COMMISSION OF THE EUROPEAN COMMUNITIES

Brussels, 13.5.2008
COM(2008) 241 final

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS

Addressing the challenge of energy efficiency through Information and Communication Technologies

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(Text with EEA relevance)

At the 2007 Spring European Council, the Heads of State and Government highlighted the development of a sustainable integrated European climate and energy policy as a top priority and adopted an energy and climate package to guide the EU towards a competitive and secure energy economy while promoting energy savings and climate-friendly energy sources[1]. Europe faces three main challenges in this field — tackling climate change, guaranteeing secure, sustainable and competitive energy, and making the European economy a model for sustainable development in the 21st century.

The resolve of the European Council to transform Europe into a low-carbon, high energy-efficiency economy means that the continued growth of the European economy, essential to achieve full employment and inclusion, needs to be decoupled from energy consumption. The current trends are unsustainable. Indeed, if nothing were to change, final energy consumption in the EU is predicted to increase up to 25% by 2012, with a substantial rise in greenhouse gas emissions.

Information and Communication Technologies (ICTs)[2] have an important role to play in reducing the energy intensity[3] and increasing the energy efficiency of the economy[4], in other words, in reducing emissions and contributing to sustainable growth. In order to achieve the ambitious targets set and meet the challenges ahead, Europe needs to ensure that ICT-enabled solutions are available and fully deployed.

But emerging changes offer the possibility of modernising the European economy, towards a future where technology and society will be attuned to new needs and where innovation will create new opportunities. ICTs will not only improve energy efficiency and combat climate change, they will also stimulate the development of a large leading-edge market for ICT-enabled energy-efficiency technologies that will foster the competitiveness of European industry and create new business opportunities.

With the above in mind, this Communication aims to raise awareness of the current and potential impact of ICTs as an enabler for energy efficiency, stimulating an open debate among the relevant stakeholders in a number of selected areas. Addressing the challenge of 'Energy Efficiency through ICTs' will start by bringing together stakeholders in the ICT and energy domains to create synergies. Business, government and civil society will then be called upon to enter a new form of collaboration and innovative leadership.

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1 http://register.consilium.europa.eu/pdf/en/07/st07/st07224-re01.en07.pdf The targets for 2020 are: 20% reduction in emissions compared to 1990 levels; 20% share of renewable energies in overall EU energy consumption; and 20% savings in EU energy consumption compared to projections.

2 ICT refers to micro- and nano-electronics components and systems, but also to future technologies such as photonics that promise both far greater computing power for a fraction of today's power consumption and high brightness, easy controllable, power-efficient lighting applications

3 The amount of energy required to produce a unit of Gross Domestic Product (GDP).

4 To assess the energy efficiency of a product the energy consumed for its manufacturing, distribution, use and end-of-life treatment is to be considered.

1. SETTING THE SCENE

During 2007, a consensus crystallised on the need to put a combined climate and energy policy at the heart of the EU political programme, central to the Lisbon and renewed sustainable development strategies and of primary geo-political importance considering oil reserves and prices. The European Council set precise and legally binding targets as a symbol of Europe's determination.

Later, on 23 January 2008, the European Commission adopted a far-reaching package of concrete measures[5] demonstrating that the agreed climate change targets are technologically and economically feasible and provide a unique business opportunity for thousands of European companies.

This Communication also builds on and supports the European Strategic Energy Technology Plan and other numerous actions launched by the European Commission in different areas, all aiming to tackle the climate change challenges.

Against this background, it is clear that, if Europe is to succeed and achieve its ambitious objectives, the role of ICTs **as an enabler of energy efficiency** across the economy including fostering the change in citizen's behaviour, as well as in improving efficiency in the use of natural resources while reducing pollution and dangerous waste, needs to be fully explored and exploited.

To put ICTs at the core of the energy efficiency effort and to enable them to reach their full potential, the following needs to be done:

- Firstly, it is necessary to **foster research** into novel ICT-based solutions and **strengthen their take-up** — so that the **energy intensity of the economy can be further reduced** by adding intelligence to components, equipment and services;
- Secondly, efforts should be made so that ICT leads by example and **reduces the energy it uses** — ICT industry accounts for approximately 2% of global CO2 emissions[6], but is pervasive throughout all kinds of economic and social activities, and increasing its use will result in energy savings from the other industries;
- **Thirdly and mainly, it is crucial to encourage structural changes** aimed at realising the potential of ICT to enable energy efficiency across the economy, e.g. in business processes through the use of ICTs, e.g. substituting physical products by on-line services ('dematerialisation'), moving business to the internet (e.g. banking, real estate) and adopting new ways of working (videoconferencing, teleconferencing).

The following sections of this Communication present the main elements to be considered under the above three priority areas.

2. ADDRESSING THE CHALLENGE: POLICY ORIENTATIONS FOR FUTURE ACTION

It has emerged from broad stakeholder consultations[7] carried out for this Communication that a limited number of actions proposed in areas with a high potential impact could be the most appropriate avenue for addressing energy efficiency through ICTs.

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5 http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0030:FIN:EN:PDF

6 Gartner's study of April 2007 http://www.gartner.com/it/page.jsp?id=503867

7 Reports are at http://cordis.europa.eu/ist/environment/workshop-210306.htm, http://ec.europa.eu/information_society/activities/sustainable_growth/docs/ee_report_draft.pdf. and at http://cordis.europa.eu/fp7/ict/sustainable-growth/event-20080131-eusew_en.html.

This Communication focuses on two main areas:

- **ICT itself**, a small but very visible energy consumer, through RTD and take-up aimed at improving energy efficiency at the level of components, systems and applications and through adopting green-procurement and substitution technologies.
- **ICTs as an enabler to improve energy efficiency across the economy**, through enabling new business models and improved monitoring and finer control of all sorts of processes and activities. All sectors of the economy, now increasingly ICT-dependent, will benefit to a varying degree, although the initial focus will be on the *power grid*, on *energy-smart homes and buildings* and on *smart lighting*.

In order to validate and test ideas for these two areas, cooperation with and input from urban communities is considered a priority. **Cities** are home to almost half the world's population**,** consume over 75% of the world's energy and produce 80% of its greenhouse gas emissions. Several initiatives focusing on cities have already been launched in Europe[8,9] and worldwide[10], and the intention is to build cooperation with these existing networks and if possible develop ICT-based initiatives with and within cities.

To inform and structure dialogue in the two areas, a **Consultation and Partnership Process**[11] on ICTs for Energy Efficiency will be launched. The objective of this horizontal activity will be to foster cooperation and understanding among all the actors involved in the energy and ICT domains, including regions, cities and authorities.

2.1. Reducing the carbon footprint of ICTs

The 'carbon footprint' of an organisation is the volume of greenhouse gas emissions it generates. It is calculated by assessing energy usage, business travel, and all components of the organisation's operations that consume power or generate waste and by-products. An organisation is 'carbon neutral' when there is balance between the amount of carbon released and the amount of carbon sequestered (for example, by planting trees).

The ICT industry is in a unique position to demonstrate leadership in reducing its footprint, through *structural change* and *innovation* as well as by leading the way in identifying and creating efficient solutions for other socio-economic sectors to follow.

2.1.1. Making the ICT sector a leading contribution to structural change

The issue:

'Structural change' means re-engineering the way an organisation operates. This can be done for instance by replacing products with on-line services (e.g. company newsletters), by moving business to the internet (e.g. costumer's support), by adopting new ways of working (tele-working and flexi-work enhanced by video-conferencing and tele-presence tools) and by exploring the viability of using green suppliers and energy from renewable resources.

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8 E.g. The Covenant of Mayors (http://europa.eu/rapid/pressReleaseAction.do?reference=IP/08/103) and URBACT network (see http://urbact.eu)

9 E.g., the 'Megacity Challenges' study commissioned by Siemens from GlobeScan and MRC McLean Hazel.

10 E.g. the Clinton Foundation's Climate Initiative, known as C40-Cities Climate Leadership Group, www.c40cities.org.

11 According with the Council conclusion on the renewed Sustainable Development Strategy (DOC 10917/06 European Council 26 June 2006) and in the context of the i2010 High Level Group: http://ec.europa.eu/information_society/eeurope/i2010/high_level_group/index_en.htm

Way forward:

- As a pilot explore, together with the ICT sector, the possibility of launching voluntary agreements on:
  - Green procurement within the ICT sector eco-system with the goal of achieving a carbon-neutral industry
- Encourage exchanges of best practices to improve the understanding of the processes involved and of the reasons for the successful take-up, or lack thereof, of specific solutions.

Example of good practice:

British Telecom has been recognised as the world number one telecommunications company in the Dow Jones Sustainability Index[12] for the seventh consecutive year and has achieved a 60% reduction in its UK carbon emissions from a 1996 baseline. The company has set a further target to reduce emissions by 80% from the 1996 baseline by 2016.

2.1.2. Making ICTs a leading contribution to innovation

The issue:

A major research focus has been on reducing the energy intensity of ICT components, sub-systems and end-systems. Progress in micro- and nano-electronics is still governed by Moore's law[13], but emerging technologies, e.g. quantum- or photonics-based, promise considerable computing power for a fraction of today's power consumption.

Tremendous improvements have been made in the area of displays**.** The substitution of old CRTs (cathode-ray tube) with LCDs (liquid crystal display) represents a significant energy efficiency gain[14] and long-life OLED (organic light emitting diode) will enable further improvements.

The power demands of data centres are increasing: currently, 15-20% of the money spent to operate data centres goes towards power and cooling. The availability of 60W servers (consuming about the same as an average incandescent light), combined with other computer techniques, offers the potential for 20-70% overall energy savings, depending on the application[15]. As all ICT and consumer electronics equipment requires power conversion, power electronics remains a crucial issue.

Way forward:[16]

- Reinforce research and technological development (RTD) in new ICT technologies and applications with a high potential for energy efficiency. The ICT Theme in the EU's

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12 http://www.sustainability-index.com/.

13 Moore's law predicts that processing power doubles every two years. The power requirements of a chip of a given capacity roughly halve every 18 months.

14 An LCD consumes around 1/3 the power of a CRT.

15 The Efficient Servers project (http://efficient-servers.eu/), the Green Grid initiative (http://www.thegreengrid.org), the Climate-Savers Computing Initiative(http://www.climatesaverscomputing.org) and The European Code of Conduct for Data Centres.

16 These activities are complementary to the Community's product energy efficiency policies, in particular eco-design (Directive 2005/32/EC),, energy label (Directive 92/75/EEC), Energy Star (Regulation (EC) No 106/2008)

Seventh Framework Programme will be instrumental here, along with national and regional research programmes:

  - RTD on technologies and components to improve energy efficiency, including: computing, displays and power electronics;
  - *RTD on energy-efficient applications and services.*

- Support the deployment of energy-efficient ICT research results via national and regional programmes, the EU Competitiveness and Innovation Programme and relevant operational programmes supported by the Cohesion Policy:
  - Large-scale pilots for footprint tracking of ICTs.

Example of good practice:

In the past, increases in computer performance were achieved by building faster processing units requiring more and more energy. HiPEAC and other research projects under the Sixth Framework Programme have proved that performance can be improved by building several 'slow' processing units in parallel in a single computing chip, therefore decoupling performance from energy consumption.

2.2. ICTs as an enabler to improve energy efficiency across the economy

The enabling potential of ICTs to reduce energy consumption will make a major contribution to improving energy efficiency in all sectors of the economy. Networked embedded components will add intelligence to systems (e.g. vehicles, production plants), making it possible to optimise operations in variable environments.

It is initially proposed to focus on *the power grid, energy-smart homes and buildings* and *smart lighting* (due to their relative importance and potential for improvement). Other sectors with considerable energy-saving potential are the manufacturing industry and transport[17] (estimated, by 2020, at around 25% and 26% of their total primary energy consumption).

2.2.1. Improving the power grid: from generation to distribution

The issue:

The need to improve the power grid is well documented in the Action Plan for Energy Efficiency. The energy transformation sector, dominated by electricity generation, uses around one-third of all primary energy. Given the potential for improvement in electricity generation (estimated at 30-40%) and the considerable losses in transport (2%) and distribution (8%), it is critical to improve transformation efficiency, address losses and identify any potential problems before they compromise supply[18].

ICTs have a major role to play not only in reducing losses and increasing efficiency *but also in managing and controlling the ever more distributed power grid to ensure stability and reinforce security as well as in supporting the establishment of a well functioning electricity retail market*. In fact, the power grid is in a process of radical change. The liberalisation of the European market for energy, the multiplication of local energy networks, the integration of

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[17] Related to transport there are several European initiatives already in place: a)Mobility of people and products http://ec.europa.eu/information_society/activities/esafety/index_en.htm, b) Green paper on urban Mobility http://ec.europa.eu/transport/clean/green_paper_urban_transport/followup_en.htm, c) the CIVITAS initiative http://www.civitas-initiative.org/

[18] See also SmartGrids European Technology Platform www.smartgrids.eu, for technologies like HVDC (High-Voltage, Direct Current) and FACTS (Flexible Alternating Current Transmission).

renewable energy sources (RES), the spread of co- and micro-generation (micro-grids, virtual power plants), and new user demands require the use of the most advanced technologies for monitoring and control as well as for electronic trading of electricity.

Way forward:

- Support awareness raising and foster the exchange of information and best practices in *new ICT-based business models for distributed generation (DG)*
- Reinforce multidisciplinary RTD on ICT for power networks, involving researchers from both the ICT and energy domains. The EU's Seventh Framework Programme will be instrumental here, along with national and regional research programmes:
  - Support for RTD actions cutting across disciplines and themes related to energy efficiency. Candidate topics are: Hardware components, Monitoring and Control, Management of Complex Power Systems, Intelligent Metering, and Distributed Generation.
- Foster the use of national and regional programmes, the relevant operational programmes supported by the Cohesion Policy and the EU Competitiveness and Innovation Programme for the deployment of ICT-enabled monitoring and control research results for distributed electricity generation:
  - Large-scale pilot(s) on ICT-enabled distributed generation systems integrating the co-generation/virtual power plant approach.

Example of good practice:

Denmark now generates half its electricity through decentralised grids, with combined heat and power accounting for 80% of local-area heating, and wind power about 20% of all electricity. As a result, its carbon dioxide emissions have tumbled from 937 grams per kilowatt hour in 1990 to 517 grams per kilowatt hour in 2005.

2.2.2. Towards energy-smarter homes and buildings

The issue:

More than 40% of the energy consumption in Europe is building-related (residential, public, commercial and industrial)[19]. The Action Plan for Energy Efficiency estimates that the largest cost-effective energy savings potential lies in the residential (around 27%) and commercial buildings (around 30%)[20].

Advanced, flexible and integrated ICT-based energy management systems for both new and old buildings, in combination with widespread control of natural lighting and ventilation as well as better insulation (of windows, floors and ceilings), will help not only to reduce energy consumption but also to increase safety and security, to promote welfare and to facilitate assisted living.

Such systems — including smart metering and advanced visualisation — can continuously gather data on what is taking place in a building and how its equipment is operating, feeding it into a (cognitive) control system to optimise energy performance. At the same time, a heightened energy consumption awareness is expected to stimulate behavioural changes both at household and enterprise level.

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[19] Recital (6) of the EPBD 2002/91/EC.

[20] See also The European Construction Technology Platform - www.ectp.org.

Way forward:

- Reinforce multidisciplinary RTD involving researchers from both the ICT and the building domains. The EU Seventh Framework Programme will be instrumental here, along with national and regional research programmes:
  - Support for RTD actions cutting across disciplines and themes. Candidate topics are: Energy Visualisation, Energy Management Systems for Buildings and Neighbourhoods
- Foster the use of national and regional programmes, the relevant operational programmes supported by the Cohesion Policy and the EU Competitiveness and Innovation Programme for the deployment of ICT-enabled research results:
  - Large-scale pilots of energy management systems for public and commercial buildings
- Support awareness raising and foster exchanges of information and *best practices in e-metering*[21]

Example of good practice:

Gains of 7% have been observed in Finnish households just by providing consumers real-time feedback on their consumption. Early trials suggest the energy savings in companies could be as high as 10%.

2.2.3. Towards smart lighting — indoor, outdoor and street lighting

The issue:

According to the Action Plan on Energy Efficiency, about one fifth of the world's electricity consumption is for lighting, presenting a major potential for savings. The adoption of high-efficiency light-emitting diode (LED) technology, already available on the market, could save 30% of today's consumption by 2015 and up to 50% by 2025. By adding sensing and actuation capabilities to energy-efficient bulbs, so that they automatically adjust to the environment (e.g. to natural light, people's presence) — intelligent lighting – further improvements are possible.

Organic light-emitting diodes (OLEDs) constitute a promising technology under development. OLEDs have the advantage of possessing a uniformly diffuse emitting surface, while remaining very energy-efficient and environmentally safe. Furthermore, OLEDs are form-free and could be made on flexible materials, opening up a wide range of new possibilities.

Way forward:

- Together with the lighting industry and municipalities, promote voluntary agreements aiming for:
  - Adoption of progressively smarter energy-efficient lighting for all outdoor and indoor public spaces. [22]
- Reinforce research and technological development (RTD) in new lighting technologies and applications. The ICT Theme in the EU's Seventh Framework Programme will be instrumental here, along with national/regional research programmes:

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[21] According the Directive 2006/32/EC

[22] To complement the measures taken in the framework of the Community's eco-design policy.

- RTD on lighting technologies and on intelligent lighting applications (for both indoor and outdoor systems).

- Encourage, via the Competitiveness and Innovation Programme and via the managing authorities of the relevant operational programmes, the deployment *of intelligent lighting systems*.

Example of good practice:

In May 2007, the FP6 (Sixth Framework Programme) IST project OLLA (Organic LED technology for Lighting Applications) delivered OLEDs with an efficiency of 25 lm/W, which is twice as efficient as a standard incandescent lamp.

2.3. Increasing the visibility and improving the understanding of ICTs for energy efficiency

The issue:

In order to increase the visibility and improve the understanding of the current and potential impact of ICTs as an enabler for energy efficiency, the various communities of stakeholders (industry, academia and research institutes, consumers, public authorities, etc) need to get involved and work together. To this end, cooperation needs to be promoted between all interested players at local, regional, national and European level. In this particular case, bringing together sectors as diverse and distinct as ICTs and energy is rather challenging, as the approaches, and even timelines for investment, are quite contrasting (short-term for ICTs versus very long-term for energy).

Way forward:

- Launch a consultation and partnership process on ICTs for Energy Efficiency with the aim of creating momentum and concerted efforts towards developing and deploying user-friendly ICT-based solutions to support other policy areas addressing energy challenges. The relevant and active business partners (small to large enterprises) will be involved in the process as well as research and academia stakeholders; national, regional and local authorities; and specific consumer groups. The process will focus on:
  - *Promoting interoperability among solutions and standardisation work*
  - *Coordinating awareness raising and sharing of best practices*
  - *Advising on operational details, the effects of regulation and the impact of energy market liberalisation*
  - *Encouraging the production of RTD roadmaps and identify RTD priorities*
  - *Ensuring synergies with relevant policies and initiatives like URBACT and the Amsterdam Forum*[23].
  - *Recommending actions to be taken to follow up this Communication*

- Launch an information gathering and analysis exercise on the impact of ICT on energy efficiency.

[23] http://www.senternovem.nl/amsterdamforum/index.asp

3. CONCLUSIONS

The combined climate and energy policy is at the heart of the EU's political programme. This will bring about alternative ways of running our daily lives so that Europe can continue on the path of growth and jobs while leading the global effort to tackle climate change and energy efficiency.

This communication highlights the potential of ICTs for improving energy efficiency (i.e. enabling energy productivity growth) and opens a debate on priority areas. It proposes to focus on the most promising domains — namely the power grid, smart buildings, smart lighting and ICT itself — to boost awareness raising and exchange of best practices, reinforce RTD, promote take-up and foster demand-driven innovation. It also notes that special attention should be paid to urban areas, which represent a particular challenge in this context and can provide the right setting for testing, validating and deploying ICT-based solutions.

This communication is launching a consultation and partnership process together with an information gathering and analysis exercise that will provide the basis for the elaboration of a second communication in which the main areas for action should be identified.

It aims to facilitate increasingly closer cooperation among all stakeholders with the aim of unlocking the potential of ICTs to improve energy efficiency, thereby promoting the competitiveness of European industry, creating a wealth of opportunities, jobs and services, and building an everyone-wins momentum for industry, users, and society at large.

Member States are invited to take initiatives as well as to actively support, and, where possible, coordinate complementary national and regional initiatives, including those supported in the framework of the Cohesion Policy. The European Parliament is invited to give its opinion on ICTs as a key enabler for energy efficiency and the broader implications of securing affordable and sustainable energy for Europe. Strong cooperation is also expected from the Committee of the Regions and the European Social and Economic Committee.