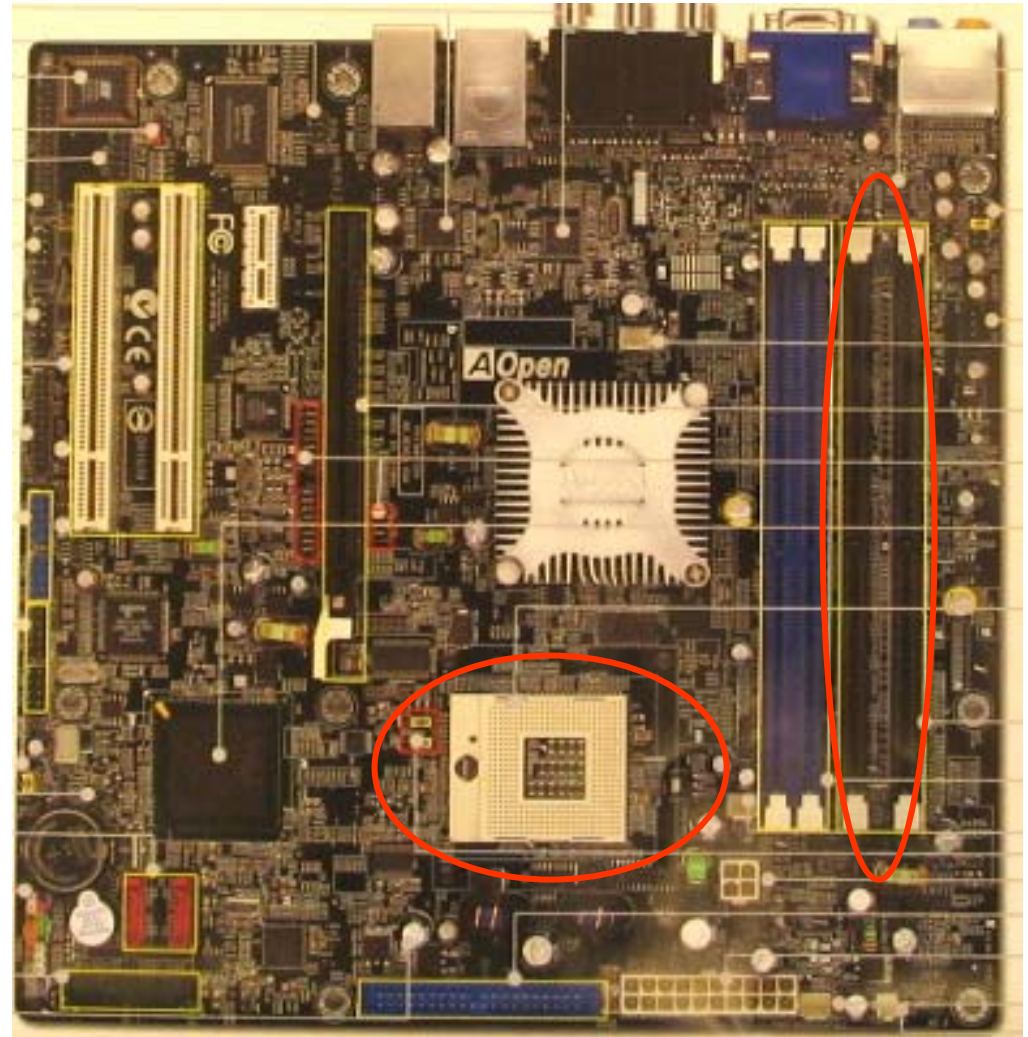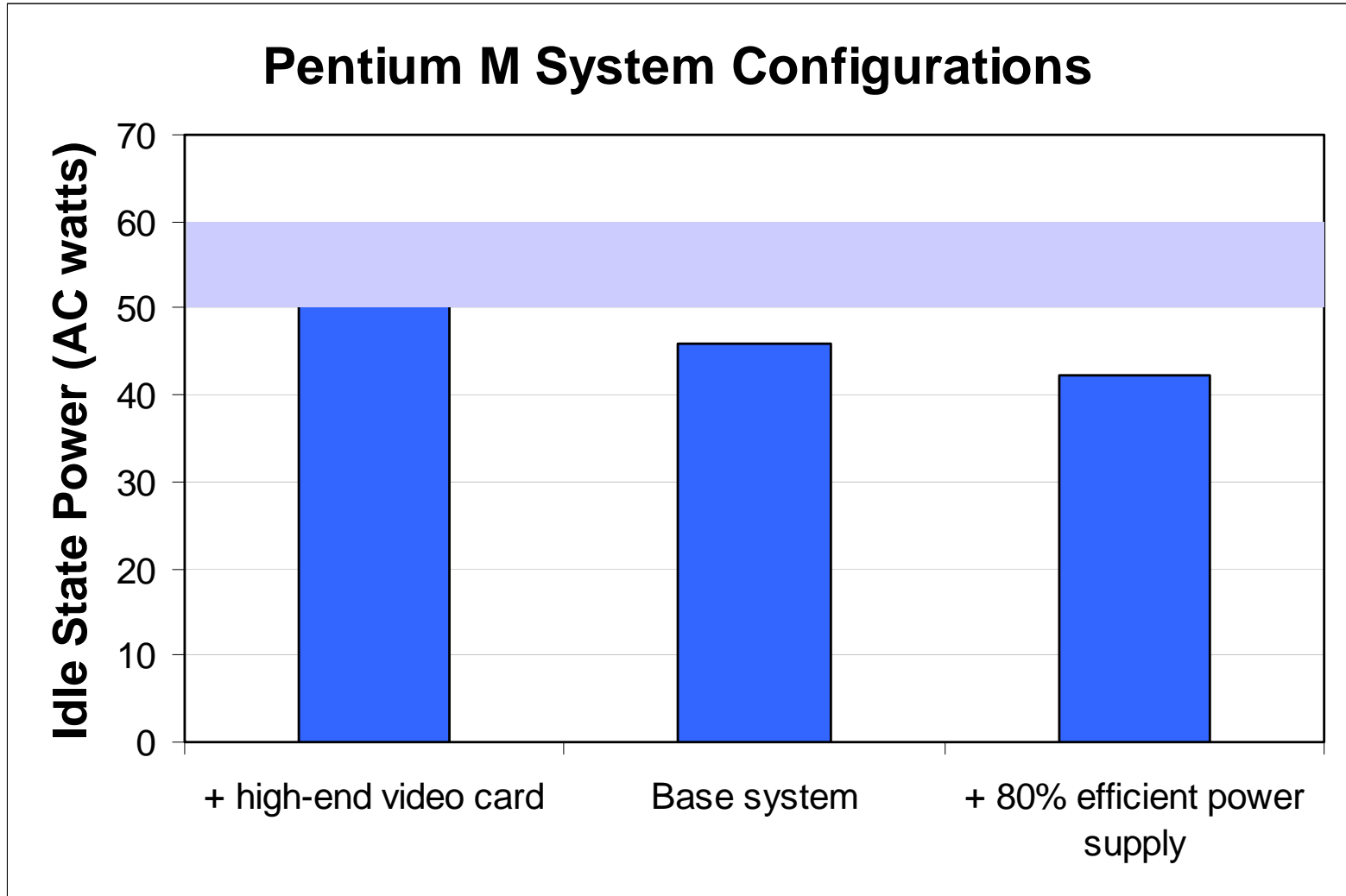
Base system: 1024 MB DDRII, on-board video, 80 GB HD, DVD/CD-RW

# Desktops Built with Mobile Processors Can Compete Well Against Traditional Desktops

Results courtesy of SilentPCReview
2.0 GHz Pentium M vs. 3.0 GHz Pentium 4

Impact of Various Processors on Desktop Idle Power and Benchmark Score

Performance and Idle Mode Power

Legend:
- ◆ Intel Desktop Processors
- ■ Intel Mobile Processors
- ▲ AMD Processors

Y-axis: Idle State Power (AC watts)
X-axis: PCMark '04 Benchmark Score

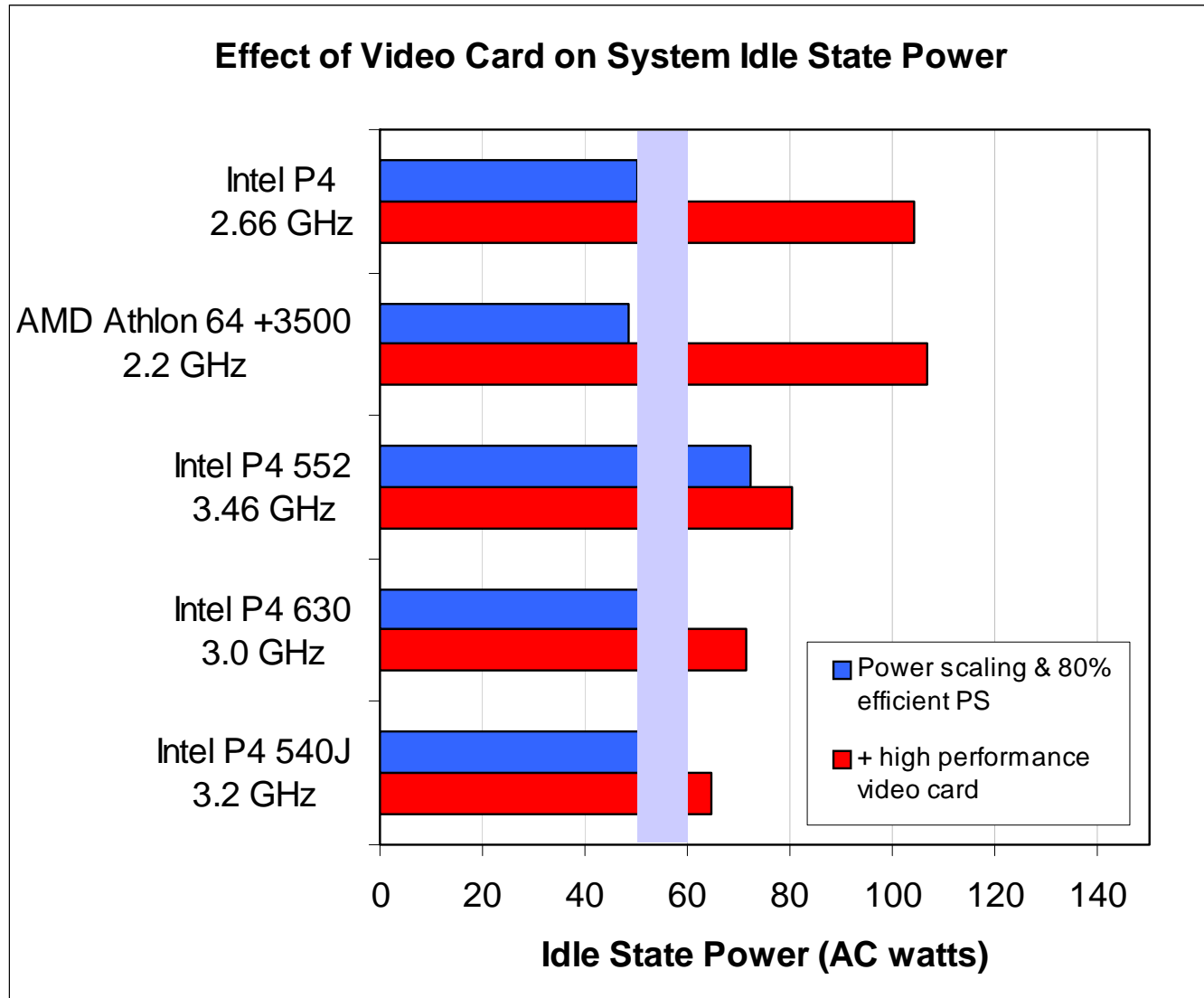# Impact of Various Components on Desktop Idle Power and Benchmark Score
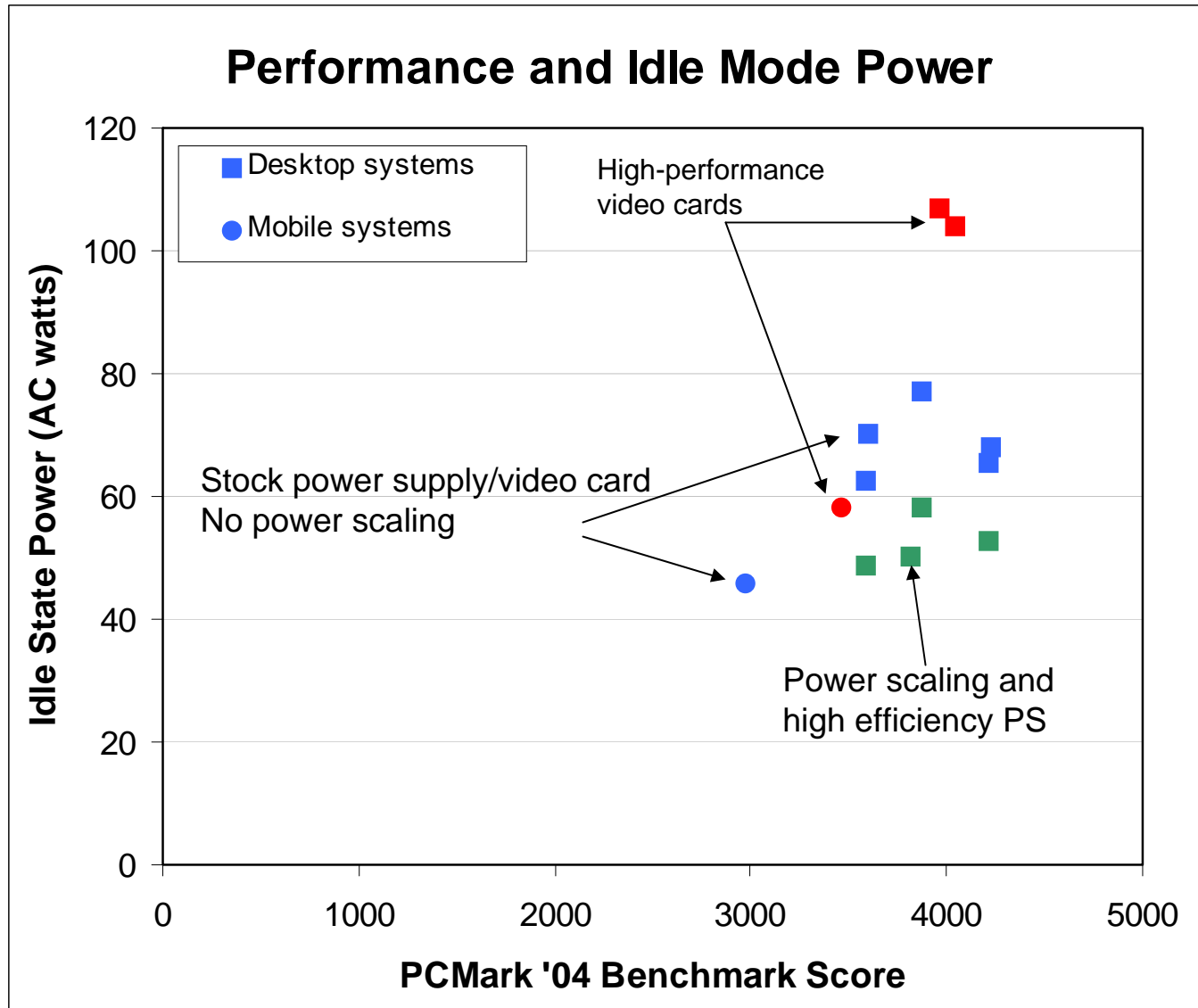
Enabling Monitor Sleep through the Computer Makes No Difference to Computer Idle Power

| System Configuration	Idle Power with Monitor On	Idle Power with Monitor in Sleep
Pentium M w/on-board video	45.8	45.9
P4 540J w/on-board video	65.5	65.2
P4 540J w/PCI Express video card	79.7	79.9
AMD Athlon 64 3500+ w/AGP 8X video card	70.2	69.7

Design changes to video cards are needed

Video cards crucial
# to meeting idle state requirements

Effect of Video Card on System Idle State Power

Legend:
- ■ (blue) Power scaling & 80% efficient PS
- ■ (red) + high performance video card

Categories (top to bottom):
- Intel P4 2.66 GHz
- AMD Athlon 64 +3500 2.2 GHz
- Intel P4 552 3.46 GHz
- Intel P4 630 3.0 GHz
- Intel P4 540J 3.2 GHz

X-axis: **Idle State Power (AC watts)** — 0, 20, 40, 60, 80, 100, 120, 140

Assessing the Continuum of Measures to Reduce Energy Use in Idle Mode and/or through Power Management

|	Idle Measures				Power Management Measures				
	Efficient Power Supply	Efficient Cooling	Processor Throttling	Video Card Power Scaling	Enable Hard Drive Sleep	Enable Monitor Sleep	Wake on LAN Solution	Enable Computer Sleep	Manually Switch Off Computer
Wait Time Imposed	None	None	Minimal	Minimal	<5 sec	<5 sec	10 sec	10-30 sec	>60 sec
Performance Impact	None	None	Small	Small	Small	None	Small	Maximum	Maximum
Magnitude of PC Power Savings	15-25%	<5%	10-15%	5-60%?	5-10%	<1%	40-90%	40-90%	90-95%
Extent of User Control	None	Minimal	Minimal	Minimal?	Moderate	Moderate	High	High	High
Certainty of Power Savings	High	High	High	Moderate	Moderate	Moderate	Low	Low	Low
Timeframe of Solution	0-6 months	0-6 months	0-6 months	6-18 months	Now	Now	12-24 months	Now	Now

Graphs of CPU Utilization vs. Time Can Be Deceptive…
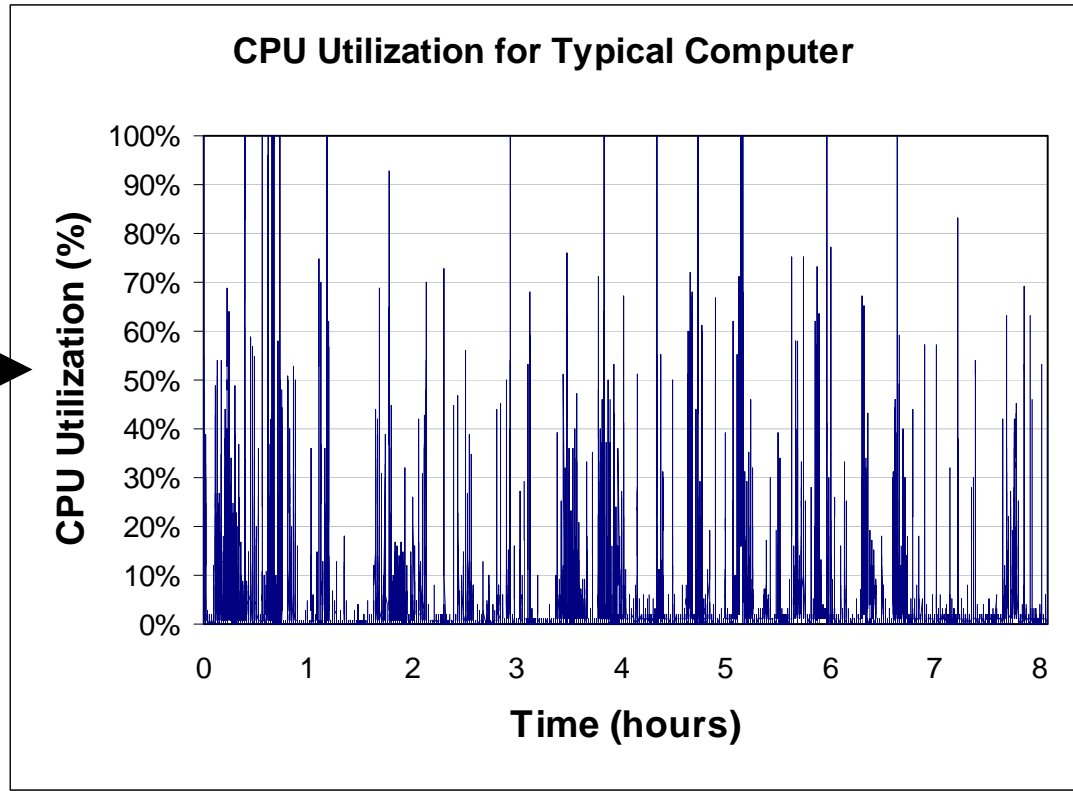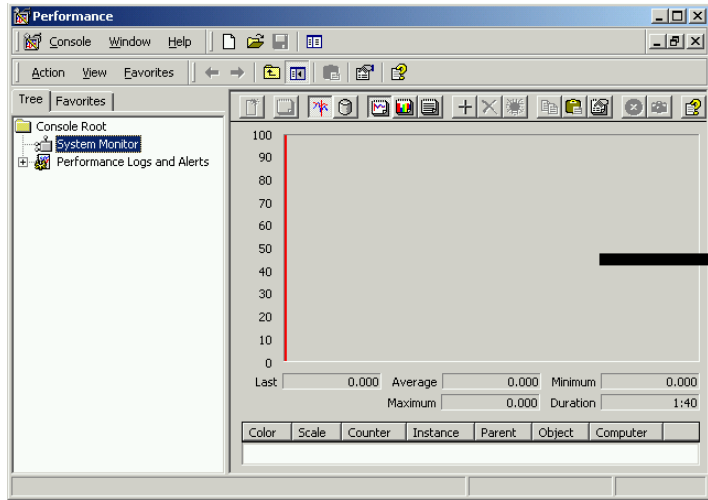
Sorting Reveals that a Typical Computer Spends > 80% of Time at Less than 5% CPU Utilization
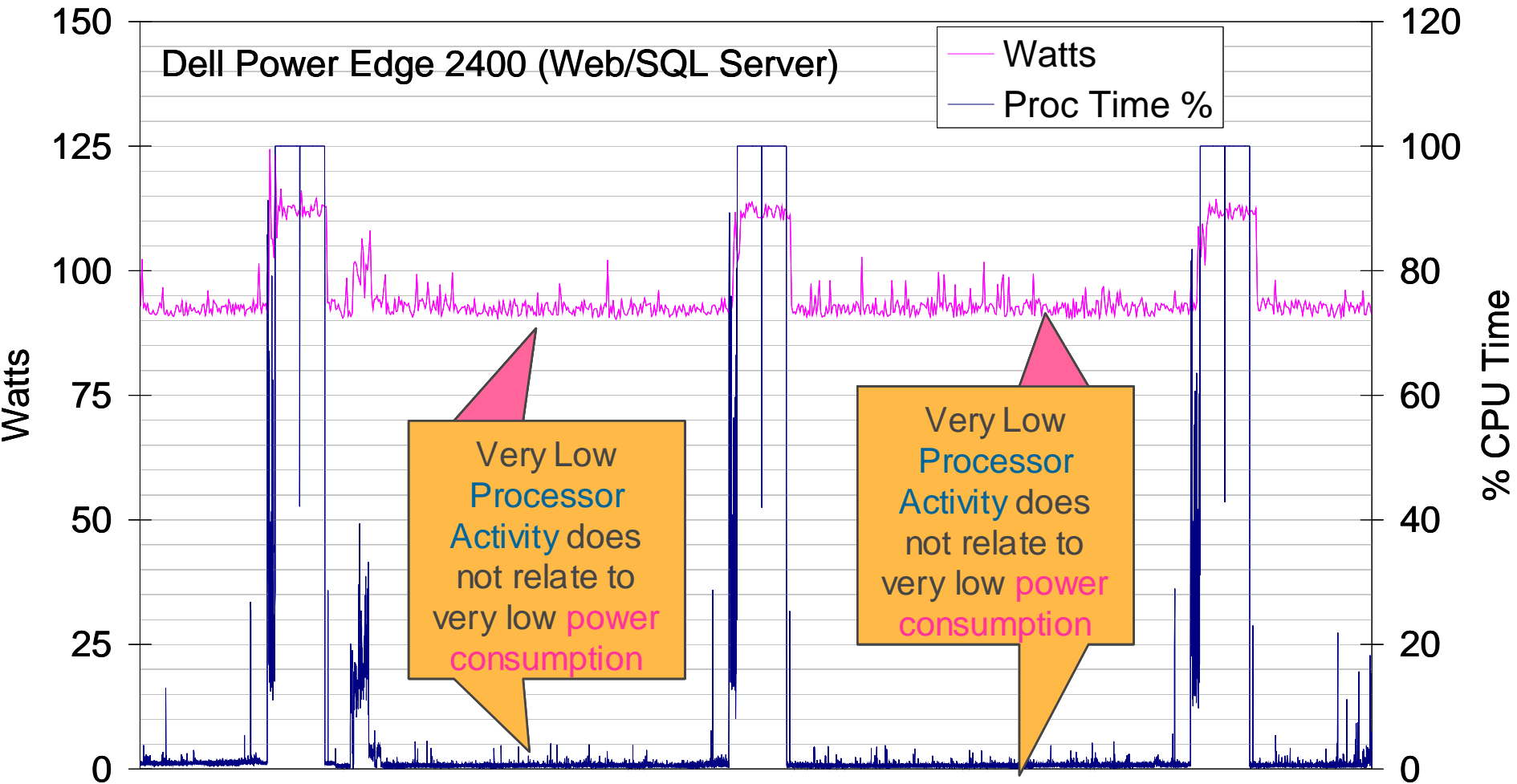

CPU Utilization for Typical Computer
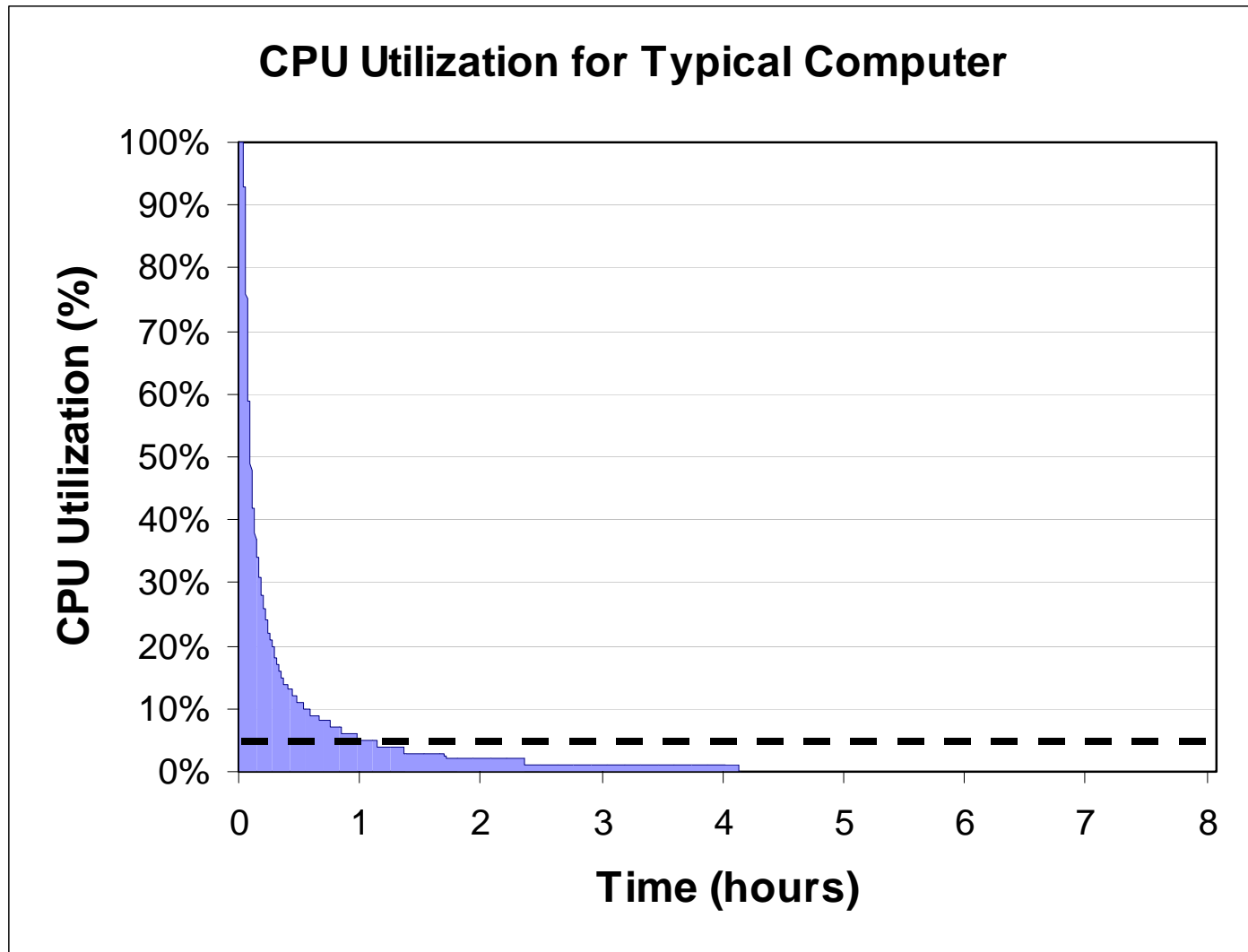
How Much Consecutive Time Does a Computer Spend in Idle State During Typical Workday?
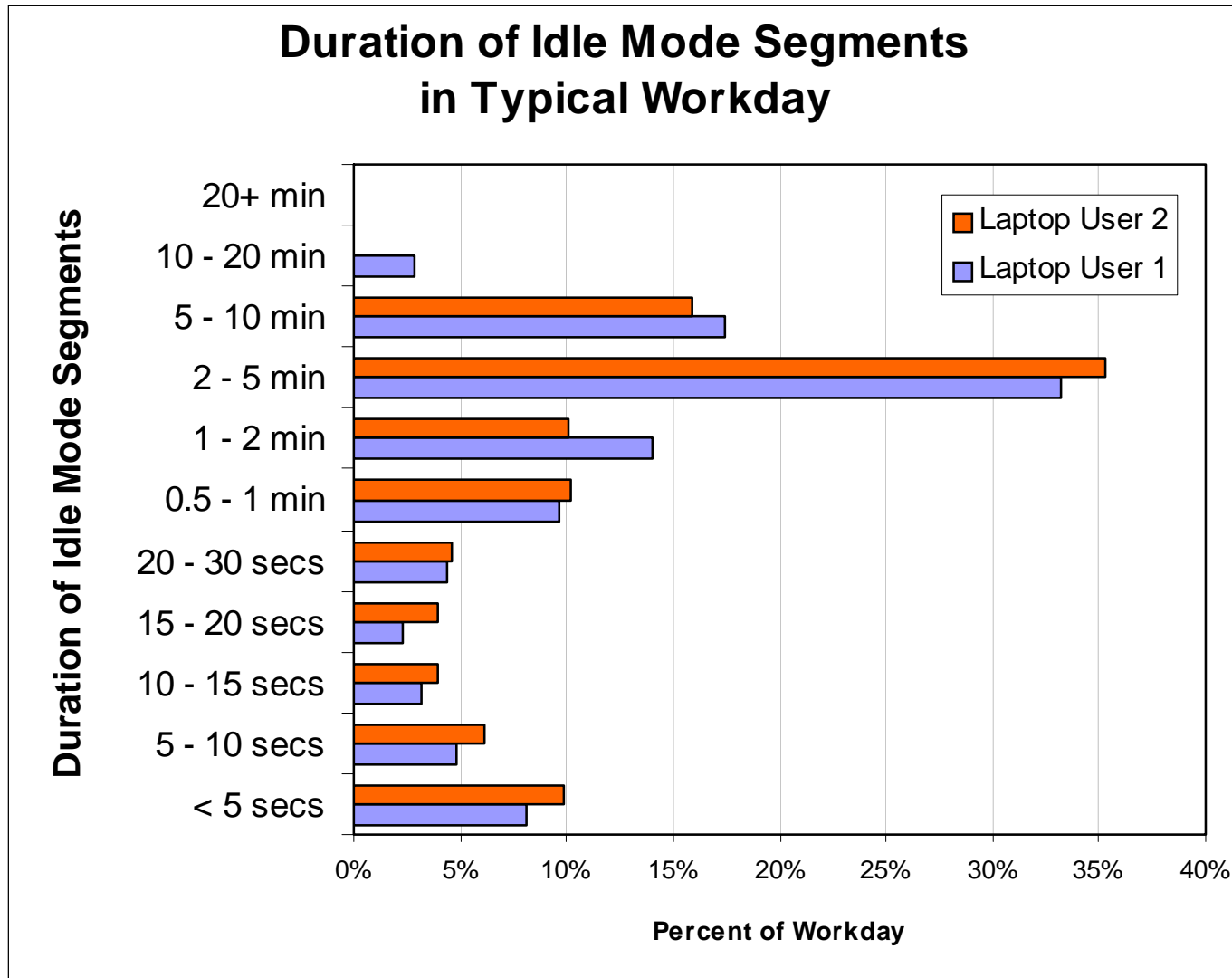
CPU Utilization Differences between Typical Office Usage and an Unattended Computer Are Small

CPU Utilization in Typical Computers
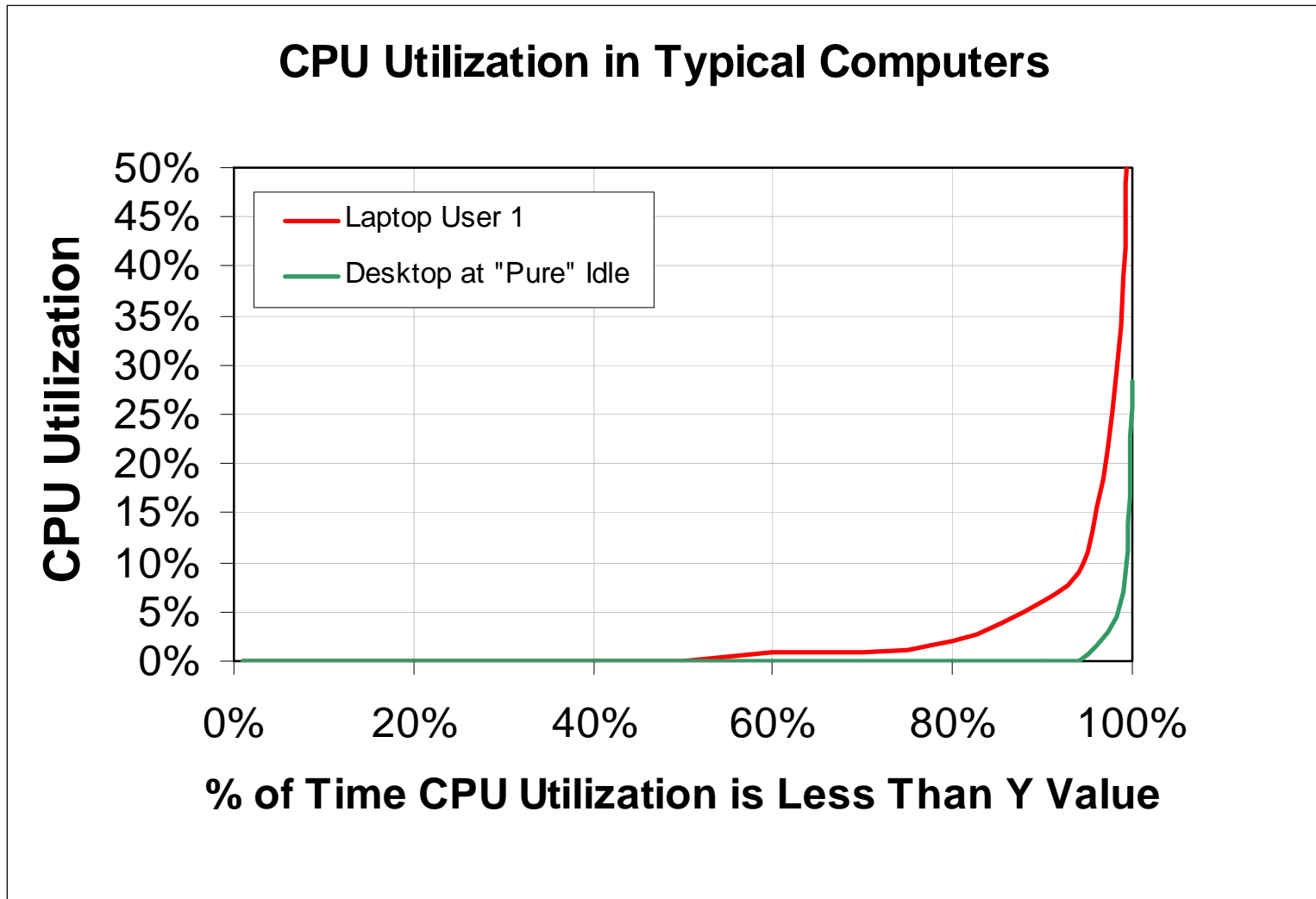
Most Computers Cannot Scale Total Power Use Effectively with CPU Utilization
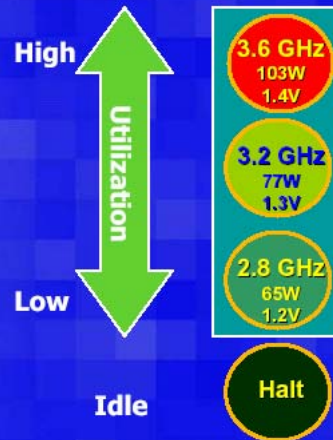
Results of Field Testing of Servers
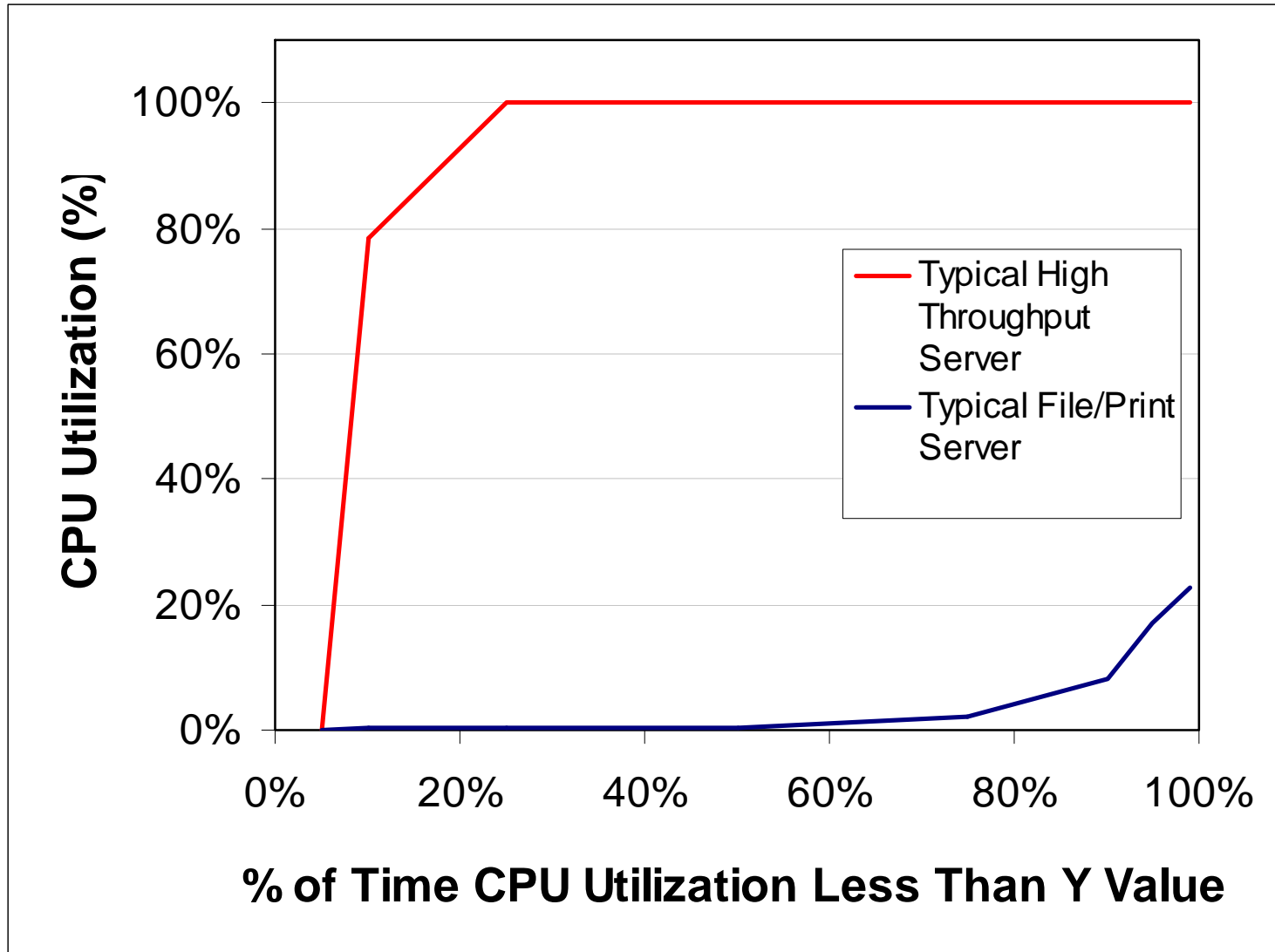
Processor Throttling is a Well-Established Way to Reduce Power Use and Protect Processors from Excess Heat

- Processor throttling can cut *processor* power use by roughly 25 to 70% during periods of inactivity (idle)

- Processor throttling can cut *system* power use by roughly 12 to 24%, depending on system configuration and duty cycle

- AMD and Intel both employ this technology to varying degrees today

CPU Families

Intel

Desktop
- Celeron
- Pentium 4
- Pentium D

Mobile
- Pentium M
- Pentium 4-M
- Celeron M

Server
- Itanium 2
- Xeon

AMD

Desktop
- Sempron
- Athlon XP
- Athlon 64
- Athlon FX
- Athlon X2

Mobile
- Turion

Server
- Opteron

IBM

Desktop
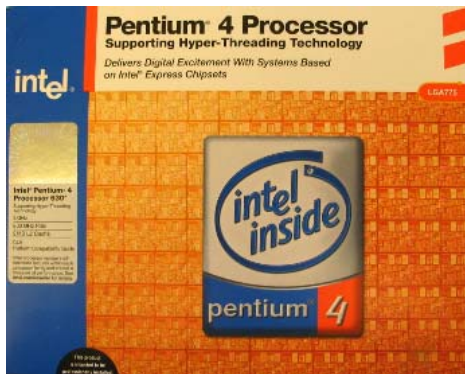- PowerPC G5
- PowerPC G4
- PowerPC G3

Mobile
- PowerPC G4
- PowerPC G3

Server
- PowerPC G5

Next-generation Desktops

EIST/PowerMaster	Cool 'n Quiet	Pentium M

Socket T/Pentium System

- Enhanced Intel SpeedStep (EIST) power scaling technology

- AOpen PowerMaster technology on motherboard allows dynamic power scaling for any Socket T
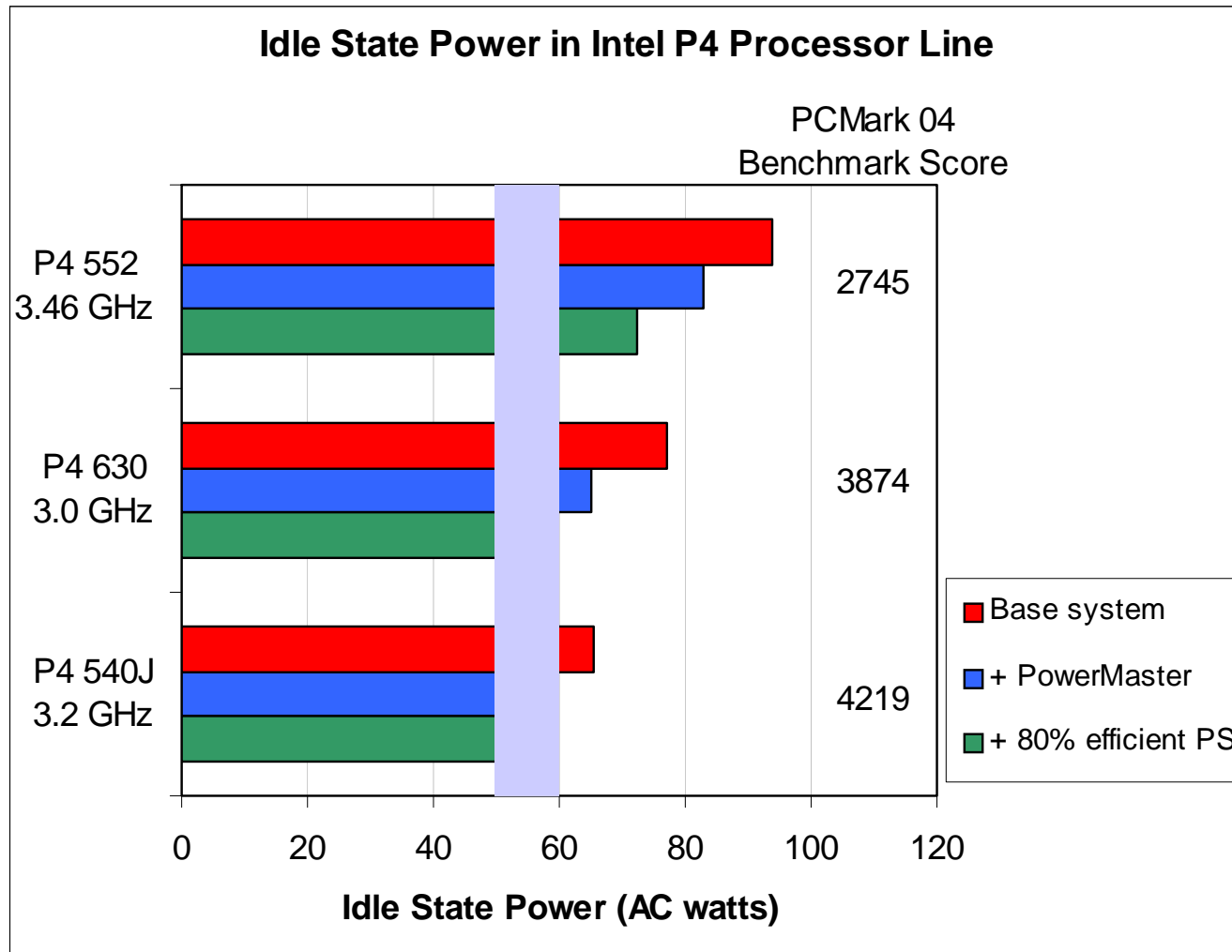
What is PowerMaster?

- Lowers processor power by adjusting frequency of FSB when processor idling
- Brings a degree of power scaling to non-scaling processors
- Configurable in system BIOS
- http://usa.aopen.com/

High Efficiency in Socket T Systems

Base system: 1024 MB DDRI, on-board video, 80 GB SATA HD, DVD/CD-RW