



# Computer Power Management: Observations from the Field

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# Overview



- Background
- Major CPM Obstacles
- Workarounds and Near-Term Solutions
- Network Availability
- Open Questions

# Background: ENERGY STAR Power Management Program



- Over the last 4 years, EPA promoted monitor power management (MPM) “sleep” settings
  - Provided network tools and technical advice to activate MPM organization-wide
  - Recognized contributors through the Million Monitor Drive (MMD)
  - Promoted their efforts through an overall ENERGY STAR PR campaign
    - Article placement in tech, energy, and management publications
    - A NPR story that generated a large response
- Large US companies have joined the MMD – Dell, HP, Intel, CitiGroup, Cisco Systems, Wal-Mart, GE, and GM.
- For the past year, EPA has promoted the activation of computer (The box: hard drive, CPU, etc.) power management.

- Computer power management is not often implemented (1-5%) in commercial settings for hardware, software, and behavioral reasons
- In some environments, CPM can be enabled using several methods and third party software tools
- However, the need remains for an integrated solution that allows CPM to be easily managed
- We suggest several next steps and raise further questions

# Background: Computer Power Management (CPM)



- Original goal of CPM: maximize laptop battery life
- Increasingly deployed to save electricity on desktops (on AC power) -- can save up to \$50 per computer annually
- Modern CPM shuts down critical system components -- CPU, PCI bus, fans, et al;
- Most PCs currently use S3/S4 for sleep, and S5 is sometimes used to save power

## Flavors of CPM

### •Sleep(System Standby S3)

- saves 40-80W
- wakes up in seconds

### •Hard disk spin down

- saves little

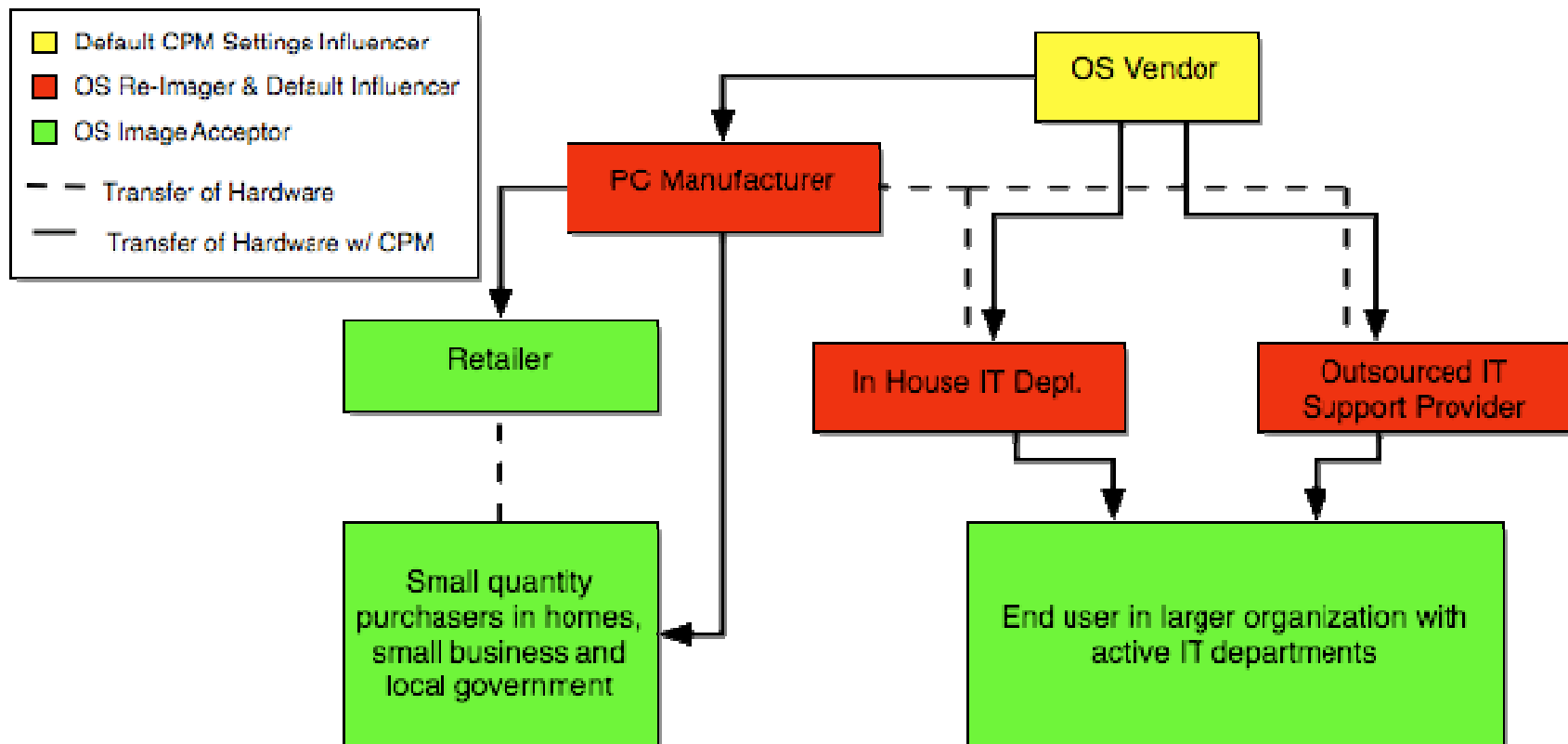
### •Hibernate (S4)

- same energy savings as S3
- wakes up in 20+ seconds
- saves work in the event of power loss

### •Shutoff (S5)

- same energy savings as S3
- wakes up in 20+ seconds
- saves work in the event of power loss

# Background: Market Actors That Influence CPM Enablement Rate



# Four Major Obstacles to CPM



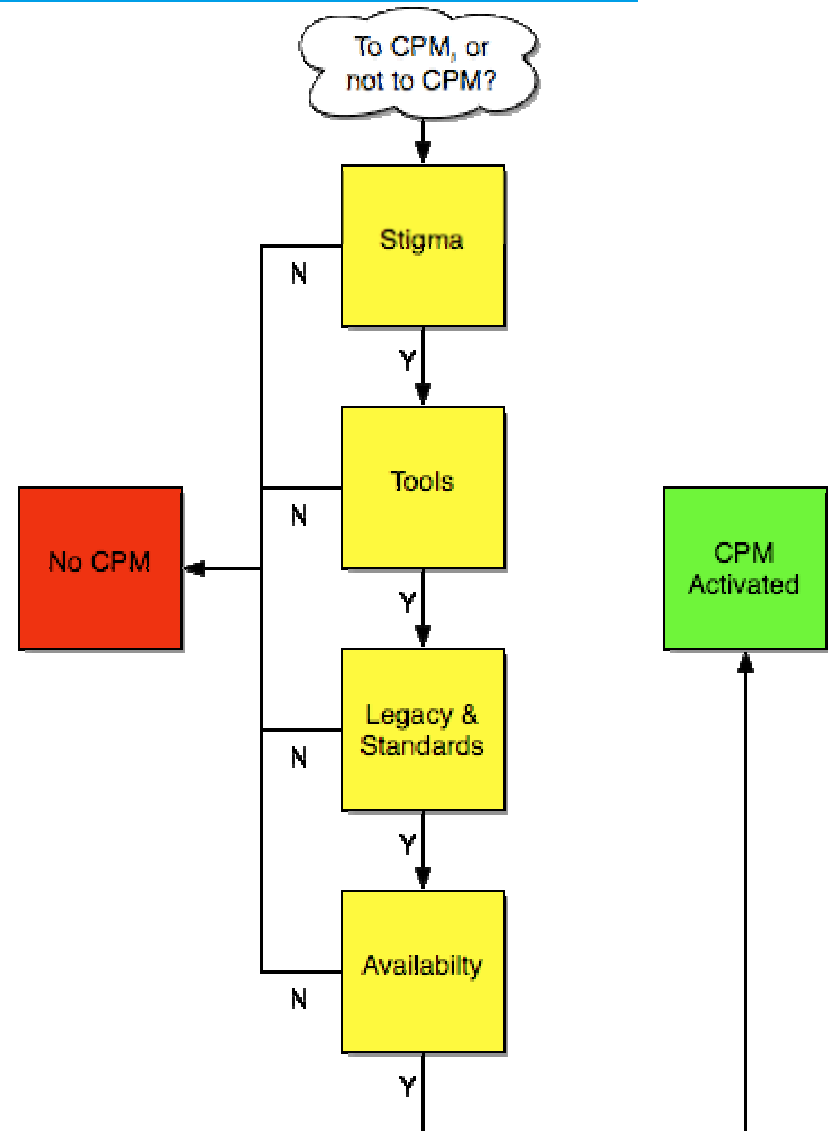
1) Stigma: CPM not generally stable or effective until recently -- reluctant IT admins

2) Tools: Lack of integrated tools to centrally activate CPM

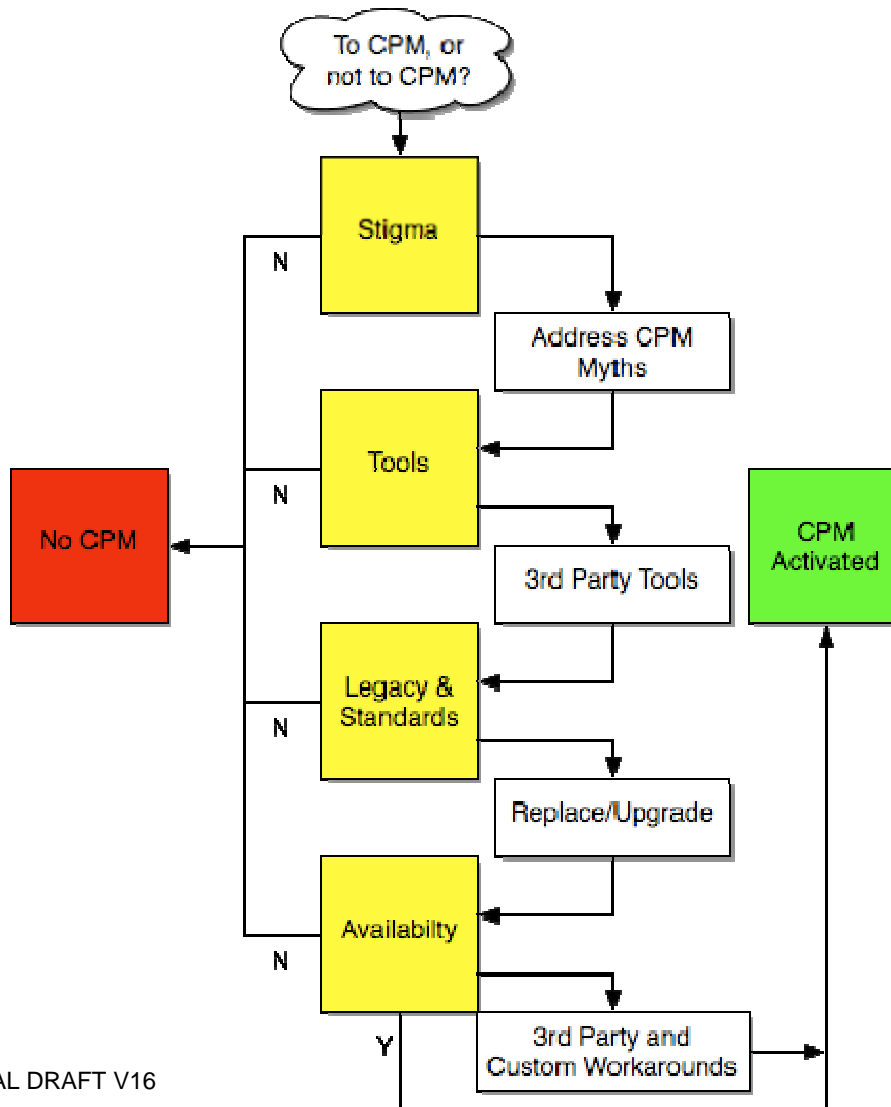
3) Legacy & Standardization: Older software and some peripherals are not CPM compatible

4) Availability: Scheduled patching, backups and other automated maintenance procedures need to run when scheduled.

RESULT: Have not observed many sites activating computer power management.



# Possible Solutions to Major Obstacles





# CPM Enablement Obstacle 1: Stigma



- **OBSTACLE:** Stigma surrounding CPM due to historical stability issues.
  - Not until Windows 2000/XP with P4 (ACPI v2) or Mac OS X did stability improve
- **SOLUTION:** This problem has decreased over time but we need to:
  - Educate IT admins with case studies and IT support
  - Work with industry associations such as IAITAM to conduct training on the CPM issue

# CPM Enablement Obstacle 2: Tools



- **OBSTACLE:** Lack of native tools to activate CPM:
  - software based issue
  - OS vendors may have a major role
- **WORKAROUND:** Network tools help to enable and manage CPM, including:
  - *NightWatchman* (1E) remotely turns off computers (S5); requires enabled WOL
  - Desktop Standard's *Policy Maker* activates S3/S4
  - EPA's *EZ GPO* tool activates system standby (S3/S4)
  - Verdiem's *PC Surveyor* manages PM features and implements time-based power profiles
- **FUTURE:** The OS needs to support central management of CPM related settings

# CPM Enablement Obstacle 3: Legacy & Standardization



- **OBSTACLE:** Older software apps and device drivers that do not handle sleep states well: crashes, vetoing sleep states, etc.
- **WORKAROUND:** With increased laptop use, PC makers and OS vendors have:
  - Addressed issues through certification programs;
  - OS vendors have influenced ISVs through crash report data
- **FUTURE:** Problem will likely decrease over time with continued pressure from the OS Vendors and increased development and use of standards

# CPM Enablement Obstacle 4: Availability

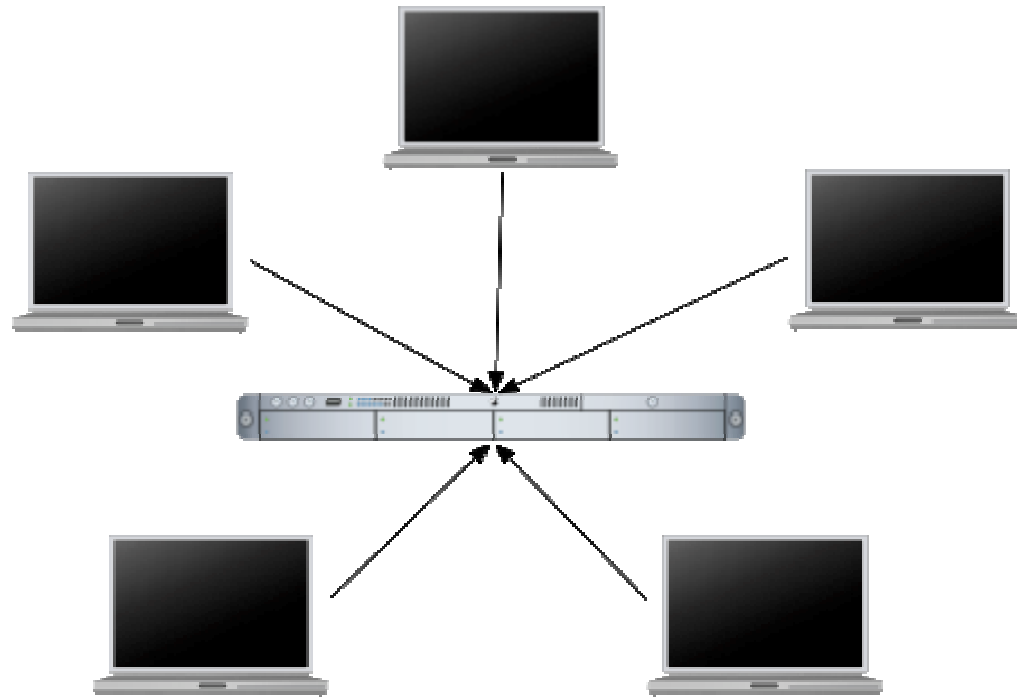


- **OBSTACLE:** Many IT managers perceive need for continuous availability. Any state other than S0 (on) can interfere with continuous availability
- **WORKAROUND:**
  - Sites can wait for maintenance events (patching, backup, etc) to occur on wake up
  - WOL can be implemented
  - Schedule wake ups can provide needed availability
- **FUTURE:** More manageable WOL, better support for waking the machine up from sleep in general

# Client/Server Network Example



- In a centralized Client/Server Model, clients typically initiate network connections to servers listening for incoming connections.
- While the client is asleep it can not initiate the connection
- Maintenance activities are deferred until the PC wakes up by user, WOL intervention or scheduled wakeup



**Typical Client/Server Network Model**

# Accessing Unavailable PCs



- Wake on LAN (WOL)
- Scheduled wake ups on client PCs
- Wait for local user initiated wake up

# Wake On LAN (WOL): What is it?



- WOL is a means to wake networked machines
- Originally designed to allow for remote administration of client PCs
- NIC signals a PME to wake the machine when it receives network traffic
  - The NIC can be configured to look for specific types of network traffic (ie “The Magic Packet”)
  - Various configuration and network topology is required to make this work

# Barriers to WOL Adoption



- Centralized control needed
  - WOL settings are bifurcated between BIOS and OS
  - Bios Settings
    - Controls S5 wake up
  - OS Settings
    - Controls S3 and S4 wakeup
- Network Topology and Configuration an Issue
- WOL has other issues:
  - Wireless networks (cannot receive WOL packet, but can send)
  - Unintended wakeup (Wake on junk)



# WOL in the Field



- Computer/BIOS vendors offer vendor specific solutions for central management of WOL from S5
- Solutions to centrally manage WOL in OS to wake from S3/S4 are NIC vender specific
- 1E Nightwatchman uses WOL in BIOS (portion of 200,000 computers)
  - Scheduled S5 shutdown through Nightwatchman
  - Followed by S5 wakeup via WOL
- Preliminary data from EZ GPO Tool users indicate:

Wake from state:	Number	Percentage
Wake From S5	36	17%
Wake From S3/S4	12	6%
Neither	203	77%

# Scheduled Wake Ups



- Centralized control needed
  - Scheduled wake up settings are bifurcated between BIOS and OS
  - Bios Settings
    - Controls S5 wake up
  - OS Settings
    - Controls S3 and S4 wakeup
- Easier to centrally manage and tools exist to centrally manage BOTH in BIOS and OS
  - Some computer/BIOS vendor solutions exist for WOL from S5
  - Desktop Standard's *Policy Maker 2.0* and Verdiem's *PC Surveyor* can activate scheduled events in the OS

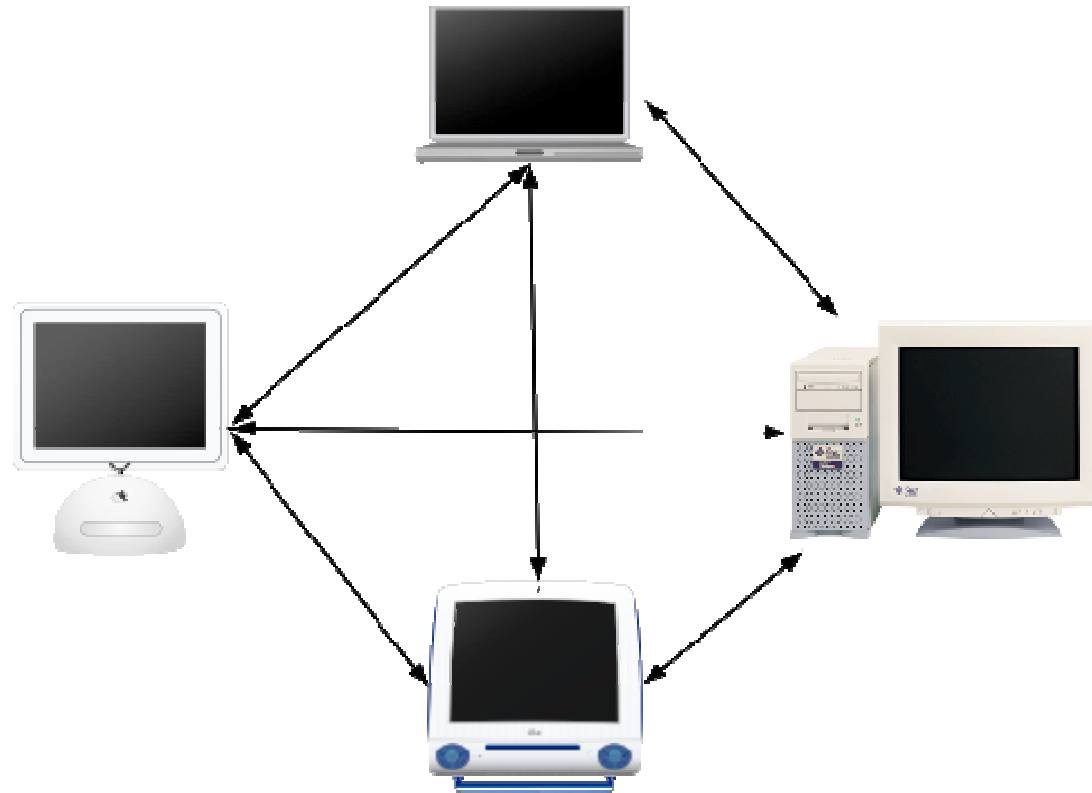
# Local User Initiated Wake Ups



- Sites that use this type of wake up have less of an availability issue when implementing CPM
- Many IT admins do not favor this technique
- Network management concerns:
  - In the case of patching, a user may have to wait for the patch to install and a restart
  - There can be significant delay for a patch to load after log in depending on network tools used
  - In the case of backup, may have files missed if backup occurs while user logged in and files are open

# Peer to Peer Network Example (P2P)

- Predominately Small Office/Home Office where network presence is an issue.
- As more household devices become network-able, this becomes a bigger issue.
- Clients can initiate network connections as well as listen for incoming connections (act as servers).
- WOL is not really viable since most using this type of environment are not IT Admins
- Scheduled tasks will help, but no obvious solution is in use today to work through the entire problem



Typical P2P Network Model

# Various Approaches to CPM are Working



Site (PCs)	Centrally managed CPM w/:	Wake up technique:
NTPS (4,000) King College (500)	Energy Star EZ GPO	User Initiated Wakeup
BEMIS (5,000)	Desktop Standard's Policy Maker	Scheduled Wakeup from S3
BC Hydro (2,000)	Verdiem's EZ Surveyor	Scheduled Wakeup (from S5?)
Central CT (1,000) State University	1 E's Nightwatchman	User Initiated Wakeup
Vision Service (2,000) Plan	1 E's Nightwatchman	WOL from S5
Spring Branch ISD (7,000)	Manually Set all PCs to Sleep	User Initiated Wakeup
Yale (200)	TBD	Scheduled Wakeup from S5

# Conclusions



- Computer power management is seldom implemented in commercial settings
  - Several root causes
  - Growing number of encouraging implementations
- In the near term, several methods and tools can be used to activate CPM
- However, there is a need for integrated native solutions for enabling and controlling these settings

# Continued Dialogue: Open questions



- Are there obstacles to PC makers pre-configuring machines to ease use of CPM and WOL activation?
- How can we best address OS based obstacles to WOL & CPM?
- Can EPA and industry work together to publicize and promote CPM?
  - Conferences: TechEd, PDC, WWDC, Linux World, Windows Connections, Mac World
  - Trade press
- How can we engage IT Admins?
- What is the best method for discussing software functionality in CPM enabled environments with ISVs?
  - OS Vendors development channels
- How do we incorporate CPM into the computer specification?

- CPM is a system, calls for a team approach
  - Hardware, software, and network need to work together for successful CPM
- CPM can deliver savings in both enterprise and residential environments
- More research is needed to find a solution that works for both commercial and residential applications





# EPA Comments

Steve Ryan

# Background: CPM Savings Potential



- Over 90 million desktop computers in commercial settings.
- With night-time updates and maintenance, half or more may be left on 24 /7
- If all power managed, US would save 25 billion kWh, equivalent to:
  - Saving \$1.8 billion
  - Lighting over 20 million homes annually (all the homes in NY and CA combined)
  - Preventing 18 million tons of carbon dioxide (emissions of over 3 million cars)

# CPM Savings for Percentage US Computers Enabled



<b>Savings from CPM Based Upon Percentage Computers in US Enabled</b>				
	<b>25%</b>	<b>50%</b>	<b>75%</b>	<b>100%</b>
<b>Energy Savings (kWh)</b>	6,478,524,000	12,957,049,000	19,435,574,000	25,914,099,000
<b>\$ Savings</b>	459,975,000	919,950,000	1,379,925,000	1,839,901,000
<b>Homes Lit</b>	5,182,000	10,365,000	15,548,000	20,731,000
<b>Tons of CO2 Prevented</b>	4,632,000	9,264,000	13,896,000	18,528,000
<b>Cars Off Road</b>	801,000	1,602,000	2,404,000	3,205,000

# EPA Requests to Industry



- Ship enabled
- CPM enabled at stakeholder facilities
  - Help with PR efforts
  - Will provide valuable insights
- Wide ranging education and PR efforts
- Consumer outreach
  - Web sites
  - Help files
  - Literature