The Economic Meltdown of Moore's Law and the Green Data Center

Presented by

Ken Brill, Executive Director

The Uptime Institute Inc.

kgb@uptimeinstitute.org

www.uptimeinstitute.org

Abstract

This presentation helps you understand

- Why facility costs are growing from 1-3% of IT′s budget to be 5-15%
- How such a major economic change could occur so quickly and invisibly
- The necessity for green data center metrics
- The role and importance of ICE teams
- Using ITIL to link IT and Facilities

It also points to Institute white papers and educational programs for further information

The Economic Meltdown of Moore’s Law Means…

- The rate of computational increase (Moore’s Law) is greater than the rate of increase of power efficiency
- Over the next 6-10 years, this lag will create invisible and ultimately career limiting increases in site TCO measured in the hundreds of thousands to millions dollars depending upon size

By The End Of This Session You'll Know

- The financial significance of the lag between the rate of increase in computational performance and energy efficiency
- Why the accompanying site cost growth occurs invisibly
- Why green data center metrics are essential to contain and reduce these costs
- How Integrated Critical Environment (ICE) Teams are critical to this cost-reduction effort

Uptime Institute Mission Statement

Our Mission Is to Continuously Increase Uptime and Global IT Productivity

Through

Benchmarking and Collaborative Learning

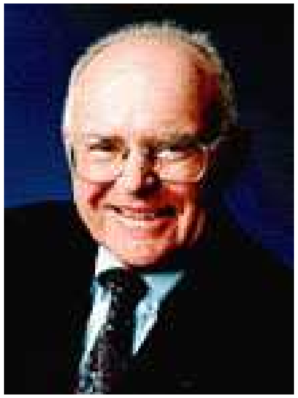
Site Uptime Network®
North America Members - 2007

AIG
A.G. Edwards
Allstate
American Express
America Online
AT&T
Bank of America
Bank of Montreal (Canada)
Barclays
Bayer
BellSouth
Boeing
BP
Capital Group
Caterpillar
Chevron
Cisco Systems
Cincinnati Bell Tech
Citigroup
Clorox
Colgate Palmolive
Confidential (3)
Consonus
Deere & Company
Depository Trust
Dept. of Veterans Affairs
Discover Financial
DST Systems
eBay, Inc.
EVERTEC
FannieMae
Fidelity Investments
GE
GMAC-RFC
GTECH
Hewitt Associates
Hewlett-Packard
Highmark
Household Int'l (HSBC)
Iron Mountain
JC Penney
Johnson & Johnson
Kaiser Permanente
Lehman Brothers
LexisNexis
Lockheed Martin
Lowe's Companies
MasterCard
Mayo Clinic
Microsoft
Mitre
Nationwide
Office Depot
Pfizer
Philadelphia Stock Exchange
Planet Internet
Progressive Insurance
Rackspace Managed Hosting
Rogers Comm (Canada)
Royal Bank of Canada (Canada)
Sabey
Savvis
SIAC
Shell
Social Security Administration
Target
Thomson Legal & Regulatory
TD Bank (Canada)
United Airlines
United HealthCare
United Parcel Service
USAA
US Bancorp
Verizon Communications
Version Wireless
Visa
Wachovia Bank
Washington Mutual
Wells Fargo

Moore's Law

"The number of transistors on a chip doubles every 24 months."

Intel co-founder Gordon Moore (1965)
http://www.wikipedia.org



Total Power Consumption by Servers in the U.S. and the World

Dr. Koomey's "at-the-meter" estimate

- Servers (not including SAN, tape, and other IT power uses) consumed 1.2% of total U.S. electricity in 2005
- This doubled from 0.6% in 2000!

By 2010, IDC projects server consumption will increase an additional 76% to 2.1% of total U.S. electricity.

- 3%, if storage and other uses are included! (1% to 3% in 10 years)
- This already assumes extensive virtualization!

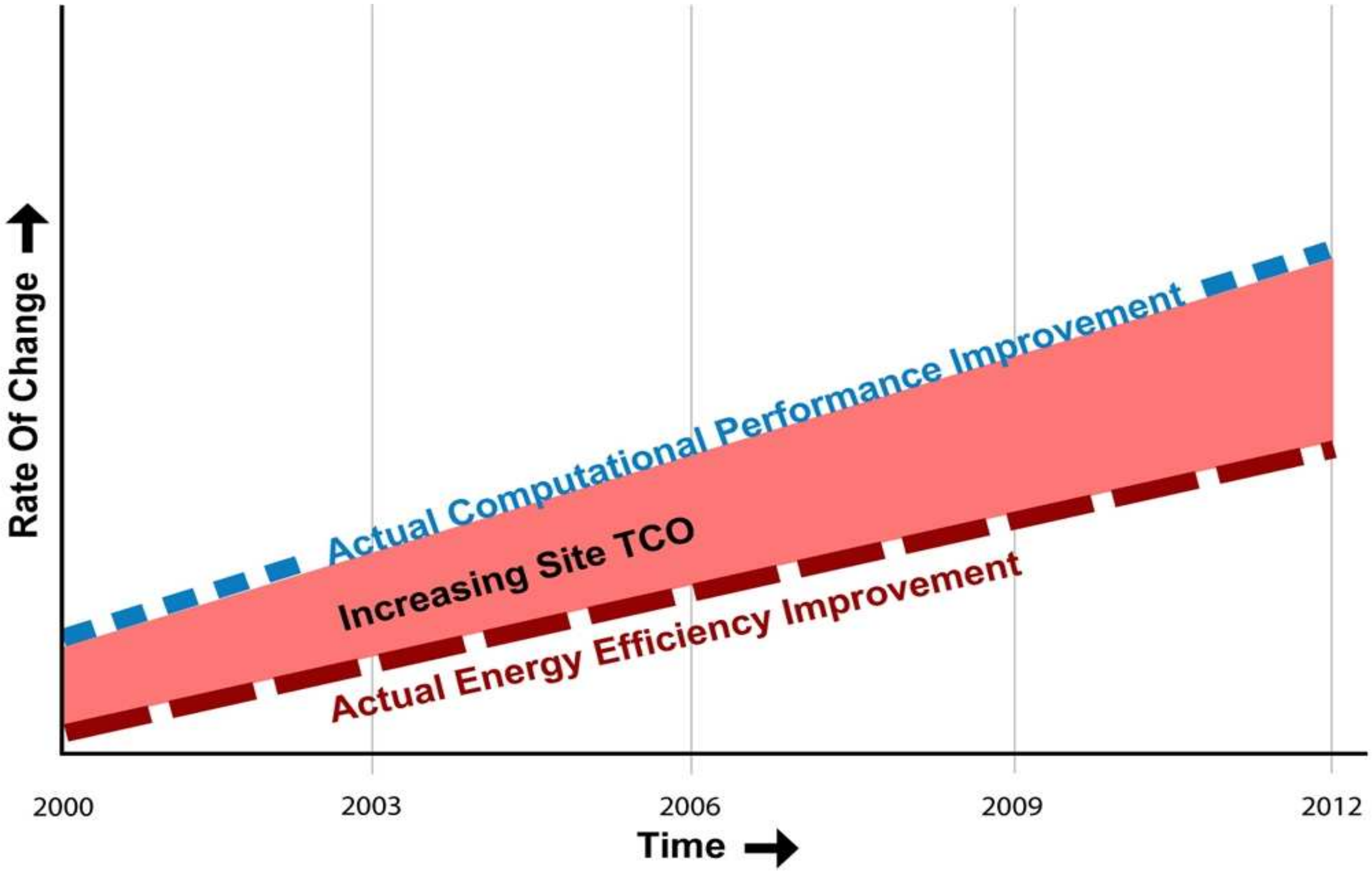
Public energy policy implications: Public Law 109-341 mandates EPA study

IT Load Growth

Sixteen Site Uptime Network member sites 2000-2006

- Actual UPS load Q4 1999 = 17,000 kW
- Actual UPS load Q4 2006 = 29,000 kW
- Compounded IT load growth rate is 8% annually

Lagging Power Efficiency Drives Site TCO Up (reducing IT's economic productivity)



Summary

- Computational increase* = 3x every 2 years
- Power efficiency increase* = 2x every 2 years
- Over 12 years
  - Computational increase = 729x
  - Power efficiency increase = 64x
- **Increased power consumption = 11.4x** (.009 power units per compu-tational unit)

Caution: <u>Actual</u> data center power consumption is growing more slowly (Koomey 15%/yr, 16 Site Uptime Network member sites 8%/yr), but over 5 years, numbers are still enormous

* Christian Belady of HP

Constant $1M in Annual Server Spending Invisibly Commits IT to Increasing Site TCO

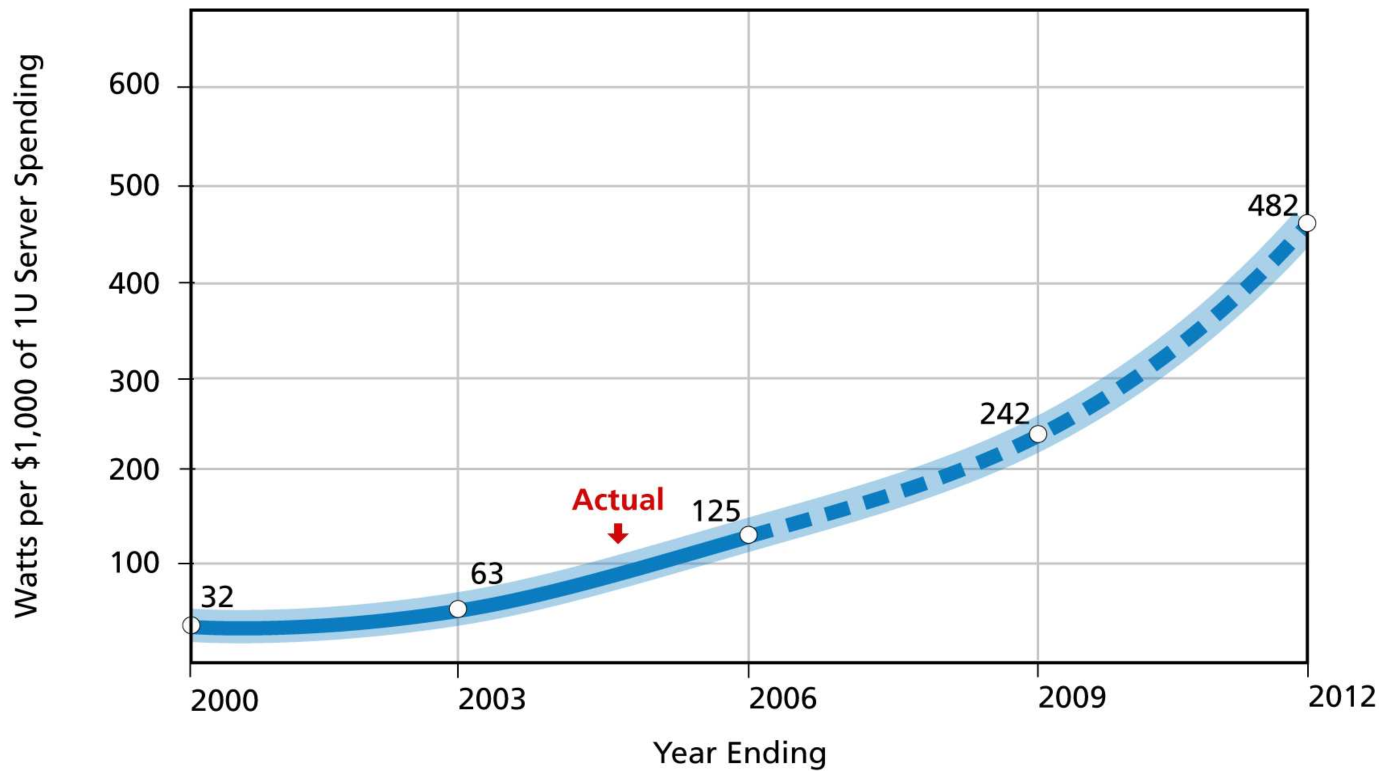
Year	IT Server Spend	Compute Units*	Server kW	Site CapEx	3-Yr Site Elec**	3-Yr Site TCO***	3-Yr Site TCO ÷ IT Acq
2000	$1.0M	1	32	$0.8M	$0.1M	$0.5M	46%
2003	1.0	5	63	1.5	0.3	0.9	91
2006	1.0	27	109	3.0	0.5	1.8	181
2009	1.0	121	283	5.8	1.0	3.5	351
2012	1.0	729	398	11.6	2.0	7.0	699

* Compute units per million dollars of hardware spending. Assumes 2000 = 1.

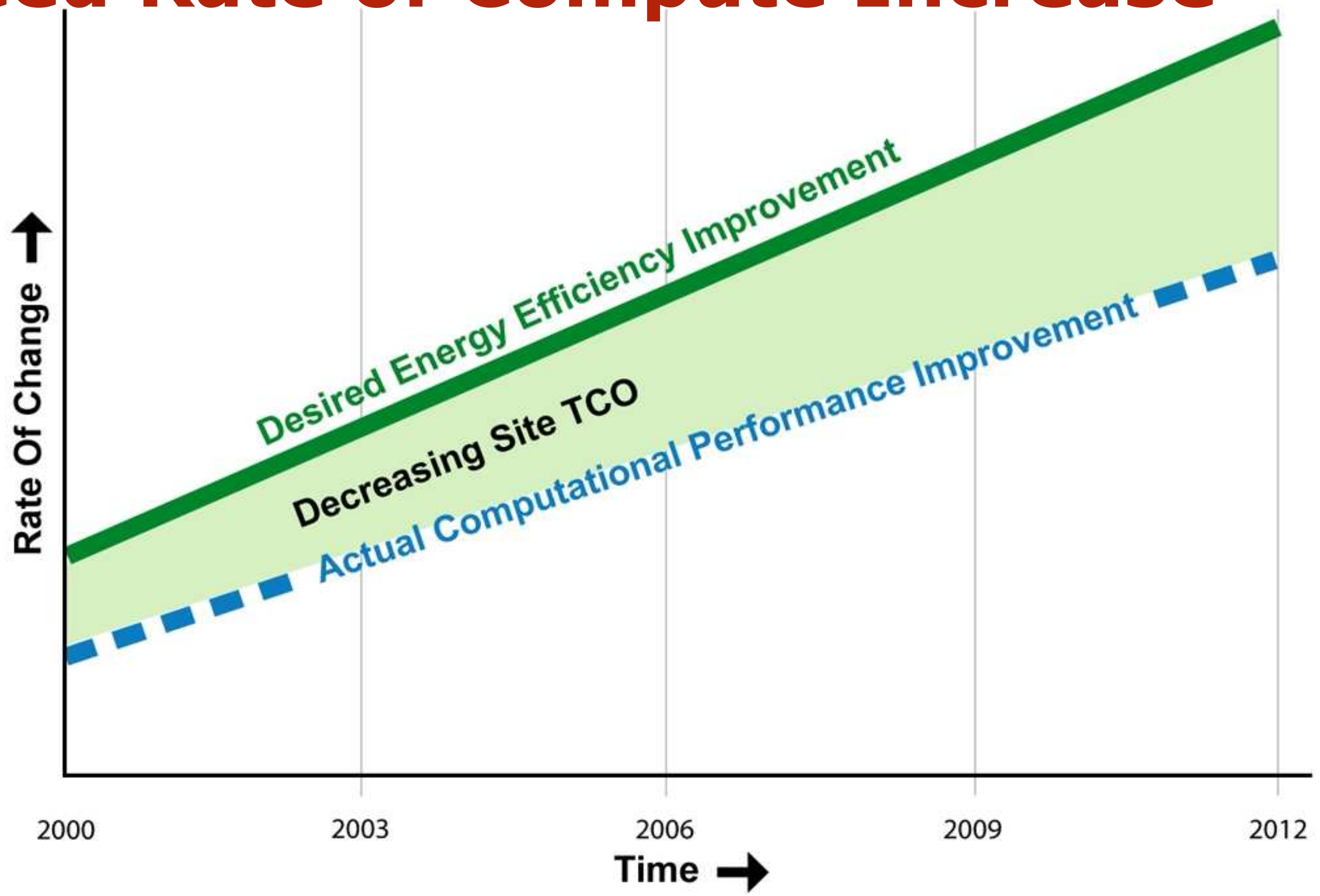
** Assumes a constant $0.07/kWH electric rate.

*** Assumes a "just right" match of site capacity and IT kW. At typical 50% excess site capacity, multiply this column by approximately 1.3

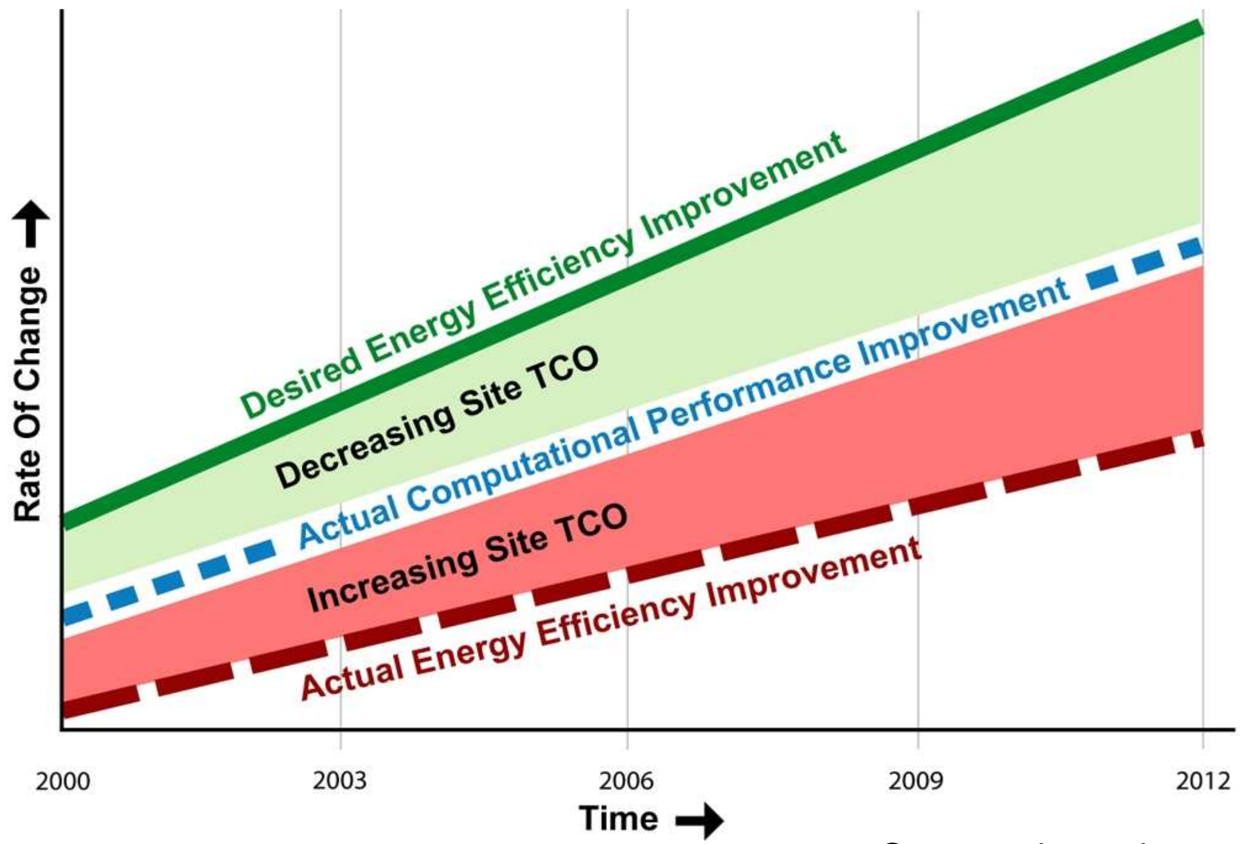
Embedded IT Watts per $1,000 of Server Spending



Rate of Power Efficiency Increase Should Exceed Rate of Compute Increase



A Decreasing Site TCO Prevents Meltdown (Literally and Economically)



Energy Efficiency for Profit

“We don’t need to sacrifice business requirements, IT performance, availability, nor reliability, nor do we need to spend CapEx to achieve significant improvements in data center energy efficiency.”

- *Ken Brill, Uptime Institute, 2007*

Enterprise Data Center Construction Costs Are Now in $100M Increments

From *Computerworld,* March 12, 2007

- **Google, $750 million in Goose Creek, SC**
- **Microsoft, $550 million in San Antonio, TX**
- **Google, $600 million in Lenoir, NC**
- **HSBC, $166 million in Buffalo, NY**

Escalating costs are driven by IT kilowatts (kW), not square feet of computer room

Four Consumption Metrics Determine Data Center "Greenness"

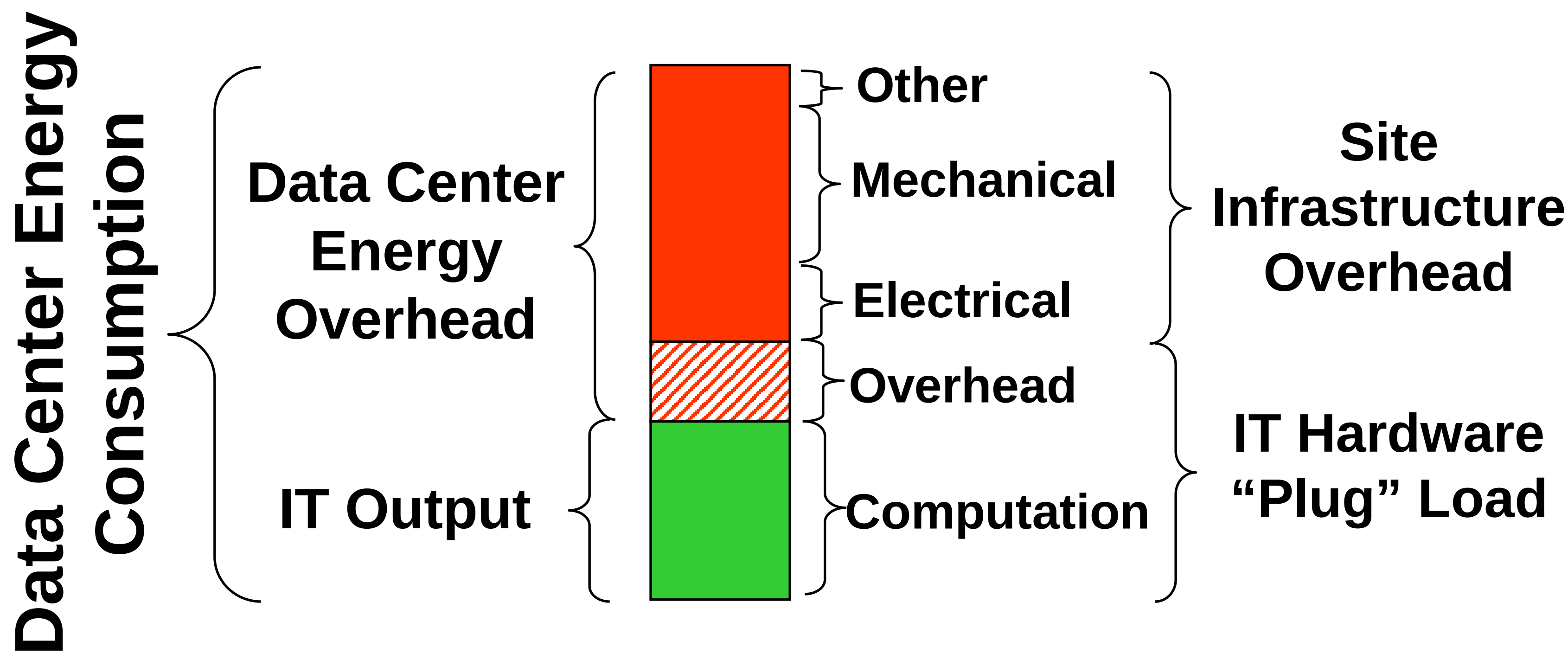
1. IT strategy optimization
- Business requirements
- Systems architecture and platforms
- Data topology
- Network design

2. IT hardware asset utilization
- Servers
- Storage

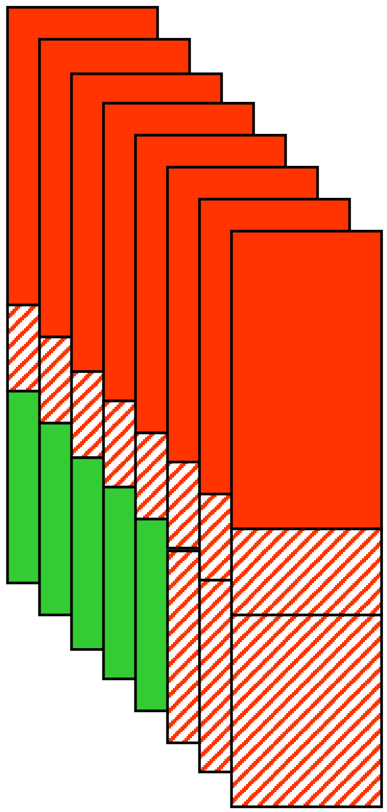
3. IT energy efficient hardware deployment

4. Site infrastructure overhead minimization

Conceptual Model for Data Center Energy Consumption



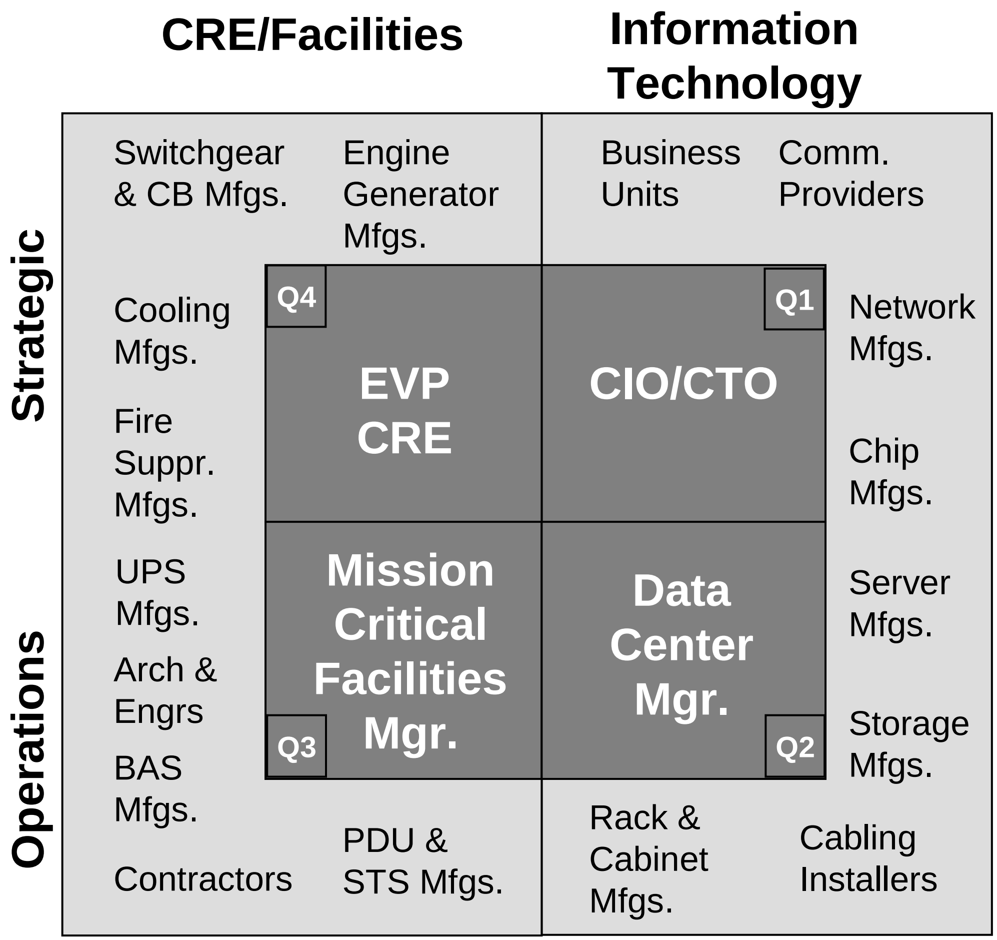
Conceptual Model for Data Center Energy Efficiency & IT Productivity



The "Green" Data Center

- **$100M or more in profit (or competitive advantage) over ten years for large, global enterprises**
- **CFO, CIO, CTO issues**
  - Overcome rigid organizational boundaries and perverse incentives
  - Correctly align authority and responsibility
  - Create and track 4 green metrics that "do no harm" & motivate good business decisions
- **Harvest the five "gold nuggets"**
- **Raise the priority of energy efficiency in chip and hardware vendor R&D roadmaps**

Integrated Critical Environment™ (ICE)



"Gold Nugget" Harvesting Can Reduce kW & Defer Site Investment

Up to 50%, one time, "at-the-meter" kW power and energy reductions are feasible

- Implement ICE Teams with Energy Czar Chair
- Kill comatose servers and storage, implement virtualization on both servers and storage, and enable power save features on both servers and storage
- For many sites, the site Infrastructure energy overhead multiplier is significantly more than 2.0 and should be less than 2.0

Data Center Greenness Index

	Site Infrastructure Overhead Multiplier	IT Productivity Per Embedded Watt
S t r a t e g i c	Quadrant 4 (Q4): EVP Corp Real Estate ▪ Benchmark SI-EOM with peer organizations ▪ Manage Corporate Social Responsibility initiatives ▪ Manage the organization's global data center asset portfolio	Quadrant 1 (Q1): CIO/CTO ▪ Benchmark existing IT hardware asset utilization and harvest lowest hanging fruit ▪ Change IT governance to better allocate resources ▪ Incorporate energy efficiency in new hardware selection ▪ Benchmark IT-PEW with peer organizations ▪ Incorporate energy considerations into IT strategy

Data Center Greenness Index

	Site Infrastructure Overhead Multiplier	IT Productivity Per Embedded Watt
O p e r a t i o n s	**Quadrant 3 (Q3):** *Facility Manager* • Measure and manage SI-EOM ▪ Implement known SI best practices ▪ Utilize more free-cooling ▪ Install more energy efficient infrastructure components (as possible)	**Quadrant 2 (Q2):** *Data Center Manager* ▪ Implement Q1 harvesting decisions ▪ Implement known computer room best practices

Information Technology Infrastructure Library (ITIL)

- **Site Infrastructure equipment needs to be included in the Configuration Management database**
- **IT hardware needs site data**
  - Physical location
  - Power source
  - Site service level
- **Charge back by service is the key to containing Site TCO**

Use These *Institute* Resources

New White Papers

- *"The Economic Meltdown of Moore's Law"*
- *"Four Metrics Define Data Center "Greenness"*
- *"Model for Determining True Total Cost of Ownership for Data Centers"*

Seminars/Workshops

- EPA server performance/efficiency metrics
- ITIL for facilities
- Tiers and Site Resiliency

08 Symposium – The Green Data Center, April 27-30, 2008, Orlando, FL

QUESTIONS?

For More Information

Ken Brill, Executive Director

The Uptime Institute Inc.

kgb@uptimeinstitute.org

www.uptimeinstitute.org