Green Computing

the next wave in computing

Jordi Torres, February 2010

Facultat d'Informàtica de Barcelona: Aules Empresa FIB 2010

UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

This material is composed of a set of slides presented in the *Aules Empresa 2010* (February 2010) at the *Facultat d'Informàtica de Barcelona* (FIB).

The broad objective of these slides is to give an overview of Green Computing to the students. It is impossible to provide an in-depth treatment of the topic in this talk. However more information can be obtained from the courses of master CANS at UPC (http://docencia.ac.upc.edu/master//es/course.24.html).

We present information obtained or inspired from several courses devoted to these topics in other universities around the world or articles from well known people in the area. We will indicate the source of the information in the slides. We are especially thankful to all the authors. We also thank the information about Marenostrum Supercomputer provided by the Operations department at BSC. Furthermore, we would like to thank the research group "Autonomic Systems and eBusiness Platforms" at BSC and UPC for their hard work on many interesting projects in this field that gave us some of the input for this material.

Finally I want to thank the engineers Sergi Morales (www.ExpertosEnTI.com), Daniel Urgell (CISCO) and Oriol Farré (HP) for their review on this material and suggest important improvements in this last version.

References on these slides: *"Green Computing: the next wave in computing", Jordi Torres. Ed. UPCommons. Technical University of Catalonia (UPC). February 2010. http://hdl.handle.net/2099.3/33669*

You can download these slides at:

http://www.frombarcelona.org/JordiTorresHomePage/2010/01/28/conference-green-computing-the-next-wave-in-computing
(or *http://hdl.handle.net/2099.3/33669*)

Impact of the computing on to the environment:

Foto: J.T.

ICT industry, which includes the Internet, produces roughly 2 to 3 percent of global GHG emissions.

Source: Climate Group's Smart2020 report (www.smart2020.org)"

Impact of the computing on to the environment:

- **Same as aviation**
- **2-3% ICT emissions (aprox.):**
  - 35% Telco infrastructures
  - 65% Data Centers and terminals
- **ICT Carbon emissions are increasing faster than other carbon emissions.**

WHY?

Images courtesy of BSC

Source: SMART 2020 Report, http://www.theclimategroup.org

Content

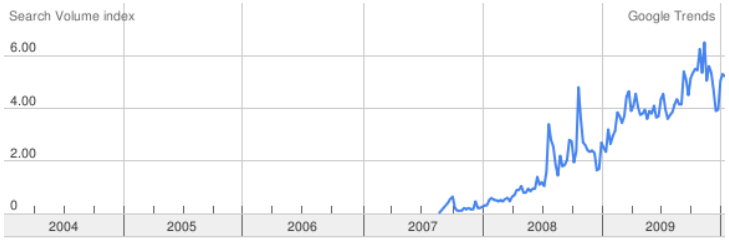
1. **Current computation trend:**
   Green IT pushes adoption of Cloud-based systems
2. **Green Computing:**
   The growing interdependence of the ICT and the greenhouse gases
3. **The challenge of sustainable growth:**
   ICT reduces emissions of other activites

Cloud-Based Systems

- **Green IT Pushes Adoption of Cloud-Based Systems**
  - As Data Centers grow with new servers, storage, switches, memory and I/O capabilities, they will be forced to take a closer look at energy use.
- **Cloud Computing?**
  - Our data?
    - In the cloud
  - Our applications?
    - In the cloud!
  - High availability!
  - From where you want!
  - With whatever you want!
  - Almost unlimited capacity!

What cloud computing means

- **It became a buzzword even before it was defined!**
- **It is a recent (and evolving) concept**



http://www.google.es/trends

- **Is is yet another buzzword or a real change of paradigm?**

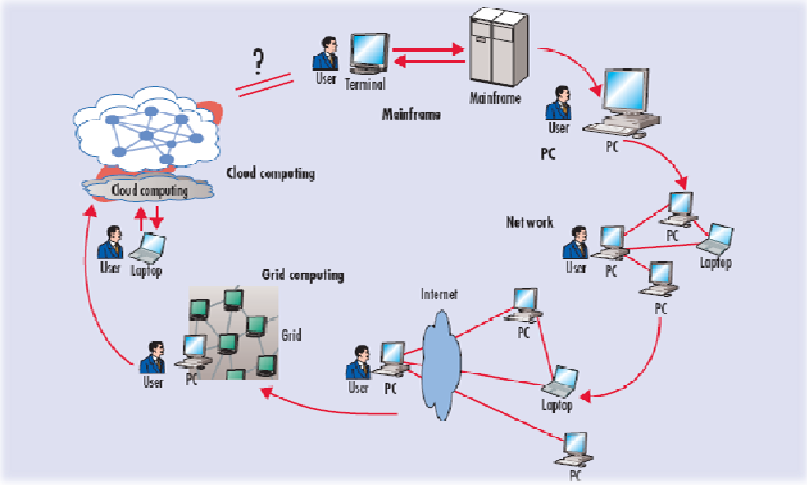
What cloud computing means

- **No consensus in the definition yet**
- **Cloud computing is a new and rapidly growing model of computing**
  - according to the U.S. National Institute of Standards and Technology:

    "is a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction."

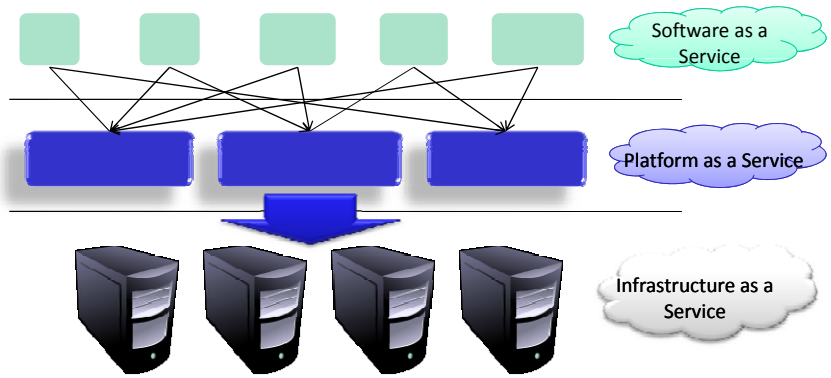
Foto: J.T.

Cloud Computing: New Wine or Just a New Bottle?



Source: Jeffrey Voas, Jia Zhang, "Cloud Computing: New Wine or Just a New Bottle?," IT Professional, vol. 11, no. 2, pp. 15-17, March/April, 2009.

Cloud Computing: Layers of Abstraction



Source: http://www.slideshare.net/Cumulux/what-is-cloud-computing-presentation?nocache=4789

Cloud Computing: Services

- **Cloud computing services can be classified as:**
  - **Infrastructure as a Service (IaaS)**

    It is at the lowest layer, and it is a wayof delivering basic storage and compute capabilities as standardized services over the network.

  - **Platform as a Service (PaaS)**

    It is in the middle, consisting of higher-layer capabilities that developers can knit into applications.

  - **Software as a Service (SaaS)**

    It is at the highest layer and features a complete application offered as a service, on-demand, via multi-tenancy.

Infrastructure as a Service (IaaS)

- **IaaS providers**
  - make it affordable to provide resources such as servers and storage.
  - provide tools to monitor and manage resource usage.
- **Benefit of IaaS is rapid provisioning**
  - You can have a new server up and running in minutes.
- **Example: Amazon**
  - Two core services provide Simple Storage Services (S3) and Elastic Compute Cloud (EC2).

Platform as a Service (PaaS)

- **PaaS providers**
  - make it easy for application developers to build and deploy their applications.
  - PaaS cloud tries to hide the complexity of underlying IaaS cloud from developers.
- **Benefit of PaaS platform is that you can get started with cloud application development with very small capital investment**
- **Example: Google App Engine, AZURE**

Software as a Server (SaaS)

- **SaaS providers**
  - Make their application hosted as a service provider to their customers on Internet.
- **Benefit**
  - The biggest advantage of SaaS is that it alleviates the customer's burden of software installation and maintenance. Also, no additional hardware needs to be procured.
- **Examples include Salesforce.com and the iTunes store.**

Outsourcing to the cloud

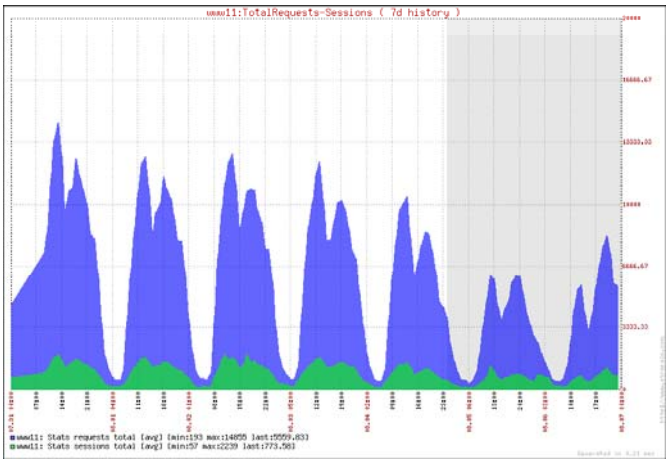
- **Cloud computing offers the economies of scale of the utility model**
  - Most organizations don't build their own power generators and water treatment plants
  - So why should every IT organization need to acquire and maintain all of the hardware, software, and development resources it uses?
- **Is IT a commodity?**
  - Some people believe so (e.g. Carr's "IT doesn't matter")
- **Why not move everything to the cloud?**
  - But attention! → *we will discus it later*

New concept: Utility Computing

- **Cloud Computing offers a new alternative for computation and storage**
- **Large organization builds a large infrastructure and then rents out computation**
- **Think of computing as a metered service, just like electric power, natural gas, or water**
  - You rent computational/storage capability, based on your application needs
  - No infrastructure costs
  - Very small initial delays
  - …

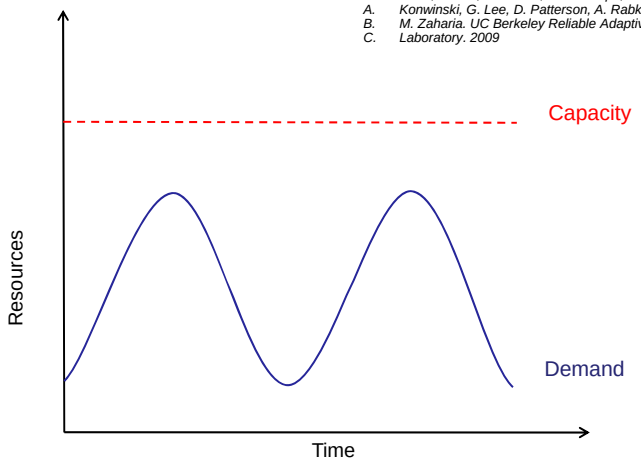
Utility (on-demand) computing Example

- **Website weekendly workload**

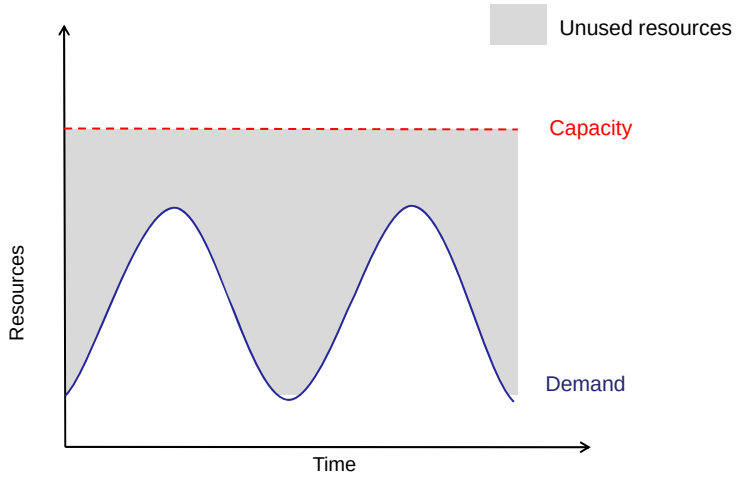


Utility (on-demand) computing Example

Source: Above the Clouds: A Berkeley View of Cloud Computing. M. Ambrust, A. Fox, R. Griffith, A.D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stooica, B. M. Zaharia. UC Berkeley Reliable Adaptive Distributed Systems C. Laboratory. 2009

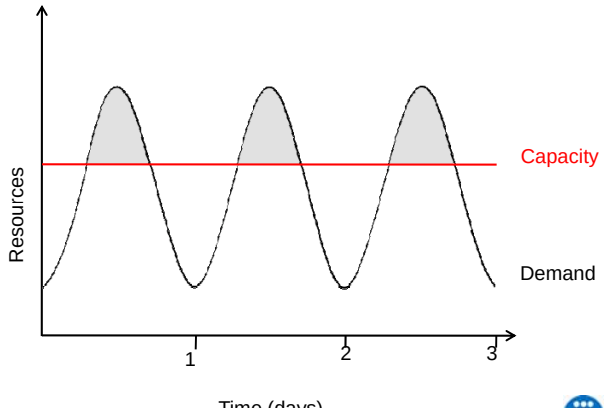


Utility (on-demand) computing Example



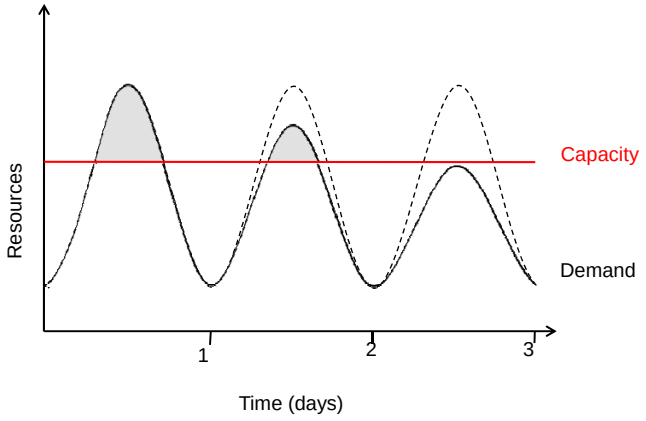
Utility (on-demand) computing Example

- **Underestimation is even worse, user dissatisfaction is difficult to measure.**



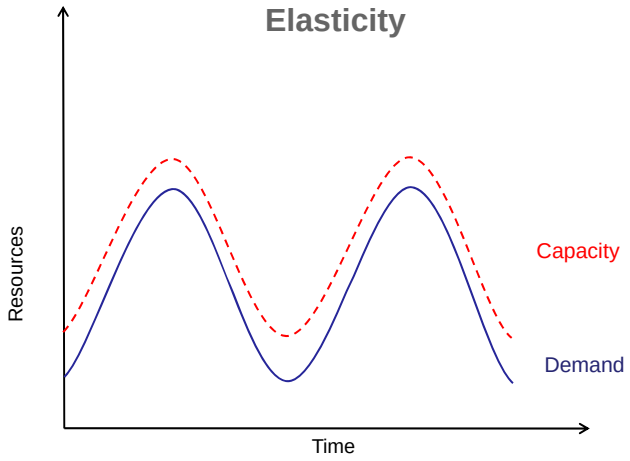
Utility (on-demand) computing Example

- **Clients are lost**



Utility (on-demand) computing Example

Elasticity



Cloud Computing is here!

The industrialization of ICTs is unstoppable,

mega datacenters,

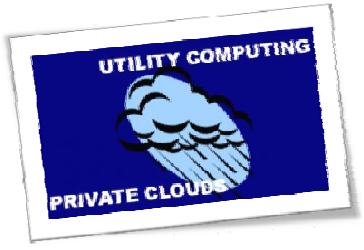
which will compete only on the price of energy,

as hardware is becoming cheaper all the time

Image courtesy of UPC

Cloud Risks

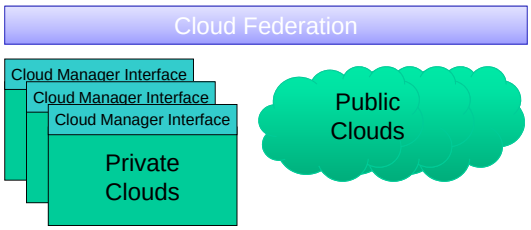
- **Some questions:**
  - How the data is protected and backed-up
  - The policies and procedures the company follows to ensure the integrity and security of your data
  - How long the service is guaranteed to be available
  - How stable is the service the company is running.
  - …



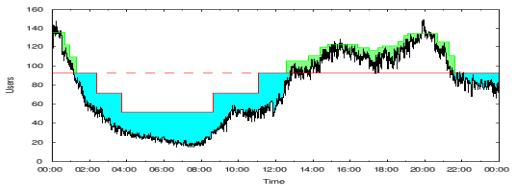
Source: http://ittrainingtips.iu.edu/getting-started/computing-in-the-cloud-risks-and-rewards/10/2009

Alternative: Private Cloud

- **Federated internal and external Cloud**



- **Providers could outsource and insource resources within a federated Cloud**



Content

1. **Current computation trend:**
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2. **Green Computing:**
   The growing interdependence of the ICT and the greenhouse gases

3. **The challenge of sustainable growth:**
   ICT reduces emissions of other activites

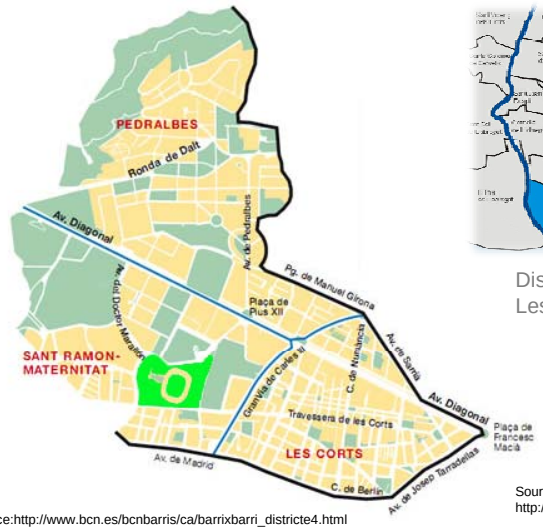
Behind the Cloud?

Source: *Tech Titans Building Boom By Randy H. Katz. IEEE Spectrum, February 2009*

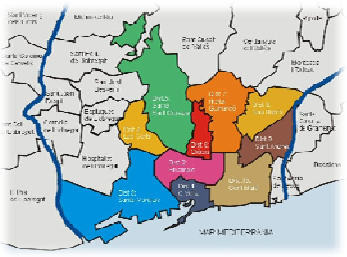
Does anyone know what this means?

foto: Google

Does anyone know what this means?



Source:http://www.bcn.es/bcnbarris/ca/barrixbarri_districte4.html



Districts of Barcelona,
Les Corts coloured yellow.

Source:
http://en.wikipedia.org/wiki/Les_Corts,_Barcelona

Does anyone know what this means?

Facebook Expanding its Data Centers. Again

March 30th, 2009 : Rich Miller

Facebook has recently signed leases for additional data center space as it expands its infrastructure to support the social network's phenomenal growth. Facebook, which has just surpassed 200 million users, is also reportedly seeking up to $100 million for additional servers.

The company may be spending as much as $1 million a month on electricity to power its servers and data center space.

Source: www.datacenterknowledge.com

Does anyone know what this means?

Facebook says the 147,000 square foot Prineville data center will be designed to LEED Gold standards and is expected to have a Power Usage Effectiveness (PUE) rating of 1.15.

January 21st, 2010 : Rich Miller

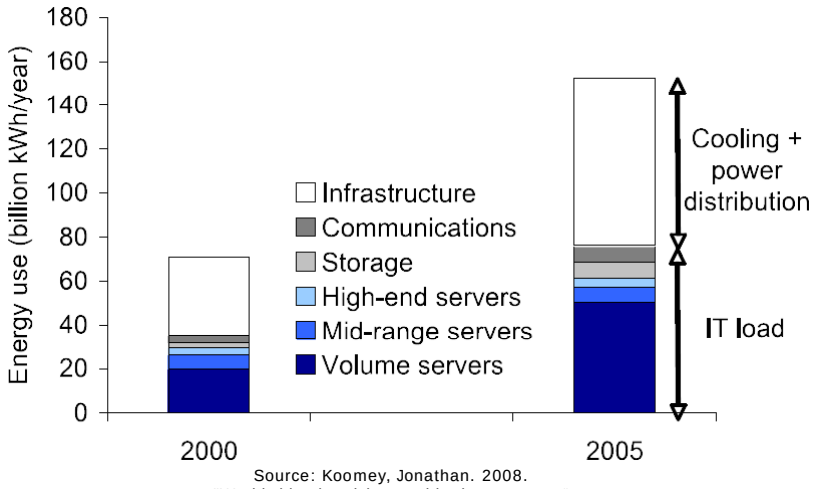
"Now with more than 350 million people worldwide

DATA CENTER KNOWLEDGE

An architectural rendering of the new Facebook data center planned for Prineville, Oregon.

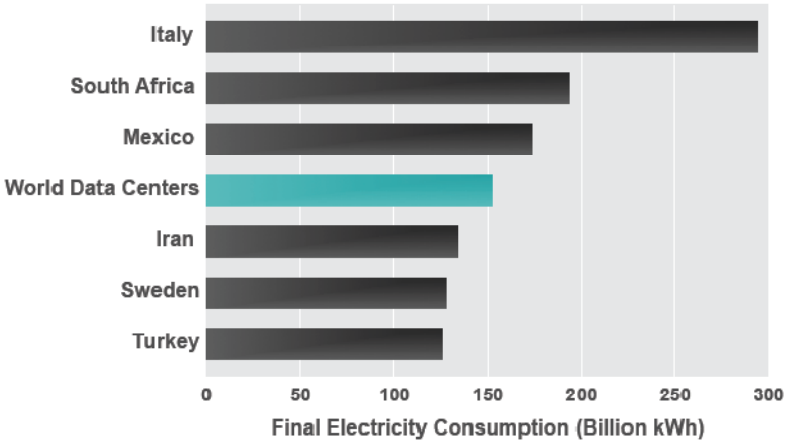
Facebook's first company-built data center will be in **Prineville, Oregon**, the company confirmed today. The new facility will be among the most energy efficient in the industry,

World data centers electricity use



Source: Koomey, Jonathan. 2008. "Worldwide electricity used in data centers." Environmental Research Letters. vol. 3, no. 034008.

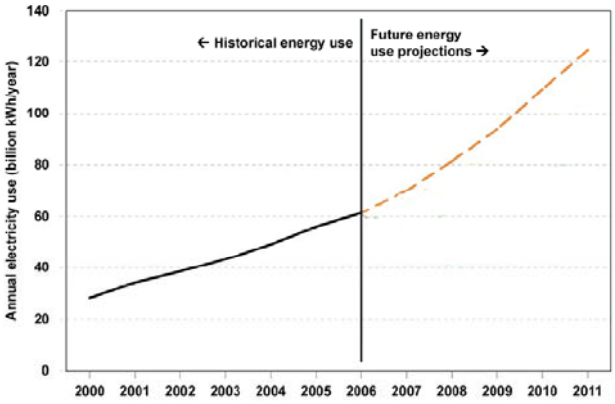
How much is 152B kWh?



Source for country data in 2005:
International Energy Agency, World Energy.
Balances (2007 edition) (Koomey, Jonathan)

Energy collapse?

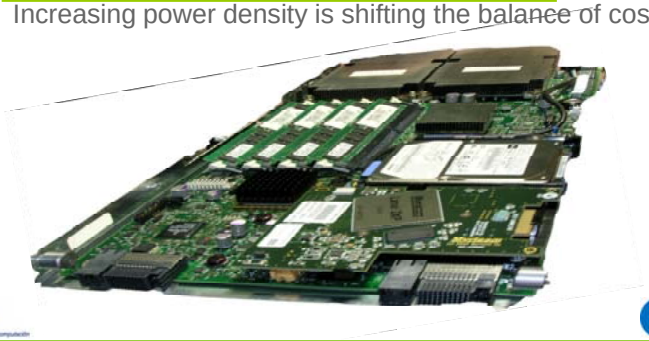
- **The risk of availability is becoming an increasing concern.**



Source:U.S. Environmental Protection Agency report to Congress 2007

Motivation for being green

- **Data Centers are growing, with more servers, storage, switches, memory and I/O capabilities:**
  enterprises will be forced to take a closer look at energy use.
- **And:**
  Energy cost will exceed hardware cost soon
  Increasing power density is shifting the balance of cost

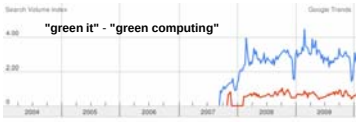


Solution: Green Computing

- **Green computing (Green IT)**
  This term generally relates to the use of computing resources efficiently in conjunction with minimizing environmental impact (eWaste).

  Common green initiatives include also the use of e-documents, reducing travel and teleworking.

  IT can also provide the tools that others areas may use to reduce energy consumption.



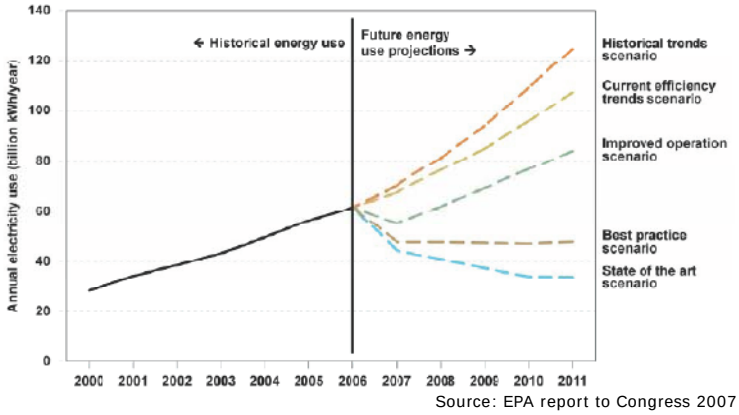
http://www.google.es/trends

Advantages of Cloud Computing

- **The focus on green IT will stimulate the adoption of new technologies such as cloud computing,**
  - which is both driven and defined by concepts like automated processes, elasticity, scalability, …
- **Cloud computing suppliers have at least two inherent advantages on power and costs over "in-house" IT**
  1) Diversity
  2) Economies of scale

Reduce DC energy use is possible

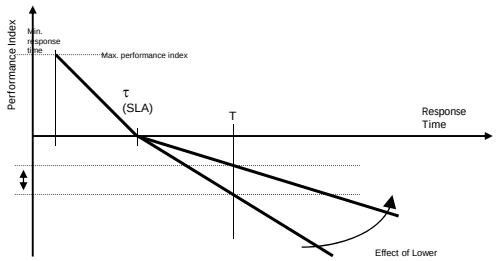
- **In spite of our historical progress, there's still great potential for improving the energy efficiency of data centers**



Source: EPA report to Congress 2007

Solution to the Challenge

- **Research and Innovation**

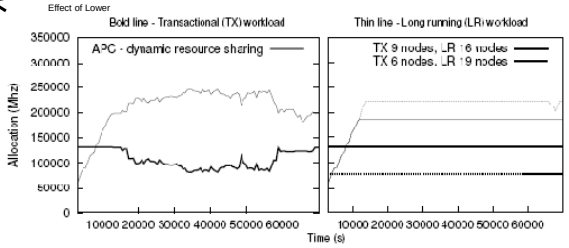


$$\omega_m(u) = \frac{\alpha^{cp}_{N_m,m}}{t_m(u) - t_{\text{now}}}$$

$$W_{i,m} = \begin{cases} \omega_m(u_i) & \text{if } u_i < u_m^{\max} \\ \omega_m(u_m^{\max}) & \text{otherwise} \end{cases}$$

$$V_{i,m} = \begin{cases} u_i & \text{if } u_i < u_m^{\max} \\ u_m^{\max} & \text{otherwise} \end{cases}$$

$$\sum_m W_{k,m} \leq \omega_g \leq \sum_m W_{k+1,m}$$



GreenIT conferences

www.greenIT-conferences.org

Green Computing Research Challenges

- **Transform ICT energy efficiency into a more formal and scientific endeavor, establishing a holistic theoretical model to a better understanding.**

- **Suggested Approach**
  - Try and see out of the ICT world in itself and think globally
  - Identify global metrics
  - To build abstract and strong models
  - Create more powerful formal optimization techniques
  - A new Autonomic Computing cores are required
  - Encourage integrative efforts between different research areas

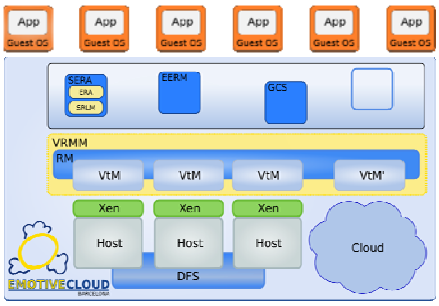
Green Computing Research Challenges

- **The Challenge proposed can be addressed at all levels of ICT systems design such as:**
  - System architecture.
  - Algorithm design.
  - Runtime and Compiler.
  - Middleware design.
  - Operating System design.
  - Hardware design.
  - Network design.
  - Storage.
  - Data Centers.
  - …
- **And also out of the ICT area such as it is the supply of energy or business models of the ICT infrastructures.**

Research in Barcelona

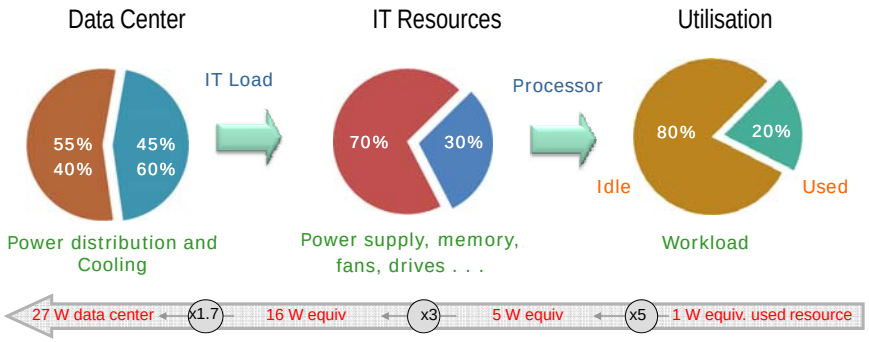
- **Creating Power-Aware Middleware for Energy-Efficient Data Centres**
  - **Self-managed** middleware should be able to manage resources transparently and cost-effectively,

    while **hiding the underlying complexity** from users.
  - **wwww.bsc.es/autonomic**



Energy spent in a DC

- **How is the energy spent in a Data Center?**



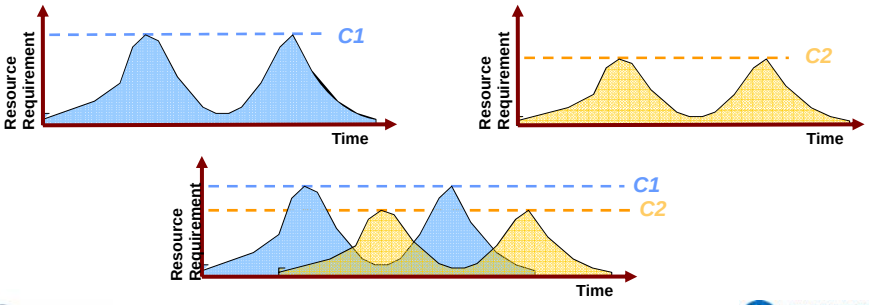
Idea: IBM and Dynamic Infrastructure, Doug Neilson, IBM Systems Group, 2009

Underutilization

- **"One application – one server" paradigm:**
  - **Server sprawl**: Because of application compatibility issues, IT has to separate applications by running them in different silos and on different servers.
  - **Servers are underused**: Typically, server workloads consume only around 10 to 20 percent of total physical server capacity, wasting resources.

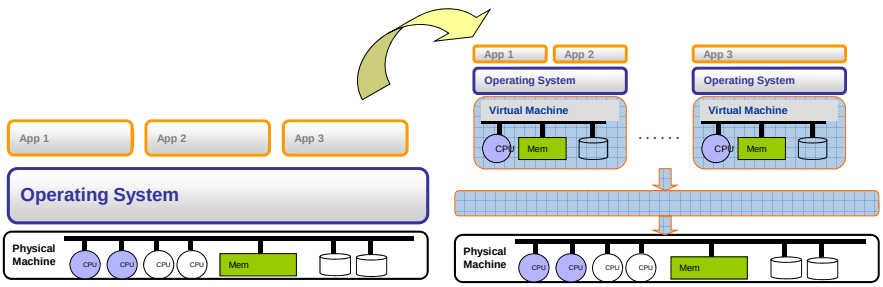
Consolidation

- **Server consolidation**
  - Implies combining workloads from separate machines or applications into a smaller number of systems or applications.
- **Consolidate into a single machine with capacity C12<C1+C2**
  - Resource multiplexing if different peak times



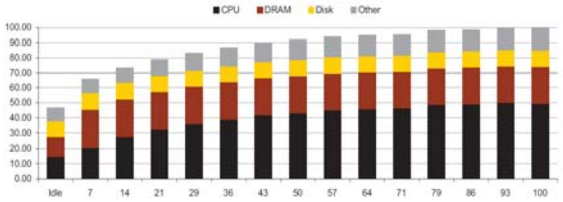
Virtualization

- **After consolidation we have the problem of how to share the resources:**
  - Virtualization software divides a physical server into isolated virtual environments, enabling organizations to run multiple applications or OS on a single server.
- **Server or hardware virtualization**



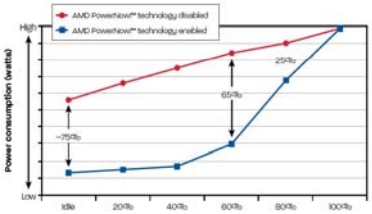
Power Usage

- Subsystem power usage varies from idle to full usage:



Font: Luiz Andre Barroso, Urs Hoelzle, "The Datacenter as a Computer: An Introduction to the Design of Warehouse-Scale Machines", 2009.

- Processors – Power stepping CPUs



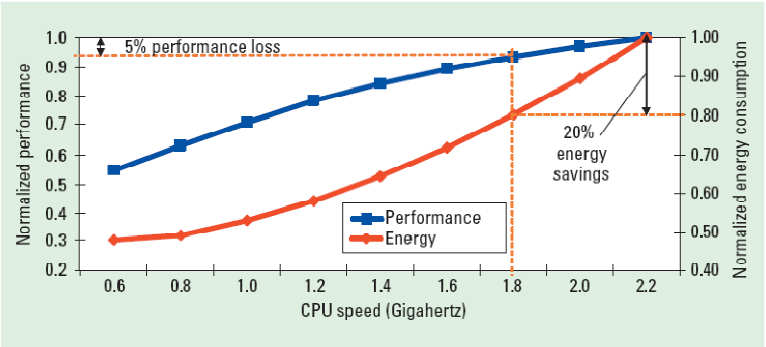
CPUs can step down into reduced performance modes by adjusting frequency and voltage in synchronization with load.

Source: AMD

Power Usage

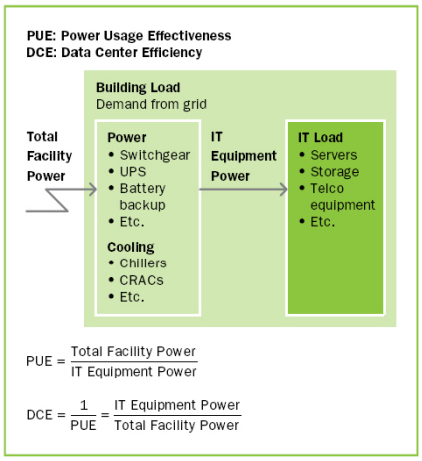
- Energy–performance trade-off

Source: The Case for Energy-Proportional Computing, Borroso, Holze, IEEE Computer, December 2007



Power Efficiency Metrics

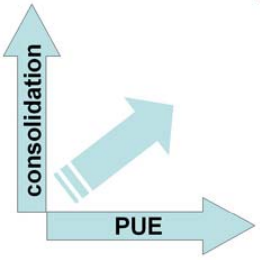
- Refers to a metrics used to determine the energy efficiency of a data center.



Source: The Green Grid, 2008, "The Green Grid Metrics: Data Center Infrastructure Efficiency (DCiE) Detailed Analysis"

Power Efficiency Metrics

- **Is PUE by itself enough?**
  - Usually the goal is to reduce the data center PUE.
  - Nevertheless any project that improves an IT load alone will yield a worse PUE.
- **Example:**
  - 100 Mw coming into a facility and 50 are taken up by the IT load → PUE = 2
  - A consolidation estrategy reduce the IT part to 40 Mw.
  - The PUE is now 2.25 (90/40), which is worse than the PUE of 2 we had before our virtualized/consolidated strategy.



Example: Best Practices to save energy at Marenostrum

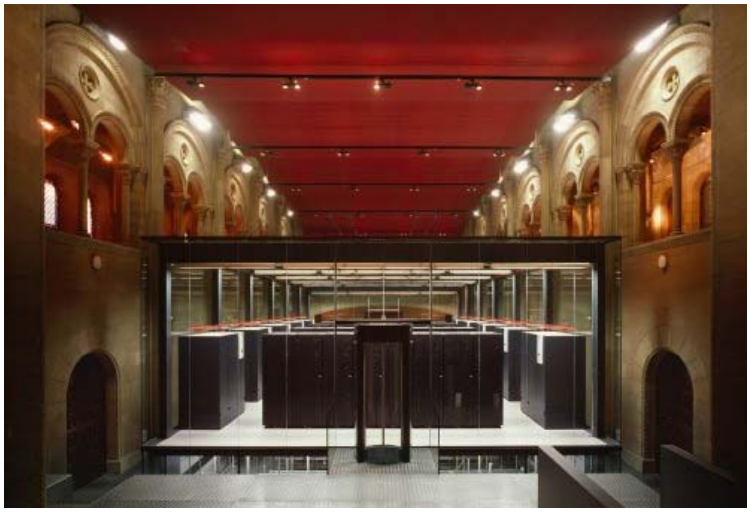
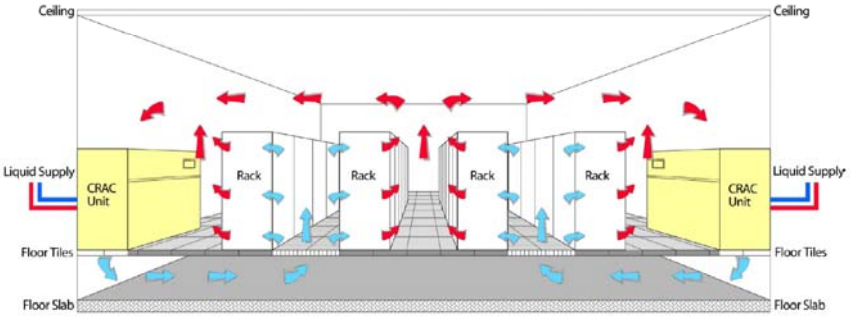


Foto: BSC

Improving Air Flow Management

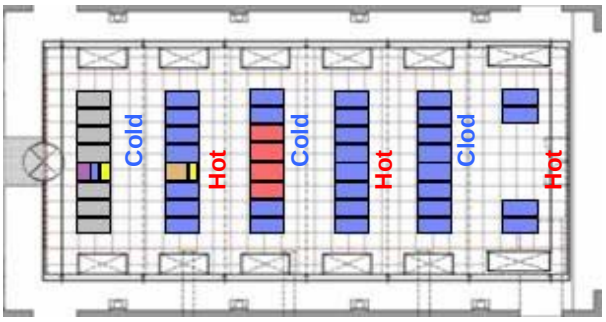
- **Usual scenario: Isolate Hot and Cold**



Font: Luiz Andre Barroso, Urs Hoelzle, "The Datacenter as a Computer: An Introduction to the Design of Warehouse-Scale Machines", 2009.
(Image courtesy of DLB associates , ref [23] of the book)

Improving Air Flow Management

- **Marenostrum layout**



Source: El reto operacional de dirigir el tercer supercomputador más grande de Europa. Sergi Girona, Director Operaciones BSC-CNS, 2009.

Under-floor pressure

- **Problem measured: to much under-floor pressure**
- **Test: Move some floor tiles**

- **Benefits observed:**
  - Improvement of AC equipment performance
  - Improved the rack-bottom temperature

Foto: BSC

Substituting Floor Tiles

- **Composite**
  - 20% opening

- **Metallic tile**
  - 40% opening

- **Benefits observed:**
  - Less working pressure for the Cooling components
  - All bladecenters reduced 2º C
  - Cold barrier that prevent the reflux of hot air

Foto: BSC

Temperature map

- **Problem measured:**

  not all the Racks have the same temperature

- **Test:**

  Force the air flow

28.50	28.00	25.50	28.00	25.50	25.50	25.50	31.00
27.00	24.00	24.00	25.00	23.00	24.00	23.00	28.50
26.50	25.50	23.50	25.00	24.50	23.00	24.00	29.50
28.00	24.50	23.50	26.00	24.00	24.50	23.50	28.50
22.50	26.00	25.00	27.00	24.50	25.00	25.00	27.50
27.50	27.00	27.00	27.00	25.50	28.50	25.00	27.50
27.50	26.50	27.00	27.50	26.50	26.00	28.00	27.50
27.50	25.00	23.00	25.00	24.00	26.00	24.50	30.00
29.00	24.00	24.50	23.50	23.00	23.50	24.50	29.00
28.50	24.00	23.50	25.50	24.50	25.50	24.50	28.00
27.00	23.50	25.00	25.50	21.50	25.00	25.50	26.00
27.00	24.50	24.50	22.50	22.50	25.50	24.00	27.50
26.00	25.50	MYRI	MYRI	MYRI	MYRI	24.00	30.00
28.50	24.00	MYRI	MYRI	MYRI	MYRI	25.00	27.50
26.00	24.00	MYRI	MYRI	MYRI	MYRI	23.50	30.50
27.00	24.00	19	19	19	19	25.50	31.00
28.50	21.50	19	19	19	19	22.00	29.00
25.50	25.50	19	19	19	19	21.50	27.00
28.50	25.50	26.00	26.00	NET	26.50	26.00	27.50
29.00	25.50	24.50	23.50	NET	24.50	23.00	25.50
26.50	24.50	24.50	24.00	NET	24.50	23.00	26.50
27.50	25.50	25.50	25.00	NET	22.50	23.00	23.00
25.50	26.00	26.50	27.50	NET	24.50	25.50	21.00
27.00	26.00	27.00	28.00	NET	26.50	27.00	24.00

Temperature map (cont.)

- **Proposal:**
  Methacrylate screens
  - designed and installed in front of each rack of machines
    - to guide the cold air flow directly to the computer, instead of each rack having to take cooling air from the general environment
- **Benefits observed:**
  - All BladeCenters Rack equal temperature +/- 1ºC
  - BladeCenter fan speed reduced

Foto: BSC

Results (including other improvements):

- **Power consumption: aprox. 1.2 Mwats**
  → aprox 1.100.000 €/year
- **reduction of 10% of power consumption**

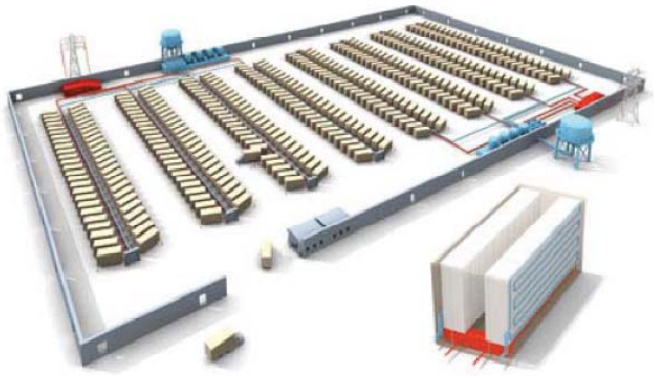
Images courtesy of UPC

Time for containers

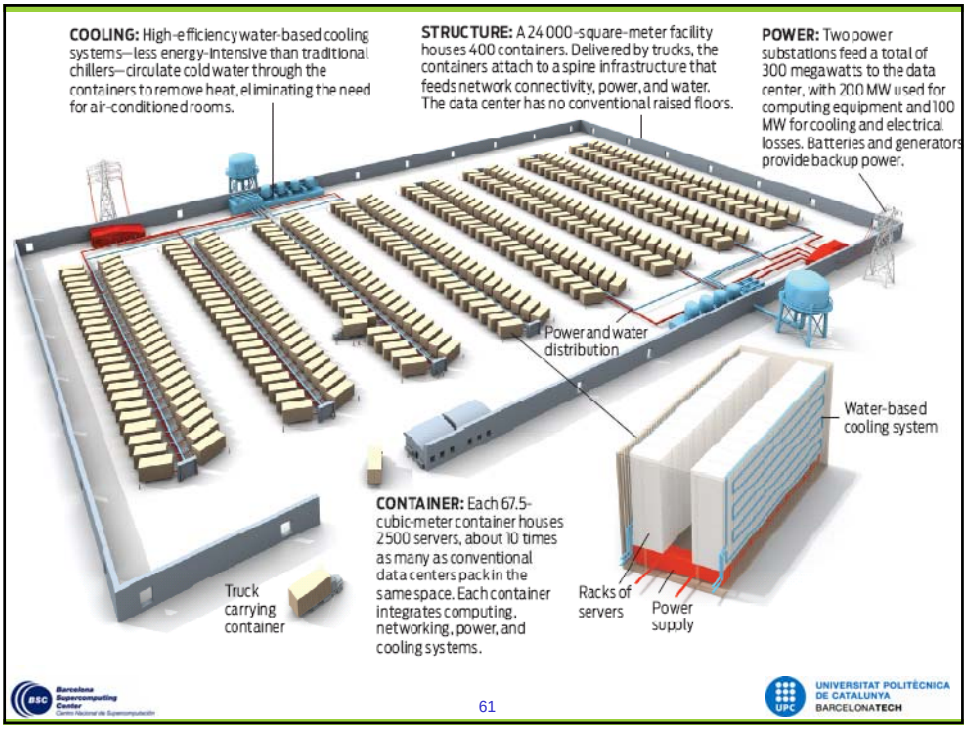
- **Data center containers**
  - Rapid expansion of IT infrastructure
  - Provides excellent energy efficiency by offering more precise control of airflow within the container
  - Examples: Microsoft and Google have used containers as building blocks in large data centers

Source: Henry Daunert, ast-global

Next generation Data Centers?

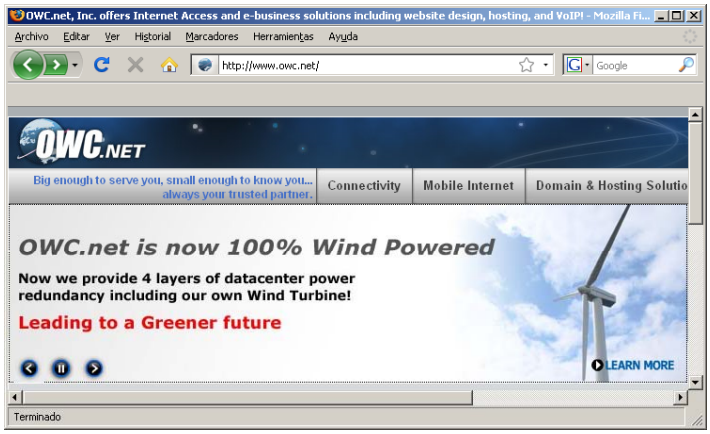


Source: Tech Titans Building Boom , Randy H. Katz.
IEEE Spectrum, February 2009
http://spectrum.ieee.org/green-tech/buildings/tech-titans-building-boom



Be ready for new ways to power your DC

- **Some small hosting companies already power their facilities with wind power from an on-site turbine.**



Environmental Footprint

- Example: Where Apple greenhouse gas emissions come from?

Comprehensive life cycle analysis:

http://www.apple.com/environment/complete-lifecycle/

Content

1. **Current computation trend:**
   Green IT Pushes Adoption of Cloud-Based Systems

2. **Green Computing:**
   The growing interdependence of the ICT and the greenhouse gases

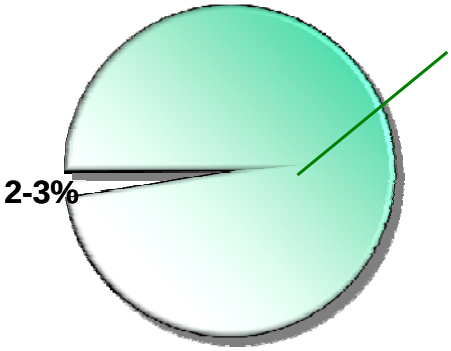
3. **The challenge of sustainable growth:**
   ICT reduces emissions of other activites

ICT pushes power use up…

- **Today delivery of IT services from the Cloud is increasing rapidly**
  - **E-commerce**
  - **VoIP**
  - **Internet search**
  - **Software as a service**
  - **Video downloads**
  - **…**
- **But ICT are becoming more energy efficient at a furious pace pushing power use down by:**
  - **Virtualization/consolidation**
  - **Cooling and power improvements**
  - **Efficient resource management**
  - **…**

ICT reduces emissions of other activites

- **ICT can significantly contribute to control and reduce the 98% of emissions caused by other activities and industries.**



Many of the solutions being introduced for reducing the carbon footprint via more efficient energy used worldwide are heavily dependent on ICT: electricity grids, logistic chains, intelligent transportation, building infrastructure and cities, dematerialization, telepresence, etc.

ICT increase business efficiency

Source:
(1)
http://www.archives.gov/research/american-cities/images/american-cities-040.jpg
(2)
http://www.noticiasdealava.com/ediciones/2007/01/16/economia/alava/fotos/3014023.jpg

ICT reduces waste of resources

- Enable dematerialization
- Reduce the need for travel
- …

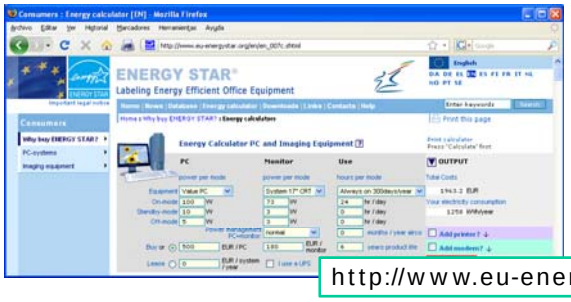
“being green” as a side effect

- **Some companies use green computing philosophies mainly to save up on costs rather than save the environment.**
  - This green computing concept emerge naturally as businesses find themselves under pressure to maximize resources in order to compete effectively in the market.
- **Aside from minimizing costs, other companies also take into account other factors such as marketing and branding.**

- **Excellent!, WELCOME!**

My IT Carbon Footprint

- **Do you know how much energy your computers uses?**
  - Self-awareness is the first step toward reducing our carbon footprint. Try it!



  - Recommended reading:

    Kirk W. Cameron, "My IT Carbon Footprint," Computer, vol. 42, no. 11, pp. 99-101, Nov. 2009, doi:10.1109/MC.2009.364

Green and Sustainable EU Growth

"ICT offers a significant toolset to build a sustainable future for the next generation of Europeans. To meet its ambitious climate change goals, the EU strongly endorses new technologies capable of improving energy efficiency and making transport systems, buildings, and cities in general smarter."

Viviane Reding, European Commission, 2010.

Green and Sustainable EU Growth

- **Smart Energy Grids**
  - Today, up to 40 percent of the energy produced might be lost on its way to the consumer,
  - but Internet connectivity, computing power, digital sensors, and remote control of the transmission and distribution system will help make grids smarter, greener, and more efficient.

Foto: J.T.

Foto: SMART 2020 Report

Green and Sustainable EU Growth

- **Smart Transport Systems**
  - Traffic jams cost Europe €135 billion a year, and drivers lose five days per year while sitting in traffic.
  - Making roads and cars “smarter” with intelligent transport systems (ITS) such as sensor networks, RF tags, and positioning systems offers a promising alternative. The Internet can interconnect diverse technologies and make mobility more efficient through the real-time management of public and private transport resources.

Foto: David Carrera

Green and Sustainable EU Growth

- **Smart Healthcare Systems**
  - Current research is working to develop technologies for “ambient” environments capable of assisting patients by treating and monitoring them from a distance to reduce medical costs and improve patient comfort.
  - These technologies combine devices (sensors, actuators, special hardware, and equipment), networks, and service platforms to harness information about medical conditions, patient records, and illnesses.

Fotos: Red Teleictus-Catalunya

Source: Back to the Future of Internet by Viviane Reding
IEEE Internet Computing, January/February 2010, pp. 24–26

Conclusions

- **ICT are challenged to rethink the resource/service management strategies, adding energy efficiency to a list of critical operating parameters that already include availability, reliability and performance.**

- **Research in Barcelona** (www.bsc.es/autonomic):

Our research is devoted to climbing the peak of Energy Efficient Computing from Barcelona

We haven't reached the summit yet, only the top of the first rise.

About the author

Jordi Torres has a Master degree in Computer Science from the UPC. Technical University of Catalonia (UPC, 1988) and also holds a Ph. D. from the same institution (Best UPC Computer Science Thesis Award, 1993).

Currently he is a full professor in the Computer Architecture Department at UPC and is a manager for the Autonomic Systems and eBusiness Platforms research line in Barcelona Supercomputing Center (BSC).

His current principal interest as a researcher is making IT resources more efficient to obtain more sustainable IT (Green Computing), and focuses on the resource management needs of modern distributed and parallel cloud computing environments. He has worked in a number of EU and industrial research and development projects. He has more than a hundred publications in the area and was involved in several conferences in the field.

Currently he is a member of the Management Committee of the EU COST action in Green Computing and a member of the Steering Committee IEEE -TCSC Technical Area of Green Computing.

He has been Vice-dean of Institutional Relations at the Computer Science School, and currently he is a member of the University Senate and member of the Board of Governors.

He can be reached at www.JordiTorres.org