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# Energy efficient ICT Products & Infrastructures for Data Centers

## Green IT - protects the environment and the budget

Juergen Heidegger

September 2008

# The importance of IT in an environmentally-friendly world

- "IT-Equipment worldwide is responsible for 2% of $CO_2$ emissions which corresponds to the amounts of $CO_2$ emitted by airplanes."

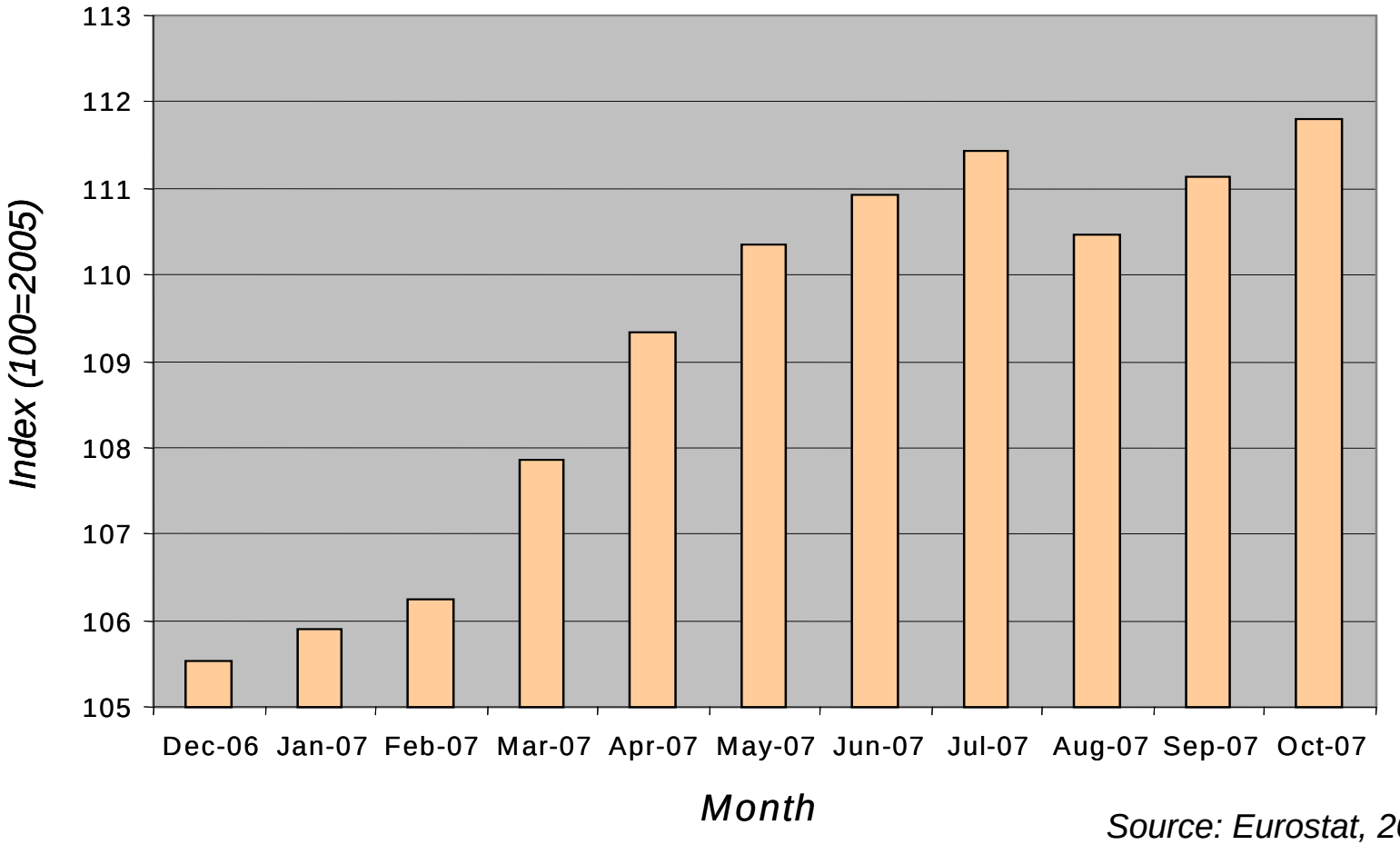
  *Simon Mingay, Gartner*


- "For approx. each $1 spent on computer hardware, further $0.5 need to be spent for electricity. Within the next 4 years, this number is to rise by 54%."

  *IDC, Worldwide Server Power and Cooling Expense 2006 – 2010*

# European Union Energy Price: Index 2006 - 2007

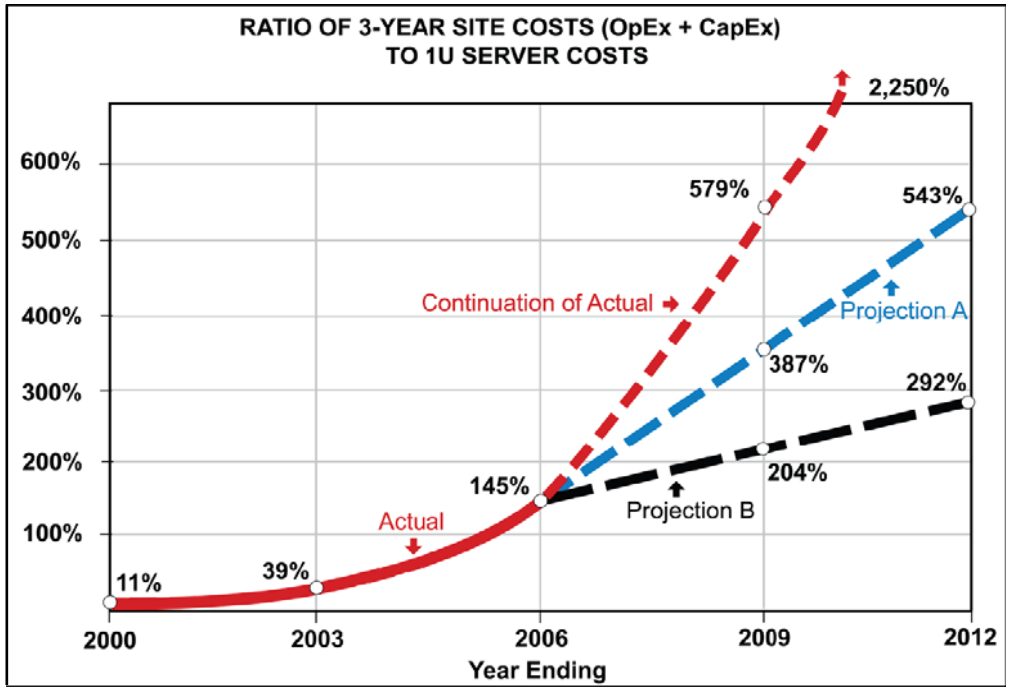



*Source: Eurostat, 2007*

# Infrastructure costs powering & cooling versus server costs

- Infrastructure costs for powering and cooling data centers are rising faster than the procurement costs for new servers




**Electricity supply and thermal waste are driving costs when building a data center**

Data Center Energy Efficiency and Productivity, The Uptime Institute, 2007

# EPA Study: Projected Energy Use (U.S.)

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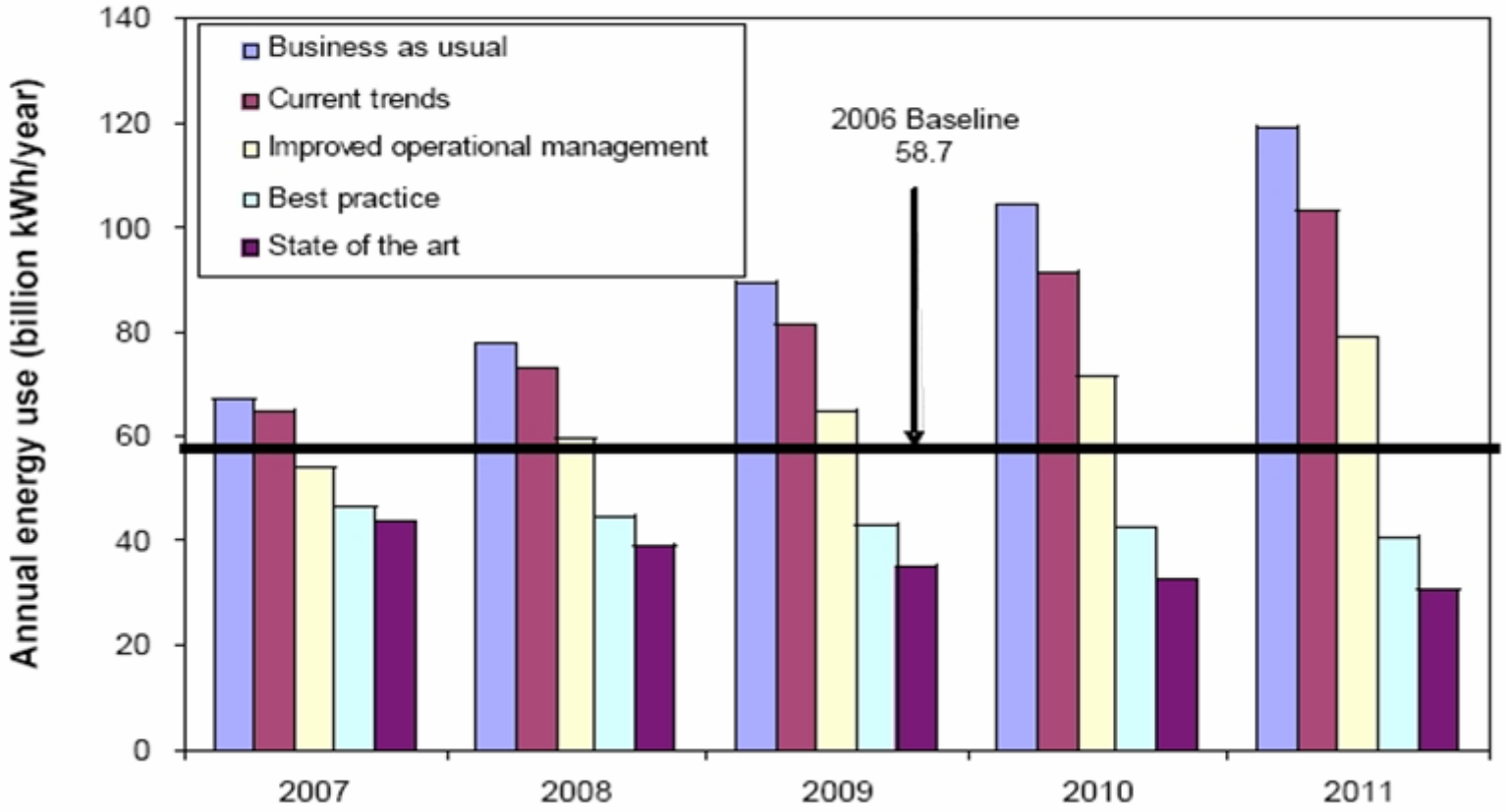
**Figure 3-5. Comparison of projected electricity use, all scenarios, 2007 to 2011**




EPA = U.S. Environmental Protection Agency

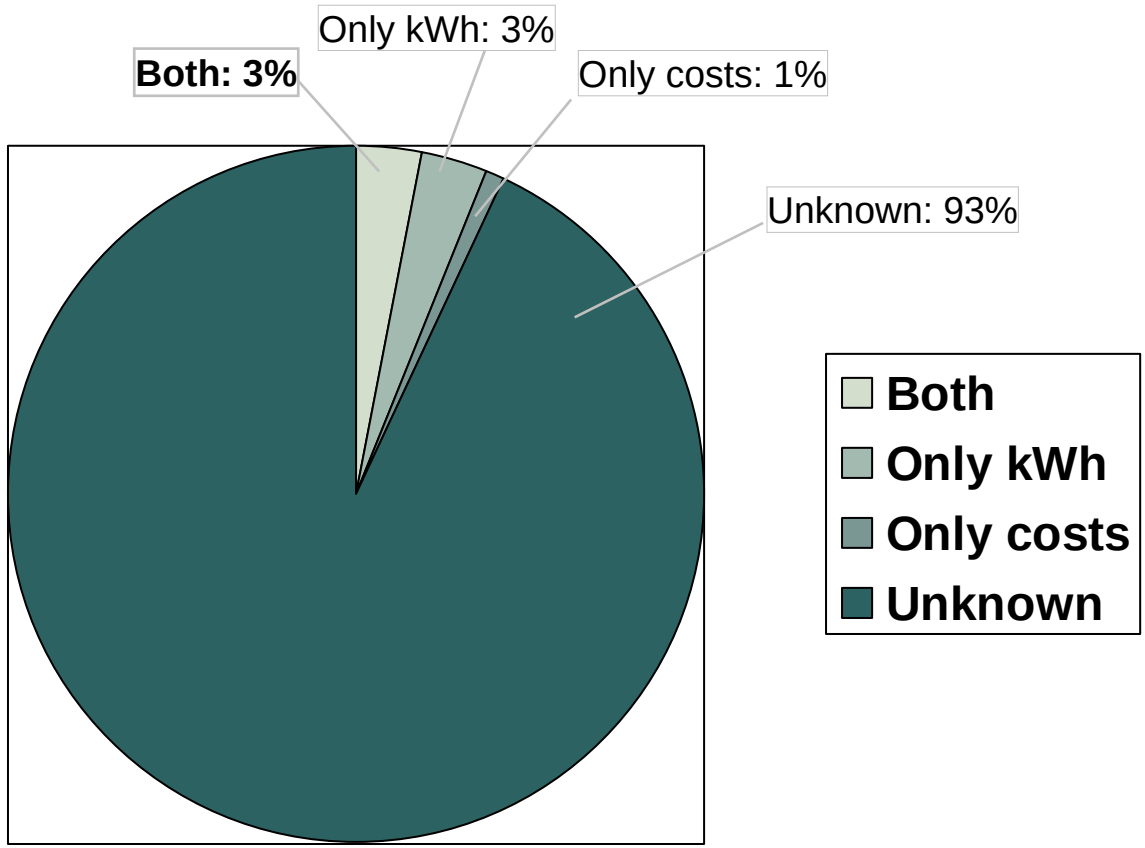
 

# Knowledge of Energy Consumption in Data Centers

**Do you know the energy consumption in**

- **kWh**
- **Euro**

**of your data center?**

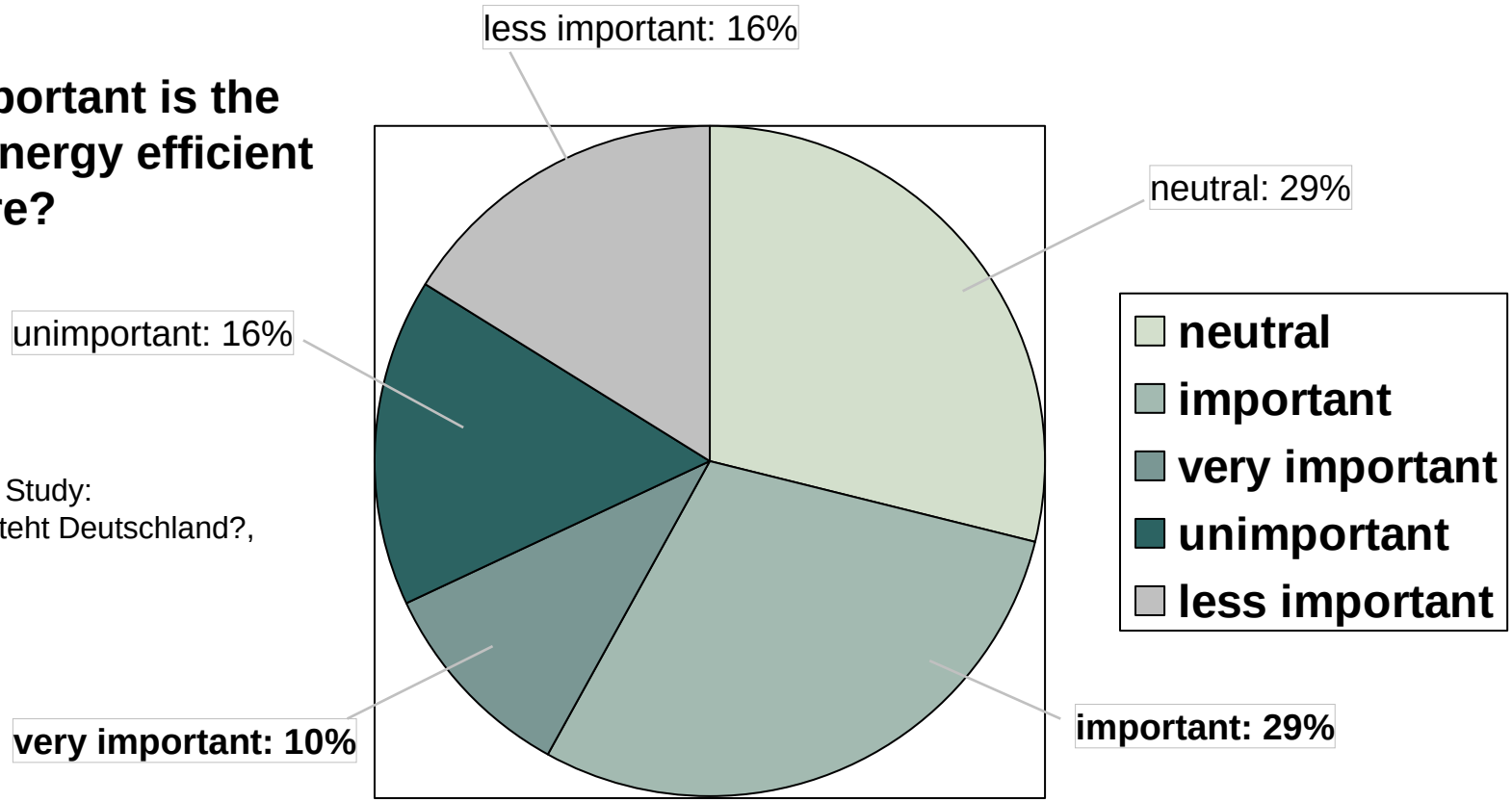



Experton Group Study:
Green IT – wo steht Deutschland?,
November 2007

# Importance of Energy Consumption in Data Centers

**How important is the use of energy efficient hardware?**




Experton Group Study:
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# Fujitsu Siemens Computers' environmental pioneering and social commitment has long tradition

- 1988: Taking back old IT equipment
- 1992: Guideline set for environmentally conscious design
- 1993: First 'Green PC' in the market
- 1994: First IT manufacturer to receive Blue Angel eco-label
- 2002: First 'green' mainboard
- 2005: Joining the U.N. Global Compact
- 2006: PRIMERGY - Intelligent Power Management
- 2007: First "Green Server" PRIMERGY TX120
- 2007: Energy Star 4.0 Compliance

 

# How to cope with the Green IT challenges?

- Boost Energy Efficiency in IT Infrastructures
  - Increase use of energy efficient components
  - Reduce consumption through efficient systems
- Optimize IT Infrastructures
  - Consolidation
  - Virtualization
  - Automation
  - Transition from a static to a dynamic IT environment
- Optimize Data Management
  - Information Lifecycle Management
- Boost Energy Efficiency in Cooling Infrastructures
  - Management of cooling airflow in racks / data centers

 

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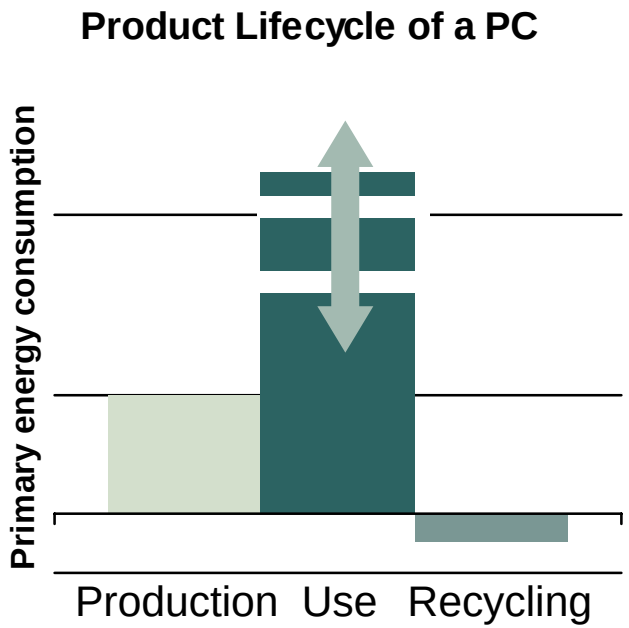
# Greening of Business Clients

## Boost energy saving in product use

- Latest technology
  - Components
  - Systems
- ECO Button
- Power management
- Switched monitor outlet
- Zero Watt monitor (standby)
- Label certified
- Manageability



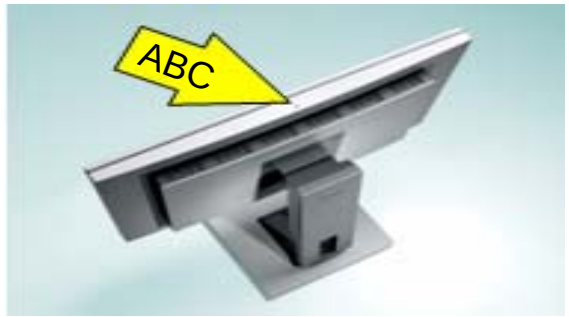

| Settings for | FSC mains | Blue Angel requires | Energy Star requires |
|---|---|---|---|
| Screen off | 10 min | - | 15 min |
| HD off | 15 min | - | - |
| Standby | 20 min | 30 min PC<br>15 min Notebook | 30 min |
| Hibernating | 1 h | - | - |

Source: Fraunhofer Institute

# Green Monitor

- Unique Green combination for energy saving
- First 0,0 Watt Power Save solution
  - Real 0,0 watt power consumption in standby
  - Fujitsu Siemens Computers patent applied
- Light sensor and Automatic Brightness Control (ABC)
  - Automatic adoption of brightness to ambient brightness
  - Energy saving potential up to 30%
- “INNOVATIONSPREIS 2008” awarded by Initiative Mittelstand



# Server based computing and Thin Clients
# Virtual Desktop Infrastructure

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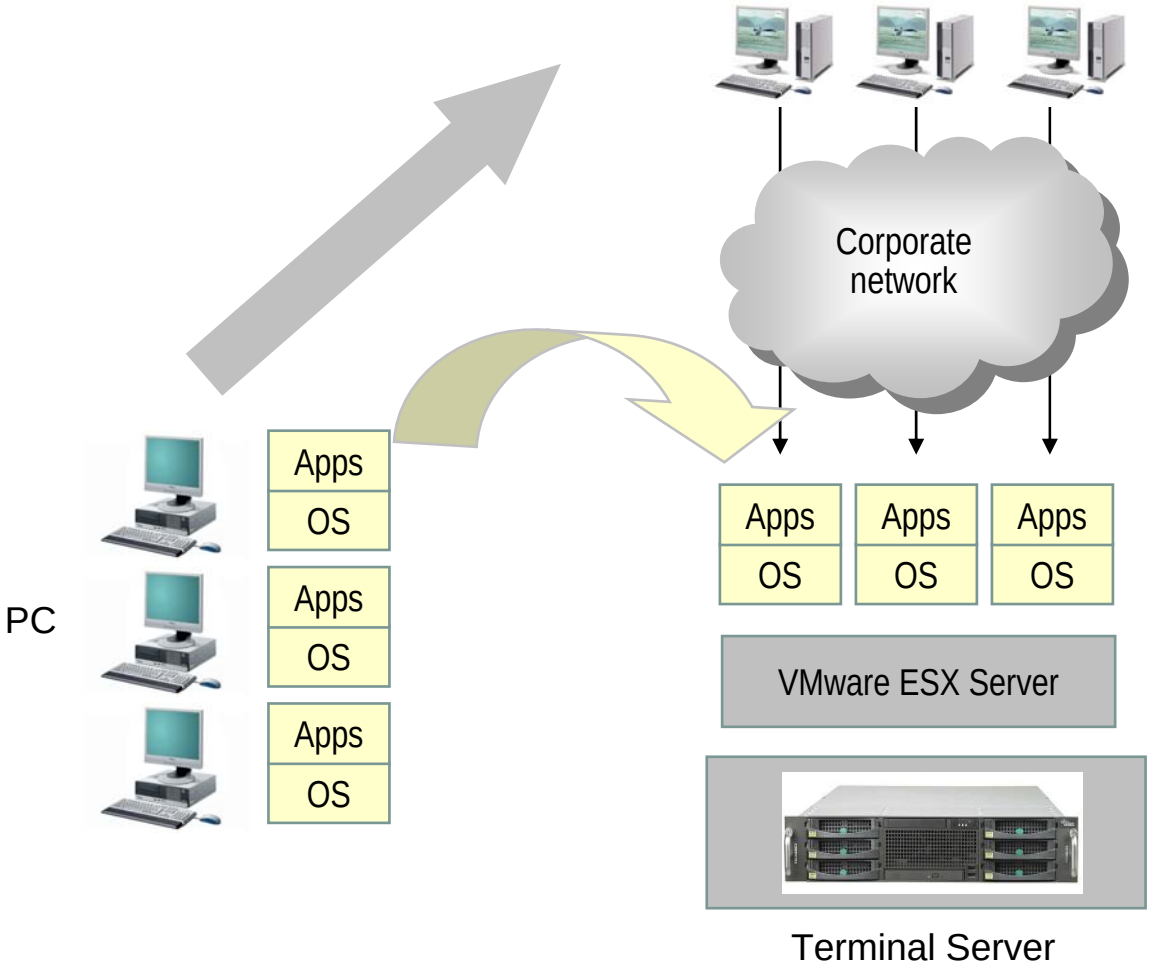



**DIT4WP[1)]**

- Thin clients (and other devices)
- Desktop management
- Guest OS, apps
- Virtualization management
- Virtualization layer
- Server hardware
- Storage systems

End-to-end Services

*Solution stack*

[1)] DIT4WP = Dynamic IT for Workplaces

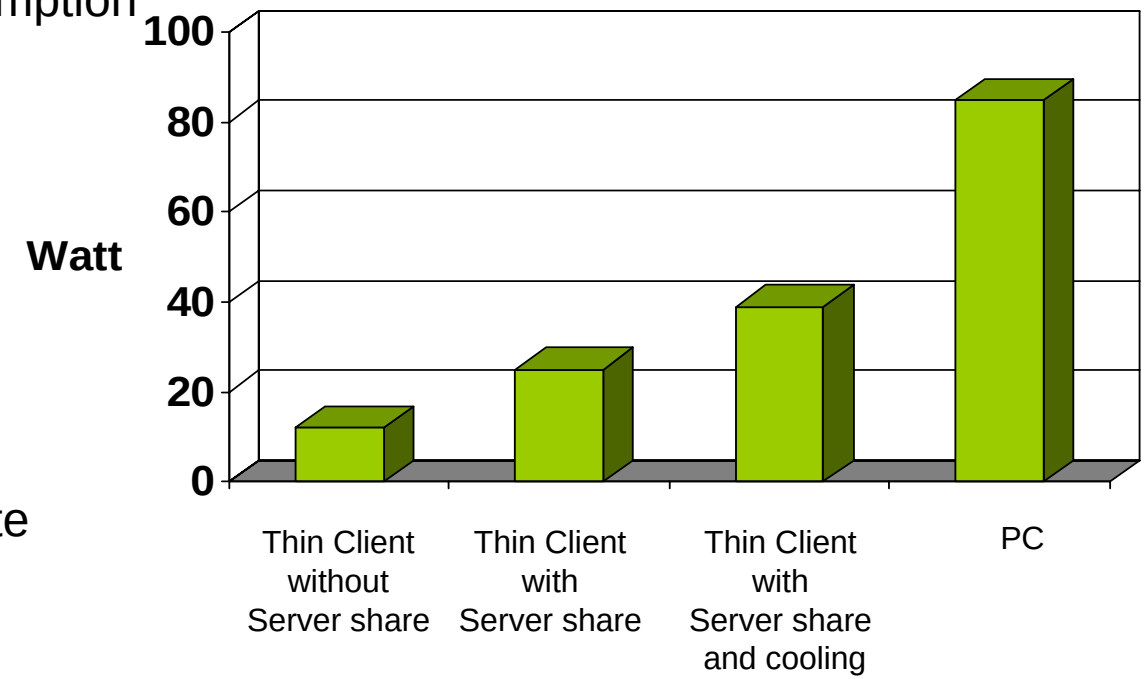
 

# Environmental comparison PC versus Thin-Clients

**Thin Clients** compared to PC:

- ~ 50% less energy consumption
- Less weight (up to 70%)
- Smaller footprint
- Fewer cargoes
- Reduced raw material
- Reduced recycling
- Reduced disposal of waste

**Energy Consumption**

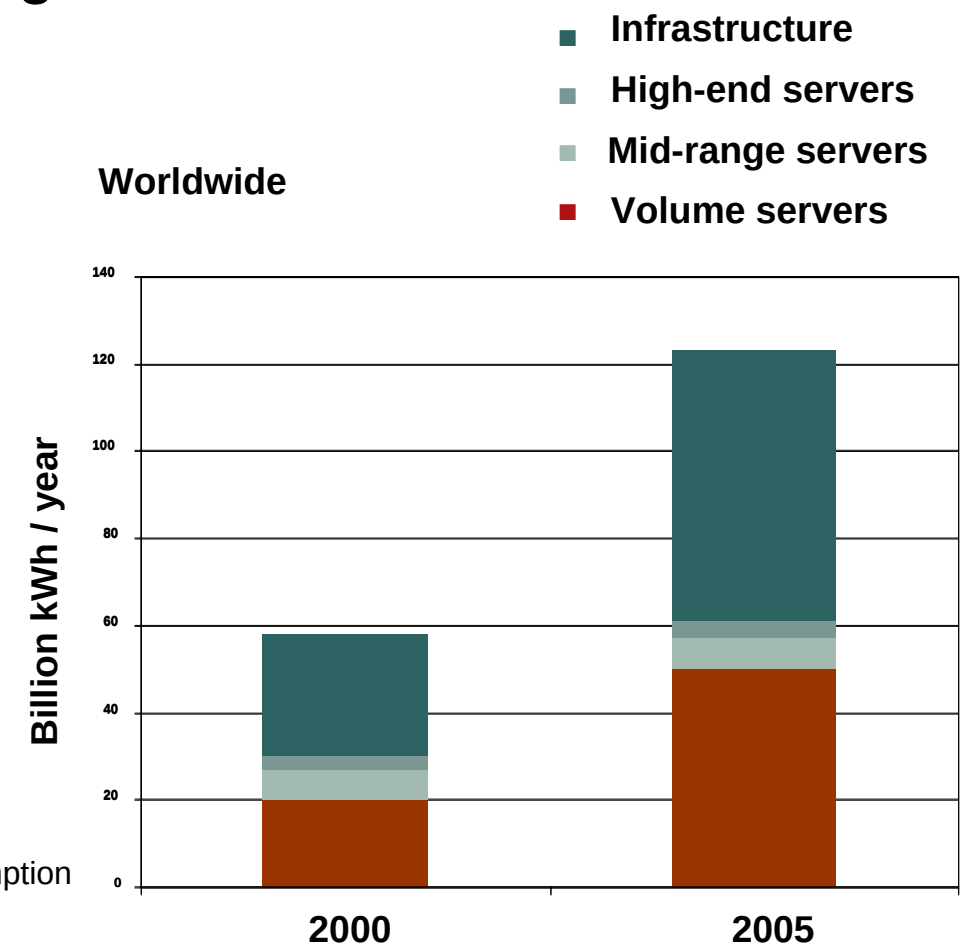



Source: Fraunhofer Institute UMSICHT, Sept. 2007

# Electricity consumption of servers including power and cooling infrastructure

- Data centers consume large amounts of electricity
- Power is already second largest cost factor of data centers
- In the focus:
  - Volume servers
  - Infrastructure



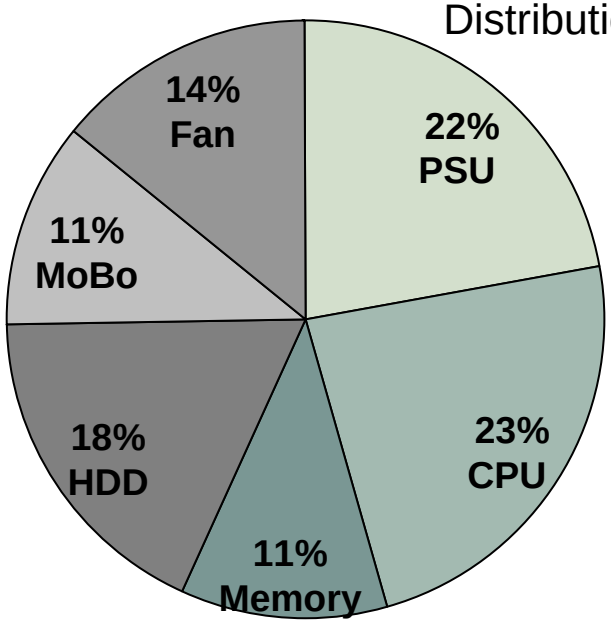

Jonathan G. Koomey: Estimating total power consumption by servers in the U.S. and in the world, Feb. 2007

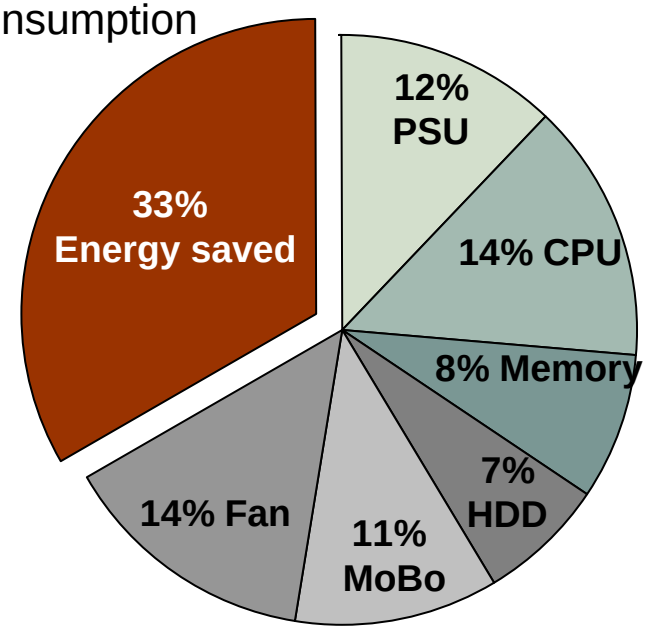
 

# Increase use of energy efficient components

## Power optimized server PRIMERGY RX300 S3

Distribution of power consumption




**Standard system:** (SPECint_rate_base 148)

E5335 CPU, 8x 1GB RAM, 6x HDD 3,5“ 15K

**Energy optimized system:** (SPECint_rate_base 148)

L5335 CPU, 4x 2GB RAM, 6x HDD 2,5“ 10K

**Using different components results in reduced energy and cooling costs.**

# Reduce energy consumption through efficient systems

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## TX120 - The most energy efficient server in the world

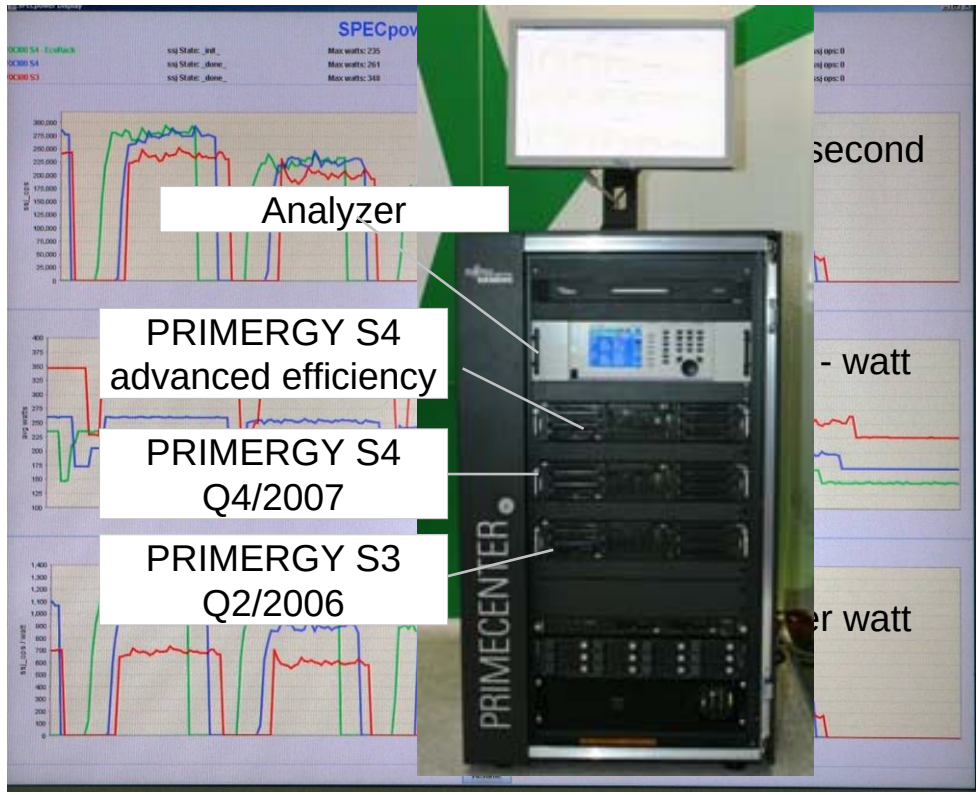
- Lowest energy consumption
  - 163 Watts active power fully equipped
  - Latest Dual-Core Intel® Xeon® UP processor 3070/3040
  - Hot-plug 2.5-inch SAS HDD
  - Further power reduction possible (Celeron® processor with 35W)
- Lowest noise
  - 28 decibels (dB) in idle mode
  - 31 decibels (dB) in operation
- Smallest footprint
  - Compact chassis: 99 x 340 x 399 mm (WxHxD)
  - Tower server
- A real server
  - Raid1 & hot-plug HDD, ECC memory, Server processor, Server Operating System, full Server Management

# New Server Technology reduces energy consumption

Comparison: PRIMERGY S3 versus -S4 versus -S4 AE (Advanced Efficiency)

- PRIMERGY leadership in new SPECpower efficiency benchmark
- Best ratings in mono socket benchmarks
- New quad-core generation will extend the lead
  - Low voltage processors
  - Low power memory modules
  - Optimized memory performance and power consumption by controlling memory refresh depending on memory chip temperature
  - Extended sleep states to save power under lower system load conditions



# Record SPECpower result
# Set in March 2008

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- PRIMERGY TX150 S6 – leads SPECpower efficiency benchmark today
- First server to achieve a 1000-plus rating in the SPECpower_ssj2008 tests
- TX150 S6 performed **1018** ssj_**ops/watt** while running the BEA JRockit(R) benchmark (build R27.5.0-110-94909-1.6.0_03-20080204-1558-windows-x86_64, in compiled mode)
- One-way server,
  - quad-core Intel Xeon X3360 processor,
  - using 4x 2GB DIMM memory modules,
  - a 500GB SATA hard drive running at 7200rpm,
  - and running Microsoft Windows Server 2003 Enterprise x64 Edition

 

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  - **Virtualization**
  - **Automation**
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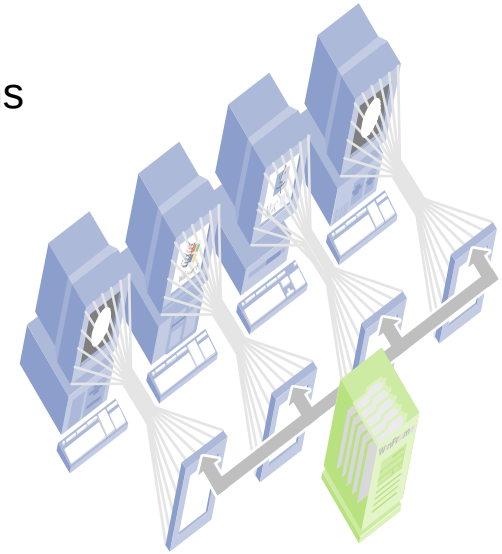
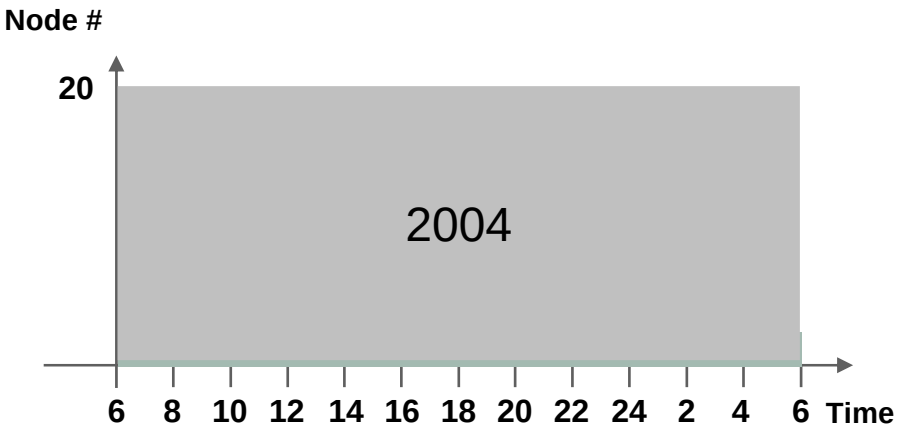
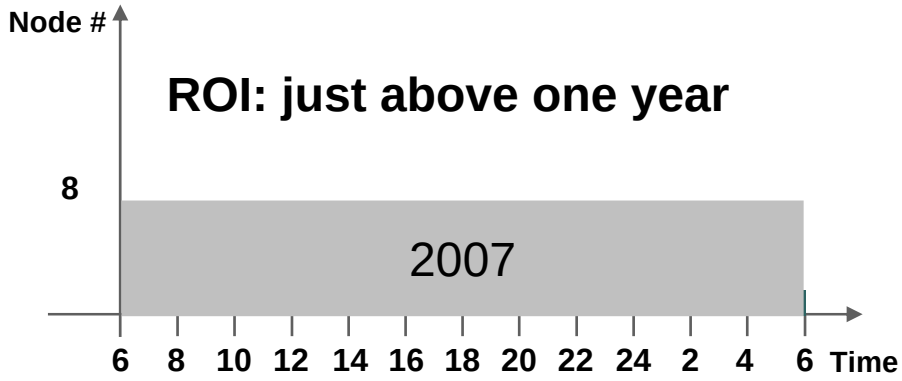
# Consolidation

- Terminal services provided by RX300 dual processor systems
- Tool for User Simulation benchmark users
  - PRIMERGY RX300 S2 (single core): 127 User
  - PRIMERGY RX300 S3 (quad core): 300 User
- Usage Scenario:
  - 2,500 Users Terminal Server
  - Either 20 FSC RX300 S2 or
  - 8 RX300 S3 (quad) servers needed to fulfill SLAs
- **Saves 60+ % of power consumption** to serve the existing number of users
  - Saving on energy cost, plus less service and less administration cost



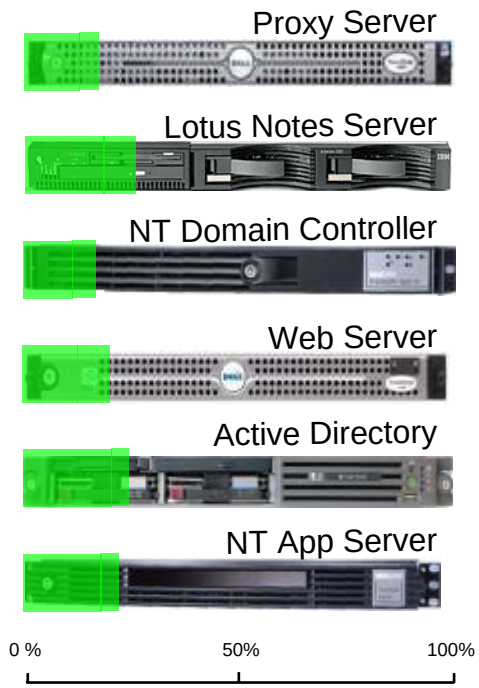


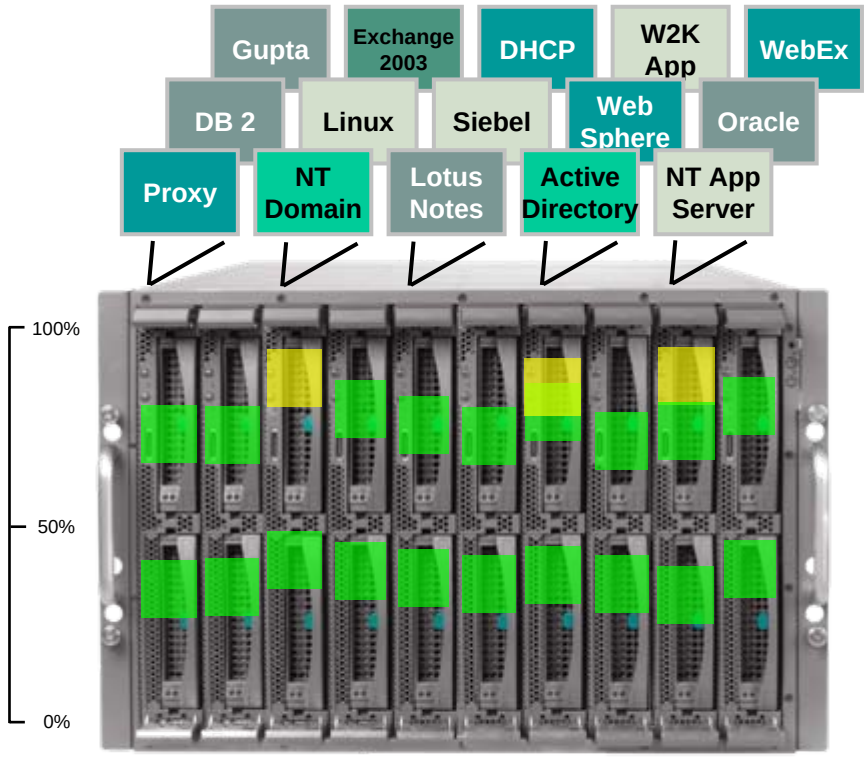



# Virtualization

## A Perfect Combination: Blades & Virtual Machines



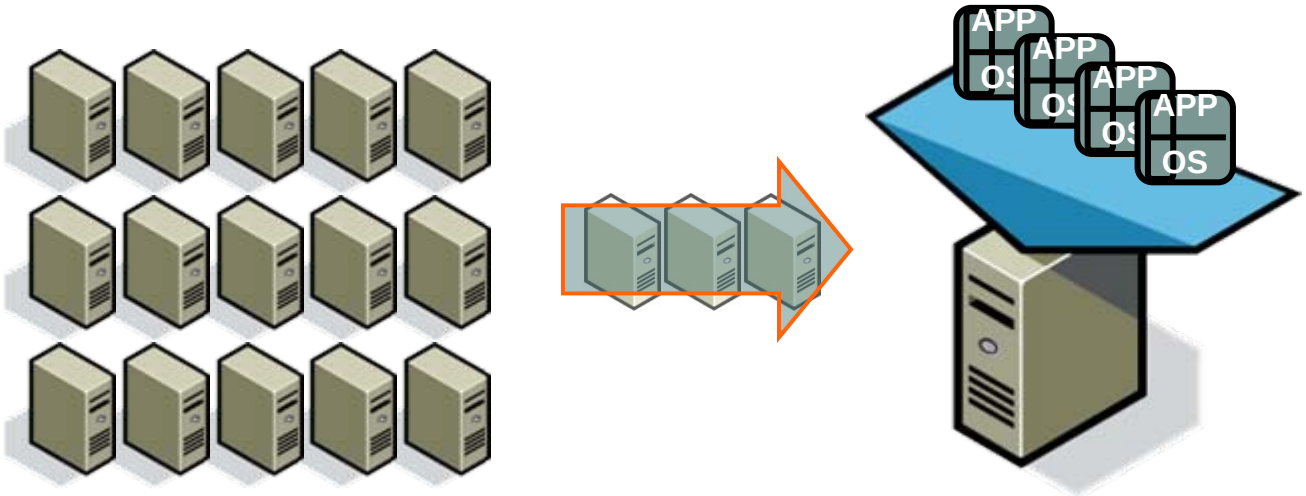



# Energy efficiency through virtualization

## Server consolidation with virtual machines

- less servers ==  less energy consumption




VMware Server

Oracle VM

Hyper-V

XenServer

# HypoVereinsbank opts for virtualization

*Consolidation through server virtualization yields significant improvement in terms of ecology, economy and quality. We expect to save 1.2 million kWh a year in electricity.*

Stefan Schmidt, Senior System Architect, HVB IS

**Challenge:** Server virtualization as strategic approach to reorganization of the data center

**Solution:** Server virtualization with PRIMERGY industry standard servers and VMware

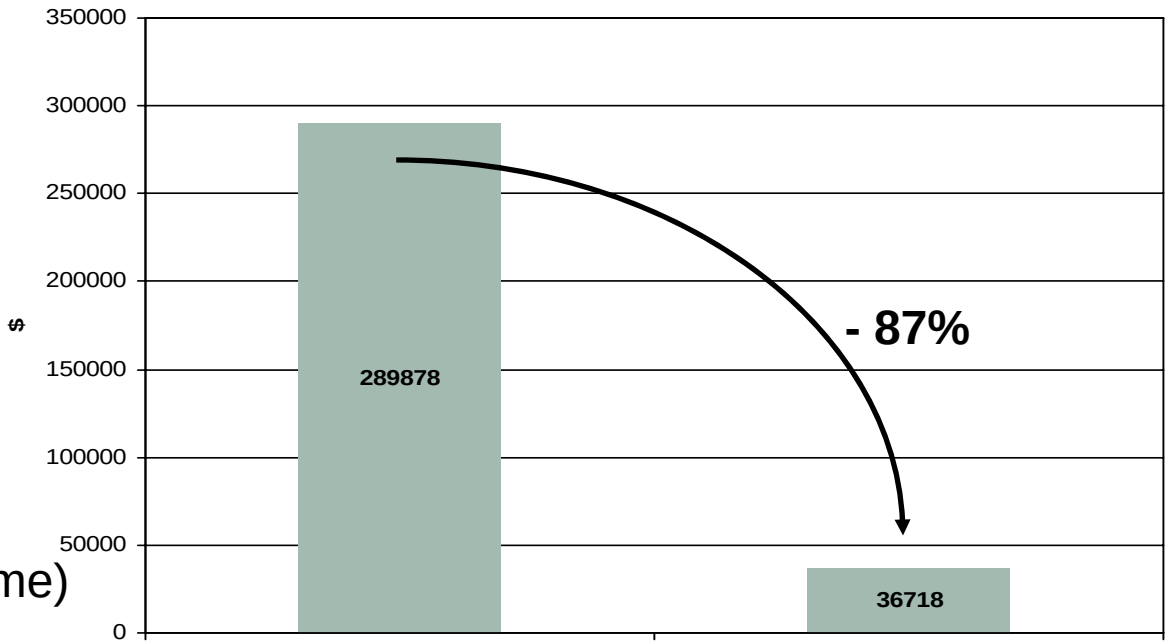
**Success:** Comprehensive consolidation as well as more economical and more flexible IT operation

HVB Information Services
Member of UniCredit Group

# Virtualization reduces Energy Consumption

- Virtualization technology increases system utilization
- More efficient use of the electricity supplied
- Combination of software-based and hardware-supported virtualization concepts available (e.g. PRIMERGY BladeFrame)

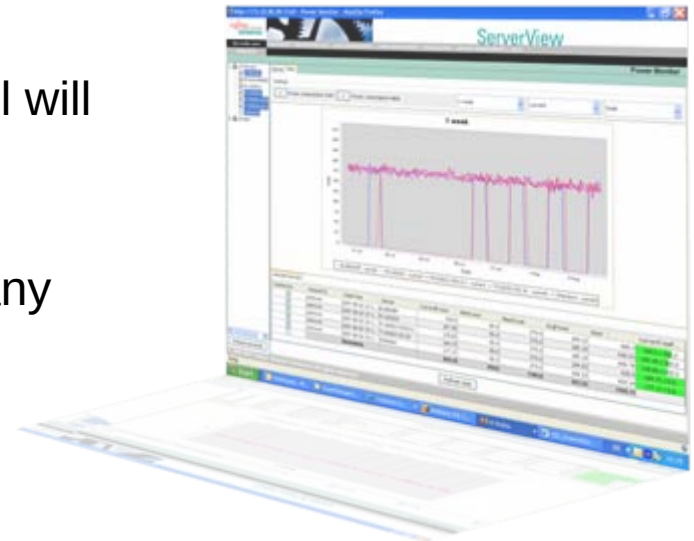



**Yearly energy savings potential due to server virtualization with VMware for a consolidation of 12.5:1**

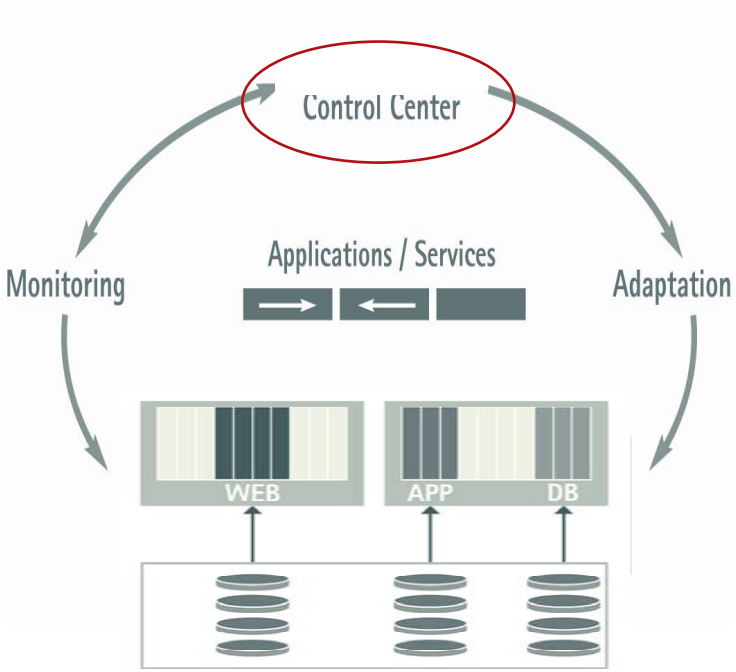
# Automation

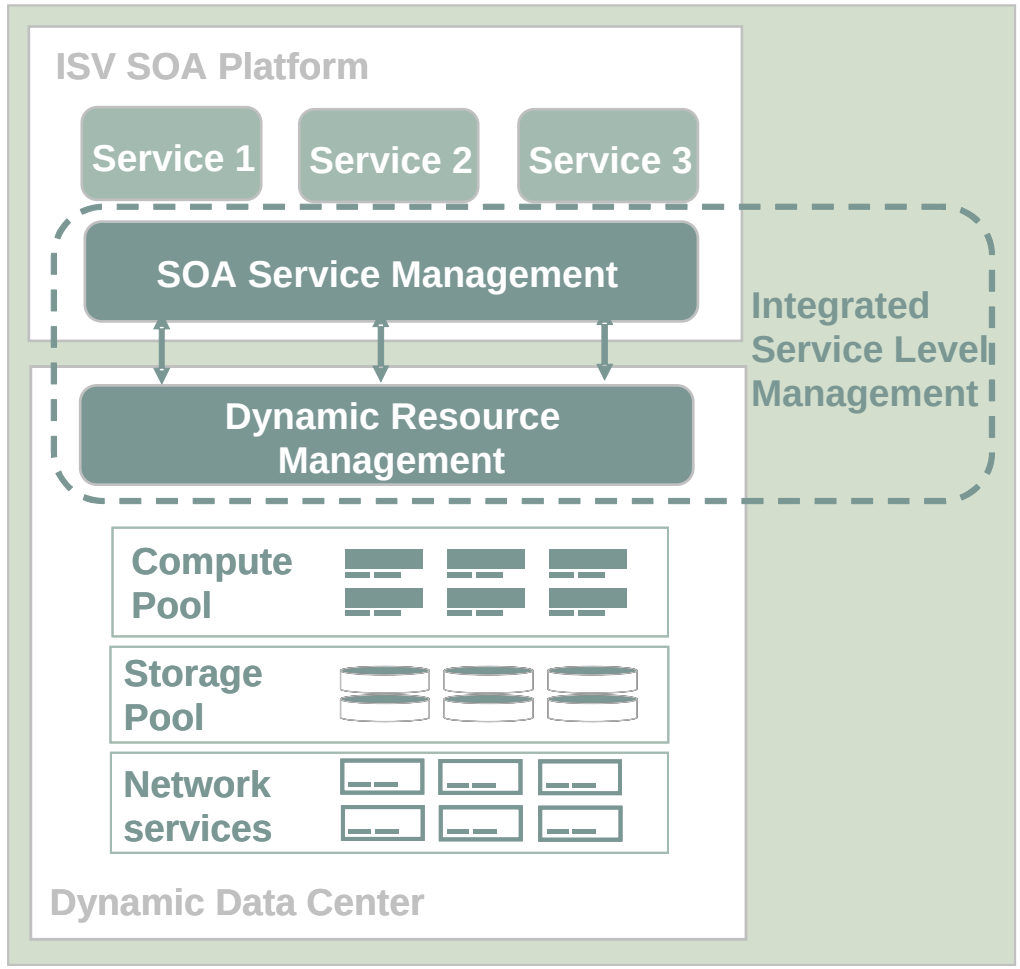
- Idling servers consume almost as much electricity (and require cooling, too)
- **ServerView Power Control** monitors the status of servers and displays it within the ServerView GUI
- If an event occurs, ServerView Power Control will power up / off a particular server or group of servers
- Events could be a specific time or date – or any event sent by a script or process
- Power consumption control
  - Best performance
  - Lowest power
- Through consolidation and automation up to 75% of power consumption is saved to serve existing number of users



# Service-oriented Infrastructure – energy efficient consumption



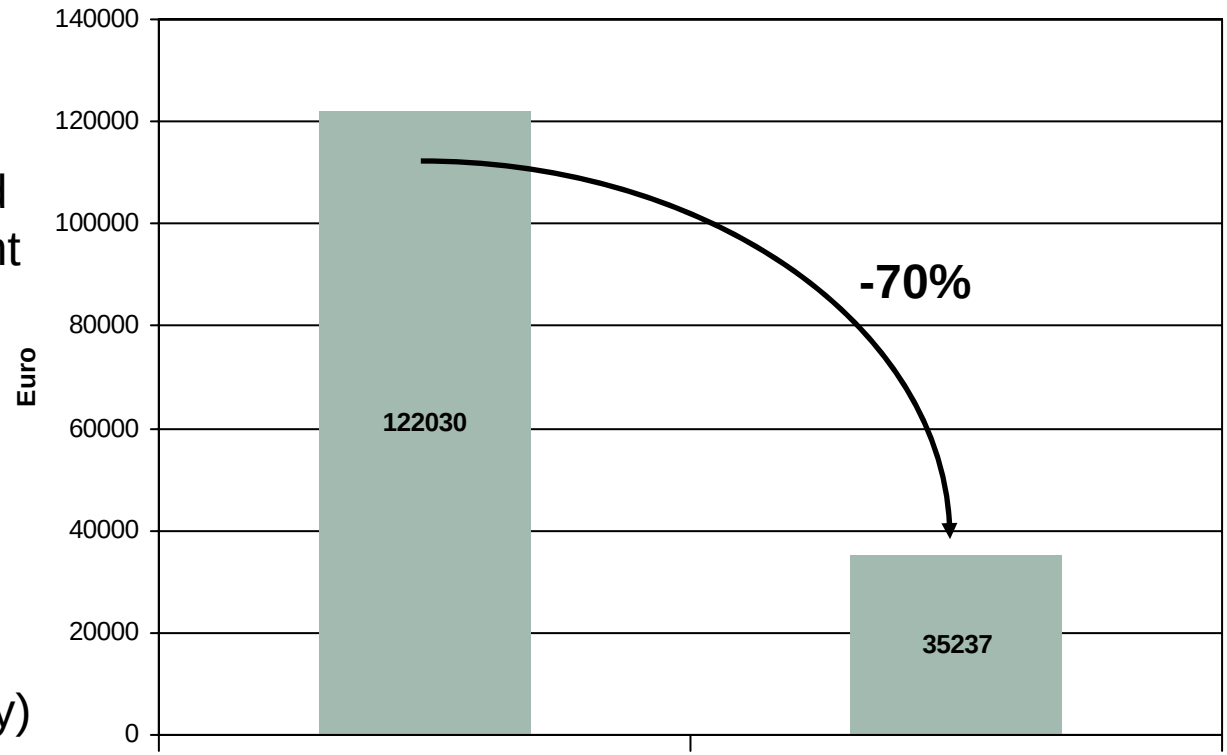

 

# Flexible Energy Consumption through Dynamic IT Solutions

(e.g. FlexFrame for Oracle)

- All Oracle services are managed by the Control Center
- Servers are only switched on / off due to requirement to avoid energy waste (e.g. idle mode)
- Energy efficient N:1 redundancy concept
- Shared storage systems (higher disk utilization supports energy efficiency)

Energy cost savings "**FlexFrame for Oracle**"
(concrete customer scenario)




**A service oriented infrastructure significantly reduces energy consumption**

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  - **Information Lifecycle Management**
- Boost Energy Efficiency in Cooling Infrastructures
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# Optimize Data Management

## Information Lifecycle Management (ILM)

- Mapping information to storage resources appropriate for its value
  - Mission critical data should be stored on the high performance and secure SAS disks
  - None critical data can be stored on the cheap and power efficient SATA disks
  - Other technologies: MAID, hybrid disk, SSD
  - Tape is the most energy and cost efficient way to store data

Systems

- FibreCAT SX - supports power-efficient SATA drives and uses long-lasting capacitor instead of batteries
- CentricStor – Virtual Tape Library
  - Dual target approach (disk and/or tape within one system)
  - Managed tape storage needs less power than comparable disk solutions

 

# Tape consumes less energy than disk

| | Disk storage system (15 disk controllers, 105 expansion units, SATA disks, 9 racks) | Tape library (1 LTO tape library, 4 LTO 3 FC tape drives, 683 LTO 3 cartridges) |
|---|---|---|
| Capacity | 672 TB | 672 TB |
| List price | 1.250.059 € | 193.464 € |
| Floor space | 65,3 square feet | 10,4 square feet |
| Energy costs | 81.334 € | 3.140 € |

SATA disk systems have nearly 26 times higher energy costs than tape systems

SATA disk system acquisition cost are about 6.5 times the cost of tape systems

The cost to power and cooling equipment must be part of the TCO

**CentricStor makes tape fit for ILM and allows dramatic energy savings**

 

# Virtual Tape Library CentricStor ILM[1)] with disk and tape

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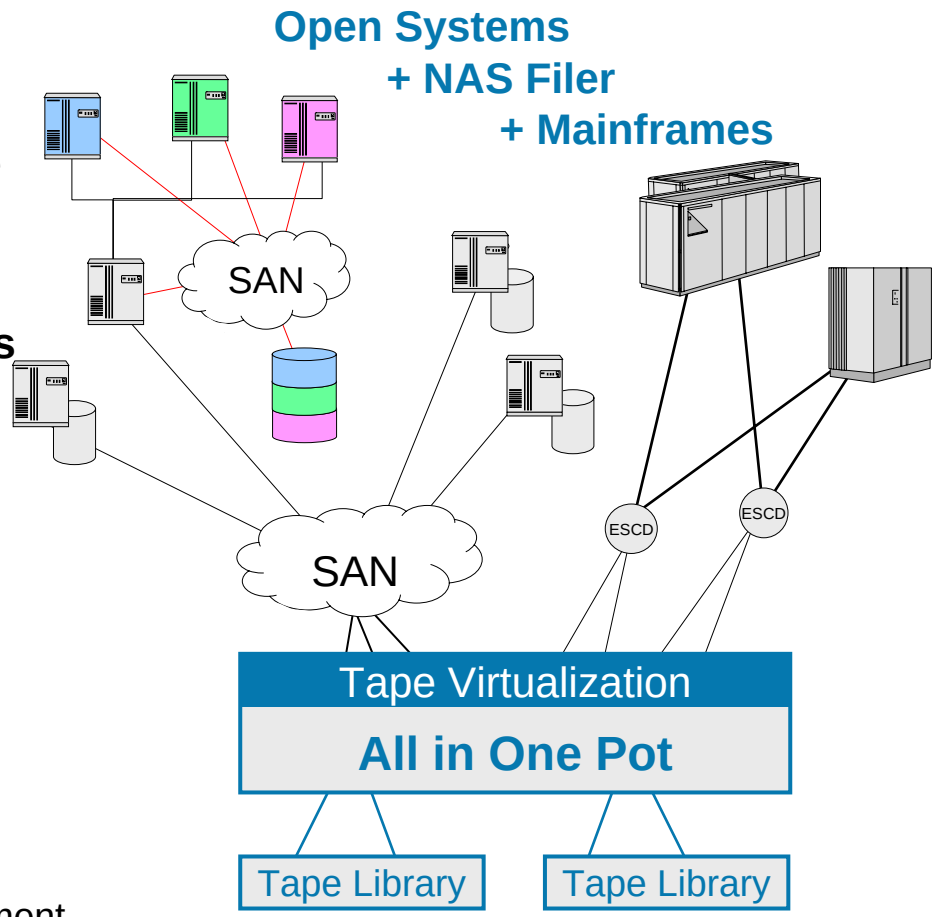
The most advanced integration of tape

- Consider different values of data
- Optional choose of tape and/or disk
- Always use of the most effective storage media
- **Managed tape storage needs less power than comparable disk solutions**




Consolidation reduces

- Total cost of backup storage
- Footprint for backup and archiving
- Power consumption
- Data center clime

[1)] ILM = Information Lifecycle Management

# New technology saves energy

|  | FibreCAT S80  | FibreCAT SX80 (SATA)  | FibreCAT SX80 (SAS)  |
|---|---|---|---|
| Announced | 01.3.2002 | 01.02.2006 | 01.02.2006 |
| Capacity | 4,1 TB*<br>56 FC disk (73 GB) | 4,5 TB**<br>6 SATA disks (750 GB) | 4,2 TB**<br>14 SAS disks (300 GB) |
| Power consumption | 3.257 W | 295 W | 666 W |
| Watt / TB | **795** | **65,56** | **158,57** |
| Energy costs / year | **2.853,13 €** | **258,42 €** | **583,42 €** |

Save real money by using state of the art storage technology

* max capacity **capacity to compare, max capacity 42TB(SATA)/16,8TB(SAS)

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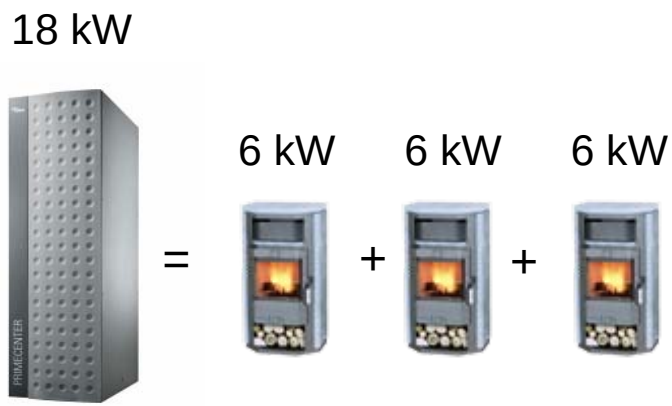
# Power consumption and thermal challenges

- Total number of servers installed increased by factor 100 in one decade
- Number of servers/processors per rack increased by factor 10 in ten years
- Power and thermal waste per server increased by factor 5 in ten years
- Typical infrastructure can cope with
  - 1 kW per rack in 2000
  - 4.5 kW per rack in 2005
  - 8 kW per rack today,
  - up to 20 kW in future

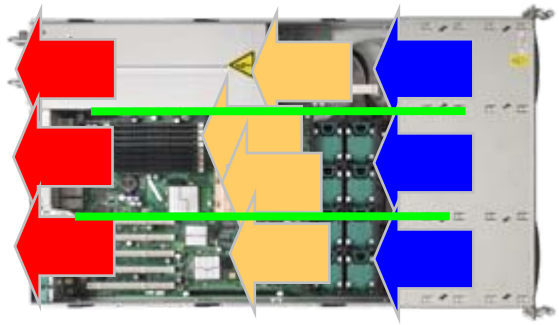


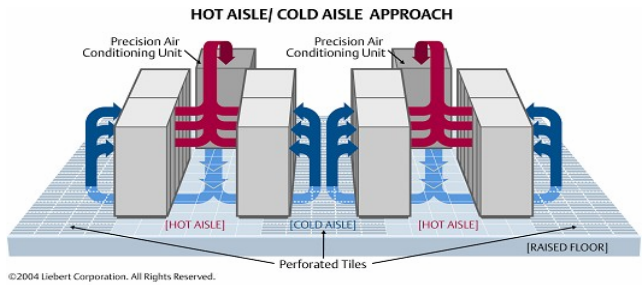

Electricity supply and thermal waste are driving cost when building a DC

# Energy efficient cooling

- The flexible and future-proven Cool-safe™ System design
  - Separate air tunnels
  - Automatic controlled large fans
- PRIMECENTER Liquid Cooling Rack – reliable and energy-efficient water-cooled rack solution for highest cooling requirements
- Optimize cooling infrastructure
  - Careful management of the air flow in racks and in the data center
  - Constant matching of the cooling system of current operating needs
  - Use of low-loss UPS systems





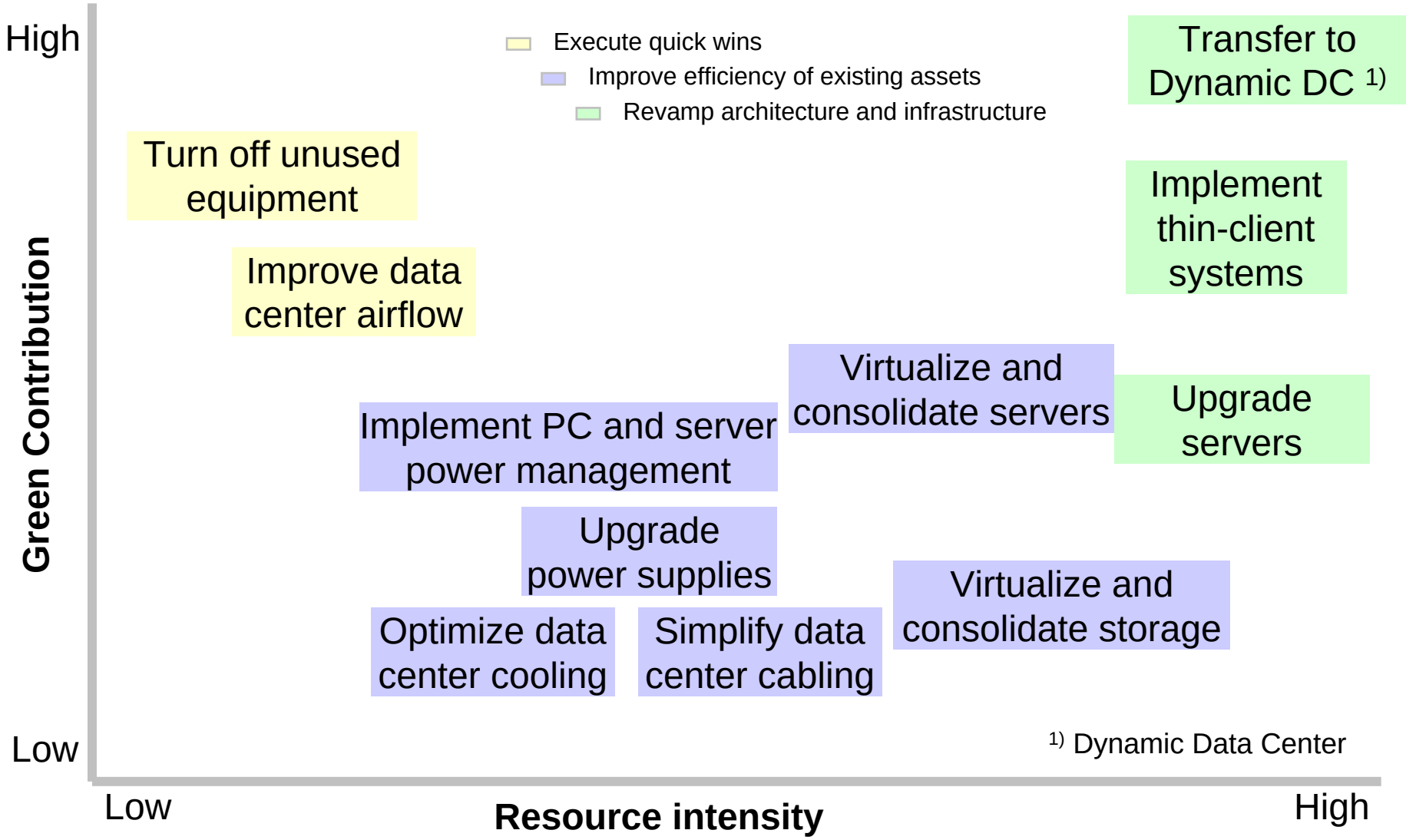
# Services for Green IT

## Data Center assessment

- Analysis of the physical infrastructure in the data center
  - Survey of packaging density, physical room architecture, energy consumptions, air conditioning etc.
- Energy efficiency reports and models
  - Proposals for immediate measures to solve acute problems
  - Analysis of weak points with long-term action recommendations
  - Return on Invest Analysis
- Design & build of data centers infrastructure based on Green IT aspects and policies

# Cost / Benefit of Green IT Activities



# “Greener Computing”

- Energy efficient IT systems
- Energy efficient IT solutions
- Energy efficient IT infrastructures

**For a better business**
**For a better planet**