# SEESGEN-ICT

**MEETING**
**Paris, April 15th 2011**

**WP 6 - ICT and Environment protection in Smart Grids**

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**Improving energy efficiency in computing activities:**
**Overview of policies & recommendations**

# General objectives of Topic 6A

The topic focuses on *the improvement of energy efficiency in computing activities related to smart grid operation and management*.

**WP 6A has taken into account the following aspects:**

- **Evaluation and assessment of strategies** to reduce ICT's own carbon footprint in data centres and infrastructures dedicated to smart distribution grids.
- **Identification of solutions** for the improvement of energy efficiency in data centres. Best practices for green data centres – regarding buildings and computing architectures (in detail, the impact of grid, cloud and virtualization technologies on energy efficiency).
- **Monitoring and optimization of performance** of the computing facilities, cooling facilities and power supply equipment.
- Survey and analysis of **data on EE measures adoption** and its impact in European and non-European countries (e.g. Green Data Centre developments in US)

# Objectives of D4

- Identify and categorise policy actions
  - assessment of alternative strategies to implement, operate, maintain large ICT hardware systems and /or evaluation of alternative SW architectures and business strategies
  - Definition of policies and recommendations to be proposed to targeted stakeholders in order to promote the adoption of innovative technologies in computing activities in smart distribution grids in European Union context
- Share and prioritise policy actions and produce recommendations
  - Identify policy measures also looking at developments and experiences in non-European Union countries.

# Contents of D4

1. Update on state of the art of energy efficiency solutions for data centres
   - Best practices scenario:
     a) Management & Organizational strategies
     b) Technical strategies

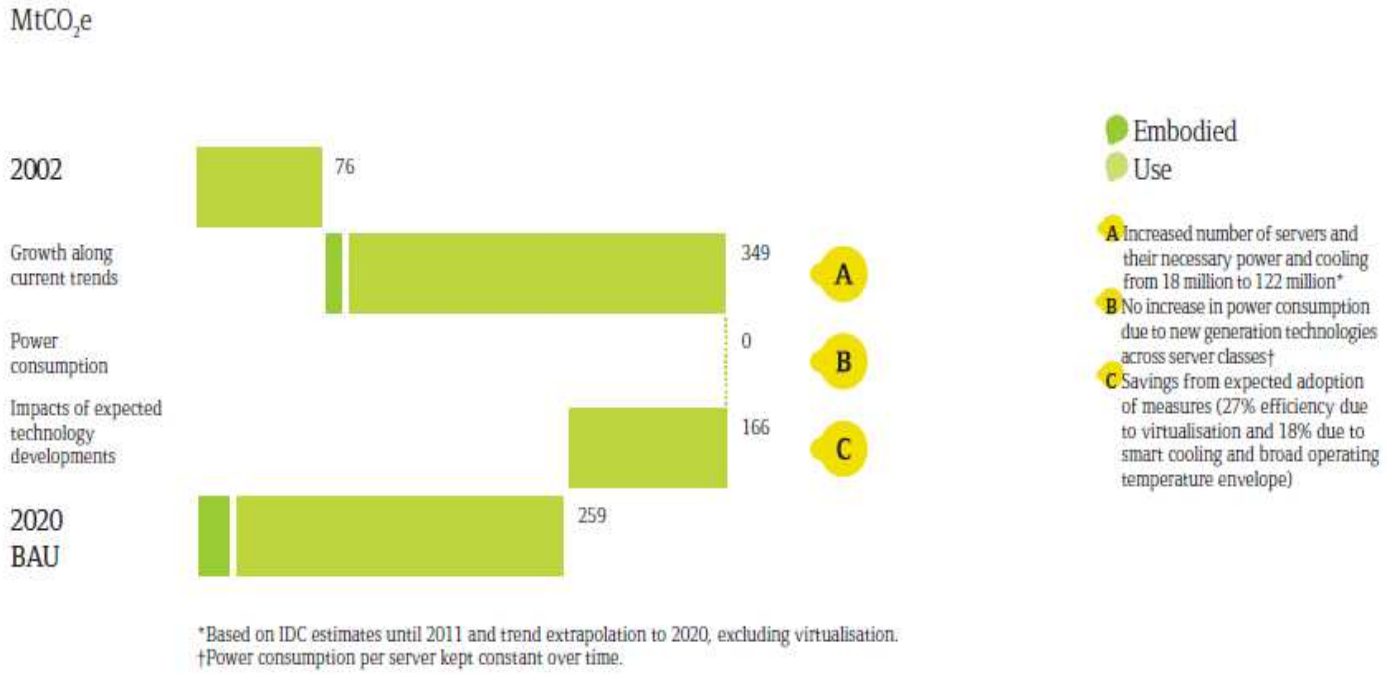
2. Impact of new ICT technologies, and particularly Cloud Computing, on Energy Efficiency solutions for Data Centres

3. Overview on public policies, studies, organisational and economical aspects on Energy Efficiency in Data Centres
   - USA
   - INDIA
   - EUROPE
   - ITALY
4. Recommendations for policy actions to be taken to promote EE in Data centres

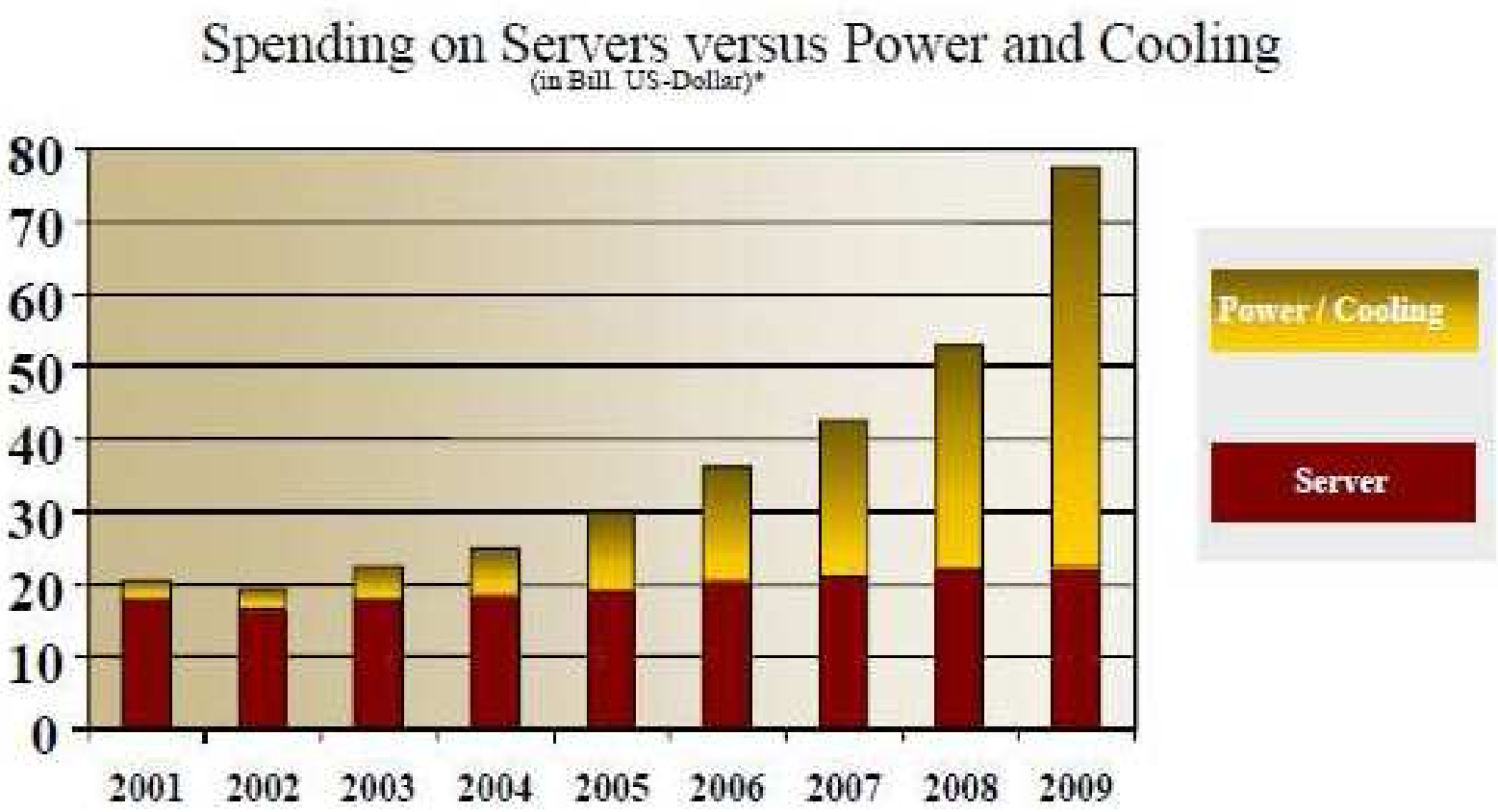
# General overview

In 2007,the total footprint of the ICT sector – including personal computers (PCs) and peripherals, telecom networks and devices and data centres – was 830 MtCO2e, about 2% of the estimated total emissions from human activities.

The global Data Center footprint (from Smart2020):

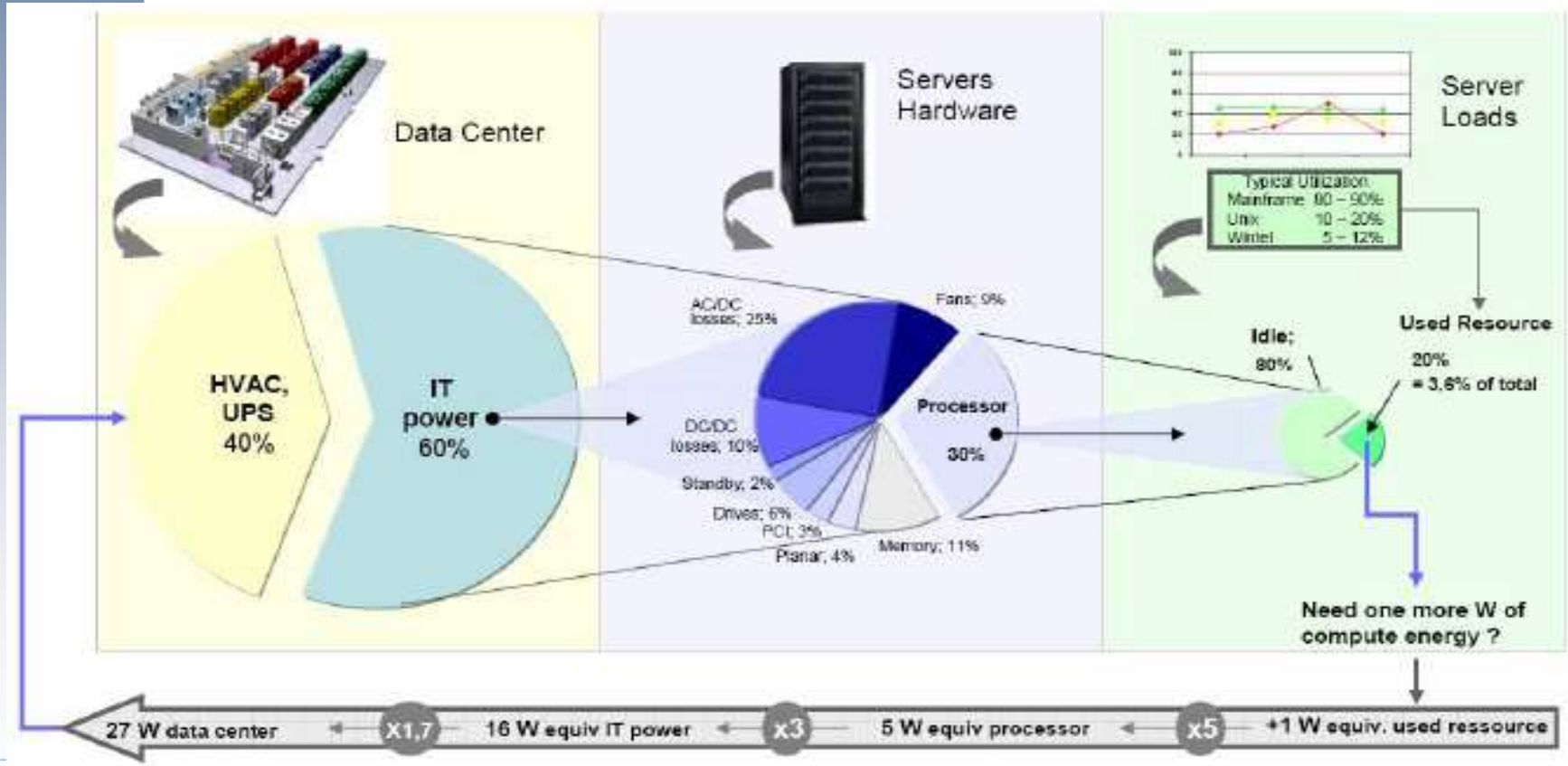


# Evolution of DataCentre cost breakdown



# Power use in computing activities

Data centres are complex systems that use a significant amount of energy to supply three key components: IT equipment, cooling and power delivery.



# Scenario of best practices/1

In the report, an extensive checklist of best practices in order to improve Energy Efficiency in Datacentres is provided and discussed.

Two levels of best practice information can be identified:

**1. Technical best practices**

- Airflow Management
- Air Handler Systems
- Humidification
- Chiller system efficiency
- IT Equipment
- Electrical Infrastructure (UPS, self-gen)
- Lighting
- Commissioning and Retrocommissioning

# Scenario of best practices/2

**2 Management & Organizational strategies**

- Use life-cycle cost analysis as a decision-making tool;
- Minimize construction and operating costs by introducing energy optimization at the earliest phases of design
- Include integrated monitoring, measuring and controls in the facility design.
- Benchmark existing facilities, track performance, and assess opportunities.
- Incorporate a comprehensive commissioning (quality assurance) process for construction and retrofit projects.
- Include periodic "re-commissioning" in the overall facility maintenance program.
- Evaluate the potential for power generation, including combined power technologies.

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# Metrics - Benchmarking

**Evaluating Energy Efficiency:** it is a complex task to define *energy efficiency* for data centres.

The current metrics commonly used for Data centres was established in 2007 by the **Green Grid** (www.thegreengrid.org):

**Power Usage Efficiency (PUE) = (**Cooling+Power+Lighting+IT) / IT

Average efficiency value PUE = 2

New metric recently proposed:

**Energy Reuse Effectiveness** (**ERE**) =
*(*Cooling+Power+Lighting+IT-*Reuse*) / IT

The **SPEC** Power and Performance Committee began developing benchmarks for evaluating energy efficiency in server-class computers in January 2006.

# Emerging ICT technologies and their impact: cloud computing

Results from Pike Research report (2010):

Market for cloud computing services has continued to expand: compound annual growth rate (CAGR) of 28.8% between now and 2015 (from $46.0 billion in 2009 to $210.3 billion by 2015).

By 2020 an important portion of DCs will have been outsourced to the cloud.

The energy efficiency benefits of cloud computing are substantial: optimization of resources, reduction of expenses.
Important implications for both energy consumption and greenhouse gas (GHG) emissions: the adoption of cloud computing will lead to a 38% reduction in worldwide data centre energy expenditures by 2020

# Other emerging technologies

Besides the significant opportunities to improve data centre energy efficiency using new paradigms like cloud computing, there is a new generation of "emerging technologies" in the pipeline:

- **New generation**, energy efficient IT equipment
- **Improvement of power supplies** in electronic equipment: current efficiency ~ 70%; target efficiency 80-90%
- **Direct DC power systems** (experimental work under way)

# Overview on public policies and studies / USA

## USA

**DOE's Industrial Technologies Program** (ITP) is partnering with industry to reduce data centre energy use and improve efficiency. Through **Save Energy Now**, DOE's Industrial Technologies Program is developing resources to help data centre operators identify opportunities to increase capacity and reliability, save energy and costs, and reduce environmental impacts**. Save Energy Now's** strategy focuses on these activities to help companies reduce energy use:

- **Energy assessment protocols and methodologies** for data centres to pinpoint energy and cost savings opportunities.
- **Metrics** to benchmark and track performance**.**
- **Data Centre Energy Profiler (DC Pro) software,** an energy assessment tool.
- **Qualified Specialists** program to certify data centre efficiency experts to assist data centres with energy assessments**.**
- **Training** curriculum for data centre personnel.

# Overview on public policies and studies / USA

- **USA**

  The voluntary ***National Data Centre Energy Efficiency Information Program*** (March 2008): is engaging many industry stakeholders who are developing and deploying a variety of tools and informational resources to assist data centre operators in their efforts to reduce energy consumption in their facilities. The elements of the Program include:

- **Consensus energy efficiency metrics and benchmarking**
- **Energy saving tools and training**
- **Certification of data centre energy efficiency experts**
- **Equipment performance specification and labelling**
- **Recognition of Best-in-Class data centres**
- **Designation of a Data Centre Energy Efficiency Organization**

The ***Program*** integrates and coordinates existing activities from the DOE Save Energy Now initiative, DOE FEMP, and the EPA ENERGY STAR program.

# Overview on public policies and studies / INDIA

There has been a rapid growth of the Information Technology (IT) industry in India. Data Centres, the key infrastructure component powering this sector, are experiencing significant growth in India, making it one of the fastest growing energy use sectors and impacting electrical supply and distribution.

January 2008: **USAID ECO-III Project** : The project objectives consist in establishing a public-private partnership to support the efforts of data centres from India and improve energy efficiency.

Workshop in Delhi, February 2011:

- Update on current US and India **data center R&D**
- Evaluate and take stock of **DC efficiency activities** since 2008, what was accomplished, and what remains to be done.
- Reassess **current challenges** to energy efficiency in Indian data centers.
- Identify **potential actions** to overcome those challenges.
- **Emerging** data center energy efficiency **technologies**

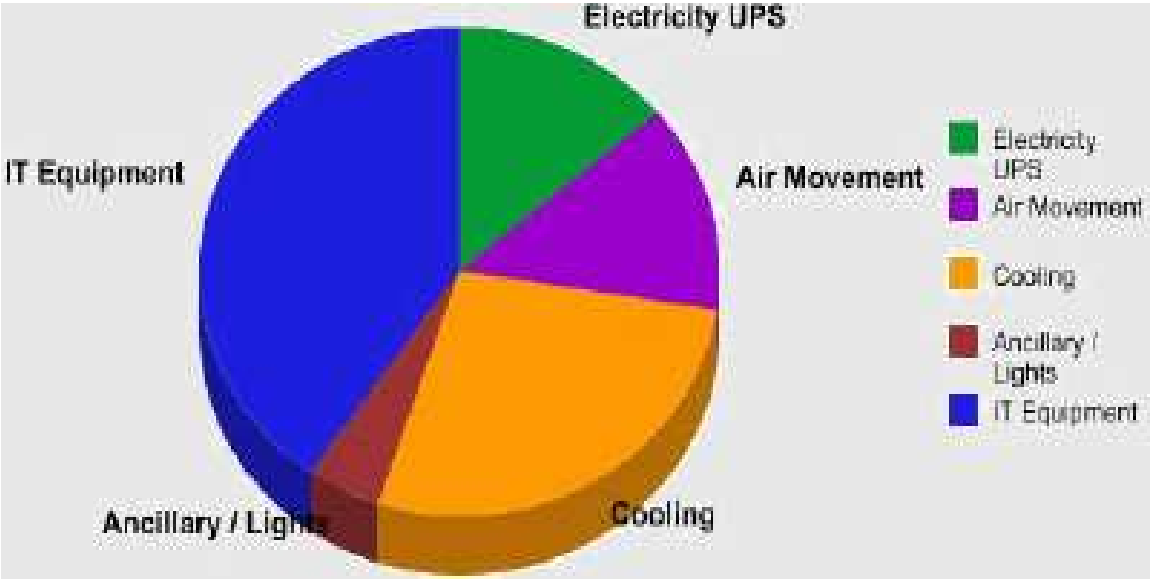
# Overview on public policies and studies / EU

The European Commission has introduced the **Data Centres Code of Conduct,** which is a voluntary scheme aimed at energy reduction.

By adhering to the “Code of conduct” the signatory parts agree to reduce the data centres energy consumption by a certain percentage.

The fulfilment of the proposed objectives is **monitored by a committee** at the level of the EC Joint Research Centre that issues the guiding documents, studies the best practices solution and quantifies the results.

Recommended best practice has been split into seven distinct areas:



# Overview on public policies and studies / Italy

In Italy, the Ministry of Economic Development is developing an energy efficiency action plan, which includes a section on data centre sector.

This action plan:

- identifies the main technical guidelines related to energy efficient design, specification, technologies and management of data centres; includes key policy implications for the data centres sector;
- explores the implications for data centres of the identified energy policies, specifically opportunities and threats;
- provides a suite of recommendations for consideration and action.

The aim of this action plan is to support the policy- makers in order to define a specific legislation in terms of energy policy for data centres.

# Recommendations

To date, there has been little public sector role in promoting and facilitating improved data centre energy efficiency and overcoming the barriers. The key policies affecting data centres and a suite of recommendations identified in D4 are summarized below:

1. **Standardize energy performance metrics -** Defining "energy performance" is a prerequisite for most energy efficiency policies and programs.

- ***Recommendations***

– ***Metering data centre energy use*** - to help isolate energy efficiency opportunities among various loads and over time.
– ***Energy performance measurement*** – to develop server and power supply energy performance metrics.
– ***Energy performance standards*** – for power supplies; for server power supplies.

# Recommendations /2

2. **Design and Operation Guidance -** Despite the actions already undertaken under the design and operational best practices in order to providing technical resources to help designers and operators improve data centre energy performance, this field remains to explore

- ***Recommendations***
  - ***Building codes*** - Governments should ensure that data centre best practices are included in commercial building codes.

3. **Procurement guidelines and regulation – government and private sector -** Several procurement activities are taking place in the European and non-European countries, which support the development of energy efficient products including data centres

- ***Recommendations***
  - ***Financial incentives*** - Governments should establish tax and/or utility incentives for servers, power supplies and other data centre equipment and even best practices, such as virtualization and consolidation of resources.
  - ***Technology procurement*** - Provide incentives to bring new technologies and products

# Recommendations /3

4. **Cloud computing -** it is important that the European Commission steps up its efforts to create guidelines and a proper legal framework for cloud computing

- ***Recommendations***
  - ***Developing and Use of new technologies*** - applying technologies with a short payback time; developing technology rather than replacement.
  - ***Regulation and guidelines*** **-** to create guidelines as well as a proper legal framework for cloud computing.

| RECOMMENDAT. FOR POLICY ACTIONS | Scope/Objective of the Action | Target of the Recommendation | First Impacted Stakeholders |
|---|---|---|---|
| **Standardize energy performance metrics** | 1. Standardization objectives<br>2. Improvement existing techn./practices | Policy Makers<br>Standardization Bodies | 1. Industry – ICT<br>2. Users |
| **Design and Operation Guidance** | 1. Standardization objectives<br>2. Improvement existing techn./practices<br>3. Sharing of Best Practices | Policy Makers<br>Standardization Bodies | 1. Industry – ICT<br>2. Users<br>3. Market operators |
| **Procurement guidelines and regulation** | 1. Improvement existing techn./practices<br>2. Market opportunities<br>3. Government and private sector | Policy Makers | 1. Industry – ICT<br>2. Users<br>3. Public Institutions |
| **Cloud computing** | 1. Development of new technologies<br>2. Market opportunities | Policy Makers | 1. Industry – ICT<br>2. Users<br>3. Research & Academia |

# Additional recommendations

- **Research** in the following three areas: 1) server and data centre energy performance measures; 2) potential savings and costs from more efficient coding; 3) potential savings and costs from better applications management.
- **Demonstrations and case studies** - Provide objective, credible information about the effect of energy-efficient technologies and practices on data centre availability and performance
- Promote **exchange of experiences** between data centre managers
- Raise **awareness** in industry and public organisations on existing information resources about data centres and promote awareness that significant opportunities exist for EE
- **International collaboration** –essential to achieve fast results within these areas
- Promote **training and education**
- **Involvement of the user community**

# Sources

The analysis was based on literature, European Commission reports, congress and workshop proceedings, interviews with partner of the SEESGEN network, company case studies.

Some references (for D4):


- http://hightech.lbl.gov/DCTraining/best-practices-technical.htm
- http://www.pikeresearch.com/
- http://www.pcworld.com/businesscenter/article/164933/cloud_computing_explained.html
- The Green Grid, www.thegreengrid.org
- Report to Congress on Server and Data Center Energy Efficiency Public Law 109-431, U.S.
- Environmental Protection Agency ENERGY STAR Program, August 2, 2007
- Improving Data Center Efficiency: Some Policy Possibilities, Alliance to Save Energy, 2007.
- http://www.netapp.com/us/company/news/news-rel-20100714.html
- www.eere.energy.gov/datacenters
- www.energystar.gov/datacenters

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# Thank you for your attention!

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