Green IT: A New Industry Shock Wave

Simon Mingay

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Findings: Early Indicators of a Rising 'Green Business' Trend

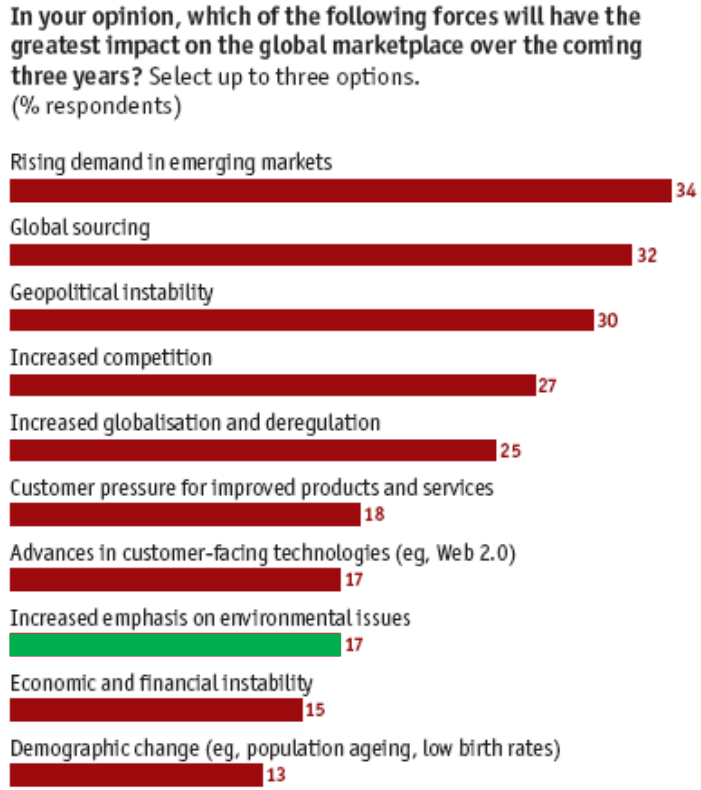
Davos, January 2007

Climate change voted the most important shift that will affect business, technology, society and the global economy

"There will be a move away from corporate social responsibility toward long-term sustainability."

Scott Friedheim, Co-Chief Administrative Officer, Lehman Brothers

January 2007: **Marks & Spencer CEO Stuart Rose committed the company to become carbon-neutral and send no waste to landfill by 2012.**



Source: Economist EIU

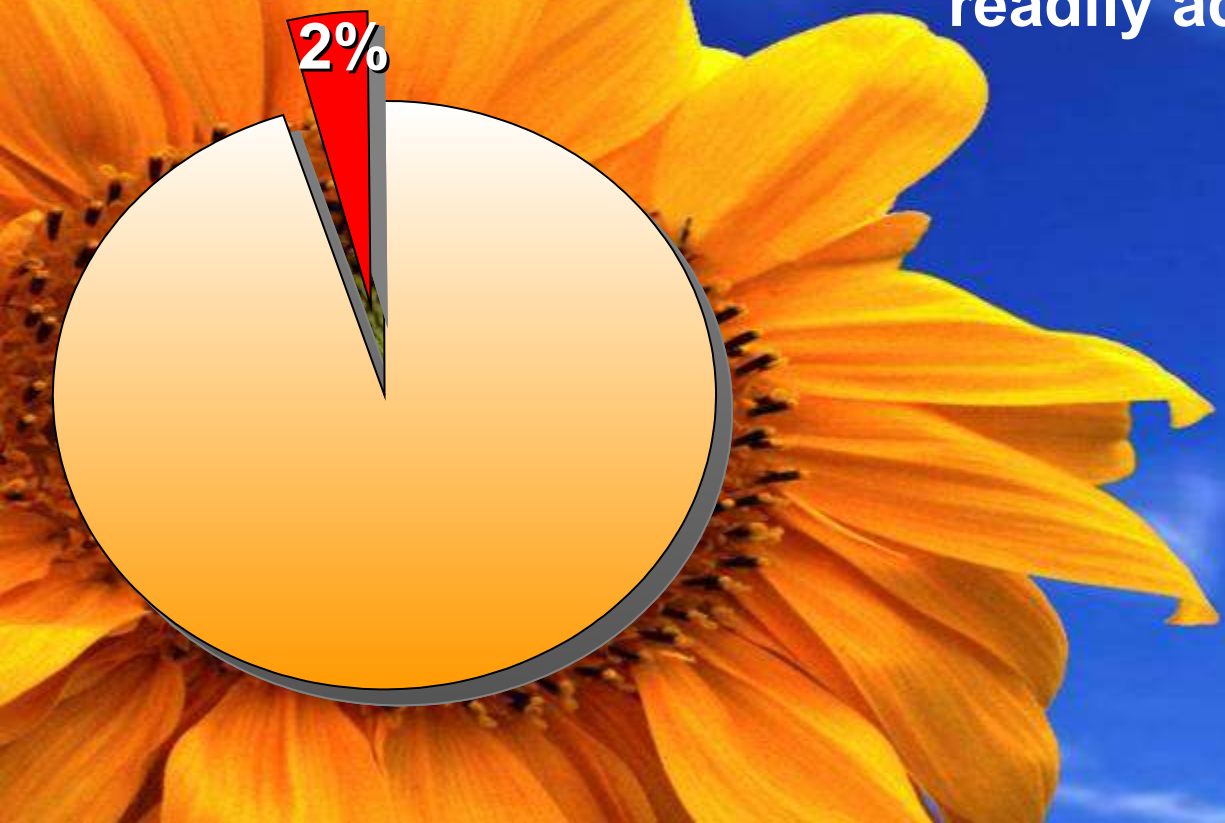
IT's Carbon Contribution

The Bad News: ICT Accounts for Approximately...

2%

…of Global CO_2 Emissions.

But This Industry Cloud Has a Silver Lining

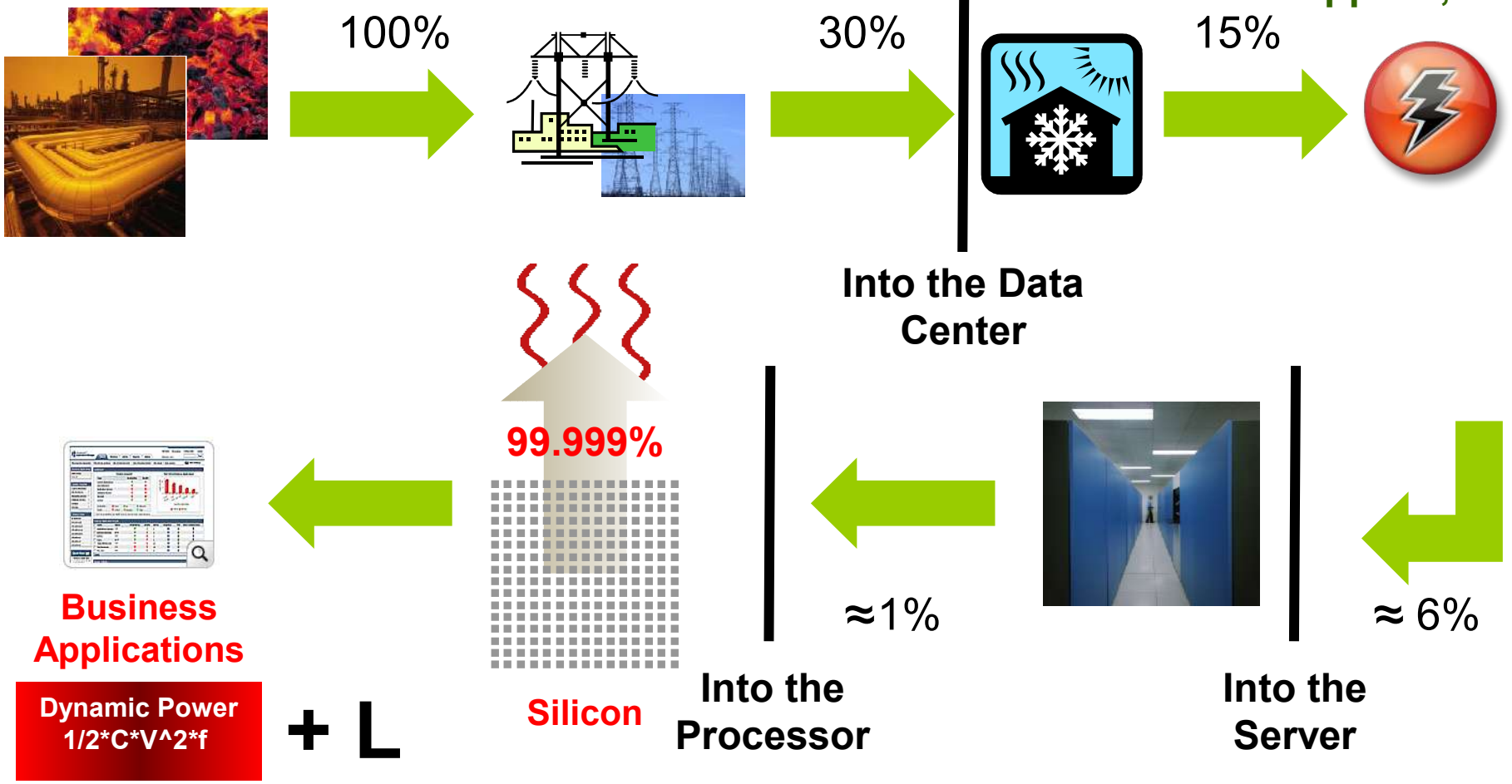


The Good News:

There are substantial inefficiencies in the technology and use behaviors that can be readily addressed …

…and IT can significantly contribute to control and reduce the 98% of CO_2 emissions caused by other activities and industries.

What Percentage of Energy Actually Does Productive Work?



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The Effects of ICT on Environmental Sustainability

1st Order

(direct result of its existence)

GHG Emission

E-Waste

Hazardous Substances

Use of Scarce and Nonrenewable Resources

2nd Order

(from application)

Travel Substitution

Transportation Optimization

E-Business E-Government

Environmental Control Systems

3rd Order

(Long term socio-economic structural changes)

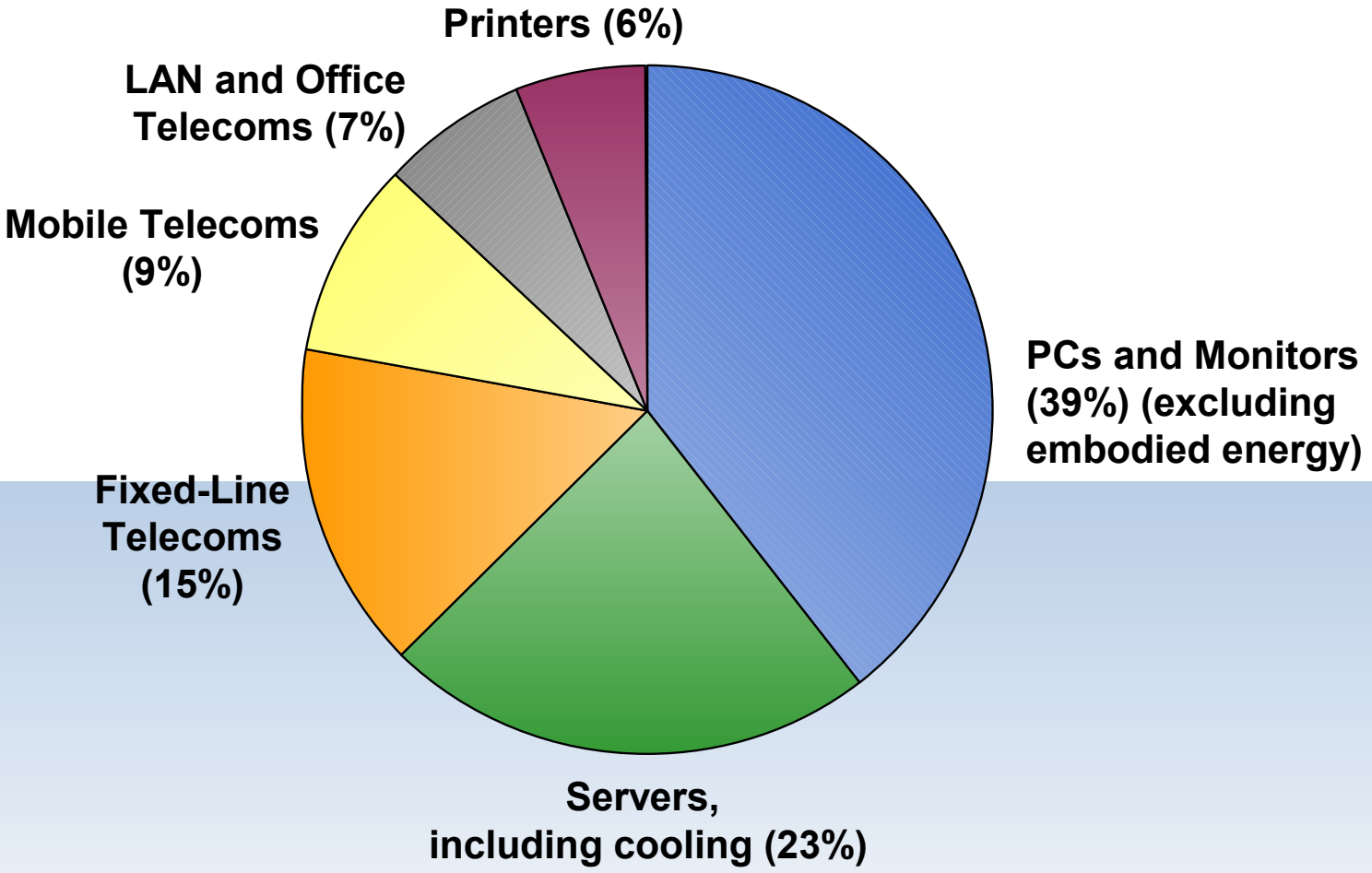
Energy Intensity

GHG Intensity

Transportation Intensity

Material Intensity

ICT's Global Carbon Dioxide Emissions



ICT accounts for approximately 2% of global CO_2 emissions.

Strategic Planning Assumption

By 2010, 50% of IT organizations will declare an environmental imperative (0.7 probability).

By 2009, more than one-third of IT organizations will have one or more environmental criteria in their top six buying criteria (0.6 probability).

Four Scenarios for the Data Center Energy Crisis

SCENARIO 1 — Data Centers in Crisis

Blade penetration and density increase rapidly.

Efficiencies in processors, power supplies, cooling, power mgt. and DC design fail to deliver.

Use behaviors don't change.

Carbon prices high; tighter quotas.

Power consumption continues growing rapidly.

Energy costs rise. Insufficient capacity in renewables.

Data center load increases.

Data centers become a political and media target.

SCENARIO 2 — Mid-Case

Blade penetration increases gradually; blade density increases.

Technology innovations and use behaviors deliver reductions in power consumption.

Carbon prices rise moderately; tighter quotas.

Power consumption and CO2 emissions stable.

Energy costs rise slightly. Renewables help.

Data center load increases slightly.

SCENARIO 3 — Best Case 1

Blade penetration and density increase slowly.

Use behaviors and technology innovations deliver reductions in power consumption.

Carbon prices rise moderately; quotas tolerable.

Power consumption and CO2 emissions fall.

Energy costs rise slightly. Renewables help.

Data center load falls.

SCENARIO 4 — Best Case 2

Blade penetration and density increase rapidly.

Technology innovations and use behaviors deliver substantial reductions.

Carbon prices high; quotas tolerable.

Power consumption and CO2 emissions fall.

Energy costs rise slightly. Renewable capacity available.

Data center load rises.

ICT seen as critical to combat climate change.

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- ICT seen as critical to combat climate change.

Action #1: Define a Policy and Strategy for First- and Second-Order Effects

- Identify the enterprise's position on climate change, e-waste and the environment — act as a catalyst, if necessary.
- Conduct a risk assessment of doing nothing.
- Decide whether the enterprise is going to be aggressive, measured or passive in its response and to which issues.
- Develop a strategy to reduce power consumption and CO_2 emissions in the data center, client computing, network, printing and so forth.
- Create an environmental assessment process for all ICT-related investments.
- Create an equipment disposition process and controls.
- Strategize to identify the second-order effect opportunities within the enterprise.
- Appoint a manager to take oversight.

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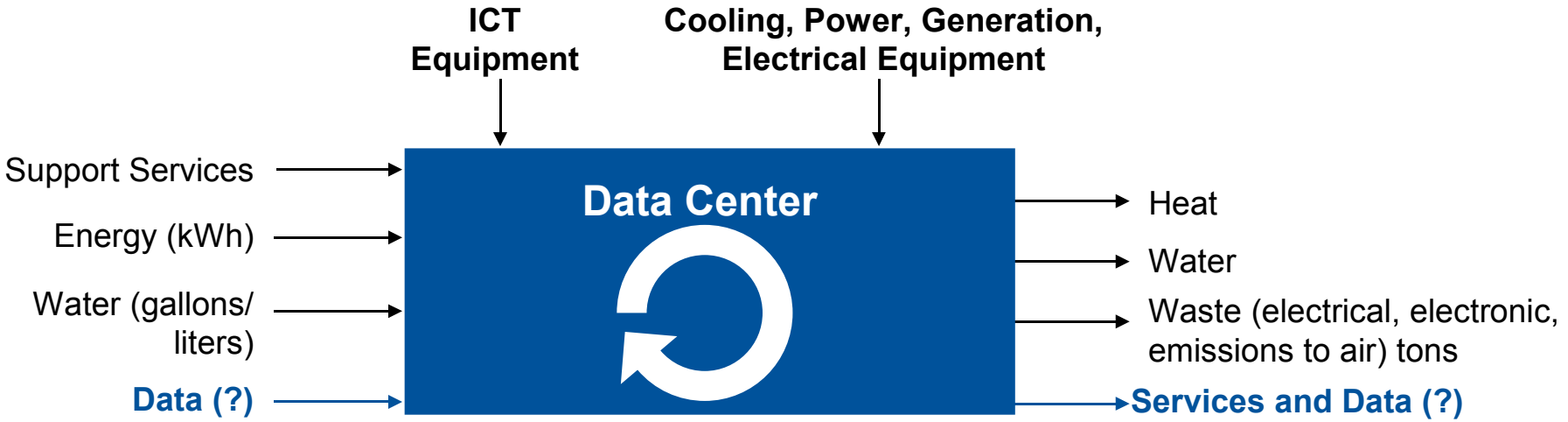
Action #2: Measure Data Center Energy Efficiency, Reward the Right Behaviors

		Potential Range	Avg.
Power Usage Effectiveness (PUE) [2]	Total Data Center Electricity Consumption / Electricity Consumption by ICT Equipment	3 — 1.35[1]	2.0 — 2.4
Data Center Efficiency (DCiE) [2]	Electricity Consumption by ICT Equipment / Total Data Center Electricity Consumption	0.33 — 0.74[1]	0.42 — 0.50
Real DC Efficiency	Electricity Consumption by ICT Equipment / Electricity Consumption Doing Useful Work	???	



1) Greenberg, S., E. Mills, and others (2006). "Best Practices for Data Centers: Results from Benchmarking 22 Data Centers." Proceedings of the 2006 ACEEE Summer Study on Energy Efficiency in Buildings. (http://eetd.lbl.gov/emills/PUBS/PDF/ACEEE-datacenters.pdf), Rocky Mountain Institute High Performance Data Center, 2004

2) www.thegreengrid.org and others

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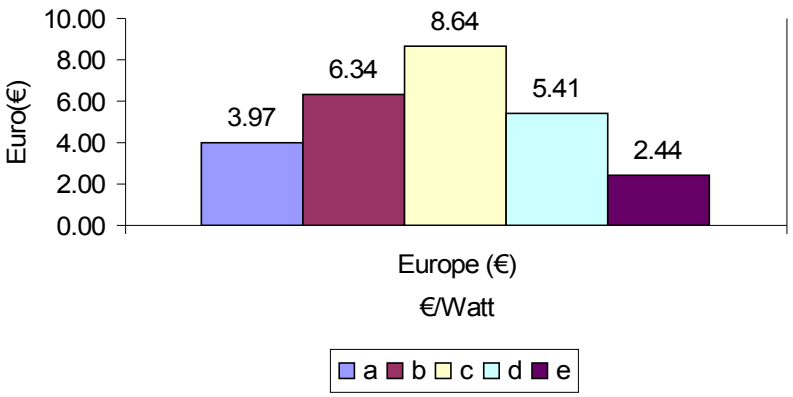
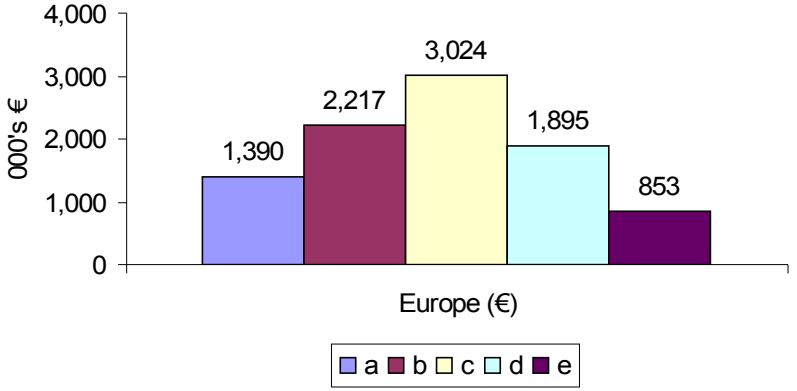
Why Care About Energy Efficiency In the Data Center?

Operational Energy Costs (€) per Watt Over 3 yrs



Energy Costs (000's €) for 1,000 servers Over 3 yrs @ 350W/server



a. €0.686/kWh, PUE 2.2

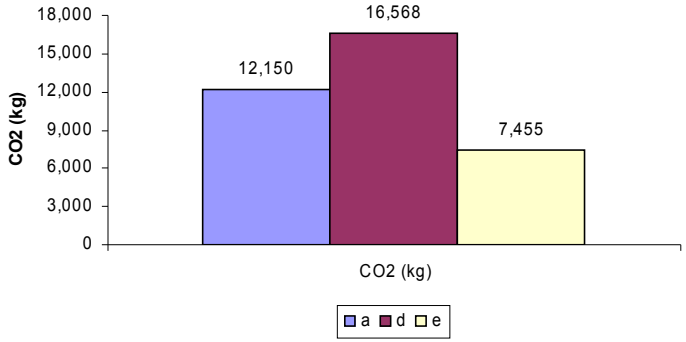
b. €0.1095/kWh, PUE 2.2

c. €0.1095/kWh, PUE 3

d. €0.686/kWh, PUE 3

e. €0.686/kWh, PUE 1.35

CO2 Footprint (000's kg) For 1,000 Servers Over 3 yrs @ 350W/server



Just Imagine How Good It Would Be If You Reduced the Load as Well!

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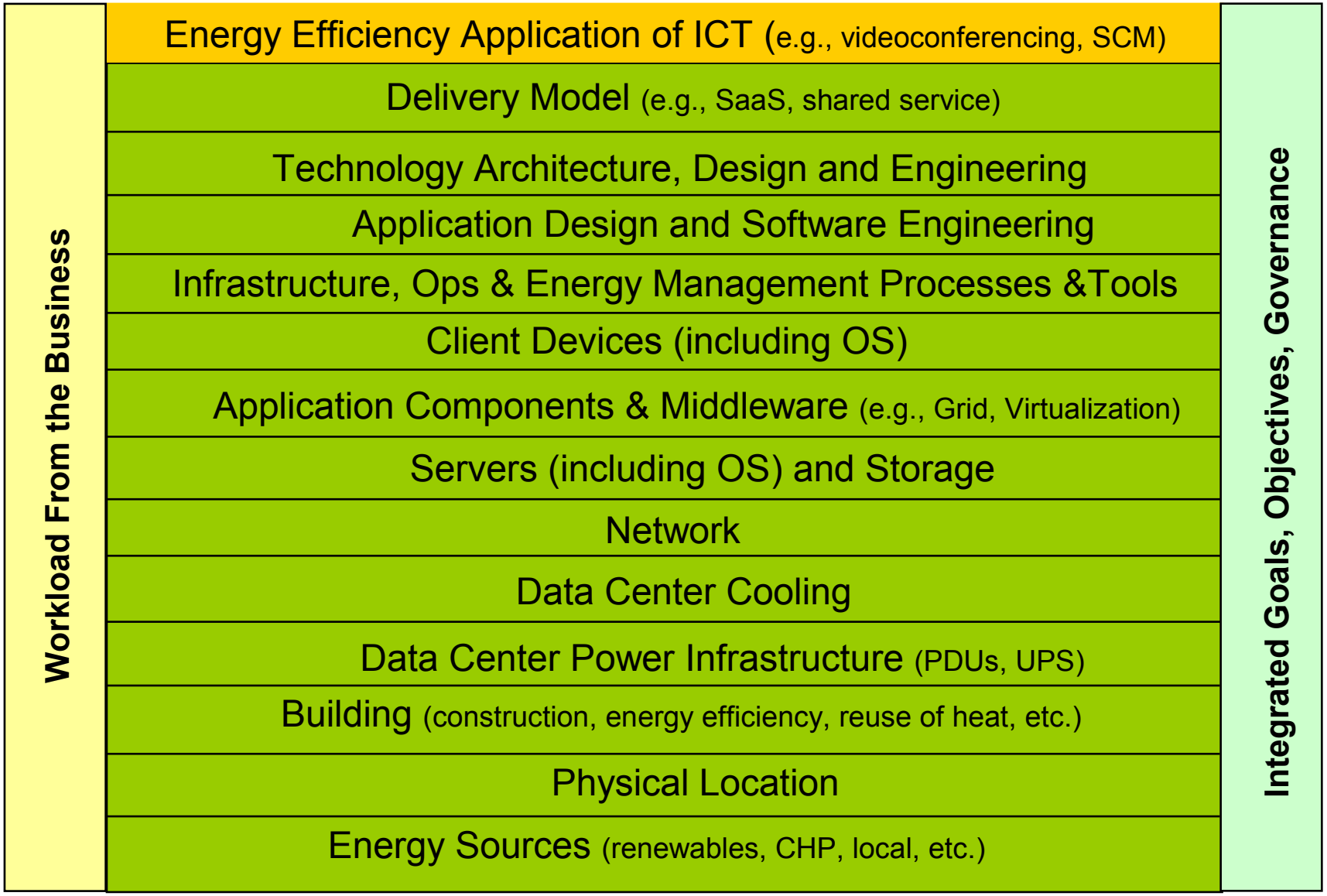
Strategic Planning Assumption

By 2010, two-thirds of best-practice enterprises will achieve a 25% reduction in ICT-related power consumption compared with 2007 levels for the same workload, simply by changing the behaviors associated with client devices and in the data center.

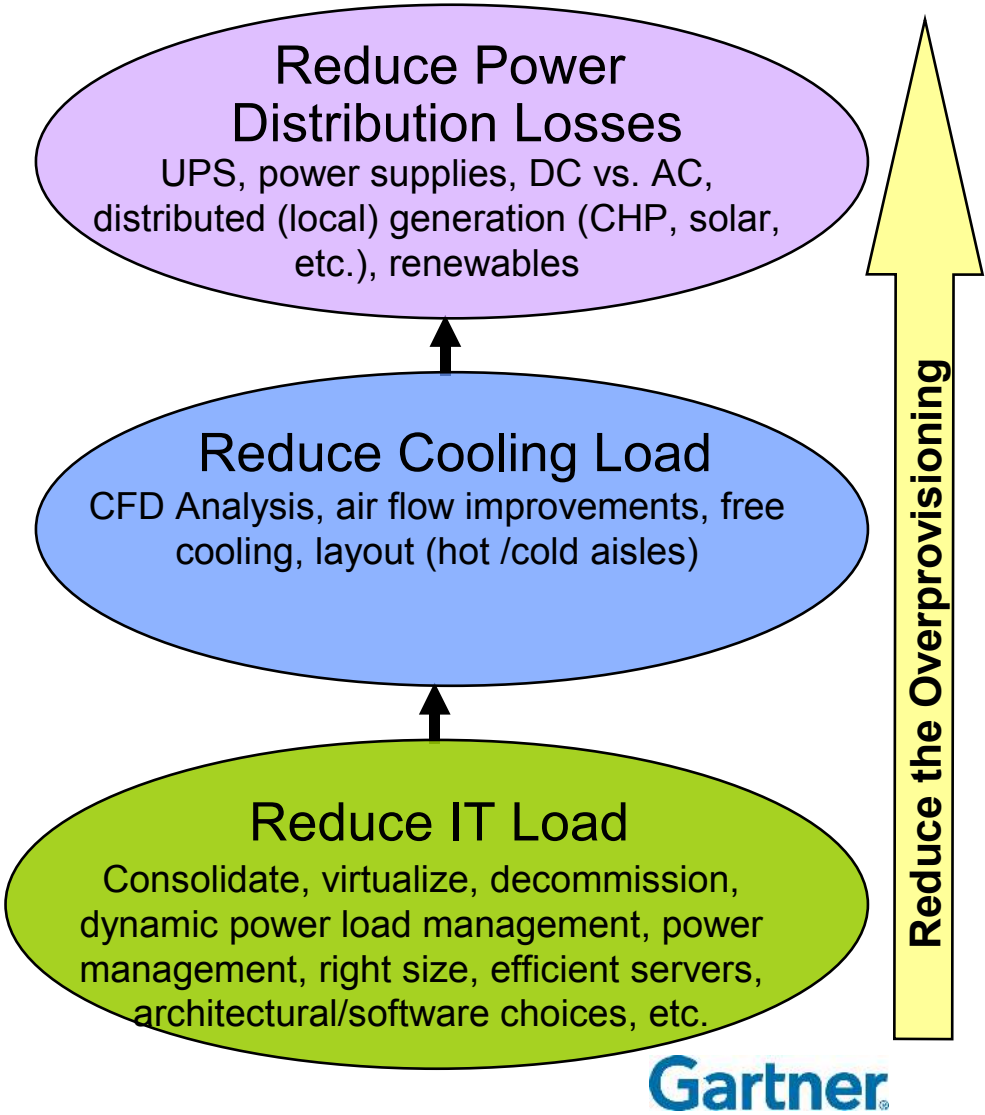
Action #3: Consider Energy at Every Decision Level — Use the ICT Energy Stack



Action #4: Take a Holistic Approach to Reducing IT, Cooling and Power Loads

Cooling Efficiency Is a Big Opportunity

- Must be made smarter, more dynamic.
- Check airflows around the data center.
- Conduct a CFD analysis.
- Investigate local options for free cooling — look at air-side and water-side economizers.
- Bottom-to-top airflow.
- Use cold-aisle/hot-aisle rack configuration.
- Maintain static pressure at 5% above room pressure.
- Avoid air leaks in raised floor.
- Use blanking panels.
- Plumb new builds for liquid cooling.
- Investigate local power generation. (combined heat and power particularly)



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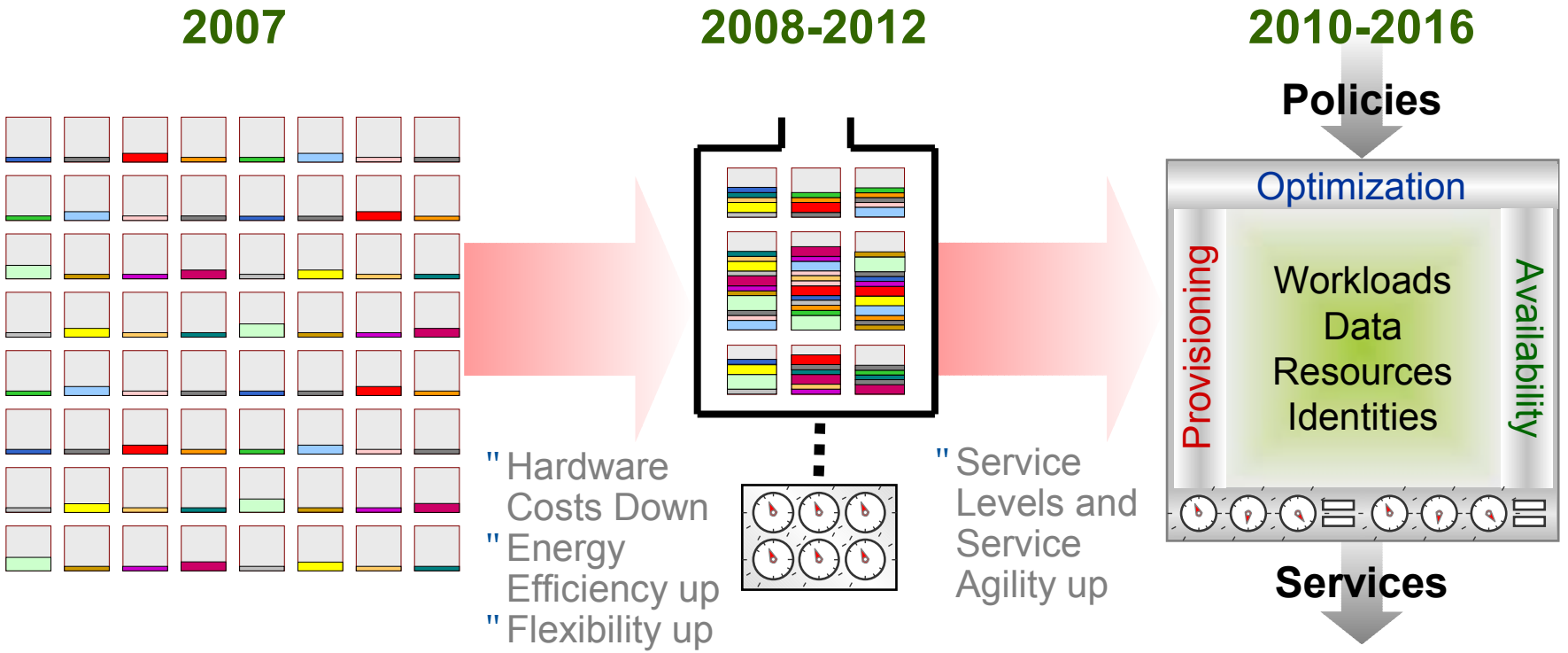
Consolidate, Virtualize and Decommission in the Data Center



Virtualize

and

Decommission

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Begin the Journey From Always on, to Always Available

The Data Center Problem

- Everyone is working on power efficiency, but a technology "fix" is more than three years away for most enterprises.
- "If it ain't broke, don't touch it" — Well, it's broke now.
- Energy management and cooling are very static.

The Opportunity

- Low server utilization.
- The technology exists to reduce power consumption.

The Fix

- Virtualize.
- Stop overprovisioning (servers, UPS and cooling).
- Use power management features to throttle power based on use.
- Use a low power state or shut servers down when not in use.
- Use management software to automate changing the power status of equipment.

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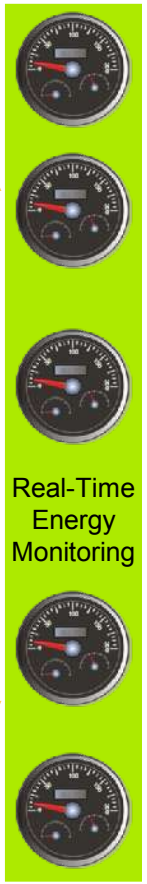
A Vision for the Dynamic, Integrated ICT Energy Management Architecture

Energy Is Just Another Resource That Needs Managing

Energy Policies and Event Correlation



Real-Time Energy Monitoring

Services

Applications

Application Components

Middleware **Portals** **Virtualization** **Grids**

Enterprise and Ops. Mgmt. Tools

BSM

Energy Monitoring

Job Schedulers

Configuration Mgmt.

Event Mgmt.

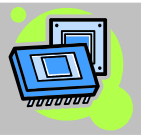
Chargeback Tools

Performance Mgmt.

Global Infrastructure Components

Servers/OS **Storage** **Networks** **Databases** **Clients/OS** **Cooling** **Power Infra.**

Microprocessors



Chip Sets

Hardware Energy Mgmt.

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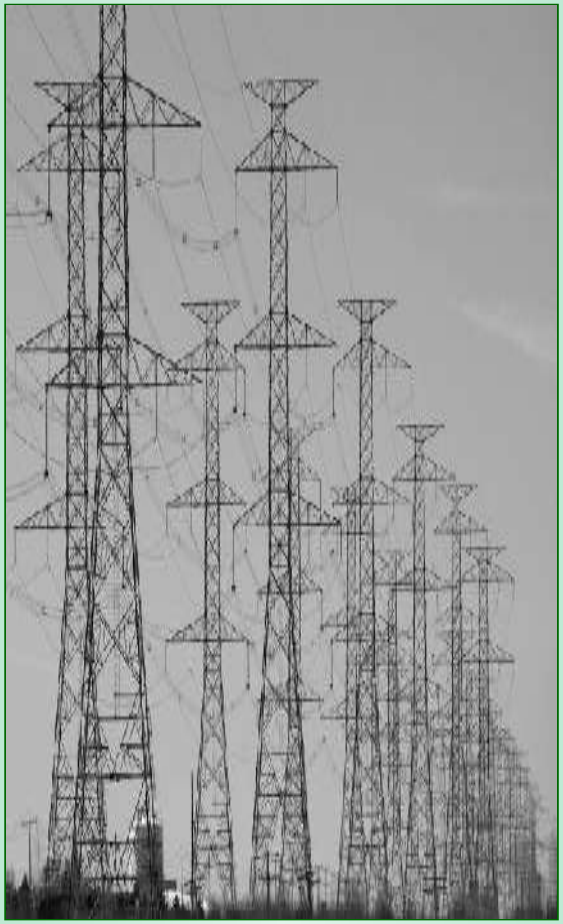
Power Supplies and Distribution Inefficiencies and Energy Waste

Grid supplies and facilities

- Need improvements in building and facilities
- Distribution and management of energy
- Use of more-efficient
  - Generators
  - Beware of efficiency vs. reliability
- AC vs. DC
  - Efficiency vs. usage
  - Safety of high-voltage systems
- UPS * PDU units
  - Need to improve efficiency
  - Rotary and cell
  - Better power monitoring
- CHP
  - Adoption of combined units improves usage
  - Use of economizers (lower operating temperatures)



Computer

- More-efficient power supplies
  - Multiple vs. single supply
  - Availability vs. energy use
- Focus on fans/blowers
  - Idle power usage vs. peak
  - Technology, patents
- Electrical conversion at the server
  - Use of multiple paths
- Processors
  - Dynamic power vs. leakage
  - Horizontal scaling, cores
  - Silicon
- Energy management software
  - Use of server management tools
  - External tools

Action #5: Live Life on the Edge; Dare to Switch Some of It OFF When Not in Use!

The Opportunity

- PCs, monitors account for more than a third of ICT power consumption and CO_2 emissions
- Nine percent to 15% of office power is consumed by office equipment (PCs and monitors)
- Sixty percent of PCs are left on after hours

The Fix (mostly behavioral)

- Measure and report office power consumption — get granular.
- Use and enforce "aggressive" power management.
- Ditch the active screen savers.
- Educate staff.
- Use a low-power state, such as standby, for PCs and monitors after hours.
- Use agents and schedulers to automate.

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Action #6: Greening Printers and Printing

The Opportunity

- The paper itself consumes 10x the energy of printing on it.
- 178 million printers, copiers and MFDs shipped in 2007.
- Average office worker prints 1,000 pages/month, 40 lbs/month.
- Too many printers on desks; too many models.

The Fix (mostly behavioral)

- Print less — measure and Analyze document flows
- Educate staff — why this makes a difference.
- Enforce duplex printing (explain why).
- Use pull printing and drop the banner page.
- Buy Energy Star devices.
- Consolidate printers into fewer, standard, low -impact, better MFDs that share the same consumables.
- Use long-life drums. Check remanufactured quality and recycling.
- Recycle — paper, toner cartridges.
- Dispose of used drums and printers appropriately.

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Action #7: Greening the Staff (a Case Study): 'It's Mostly a Behavioral Challenge!'

- The employee charter
  - Why this is important for all stakeholders
  - Lays out employee's personal responsibilities
  - What behaviors are expected
  - Services the company will provide
- Regularly communicate the enterprise environmental goals, footprint and progress through multiple channels
- Create a work environment that includes subtle reminders
  - Remove deskside bins; provide recycling points
  - Offer recycling for domestic waste, such as WEEE
  - Car share/carpool
- Points and reward schemes for walking, cycling, using public transport, train vs. plane
- Energy-efficiency advice and assistance for home workers
- Financial assistance for purchase of hybrid/electric cars

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What Does the Future Hold?

- Carbon cap and trading, increasing costs of energy.
- Increased legislation, regulation and tax breaks — power consumption, hazardous substances and e-waste.
- Broader-based and more-demanding energy-rating and eco-labeling schemes, such as Energy Star for servers, Energy Star 4, EPEAT Gold.
- Energy management across the ICT infrastructure, creating a more dynamic sense-and-respond environment.
- More-efficient and smarter cooling, UPS and power supplies in the data center and for client devices and so on.
- Improved screen technology — more power-efficient and mercury-free.
- Better power management at every level — processors, PCBs, systems, operating systems and applications.
- Power consumption as a design criterion for software and energy profiling.
- Limited materials innovation until there's a commercial driver.
- A biodegradable, non-toxic PC — probably not, but certainly massive improvements.

Recommendations — It Starts With Measuring

Reduce

- ✓ Consume fewer servers, printers and so forth by increasing utilization — virtualize.
- ✓ Stop overprovisioning; improve capacity planning.
- ✓ Turn equipment off, turn power management on.
- ✓ Print less.

Reuse

- ✓ Extend the life of assets by reusing them within the enterprise and externally.
- ✓ Use recycled paper.

Recycle

- ✓ Ensure and validate the correct disposition of ALL electronic equipment.
- ✓ Analyze all waste.
- ✓ Buy recyclable products.

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