DELIVERABLE

EU Project No.: 238868

SEESGEN-ICT

Supporting Energy Efficiency in Smart Generation Grids Through ICT

Thematic Network

ICT PSP Programme

ICT AND ENVIRONMENT PROTECTION

Report on technical and non-technical barriers and solutions

D6-3

Revision: Final R0
September, 2010

This is a Deliverable of WP6

Deliverable Leader: Josco Kester (ECN)

Authors:

Andrea Quintiliani, Marta Chinnici (ENEA) (lead authors of Topic A)	**Efstathia Kolentini (ICCS-NTUA) (lead author of Topic B)**
Irina Racovițan, Ion Ionescu (Icemenerg)	**Josco Kester (ECN)**

Project co-funded by the European Commission within the ICT Policy Support Programme		
Dissemination Level		
P	Public	X
C	Confidential, only for members of the consortium and the Commission Services	

Revision History

Revision	Date	Author	Organisation	Description
R0	Sept 2010	Josco Kester	ECN	First issue

Statement of originality:

This deliverable contains original unpublished work except where clearly indicated otherwise. Acknowledgement of previously published material and of the work of others has been made through appropriate citation, quotation or both.

NOTES:
For comments/suggestions/contributions to this Document, contact:
the Leader for this Deliverable at kester@ecn.nl
or the Coordinator of SEESGEN-ICT at Giorgio.Franchioni@erse-web.it

For more information on the project SEESGEN-ICT, link to http://seesgen-ict.erse-web.it

EXECUTIVE SUMMARY

The objective of WP6 is to explore the opportunities offered by ICT systems for the protection of the Environment in the Smart grids panorama. In this report technical and non-technical barriers and solutions are collected for two specific topics concerning this Smart grids panorama:

- WP6 Topic A: „ Improving energy efficiency of computing activities in Smart grids"
- WP6 Topic B: „ICT systems to encourage reducing GHG emissions".

Each of the two topics end with a conclusion chapter. In the remainder of the project policy actions and recommendations will be developed, that can be used by stake holders and decision makers.

The WP6 Topic A deals with how the ICT sector itself is able to reduce its own carbon footprint. In particular, the Topic focuses on the computing Data Centres and on methods and technologies to increase the efficiency of energy used in their primary processes. In the previous report it was shown that there are many solutions available for this. This report identifies which barriers prevent the implementation of these solutions, using a literature review and a questionnaire.

The main barriers identified are:

- **organisational and economical barriers**, such as investment risks, split incentives and restrictions set by Service Level Agreements (SLAs);
- different **levels of knowledge** between actors, worsened by lack of monitoring equipment and the inability to exchange information for commercial reasons;
- poor **interaction between professionals** involved in design of data centres and those involved in their operation, resulting in designs that cannot operate efficiently in a part-load situation (the common mode of operation of many data centres).

Solutions suggested to overcome these barriers are various. They include:

- increasing synergies between IT managers and Facility managers.
- exchanging of experiences between data centre managers
- applying technologies with a short payback time
- data acquisition to demonstrate the effectiveness of solutions
- involvement of the user community
- adapting temperature levels in Service Level Agreements with new customers

The WP6 Topic B deals with the use of ICT technologies in the monitoring and the assessment of the GHG emission, as well as those employed in the platforms for the GHG emission certificate trading. ICT technologies can play an important role in these systems. From a review of literature and current standards and regulations it was concluded that there are many barriers, technical and non technical, that need to be overcome. To fill the gaps it is necessary to come up with common standardised ways to meter CO2, in order to give the opportunity to a large set of players of taking part in the CO2 market. Some of these barriers are:

- Non-inclusion in the Emission Trading Scheme (ETS) of a number of users sectors
- Lack of standardised methodologies adopted for CO2 emissions calculations
- Costs for implementing ETS system to a broad panel of users
- Lack of EU projects oriented on the issue

According to these barriers, the following solutions are proposed:

- Standardised ways for CO2 calculation should be adopted, under certain strategies, standards, data collection specifications
- Inclusion of further Sectors in Emission Trading Scheme

- The level of accuracy can be decided to be linked to the application
- Assurance adoption
- Training the players through EU projects on the topic
- Adoption of regulations in the countries that take part in the ETS.

INDEX

TOPIC A: IMPROVING ENERGY EFFICIENCY OF COMPUTING ACTIVITIES IN SMART GRIDS

AUTHORS OF TOPIC A REPORT

- ***Andrea Quintiliani, Marta Chinnici (ENEA)*** (lead authors of Topic A)
- Irina Racovițan, Ion Ionescu (Icemenerg)
- Josco Kester (ECN)

INTRODUCTION

Although there are many opportunities to save energy in data centres and attain significant benefits such as energy cost savings and improved reliability, many factors obstacle the adoption of efficiency measures, including costs, lack of knowledge, institutional failures and perverse incentives. In order to assess the potential benefits from the adoption of energy efficient technologies and best practices in data centres, a number of barriers need to be addressed. Most of these barriers are common to both private - and public-sector data centres.

Although energy saving opportunities in data centres are widespread and can reap significant cost savings, implementation costs and other barriers often prevent their adoption; in detail, the barriers that prevent data centres from adopting changes that offer very reasonable paybacks are typically not technological but organizational.

1 IDENTIFY BARRIERS AND SOLUTIONS TO ENERGY EFFICIENCY IN DATA CENTRES

In a report of the Environmental Protection Agency (EPA) [1] three kinds of barriers of particular importance in data centres are identified:

1. ***Lack of efficiency definitions*** (including standard measures of productivity and suitable metrics)
2. ***Split incentives,*** in that those responsible for purchasing and operating IT equipment are often separated from those responsible for power and cooling infrastructure and paying the electricity bills.
3. ***Risk aversion*** to adopting energy efficiency changes which have uncertain value and are (unjustifiably) perceived to have the potential to increase the risk of downtime.

These barriers are not unique to data centres but may be more pronounced in this sector.

First of all, it is difficult to ***define energy efficiency*** for a complex system such as a data centre. An energy efficient product or facility is usually defined as delivering the same or better service output with less energy input. The difficulty in defining efficiency is especially true for a key piece of equipment in the data centre – the server.

Additional challenges emerge in attempts to derive measurements of overall data centre energy performance that include power distribution, cooling, and lighting. Although it is a difficult process, defining “energy performance” is a prerequisite for implementation of many government and efficiency policies and programs. Energy performance measures are necessary to establish eligibility for utility rebates or tax incentives, for example, or to create procurement requirements. Energy-efficiency metrics can also be used as a benchmark for individual facilities to gauge their performance against other similar facilities.

Many data centre efficiency improvements have a high initial cost; money spent upfront on redesigning a data centre seems more tangible than the money not spent on energy costs in the future. This view can also dissuade vendors and consultants from recommending cost-effective data centre improvements. It is less risky for a vendor to offer a less-expensive, inefficient package of recommendations than to try to convince a data centre operator that the high price of the efficient design will eventually be repaid through energy savings. Despite the rising cost of electricity and the relatively large share of data centre costs represented by energy expenses, data centre energy costs remain a relatively small portion of overall costs for most data centre clients, especially those with small and medium sized data centres [2].

Attention to data centre energy use is often motivated by electricity supply, cooling, and building space constraints than by electricity costs. This is not surprising because most data centre operators do not know how much their energy costs are (these costs are typically not reported separately on the energy bill for the larger facility). This is the typical case of “***split incentives***” barrier.

Split incentives occur when the entity responsible for paying energy bills is different than the entity responsible for capital investment decisions. There are two common forms of split incentives that are relevant to data centres: when data centres operate in leased buildings and when the data centre operator is unaware of or indifferent to the energy use of the equipment.

Many data centres are housed in buildings that are not owned by the equipment operator. If the data centre owner is not the sole tenant of a given building, the utility bills are frequently prorated based on square footage occupied rather than by actual electricity consumption of each tenant and thus may not represent the actual electricity consumption of each tenant’s equipment.

The second type of split incentive is especially problematic in companies or organizations in which the company that controls the facility is just hosting the IT equipment, or in which IT equipment and facilities are managed by separate organizations within the same company.

Risk aversion: data centre operators need confidence in manufacturers' claims that operations will not be disrupted by the installation of equipment. They also need sufficient knowledge to convince budget decision makers that the measures are worth financing. The rapid growth of data centres and the lack of connections that exist between architects, financial managers and data centre operators often lead to poor data centre design and operation. The challenge is in weighing the energy efficiency and other benefits that the improvements will yield against the potential risks that they may bring to data centre operations and then communicating those benefits and risks to financial decision makers. Indeed, making the financial case for purchase of an efficiency improvement may be a greater hurdle for data centre operators than actual implementation of the efficiency measures. Facilitating conversations between these groups of people and providing guidance that can be used in those communications is a critical need.

Perhaps the greatest barrier to energy efficiency improvements has been **the rapid increase in new computer applications combined with the rapidly falling cost of processing power**. If procurement criteria do not specify the purchase of energy efficient equipment, that factor is likely to be lost in purchasing decisions. It is difficult to continually optimize data centres in such a rapidly changing environment and even more difficult to predict future requirements. Because cooling systems have long-lived components, while IT equipment has a relatively short life, cooling systems often end up being mismatched with IT equipment and its cooling requirements. Consequently, data centre operators tend to err on the side of too much capacity rather than too little, resulting in less efficient operation.

Recent research indicates that barriers described previously can include other items such as:

- ***Lack of institutional framework*** to promote energy efficiency;
- ***Lack of value proposition***
  - better cost information
- ***Informed regulatory push (e.g. European Covered Bond Council – ECBC** [3]**) coupled with incentives;***
- ***Lack of awareness***:
  - Lack of technical expertise
  - Lack of exposure to best practices and energy-efficient solutions;
  - Lack of good design information (e.g. management of cooling loads and air distribution);
- ***Poor quality/non-availability of comparative industry benchmark*** (energy input and output indices);
- ***Lack of interaction between IT and facility staff***;
- ***Lack of integrated building design approach***;
- ***Power distribution*** (energy loss at every point)
  - lack of available energy efficient solutions (e.g. Poor quality and reliability of power supply);
- ***IT Infrastructure not keeping up with IT technology***;
- ***Lack of regulatory measures***: tools for modelling the electrical costs of data centres are not widely available and are not commonly used during data centre design.

A variety of points of view are currently under consideration for quantifying and comparing barriers to data centres:

- **Barriers to address at the level of the public authorities:**
  - Non-economic pricing of energy, inappropriate tariff structures, poor collection rates;
  - Market incentives for energy suppliers to supply more rather than less:
    1. The billed electrical costs are often not within the responsibility or budget of the data centre operating group. This leads to split incentives, in which those most able to control the energy use of the IT equipment have little incentive to do so.
    2. The electrical bill for the data centre may be included within a larger electrical bill and may not be available separately
  - Lack of EE information campaigns, standards, codes, norms or labelling systems;
  - Inadequate regulatory or legal frameworks to support energy service companies.

- **Barriers to address at the level of end-users (final beneficiaries):**
  - Lack of awareness of the financial or qualitative benefits arising from energy saving measures, together with the skills to implement them;
  - Capital constraints and corporate culture leading to more investment in new production capacities rather than energy efficiency;
  - Greater weight given to addressing upfront (first) costs compared to recurring energy cost, especially if these costs are a small proportion of production costs.

- **Barriers to address at the level of provision of finance and expertise:**
  - Lack of awareness and experience among investors and financiers of potential financial returns: local banking sectors tend not to prioritise energy efficiency finance, due to inexperience and lack of competition in the area, high transaction costs associated with smaller projects, and risks associated with assessing and securitising revenues generated through energy savings;
  - Limited access to robust systems and skills for measurement, monitoring and verification of energy savings

Split incentives, limited capital, regulation distortions and confusion resulting from co-mingling of energy efficiency features from other desirable or undesirable/product features can all contribute to reasons why customers do not embrace the opportunity for energy efficiency.

To complete our survey of barriers in the context of energy efficiency for Data Centres, we report below the taxonomy adopted by NEEP (US Northeast Energy Efficiency Partnership, a non-profit organization operating in the Northeast and Mid-Atlantic States of the United States) [4]:

Market barriers (from the utility perspective):

- Customers misunderstanding the opportunity
  - What do I have to spend in order to save?
  - Given other opportunities to save money, is this urgent?
  - Will the reliability of my IT operations be at risk?
- Split incentives for customer base
  - Landlord/lessee relationships mean that the investment often does not meet an internal rate of return that makes this viable
  - Regional and local sub-metering regulations do not allow for measurement
- Utility perception that incentives are not needed because vendors can drive this change without them
- Utility staff not confident to open conversations with customers
  - Sales & service staff may be unfamiliar with data centre jargon
  - They lack role models for approaching data centre staff

- They are waiting for an invite, not “selling” the benefits
- Confusion among vendors & customers
  - Why should a utility provide incentives for virtualization if 80% of the revenue is earned by a single
  - Is this fair? Is this relevant? Is this a conflict of interest?
- Utilities may not believe their own energy efficiency programs are optimally implemented and therefore hesitate to make more choices available to customers.

Technology barriers (from the utility perspective):

- Regulation can’t keep up with speed at which IT appliances are launched
  - Moore’s Law drives semiconductor introductions every 18 months
  - PCs, servers, routers, etc offer efficiency gains faster than traditional products such as refrigerators, washers, HVAC, etc
  - In 2010, there will be 43 million physical servers as well as an additional 15 million virtual servers installed worldwide (IDC)
- Rate-payer base is changing as co-los and cloud providers carve out a substantial niche
  - Co-location may be the wave of the future - starting now
  - Co-location facilities may be leased or owned
  - Co-location facilities would require sub-metering permission to incentivize each of their own customers

Business process barriers:

- Organizational inertia: Lack of communication between facilities and IT
- Split incentives on performance for EE gains
- Accounting and definition problems; cap ex v op ex
- Unaccounted costs for energy efficiency implementation
  - Staffing hours go up
  - Software driven dashboards are purchased
  - Utility bill savings may be erased by either or both of those

2 SOLUTIONS TO BARRIERS: SURVEY OF SEVERAL EXPERIENCES

There is no evidence in literature of detailed studies on solutions to the wide range of barriers that were detected in the previous paragraph. The task of preparing such a study is beyond the scope of this project.

We have therefore chosen to collect some information on the experiences of important Data Centre operators through a questionnaire presented to a number of experts/managers from the public and private sectors.

In the following the structure of the questionnaire is presented, together with the 6 replies collected from the experts.

2.1 Questionnaire for experts from the public and private sectors

2.1.1 *Sample questionnaire*

Name:

Company name:

Position:

Phone:

E-mail:

Data Centre information

Name/Acronym of the Data Centre:

Country/City:

Web-page:

1. Make a short description of the Data Centre (computer facilities/power, storage facilities, provided, R&D programs, etc.).
2. Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more “green”?
3. Give an estimate of the energy savings obtained by energy efficiency technologies and practices adopted in your data centre?
4. Do you currently measure the energy performance of your data centre? If yes, please give us:
    - Total energy consumption (costs) of the data centre
    - PUE (total facilities power/IT equipment power)
    - Energy costs/total costs of operation:
5. Which barriers (technical and non-technical barriers) were detected to the introduction of energy efficient solutions in your data centre?
6. What are the solutions adopted by your data centre in order to overcome these barriers?
7. In your opinion, what are the most effective solutions one should adopt in order to improve energy efficiency in data centres?
8. Describe further improvements envisaged for your data centre in the near future.
9. In your opinion, which technologies/solutions will contribute in the future to improve energy efficiency in data centres?

2.1.2 *Questionnaire 1*

Name: **Massimo Mauri**
Company name: **CINECA** (Inter-university computing Consortium of 40 Italian Universities)
Position: Facility Manager
Phone: 051 6171411
E-mail: a.mauri@cineca.it

Data Centre information
CINECA Data Centre, Casalecchio di Reno, Bologna, ITALY
Webpage: www.cineca.it

Make a short description of the Data Centre (computer facilities/power, storage facilities, provided, R&D programs, etc.).

Cineca's Data centre is designed to house and maintain third party appliances. The devices are hosted in properly equipped, reliable and secure environments to ensure maximum operational efficiency.

Below is a table on the main computer rooms.

YEAR 2009					
COMPUTER ROOMS	**NUMBER of RACKS**	**NUMBER of CORES**	**NUMBER of STORAGE RACKS**	**NUMBER of STORAGE SLOTS**	**MONTHLY MEDIA POWER and FACILITY (kW)**
SALA M-N	**102**	**19 000**	**36**	**5 914**	**1900,00**
SALA F	**20**	**9 100**	**0**	**0**	**435,45**
SALA K	**24**	**550**	**3**	**3**	**123,74**
TOTAL	**146**	**28 650**	**39**	**5 917**	**2459,19**

Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more "green"?

CINECA has long since begun to adopt guidelines for efficient CED;

By placement of racks in hot and cold aisles through the study of the environment: how circulates the air inside, where to place racks and air conditioners systems.

The new chiller machines are equipped with free cooling systems.

CINECA is installing a PV array to support consumption.

IT Equipment; In the last quarter of 2009 was switched on the most efficient Super calculator (BGp) One cluster of one rack, ~4100 cores, with Reactive power management that is initiated when the power consumption data from the DC/DC converters exceeds a predefined limit. If the amount of current exceeds the reactive power management threshold, both the performance and dynamic power consumption is reduced by 10%, and the application continues to run. After initiation, reactive power management continues until the job is complete. The next job on the system does not start under reactive power management, unless that job also exceeds reactive power management thresholds.

BG/P delivers more than ultra scalable performance. Because of unique design points that allow dense packaging of processors, memory and interconnects, Blue Gene/P offers efficiency in the areas of power, cooling, and floor space consumption. Designed to run continuously at 1 PFLOPS (petaFLOPS), it can be configured to reach speeds in excess of 3 PFLOPS. Furthermore, it is at least seven times more energy efficient than any other supercomputer.

In the first quarter of 2010 was switched off the system named BCX, to make way for new concept system inherently more efficient named (PLX).This cluster of 6 racks, ~ 2300 cores has a green solution from Intel:

Intelligent Power Capability powers individual processor elements on and off as needed, to reduce power draw.

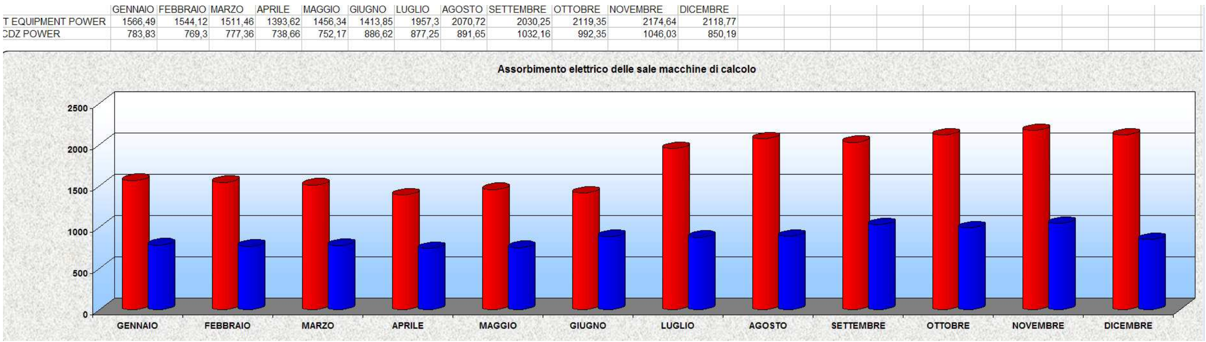
Do you currently measure the energy performance of your data centre? If yes, please give us:

- **Total energy consumption (costs) of the data centre ;**

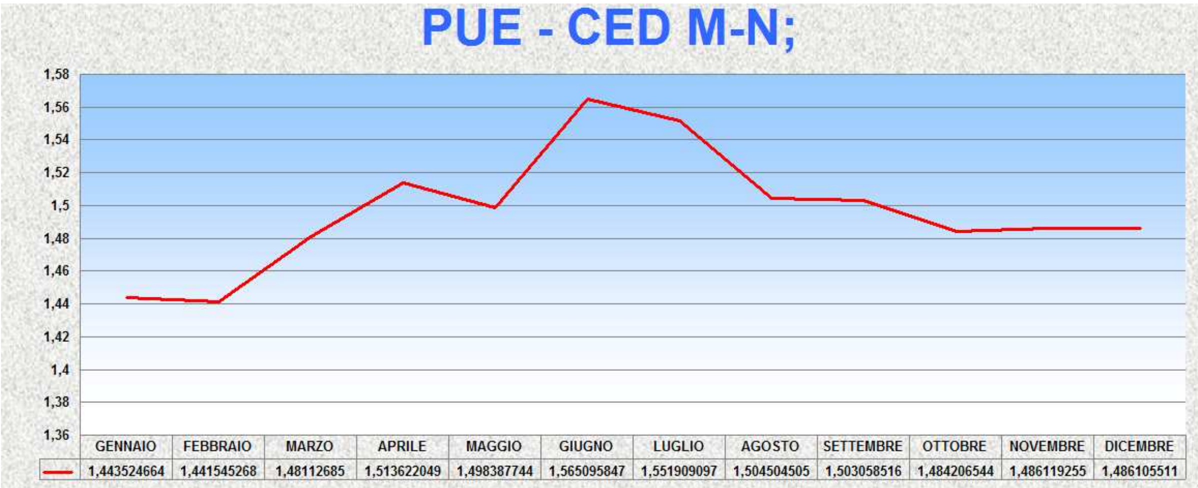
Below is a table showing the general consumption of CINECA and in particular the main computer rooms

Year 2009 Months	Final Year 2009 kW/h	Cost 2009 €/kWh	Final year 2009 €/kWh	% IT Equipment	Cost Computer Rooms
December	2 423 542,00	0,1125	€ 272 648,48	82,95%	€ 226 169,18
November	2 566 128,00	0,1110	€ 284 840,21	87,47%	€ 249 151,63
October	2 654 635,00	0,1114	€ 295 726,34	84,51%	€ 249 921,69
September	2 604 945,00	0,1128	€ 293 837,80	72,96%	€ 214 397,24
August	2 835 170,00	0,1113	€ 315 554,42	74,90%	€ 236 356,25
July	2 669 992,00	0,1135	€ 303 044,09	73,59%	€ 222 999,38
June	2 121 482,00	0,1150	€ 243 970,43	76,12%	€ 185 720,27
May	1 978 908,00	0,1133	€ 224 210,28	80,78%	€ 181 115,81
April	1 906 551,00	0,1143	€ 217 918,78	78,34%	€ 170 706,78
March	2 924 455,00	0,1121	€ 327 831,41	81,51%	€ 267 217,62
February	1 838 971,00	0,1125	€ 206 884,24	82,74%	€ 171 176,73
January	2 045 997,00	0,1121	€ 229 356,26	83,85%	€ 192 315,60
TOTALE 2009	**28 570 776,00**	**0,1127**	**€ 3 215 822,72**	**79,98%**	**€ 2 567 248,17**

Graph of the power consumption trends on main computer rooms



CINECA measured the PUE for the year 2009 of the main important Computer Rooms named (M-N);



Which barriers (technical and non-technical barriers) were detected to the introduction of energy efficient solutions in your data centre?

The budget for investments that have no immediate return.

What are the solutions adopted by your data centre in order to overcome these barriers?

We are working on solutions with a short payback time and do more work on developing technology rather than replacement.

In your opinion, what are the most effective solutions one should adopt in order to improve energy efficiency in data centres?

I think could be important try to measure in even more detail the energy performance of all components, to see where to intervene and increase the performance of supervisory and control systems.

It should increase synergies between IT managers and Facility managers.

In your opinion, which technologies/solutions will contribute in the future to improve energy efficiency in data centres?

Continue increasing the efficiency of computers and use them to their full capacity and trying to rationalize facilities- tri-generation systems should be taken to recover all the energy used for computer rooms.

2.1.3 *Questionnaire 2*

Name: **Maurizio Goretti**
Company name: **CASPUR** (Inter-university computing Consortium of 9 Italian Universities)
Position: Head of Network and infrastructure department
Phone: +39 3356895716
E-mail: m.goretti@caspur.it

Data Centre information

Name/Acronym of the Data Centre: CASPUR

Country/City: Italy/Rome

Webpage: www.caspur.it

Make a short description of the Data Centre (computer facilities/power, storage facilities, provided, R&D programs, etc.).
CASPUR Data Centre is one of main Italian data processing facilities. It hosts important infrastructures in the domains of R&D, ICT, and of the Italian Internet network.

Among these:
1) A high performance infrastructure for scientific computing included in the TOP 500 list of the most performing computing infrastructures of the world;
2) Equipment hosting critical services for the national central and local public administration;
3) The interchange and interconnection station of the main operators of the Italian Internet (NaMeX, SPC, GARR)

The Data Centre is therefore committed to high quality standards related both to the continuity and reliability of service and to energy efficiency.

Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more "green"?

- Cooling systems capable of power adjustment depending on the needs are put in place
- A thorough work of hot aisle – cold aisle confinement was carried out in the whole Data Centre, resulting in a complete reorganization of the workspace. The confinement employs fireproof polycarbonate structures that were specifically designed and built by the Consortium.
- The cold aisles are also equipped with cooling fans mounted on the floor, to improve air flow capacity and cooling efficiency.

Give an estimate of the energy savings obtained by energy efficiency technologies and practices adopted in your data centre?
We believe that the aforementioned solutions allowed a 15% saving in the amount of electricity consumed.
Do you currently measure the energy performance of your data centre? If yes, please give us:
We can only measure some global values with an extrapolation of electricity consumptions of IT equipment and of cooling equipment. This is due to an insufficient number of multimeters dedicated to electrical data acquisition. Installation of measuring equipment is under way.

Which barriers (technical and non-technical barriers) were detected to the introduction of

energy efficient solutions in your data centre?
Various barriers to the introduction of more efficient cooling solutions were detected:

1) Lack of literature and best practice surveys on energy efficiency and reliability of service in data centres;
2) Cultural barriers within the organization in the acceptance of novel technological approaches
3) Lack of adequate monitoring, through the available measuring systems, of the relevant environmental variables (temperature, energy, airflow capacity)
4) Lack of financial resources to carry out an effective design of data centre, both for consultants and for appropriate equipment.

What are the solutions adopted by your data centre in order to overcome these barriers?
Patience; data acquisition to demonstrate the effectiveness of solutions; involvement of the user community; exchange of experiences with other Data Centre managers.

In your opinion, what are the most effective solutions one should adopt in order to improve energy efficiency in data centres?
Hot aisle – cold aisle separation

Describe further improvements envisaged for your data centre in the near future.
Fulfilment of the installation of measuring sensors; adoption of condensation with water exchangers; free cooling; cogeneration and trigeneration.

In your opinion, which technologies/solutions will contribute in the future to improve energy efficiency in data centres?
Consumption optimization; water exchangers; free cooling; cogeneration and trigeneration; aisle separation.

2.1.4 *Questionnaire 3*

Name: **Giuseppe Andronico**
Company name: **INFN** (Italian Nuclear Physics Institute)
Position: Tecnologo
Phone: +390953785304
E-mail: giuseppe.andronico@ct.infn.it

Data Centre information

Name/Acronym of the Data Centre: CenCal & GRID, Sez. INFN CT
Country/City: Catania, Italy

Make a short description of the Data Centre (computer facilities/power, storage facilities, provided, R&D programs, etc.).

CenCal is the data centre, hosting services and two small computing clusters, about 50 computers

GRID is hosting the computer power of Catania grid site: about 600 computers

Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more “green”?

In CenCal cooling was changed with new splitter energy saving systems.

In both centres we are moving towards blade technology to limit power consumption.

Which barriers (technical and non-technical barriers) were detected to the introduction of energy efficient solutions in your data centre?

Not enough money to carry out the adoption of energy-efficient solutions.

Describe further improvements envisaged for your data centre in the near future.

When enough money will be available we can move towards machines we can turn on and off dynamically on the basis of the load, implement free cooling in winter, make use of the heat produced.

In your opinion, which technologies/solutions will contribute in the future to improve energy efficiency in data centres?

Solid state Disk: in this way computers will not have mechanical parts can be damaged from repeated turn off/turn on

Battery on the motherboard, to avoid use of UPS

2.1.5 *Questionnaire 4*

Name: **Mihai Barbulescu**
Company name: **ARNIEC Agency**
Position: IT manager
Phone: +40-728648600
E-mail: mihai@roedu.net

Data Centre information:
Name / Acronym of the Data Centre: "Andrei Eduard RoEduNet DC"
Country / City: Romania / Bucharest
Webpage: www.nren.ro

Make a short description of the Data Centre (computing facilities / power, storage facilities, services provided, R&D programs, etc.)
The data centre is equipped with ten 44U racks; two Gammatronic ups each with 50KVA nominal power and two liebert hiross air condition equipments. The network equipments are manufactured by CISCO, Juniper and the computer and storage equipments are manufactured by HP, Dell, and Sun.

Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more "green"?
In the last three years we've bought more compact equipments which deliver more performance and less power consumption. Also, we've switched from 380V network equipments to 220V.

Give an estimate of the energy savings obtained by energy efficiency technologies and practices adopted in your data centre?
We've managed to reduce the power consumption by 30 %.

Do you currently measure energy performance of your data centre? If yes, please give us:

- **Total Energy Consumption (costs) of the data centre:** 40 kW.
- **PUE (total facilities power/IT equipment power)**
- **Energy costs / total costs of operation**

Which barriers (technical and non-technical barriers) were detected to the introduction of energy efficient solutions in your data centre?
The main barrier was the total cost of the operation.

What are the solutions adopted by your data centre in order to overcome these barriers?
We've invested very carefully and with a very good budget plan (marketing strategies.)

In your opinion, what are the most effective solutions one should adopt in order to improve energy efficiency in data centres?
To reduce the number of unnecessary network equipments.

Describe further improvements envisaged for your data centre in the near future.
Replace the computer servers (PCs) with a blade system (ex. Sun, Hp).

In your opinion, which innovative technologies / solutions could contribute in the future to improve energy efficiency in data centres?
To install compact network equipments with low power consumption.

2.1.6 *Questionnaire 5*

Data Centre information

Name/Acronym of the Data Centre: **Undisclosed**

Country/City: Romania/Bucharest

Field of activity: Multinational bank

Make a short description of the Data Centre (computing facilities/power, storage facilities, services provided, R&D programs, etc.).

- 14 IBM RACKS
- IBM Servers: X Series and P Series
- IBM SAN
- CISCO Equipments

Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more "green"?

- Last UPS Cluster generation
- IBM and CISCO ultimate technology
- Ultimate A/C equipments for Data Centres

Give an estimate of the energy savings obtained by energy efficiency technologies and practices adopted in your data centre?

Around 10-15%

Do you currently measure the energy performance of your data centre? If yes, please give us:

- **Total energy consumption (costs) of the data centre**
- **PUE (total facilities power/IT equipment power)**
- **Energy costs/total costs of operation**

No

Which barriers (technical and non-technical barriers) were detected to the introduction of energy efficient solutions in your data centre?

Our Data Centre is powered from the electrical public network

What are the solutions adopted by your data centre in order to overcome these barriers?

None (View also previous point)

In your opinion, what are the most effective solutions one should adopt in order to improve energy efficiency in data centres?

- Reduce the number of IT&C equipments
- Use of ultimate IT&C technologies

Describe further improvements envisaged for your data centre in the near future.

View previous point

In your opinion, which innovative technologies/solutions could contribute in the future to improve energy efficiency in data centres?

No opinion

2.1.7 *Questionnaire 6*

Data Centre information

Name/Acronym of the Data Centre: **Anonymous** collocation provider (member of The Green Grid)

Country/City: Netherlands

Make a short description of the Data Centre (computing facilities/power, storage facilities, services provided, R&D programs, etc.).

Computing facilities, power facilities

Which energy efficiency technologies and practices have been adopted (in the last 3 years) in your data centre in order to become more "green"?

Cooling towers and an elevated water temperature and a very advanced metering and control system on the cooling system. And a white coloured roof.

Give an estimate of the energy savings obtained by energy efficiency technologies and practices adopted in your data centre?

Unfortunately, this number is confidential

Do you currently measure the energy performance of your data centre? YES

If yes, please give us:

- **Total energy consumption (costs) of the data centre:** confidential
- **PUE (total facilities power/IT equipment power):** 1,28 at full load. Present figure is confidential
- **Energy costs/total costs of operation:** Unfortunately, this number is confidential

Which barriers (technical and non-technical barriers) were detected to the introduction of energy efficient solutions in your data centre?

First of all, one should understand that there is a fundamental difference between in-company data centres (that work for their own company) and commercial collocation centres that work for many different customers. We are a commercial collocation centre, so we have to keep our customers happy. Otherwise they just go to another data centre.

For us as a commercial collocation centre the main barriers are reliability and sales requirements.

Reliability: Customers select a data centre based on reliability, reliability, reliability… and then whether or not it is green. So it is not possible to take risks with new techniques that can result in failures for customers.

Sales requirements: We as an independent collocation centre have customers. Customers specify SLAs. The requirements in these SLAs are not in accordance with what is desirable from an efficiency point of view: requirements on air temperature, air humidity.

What are the solutions adopted by your data centre in order to overcome these barriers?

We are less efficient than we would like to be.

In your opinion, what are the most effective solutions one should adopt in order to improve energy efficiency in data centres?

Increase the server temperature.

This is not possible in an existing data centre with existing customers. It might be possible in new data centre with new customers to start with these new requirements. You could e.g. increase the server temperature from 20 ºC to 24-26 ºC, in accordance with the ASHRAE standards.

Describe further improvements envisaged for your data centre in the near future.

Modular building of installation.

In your opinion, which innovative technologies/solutions could contribute in the future to improve energy efficiency in data centres?

Increasing server temperature will make cooling largely redundant.

General comment

The bad image of data centre as energy guzzlers disturbs me. If you remove data centres and everyone does it by himself using his own ICT equipment, then the energy consumption may be less visible, but it is higher in total! (Compare the energy use of a bus with that of many cars.)

3 CONCLUSIONS

From the literature review and the questionnaires it can be concluded that the barriers and solutions for the application of energy efficient data centres are quite diverse. Also the existing level of application of energy efficient solutions varies. The following general picture can be derived:
The main barriers as reported by the staff of data centres are of **organisational and economical nature.**

- Economical barriers include issues such as the upfront investment required, its payback time and the risks involved.
- Organisational barriers include issues such as the split incentives, which occur when data centres operate in leased buildings, or when the data centre operator is unaware of or indifferent to the energy use in the equipment.
- For commercial collation centres Service Level Agreements (SLAs) with customers put additional restrictions on the optimisation of the air conditioning installation

The **level of knowledge** is also a significant barrier as illustrated by the different responses with regard to the most effective solutions.

- A basic tool such as monitoring of equipment - a necessary instrument for optimisation of the operation of the existing data centre and of future investments - is not always present. In one of the data centres that returned a questionnaire the energy consumption of the data centre is not known. It is not separately measured at all.
- In spite of initiatives such as the Green Grid, and European and national covenants with the IT sector, exchange of information between data centres regarding their operational efficiency is hampered by confidentiality (for commercial reasons).

A third type of barrier is the lack of **interaction between** professionals involved in **design** of data centres and professionals involved in the **operation**. As a consequence of this not all data centres have a modular design of cooling and UPS systems. This results in inefficient operation in part-load situations, which is the common mode of operation of most data centres.

The **solutions to these barriers**, as mentioned in the questionnaires include:

- applying technologies with a short payback time
- developing technology rather than replacement
- patience
- data acquisition to demonstrate the effectiveness of solutions
- involvement of the user community
- exchange of experiences between data centre managers
- for <u>new</u> customers: adapting temperature levels in Service Level Agreements in accordance with ASHRAE standards [5]
- increase synergies between IT managers and Facility managers.

Some of the data centre managers also expect further improvement from the introduction of new technologies such as: computers with solid state disks; battery on the motherboard (to avoid the use of UPS); use blade systems.

REFERENCES OF TOPIC A

[1] 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

[2] Improving Data Center Efficiency: Some Policy Possibilities, Alliance to Save Energy, 2007.

[3] http://ecbc.hypo.org/Content/Default.asp

[4] http://www.neep.org/

[5] http://www.ashrae.org/members/page/612

TOPIC B: ICT SYSTEMS TO ENCOURAGE THE APPLICATION OF TECHNIQUES FOR REDUCING GHG EMISSIONS

AUTHORS OF TOPIC B REPORT

- Efstathia Kolentini (ICCS-NTUA) (lead author Topic B)

INTRODUCTION

We all know that we need to make the transition to a low carbon economy. This is vital to ensure that we reduce our carbon emissions and to enable players – energy customers to take advantage of new opportunities. The transition needs strategy and planning, a good example of doing this is the 'Low Carbon Transition Plan and the Low Carbon Industrial Strategy' of UK. An important part of this transition is helping organisations understand how what they do generates greenhouse gas emissions and what they can do to minimise them. On this basis, the first step to reduce the carbon footprint is to measure it. Under this scope it would be recommended to all organisations that they publish an annual report and accounts. Many businesses have found that once they start measuring their emissions they identify ways they can do things differently and save money as well as carbon. This applies to any business, regardless of the size. So this guidance can also help organisations manage their carbon risks and opportunities. This is something customers and investors are increasingly expecting businesses to do.

4 IDENTIFY BARRIERS FOR ICT APPLICATIONS LINKED TO GHG EMISSION REDUCTIONS

In order to better deploy ICT tools and facilitate the GHG reduction a number of barriers have to be overcome. Some of these barriers have been identified below:

4.1 Technical barriers

4.1.1 *Standardized methodology*

There are no standardised methodologies adopted for CO2 emissions calculations up to now. Several measurement equipments used in the LV/MV compute CO2 emissions basing on the energy consumption and using the '***carbon footprint***'. 'Carbon footprint' is a shorthand term to describe the total amount of greenhouse gas (GHG) emissions for which an organization, household or individual is responsible.

A carbon footprint takes into account all types of greenhouse gases – not just carbon, but it is usually expressed as a carbon dioxide equivalent (CO2-e) which is a simple unit for adding up and comparing the amount of global warming caused by different greenhouse gases. There are many different ways of calculating a carbon footprint, ranging from a quick estimate to a comprehensive audit done by qualified experts.

An '***emissions factor***' is a multiplier based on the standard rate of greenhouse gas emissions for a given activity. Emissions factors are used to calculate the amount of greenhouse gas emissions produced per unit of activity. Governments and international bodies, such as the International Panel on Climate Change, agree on standard emission factors for calculating the emissions from different activities. Emission factors are regularly being reviewed and updated based on new scientific research, changes in the way energy is produced, or amendments to the agreed way of measuring emissions.

The emissions factor used for regular electricity is given in kg CO2-e per kilowatt hour (kWh). This is the '***full fuel cycle factor'*** which, besides the emissions directly attributed to the activity execution, takes also into account:

- direct emissions from burning fuel at the power plant
- indirect emissions from the extraction, production and transport of the fuel
- indirect emissions attributable to the electricity loss during transmission from the power station to the point of use

The most common approach used to calculate GHG emissions is to apply documented emission factors to known activity data from the organisation under the concept:

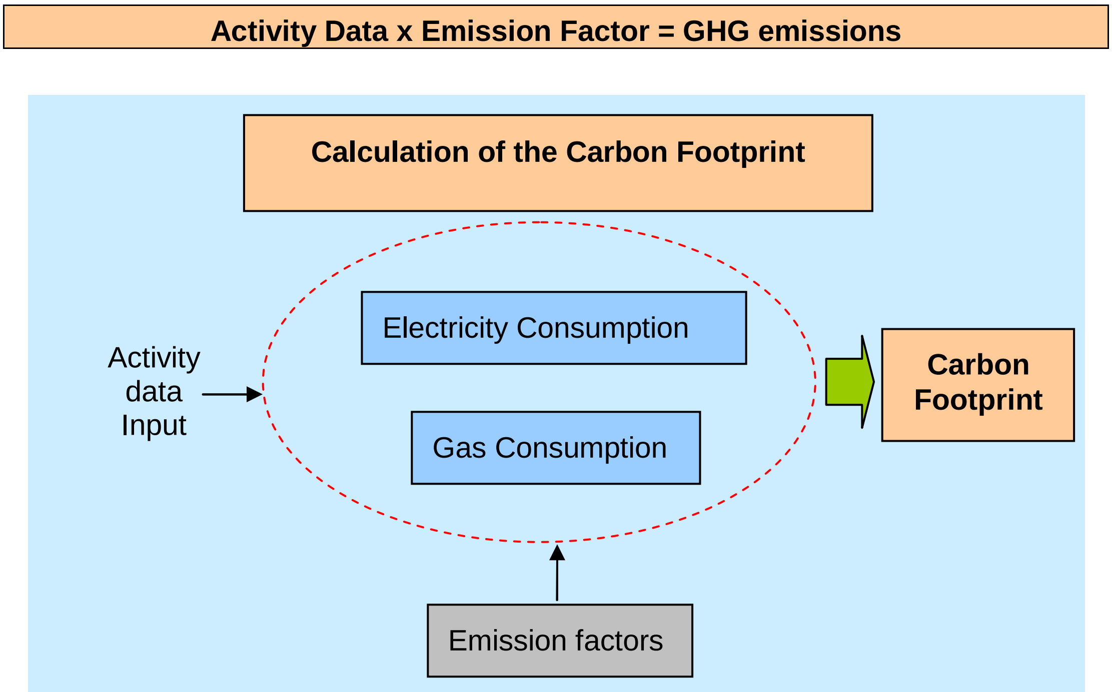


Figure 1. Calculations used for measuring CO2-e footprint

Most activity data are easy to obtain, relatively accurate and can be found on bills, invoices and receipts. Figure 1 sets out common emission-releasing activities to change this data into GHG emissions.

In some cases, like UK which is one of the most organised in this sector, the country provides to the citizens/companies emission factors in order to give all the players the opportunity to calculate the total GHG emitted

In alternative, when the metering system is applied in electricity customers for online DSM techniques, it is often that CO2 is calculated following the same concept but instead of drawing estimation from the electricity bill, the equipment deploys the measurement of the energy consumption and depicts the associated CO2 to the user at anytime.

4.1.2 *Accuracy*

The degree of accuracy depends on the methodology and the assumptions taken and on how much time and efforts are put into collecting quality information. To calculate a carbon footprint, and integrate the calculation in a measurement equipment, someone must first define the scope of what is being measured i.e. what is and isn't included. Decisions about the scope of a carbon footprint will depend on the purpose for doing the footprint, the information you have available and other considerations. A first set of criteria is determined by the participation of the players in certain schemes which can be depicted below with their assurance requirements:

Table 1: Assurance requirements

Scheme	Indicative Assurance requirements
EU ETS (European Union Emissions Trading Scheme: EU-wide cap and trade scheme.)	Annual emissions reports under the scheme require an independent verification to be submitted to the relevant regulator by the end of March every year.
CDM (Clean Development Mechanism: a Kyoto Protocol mechanism allowing industrialised countries to invest in projects that reduce emissions in developing countries.)	Independent validation of project design and verification and certification of emission reductions are required.
Regional Greenhouse Gas Initiative (Regional cap and trade scheme.)	Representative of each CO2 budget unit to install and certify monitoring systems and to collect and record data and assure quality. Report data necessary to quantify CO2 mass emissions from that unit.

4.1.3 *Assurance adoption*

Of course the lack of the accuracy requirements leads to lack of the assurance methodology. Apart from fulfilling mandatory requirements, assurance has a range of further benefits.

- Trust building: a study has shown that 70% of consumers want independent verification of corporate environmental claims [1]
- Reporting GHG emissions data certified by third-party assurers demonstrates commitment to environmental transparency and accountability.
- Third-party assurers often have broad oversight of good practice reporting processes, with experience of common weaknesses and of how efficiencies can be enhanced, providing an opportunity to review and improve the processes and controls employed,
- Assurance gives confidence that emissions information used within the business for performance management and decision making fits the purpose.
- Assurance gives confidence that externally published information is reliable and fits the purpose.

4.1.4 *Assurance standards*

There is a number of different assurance standards. The choice may be prescribed by a particular scheme or a company that is voluntarily seeking assurance of its emissions may be able to select. The main assurance standards are shown in Table 2:

Table 2: The main assurance standards

Assurance standard	Description
ISAE 3000 (http://www.ifac.org/IAASB/ProjectHistory.php?ProjID=0008)	A non-financial assurance standard produced by the International Auditing and Assurance Standard Board (IAASB), which is commonly applied to environmental, social and sustainability information. The standard is currently being reviewed/updated and a specific standard for GHG assurance standard is being drafted.
AA1000 Assurance Standard (http://www.accountability21.net/default2.aspx?id=1024)	An assurance standard for assessing compliance with the AA1000 corporate responsibility principles and reporting of sustainability information/data.
ISO 14064 Pt3 (http://www.iso.org/iso/catalogue_detail?csnumber=38381)	Provides verification/validation guidance for GHG emissions reports carried out in accordance with ISO 14064 Parts 1 and 2.

4.1.5 *Non Inclusion in the ETS*

The Emission Trading Scheme does not include all the Energy Sectors: it includes the power production units and some industries but not the distribution companies, neither the consumers. Iin order to give the opportunity to a large panel of users to take part in the emissions reduction through the inclusion in the ETS efforts of DNOs, TSOs and end users for linking and transferring the information will be necessary.

According to the conference organized by electricity industry association Eurelectric heard in Brussels ''Demands to cut power costs while investing in smart grids to reduce CO2 make for a difficult business model for electricity distribution system operators (DSOs)''. But as Hans Ten Berge, Eurelectric's secretary-general, stated "While distribution system operators have traditionally been in charge of innovating, they don't get the benefits of CO2 cuts," since "DSOs are not trading emission rights nor do they get the returns for renewables investment"

Additionally and according to the deliverable 'Advanced Architectures and Control Concepts for More Microgrids' of the MoreMicrogrids project, ''developing adequate business models where participation in CO2 emissions market is allowed in parallel with classical economic optimization can greatly increase the environmental and economic benefits achieved by distributed energy operators, with benefits for the overall society''.

4.2 Non-technical barriers

4.2.1 *Lack of knowledge*

Due to a lack of accurate data in advance of the Emissions Trading Scheme and pressures from stakeholders towards national governments, allowances to emitters were over allocated. Within the 2^{nd} and the post Kyoto period, having already recorded more accurate emissions data and a centralized cap-setting and reporting process, the emissions cap is getting lower.

Concerns about the volatility emerged when initially high allowances prices (driven largely by high global energy costs) dropped precipitously in April 2006 upon the release of more accurate, verified emissions data. Late in the trial phase, there was another sharp decline in allowance price because there were no provisions for banking emissions reductions for use in the second phase of the program. Improved data quality and provisions for unrestricted banking between compliance periods will help moderate price fluctuations in the future;

Windfall profits by electric power generators that passed along costs (based on market value) of their freely issued allowances resulted in improved understanding of how member country electricity sector regulations affect the market and calls for increased auctioning in subsequent phases of the program.

Reviewing the above it becomes obvious that when the CO2 system is mature the knowledge that is increased can be exploited in order to broaden the Emission Trading Scheme and include other sectors. Of course, in order to regulate, employ, exploit the possibilities of the Scheme, knowledge should concentrated, and trained staff should be able to use it on behalf of the corresponding players in the emissions market.

4.2.2 *Lack of EU projects*

In order to improve the awareness and obtain trained staff, EU projects on the specific issue of opening the Emissions Trading Scheme to other sectors, should be created with the overall target of setting rules on the regulation of the market, on clarifying the data transmission rules, on the level of accuracy of the data, the assurance procedure, on the standardised calculation methodologies, etc.

4.2.3 *Costs for ETS system*

The costs for maintaining the ETS system (trading, monitoring, and verification) are also a non-technical barrier to apply more ICT tools that facilitate GHG reductions, especially if one looks at smaller customers and generators.

4.2.4 *Policies*

Overall, the regulation framework of the countries is setting the rules, the limits, the policies, the government (financial) incentives, to move more aggressively on the issue of CO2 awareness, the inclusion of the rest of the sectors in the Emissions Trading Scheme, the promotion of the environmental impact on the metering equipments. The lack of motivation for moving to a low carbon economy is linked to the lack of policies that give the right incentives, economic such as regulation.

5 SOLUTIONS TO BARRIERS

The need to integrate the depicted CO2 emissions in the measurement equipment means that this equipment must comply with certain requirements. In this paragraph suggestions on some possible solutions linked to the above barriers are given, such as:

5.1 Inclusion of other Sectors in Emission Trading Scheme

Of course all the ways CO2 data will be integrated in the metering systems don't have any special meaning if other sectors, apart from power plants and industries, are not included in the ETS Scheme.

5.2 Standardised way

Standardised ways of CO2 calculation should be adopted should the carbon footprint be integrated in the metering devices. These calculations will follow the rules that will be adopted according to the inclusion of the players (MV/LV customers) in the ETS Scheme. As an example the following structure can be indicative:

- The Production Units send their emission factors to the TSO
- The TSO sends the total factor of the system to the DSO, who can be the Operator of the Metering devices, or the device directly, depending on the type of customer, HV or MV/LV respectively
- The DSO sends the factor to the device
- The devices depict the CO2 emitted and inform the end user

The proposed structure can be seen in Figure 2 below. In order to apply the above scheme, decisions on the amount of data exchanges would arise. Since the total system emissions factor changes according to the energy mix and the use of the power plants, it is critical to decide the rate of the data updates. Moreover decision on whether system losses will be included in the CO2 depiction or not is critical for their inclusion into the calculations.

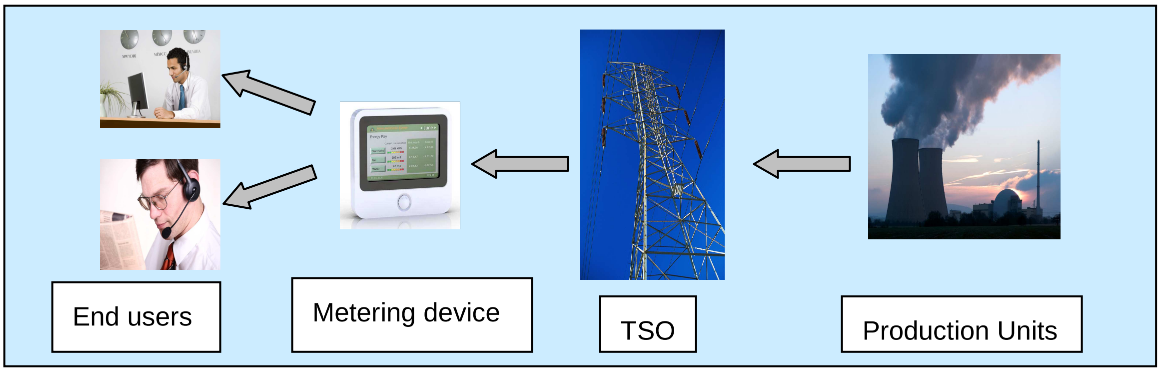


Figure 2. Structure of the interaction of players within ETS

Strategy

Measurement and reporting are a vital part of an end-user's overall carbon strategy. Therefore before starting measurement integration, it is important to consider the overall objectives and drivers, to ensure that it will cover the relevant areas.

These objectives should address the following questions. What would be an appropriate baseline and what type of targets do the player want to set (e.g. absolute or relative)? Does the reporting system allow someone to track progress against targets? What level of reporting do stakeholders expect of the customers activities? Once measured, the carbon footprint should feed back into strategy to help define specific targets and future action.

Define what is measuring and choose a standard

Energy customers can measure their performance. The challenge of measuring a footprint begins with choosing the right reporting standard. It is important to use a recognised methodology, to ensure credibility. The most commonly used standards for voluntary reporting are the GHG Protocol and the ISO 14064.9.

- An international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions, the Greenhouse Gas Protocol (GHG Protocol) was jointly agreed in 1998 by the World Business Council for Sustainable Development (WBCSD) and the World Resources Institute (WRI). The GHG protocol frames the problem of measuring emissions by dividing them into three scopes covering direct emissions, indirect emissions and emissions outside a company's direct ownership and control [3].
- ISO 14064 (Parts 1, 2 & 3) is a family of three standards that specify principles and requirements for quantification and reporting of greenhouse gas (GHG) emissions and removals at the organisational level (Part 1), the project level (Part 2) and a standard for validation (Part 3). ISO 14064 is an international standard that provides a framework enabling organisations to quantify and report on greenhouse gas emissions and removals [4]. Its companion standard, ISO 14065, details requirements for GHG validation or verification bodies for use in accreditation or other forms of recognition.

Of course these standards should be applied not on a voluntary basis but be part of directives in order to be broadly and commonly used. For this reason they should also be broaden to include rules for the TSOs, DSOs, end users exchange of data as well as communication requirements. These rules should be aligned according to the ETS operation.

Set the organisational boundaries

Each energy customer must clearly define its reporting boundaries. There is a number of accepted ways to do this. Organisational boundaries define how a player will account for its own operations. The GHG Protocol provides two approaches – equity-based or control-based responsibility. If significant areas outside the control of the customer are identified, the goal should be to widen the reporting scope over time to include these areas.

Data Collection

Develop internal procedures and guidance needed to provide data. This process should include:

- establishing data requirements including format, frequency, materiality, accuracy, and treatment of anomalies
- establishing quality control/monitoring procedures to address reporting risks. Information should be reviewed and challenged to expose any weaknesses in completeness or accuracy
- creating incentives for accurate reporting.

Key performance indicators (KPIs) should be integrated into management reporting frameworks, to remind of the importance of the task.

Reporting

The baseline and targets should be discussed and assessed when the initial strategy is created. After the emissions data have been collected they should be reassessed and defined, in accordance with the quality of data available and the message the customer wishes to communicate to its stakeholders. An historic baseline will demonstrate progress already made, but it is essential to disclose any assumptions and estimates that have been used to arrive at this historic picture; they may be based on less accurate information. The essential backbone of a report on GHG emissions is a clear description of the scope of reporting, the methodology used, and any key assumptions used in making calculations.

The next step is to demonstrate an understanding of the risks and opportunities that climate change poses to the energy customer as a whole and where possible to quantify their financial impacts, as well as how the customer intends to deal with them.

Reporting an organisation's carbon footprint internally is equally important and is often forgotten. Internal feedback on how local operations are performing, through internal benchmarking and progress reporting, can help to secure local buy-in and emissions reduction for what is often viewed as a corporate HQ requirement.

5.3 Accuracy

The level of accuracy can be decided to be linked to the application. Not the same level is needed when the scope is to solely to encourage the consumers to cut their demand. But high accuracy is needed for companies participating in the Emissions Trading Scheme

The metering equipment can for the former above reason include production factors only, also mean factors, but for the latter should also calculate system losses. Companies and Consumers (MV and LV customers) that can be included in the ETS Scheme, have the right to sell and purchase CO2 allowances. That means they are allowed to emit up to a certain limit and then manage their lack or surplus in the CO2 market. Of course when we refer to low voltage consumers, it is necessary to clarify that they have to aggregate in order to be able to trade a sufficient amount of allowances, given that they are included in such a Scheme. In this case also this type of customers will demand accuracy.

The factors can either be integrated in the equipment and updated every a certain period or sent by the TSO, again depending on the use and level of accuracy.

5.4 Approaches to assurance

Certain aspects should be agreed at the beginning of the assurance process such as:

The level of assurance

ISAE 3000 defines two levels, reasonable assurance and limited assurance, as follows:

Reasonable assurance seeks a similar level of accuracy as required for a set of financial statements. It requires a potentially significant amount of testing and evaluation of underlying information sources and processes, depending on the robustness of the controls in place. The resulting assurance conclusion is positive, usually stating that the reported information is 'fairly stated'.

Limited assurance is a lower level of assurance. It allows for a lesser amount of testing and evaluation of underlying information sources, which is reflected in the external assurance report. The result is a negative conclusion, usually stating that 'nothing has come to our attention to suggest that the reported information is not fairly stated'.

Limited assurance often suits to consumers that do not take part in the ETS and to this end they're new to assurance, and want to gain an initial understanding of the robustness of their processes, before committing to reasonable assurance, which can be a more intensive process.

The objective of the assurance

Some of the options include assurance about emission quantities, that a specific project has delivered stated reductions, production of an internal report to management containing recommendations on how the measurement and reporting processes can be improved.

Reporting and assurance criteria

Typical criteria include completeness, accuracy, consistency and transparency. The assurance provider will also consider a quantitative threshold if appropriate, but will also have qualitative aspects to ensure that information is being reported in a balanced way, and is consistent with the reporting criteria. A degree of professional judgement will always be used in assessing whether an issue is material to the assurance conclusions.

The future of assurance

Independent assurance is increasingly becoming an important control mechanism for company management, including disclosure committees, audit committees and main boards. This requires an increasing level of scrutiny and robustness in the process, as expectations evolve.

Improvements are needed in the consistency of assurance, including the approach used and the way conclusions are expressed, to provide users with a clear understanding of what assurance means. Use of recognised international assurance standards is an important way of improving consistency.

5.5 EU projects - Training

The reduction of emissions might be just one aspect to ensure the environmental protection, also combining the creation of employment or training opportunities and sustainable management.

Training courses can be established with energy consumers to ensure that they have the technical and other information they need to participate in the framework of the ETS expansion. The process then should involve the provision of training, information and resources to help communities design and build high quality, reliable systems and to engage services to maintain these systems.

Moreover new projects can focus on setting rules for the regulation of the market, on clarifying the data transmission rules, on the level of accuracy of the data, the assurance procedure, on the standardised calculation methodologies.

6 CONCLUSIONS

To summarize, there are many barriers technical and no technical that need to be overcome in order to fill the gaps and come up with a common standardised way of metering CO2 in order to give the opportunity to a large set of players to take part in the CO2 market. Some of the barriers identified are:

- Lack of standardised methodologies adopted for CO2 emissions calculations
- The degree of calculations accuracy in the metering systems is not defined
- The lack of the assurance methodology
- Non Inclusion in the ETS of a larger panel of users
- Lack of EU projects oriented on the issue
- Costs for implementing ETS system to a broad panel of users
- The regulation framework of the countries that doesn't allow broad implementation

According to these barriers, solutions that are proposed are the following:

- Standardised ways of CO2 calculation should be adopted, under certain strategies, standards, data collection specifications
- Inclusion of other Sectors in Emission Trading Scheme
- The level of accuracy can be decided to be linked to the application
- Assurance adoption
- Training the players through EU projects on the topic
- Adoption of regulations in the countries that take part in the ETS

7 REFERENCES OF TOPIC B

[1] Source: What Assures Consumers on Climate Change, Accountability http://www.accountability21.net/publications.aspx?id=1090

[2] Carbon jigsaw briefing Carbon measurement, reporting and assurance, KPMG

[3] http://www.ghgprotocol.org/

[4] http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=29516

[5] Advanced Architectures and Control Concepts for More Micrigrids, DH3. Business Cases for Microgrids, December 2009