EUROPEAN POLICY CENTRE

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Economic recovery to a greener economy: mobilising ICT-based innovations

Peter Johnston and
Waldo Vanderhaeghen

February 2010

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EUROPE'S POLITICAL ECONOMY PROGRAMME

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TABLE OF CONTENTS

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Foreword

By Hans Martens

Europe faces crucial economic challenges in the coming years. Not only do we have to deal with the impact of the deepest economic crisis of the post-war period, but we are also increasingly challenged by new global competitors to increase the quality of our products and services, and our education, skills and knowledge levels. At the same time, we also need to address our energy security and climate stability.

Many commentators see this as a contradiction, believing that we must sacrifice economic growth and competitiveness to achieve climate stability. This is a fallacy: there are opportunities to achieve both increased prosperity and a stable climate. One of these opportunities lies in the use of Information and Communication Technologies (ICT) to green our economies while simultaneously increasing productivity and growth.

To explore this issue in greater detail, the European Policy Centre set up a Task Force on ICT-based innovation for a smarter, greener economy in 2009. This brought together a wide range of EPC member organisations, including ICT companies, firms from some of the major energy-using sectors, and representatives of regions, cities and non-governmental organisations, as well as from the EU institutions. It built on the work of the EPC's earlier Rational Use of Energy Task Force, which focused on energy efficiency, aiming to meet three objectives simultaneously: to cut CO_2 emissions; reduce the EU's dependence on imported energy; and boost innovation and European competitiveness in green products and services.

The ICT for a Green Economy Task Force has already provided key inputs into the EPC's calls for the fiscal stimulus programmes to be used to invest consistently in the transformation to a smart green economy, and to break down the 'silos' in the European Commission when dealing with cross-cutting issues such as innovation and climate change.

This Working Paper contains the main conclusions of the Task Force's work. It makes recommendations for policy- and business-led initiatives, including the roll-out of software tools for carbon accounting, more efficient logistics, wider deployment of smart grids and buildings, and integrating innovations at the city and regional levels. Most importantly, the Task Force has

identified the need for an integrated approach at the EU level in which synergies between initiatives can be exploited.

Crucially, the Task Force identifies what needs to come next if we want to achieve our ambitious climate-change goals. If we do not act now to provide the framework and infrastructure required, such as carbon accounting and smart grids, the EU cannot achieve its targets.

This Working Paper provides the new Commission with a practical guide on what next steps are needed in 2010 to move the agenda forward. At the same time, it also calls on ICT companies and other actors to step up their efforts to contribute to the transformation of our economies.

I would like to thank the Task Force and its chair, Peter Johnston, wholeheartedly for the great work they have done. They have provided decision-makers in companies, governments and European institutions with a clear and coherent action plan. We at the EPC will follow developments and highlight any failure to take the necessary measures. We cannot afford to delay any longer: the ten-year timeline set by the EU for meeting its key climate-change targets is not a long time to achieve a transformation, and we must take the first steps now.

Hans Martens is the Chief Executive of the European Policy Centre.

Executive summary

Information and Communication Technologies (ICTs) can play a key role in the transition to a more energy-efficient, low-carbon economy while simultaneously increasing productivity and growth. This can be achieved through consistent monitoring of energy use and carbon emissions, by enabling more efficient energy use in existing processes and by transforming the way we live and work.

To meet Europe's ambitious climate-change targets, the key findings of the EPC Task Force on ICT-based innovations for a smarter, greener economy demonstrate that we must start putting three critical infrastructures in place now:

- a carbon-accounting infrastructure to make energy use and carbon emissions visible;
- a smart electrical power grid system to accommodate new demands for renewable energy, energy efficiency and consumer empowerment;
- high-speed broadband access to the Internet made available across all of Europe.

This requires private-sector innovations and sustained investment. Governments must introduce the regulatory reforms and create the partnerships necessary to enable and encourage these investments.

In addition to the three infrastructures, the Task Force suggests focusing on mobilising ICT-based innovations in the areas of transport and logistics, smart buildings and smart green cities:

- Europe's road, rail and waterways must move fully into the information age;
- innovation and investments in near zero-emission smart buildings are crucial;
- cities should be pioneers in the use of smart green infrastructures and applications.

In order to achieve the EU's energy and climate policy goals by 2020, Europe's pioneers of the smart green transformation need show the way, not just by cutting their emissions by 20-30%, but also by providing new approaches, business models and technologies that can virtually eliminate carbon emissions.

ICT companies must also increase transparency in relation to their own carbon emissions and energy-efficiency measures. To convince the public of the benefits of green ICT, ICT equipment and service providers should pioneer the use of renewable energies to become near-zero carbon emission businesses.

Most importantly, there is an urgent need for an integrated approach at the EU level. The numerous dispersed initiatives for smart green growth must be brought together in a coherent and synergetic framework. At the same time, the benefits of ICT-enabled green growth must be considered in all EU climate change policy-making.

Introduction

Europe is facing challenging times. As well as recovering from the worst economic slowdown since the 1930s, it also needs to deal with climate and energy security and modernise Europe's economy to meet the challenges of global competition in knowledge-based societies.

Recovery from the current economic slowdown cannot simply involve re-stimulation of unsustainable consumption. Yet most Member State investments in 2009 initially focused on rebuilding consumption in established products and services, and lacked the transformational ambition of some countries in Asia and the headline "smart green" initiatives (for example, on smart grids) in the United States.[1]

In the next phase of the recovery strategy, the emphasis must shift from public investment to stimulating private investment and innovation through fiscal incentives and changes to regulatory frameworks. To achieve this, a stronger European lead is needed to mobilise all the Member States and ensure coherence in their efforts.

European Commission President José Manuel Barroso's vision of "smarter, greener and more sustainable growth" is the way forward.[2] But success will depend on mobilising investment in all the Member States and realising synergies between their economic recovery plans – focusing on the knowledge society not only as the source of new employment and competitiveness, but also as the enabler of the transition to a more energy-efficient, low-carbon society with sustainable prosperity for all. Only by acting together can the EU assure global competitiveness in the new low-carbon economy and demonstrate that smart green growth is possible.

However, while Europe has led in the stabilisation of financial and banking systems, it now risks lagging behind in investing in a greener economy. Europe has led on climate change through its emissions' trading trials, but now risks lagging behind in innovation and investment in energy efficiency and the development of low-carbon business models and life-styles. Europe has led the world in developing mobile telephony and digital TV, but now risks lagging behind in the exploitation of web 2.0 services and realising the potential of ICT-based innovations for a greener economy.

Yet a rapid shift to smart, green growth is possible.

In the past 15 years, our economies and social lives have been revolutionised by personal computers, mobile phones and the Internet. The ICT sector is the motor of this innovation: according to the Commission, it employs nearly 7% of the EU's workforce, generates more than 6% of its Gross Domestic Product and has contributed over 40% to productivity growth in the last decade. It attracts more than 30% of all Research and Development investments and over 50% of venture-capital investment.[3]

More than 2 billion people worldwide now use the Internet and web services, and the mobile telephone networks have over 4 billion customers. ICT is fast becoming ubiquitous in our daily lives: for example, most office equipment and home appliances have embedded microchips and software to improve their effectiveness and energy efficiency.

Information and Communication Technologies (ICTs) can deliver green growth in three ways:

- by enabling consistent monitoring of energy use and carbon emissions;
- by enabling more efficient energy use in existing processes;
- by transforming the way we live and work.

By monitoring, optimising and directly managing energy consumption, ICTs enhance the efficiency of existing processes in major energy-using sectors. Recent studies indicate that this can reduce energy consumption in the EU by, for example, 17% in buildings and 27% in transport logistics.[4]

However, the potential of ICT-based innovations goes beyond incremental improvements in the efficiency of existing products and services. They also enable radical changes in lifestyles, working practices and business models, as exemplified by eCommerce, teleworking and eGovernment.

Despite ICT's green growth potential, most media attention has focused on the growing use of electrical power by ICT equipment and services. In the EU, ICT use accounts for about 8% of electrical power consumption and about 2% of greenhouse gas emissions.[5]

Power consumption is still rising, largely in the data centres used to manage online services, and will continue to increase as the ICT sector, related

online services and the knowledge economy in general continue to grow as a proportion of the whole economy. But the sector is already about three times less 'carbon-intensive' than the economy as a whole,[6] and the relative growth in ICT-related energy use must be weighed against the efficiencies it can enable across all businesses.

ICT equipment and services, if appropriately deployed, could drive down global carbon emissions by 15% by 2020 – five times their own footprint.[7] This would represent a saving greater than the current annual emissions of either the US or China.

Nevertheless, more can and should be done to contain ICT energy use. Some major ICT companies have made substantial efforts to offer more energy-efficient equipment and services. But the sector can and must do more, setting more consistent goals and pioneering the smart solutions it can offer to all.

I. The state of play in 2010

Greening the economic recovery

In December 2008, the European Council agreed a European Economic Recovery Plan to "jumpstart the economy with investment in infrastructure, green technology, energy efficiency and innovation to accelerate the transition to a knowledge-based low-carbon society".[8]

Now that the risk of financial paralysis has been averted, it is doubly important to sustain the transformational nature of new growth. The 'green growth' rationale behind the Recovery Plan is sound. However, while the €5 billion of EU spending on clean energy and broadband infrastructures has been indicative of a substantial shift towards green investment at the European level,[9] reality does not match the 'green' rhetoric at the national level. Priority has so far been given to protecting traditional industries, where many old jobs are under threat.

The initial focus has also understandably been on public investment, but this alone will not generate smarter green growth. This will come through innovations developed by the private sector, and investments by millions of companies and hundreds of millions of individuals. Market and regulatory reforms must enable and encourage these investments. Policy priorities must therefore shift to regulatory reforms and partnerships with innovative businesses.

At the EU level, the numerous but dispersed initiatives for smart growth managed by various European Commission Directorates-General and in various EU programmes must be brought together in a more coherent and synergetic framework, and better articulated in Structural Fund initiatives, support from the European Investment Bank and Member States' actions.

Stronger links are needed between Research and Technological Development (RTD), innovation, regional and city development, green public procurement, and getting regulatory frameworks right in the Single Market. A new determination is needed to integrate European policies for the knowledge society and climate and energy security in the recovery strategy.

New prosperity, with energy and climate security at its heart, must be clearly recognised as the way forward in the transformation to a smart knowledge-based society.

Beyond Copenhagen: leading the way in smart green growth

Following the political agreement reached in Copenhagen in December 2009, new action on climate change is needed urgently.

New scientific research since the Intergovernmental Panel on Climate Change's Fourth Report was published indicates that changes in greenhouse gas concentrations and sea-levels are occurring faster than expected, and the risks of major regional climate disruptions are greater than were predicted even a few years ago.[10] We may already be close to the level of greenhouse gas concentrations consistent with a stable climate.

Unfortunately, Europe is not yet on track to meet its 20% emission-reduction target for 2020, and may still need to increase its ambition. The Emissions Trading Scheme has not yet succeeded in establishing a stable carbon price and 'carbon taxes' in a few Member States are not yet at a level sufficient to mobilise substantial shifts in investment, business models and lifestyles.

In this situation, a new approach is likely to be needed, with a much stronger focus on technological innovations and investments.

Bringing ICT-enabled smart growth centre stage

The EU has recognised the transformational potential of ICT-based innovations, most notably in the Lisbon Strategy for a knowledge-based economy and associated i2010 initiatives, but has been slow to recognise the importance of ICT-based innovations for the transition to a more energy-efficient, low-carbon economy.

However, in May 2008, a Commission Communication highlighted the potential for smarter homes and offices, smarter manufacturing and logistics, and smarter electrical power grids to contribute to a greener tomorrow.[11] The Commission then launched a stakeholder consultation, on which it reported in a second Communication in March 2009, and adopted a set of recommendations in October 2009[12] following further consultations.

Yet more needs to be done: it is now urgent to kick-start the transformation to a smarter, greener economy as part of the recovery.

The critical role of ICT-based innovations is now also being recognised in other sectoral initiatives. The recast Directive on the Energy Performance of Buildings could promote highly-efficient 'solid-state' lighting systems spun off from the telecoms and home electronics' applications, as well as intelligent sensors and control systems. In transport, the eFreight initiative and related RTD actions seek to harmonise the use of ICT-based logistics' optimisation. In manufacturing, the November 2008 European Economic Recovery Plan includes €1.2 billion for a "factory of the future". And since none of these initiatives will succeed without pervasive broadband infrastructures, the plan also foresees additional investments in this.

However, these sector-specific initiatives do not yet constitute a mainstream strategy for a smart and green economy.

Not only are there as yet only modest European-led initiatives to consistently mobilise ICT-based innovations for energy efficiency, but responsibilities are also fragmented and compartmentalised (in separate Commission Directorates-General and Executive Agencies for energy, environment, enterprise and innovation, research and the information society).[13] This hinders the establishment of a consistent and effective set of initiatives, and leads to poor linkages between RTD and innovations, notably at the regional and city level, slowing the speed at which new knowledge is translated into new prosperity.

To realise the ambition of smart green growth now at the centre of President Barroso's agenda for the new Commission, much more needs to be done.

II. Three key infrastructures for a smart green economy

The three critical infrastructures for a smart green economy must be put in place before we can start making progress on decoupling growth from carbon emissions. All three will require years of sustained investment. For each, the most important role of governments will be to get the regulatory and market frameworks right in order to stimulate investments by utilities and by millions of businesses and hundreds of millions of individuals.[14] Governments and public authorities will also have a key role to play as investors in modernising their own services and as pioneers for the more innovative developments which require wide coordination.

Making energy use and carbon emissions visible to everyone

Nobody can manage what they cannot see: businesses need energy-use and carbon accounting to improve their efficiency; investors need carbon reporting to assess risks in investment decisions; individuals need energy- and carbon-labelling to 'buy green'; and governments need coherent carbon reporting and labelling to monitor progress towards the 2020 goals and to widen the scope of carbon taxation. Tighter regulation of financial services and business management practices following the financial crisis of 2008-9 will also need to look beyond financial reporting to address the risks from climate and energy disruptions.

To make energy use and carbon emissions visible,[15] we will need an accounting infrastructure comparable to that for the financial system. Common European and international standards will be required to safeguard the EU's Single Market and international trade, and an infrastructure of standards, verification, monitoring tools and regulations will have to be put into place rapidly. Governments must take the lead on regulation and verification to ensure that this infrastructure is established quickly and consistently across the EU and globally.

Carbon accounting and reporting

The ICT sector can provide the software tools and the communication facilities to make such accounting and reporting a reality within a few years. *Carbon accounting* involves measurement of carbon emissions in all

business activities and/or at all stages in a product's lifecycle or the provision of a service.

Carbon reporting[16] is the reporting of carbon emissions by companies or organisations, for example alongside, or with, their financial reporting to shareholders and equity markets and to other investor groups, such as those represented by the Carbon Disclosure Project.[17] This allows business managers and investors to better assess the risks to a company's future activities from its carbon emissions.

The ICT sector provides the software tools for all businesses to track costs, revenues and other resources. These resource management and accounting packages are already being extended to cover energy and carbon accounting. However, wider take-up is needed and formal accounting standards – for example, from the International Accounting Standards Board (IASB) and International Auditing and Assurance Standards Board (IAASB) – are still lacking.[18]

Urgent EU action is now needed to harmonise carbon-emission accounting, building on the International Organization for Standardization (ISO) standard 14064. This Greenhouse Gas (GHG) Protocol and ISO standard for carbon accounting and reporting should also be integrated into all business management software tools to allow swift deployment in large and small businesses, and public administrations.

Supply-chain tracking and carbon labelling

Tracking the carbon emissions from products and services through supply chains is much more complex. In principle, the cumulative energy use and net carbon emissions associated with a product could be included on its label at the point of sale, as well as the emissions associated with its normal use.[19] However, there are still concerns about the availability of meaningful primary data and the complexity of supply chains.

Carbon labelling would enhance transparency in the marketing of products and services by recording the total carbon emissions associated with bringing them to the customer and those that will be associated with its use.[20] This would empower citizens to make informed purchase decisions. ICT systems are essential for tracking emissions through supply chains, in the same way that software systems track costs and trace the origin of components.

Two major initiatives are already underway. The Carbon Disclosure Project Supply Chain programme enables coherent tracking of carbon emissions through supply chains. The Carbon Trust has already completed a carbon label, which is now in use for several products. It is currently based on the British PAS 2050 standard, which is contributing substantially to the development of the new international standard.[21] ISO 14067 is being developed as the new international standard for product carbon footprinting and labelling, with March 2011 set as the target date for completion.[22]

At the European level, consideration should be given to whether carbon labelling should be integrated into a broader environmental sustainability label, or stand alone.[23]

The *Carbon Trust* in the UK is already working with major brand leaders and retailers to roll out carbon labelling on a voluntary basis. Its carbon label indicates the number of grams of carbon dioxide emissions associated with a consumer product or service. It is already being used for some products sold by, for example, Tesco, Continental Clothing and HBOS.[24]

The *Carbon Disclosure Project* is working with major brand leaders and retailers to encourage and harmonise reporting by key suppliers, including small- and medium-sized enterprises. Software developers are already working on software tools that calculate carbon emissions throughout the supply chain. This will facilitate and harmonise more complete reporting by major companies (50-80% of carbon emissions are generally associated with supply chains). In the longer term, this will also enable coherent carbon labelling of products and services.

Measures in *Japan* include a requirement for manufacturers of products and providers of services for daily use to inform customers about GHG emissions.

European policy recommendations

Little has been done as yet at EU level to encourage and harmonise carbon accounting, reporting and labelling, although the Council mandated the Commission to explore options in late 2008. If a number of Member States move quickly to mandate reporting or labelling,[25] measures will also have to be introduced quickly to preserve the free movement of products and services in the Single Market.[26] If other major markets (for example, Japan, China or the US) introduce mandatory reporting or labelling,

European businesses will have to comply to preserve market access. We therefore recommend:

To the ICT sector:

- To integrate carbon accounting and reporting into business management software tools, using open data exchange formats so that various tool-sets can be used together along supply chains.

There will only be widespread take-up of these modules by business (and public authorities) if there are financial incentives or regulatory obligations to do so. We therefore recommend:

To the accounting and auditing sectors:

- To urgently establish guidelines and standards for meaningful carbon-emission accounting and reporting.

To Member States and financial and equity market regulators:

- To set a timetable for mandatory carbon reporting, consistent with the maturity of the tools and the policy goals for carbon reductions. Mandatory reporting by 2012 would seem technically feasible.

To Member States and the European Commission:

- The European Commission should propose a single carbon accounting and reporting standard, providing clear direction and setting out what is expected from businesses.[27] These requirements should be integrated into the green public procurement guidelines.[28]
- To build on the current work by the Carbon Trust, national initiatives and the software industry associations to develop the upcoming ISO 14067 (March 2011) to a fully operable standard metrics for the carbon or environmental labelling of products by 2015, with a view to Europe-wide labelling of products and services.

Smart electrical power grids

The electrical power industry is on the brink of major challenges and changes. New demands for renewable energy, energy efficiency and consumer empowerment require a smarter electrical power grid system.

The EU target of sourcing 20% of its energy needs from renewables by 2020 will require more than 35% of electrical power generation to be low-carbon.[29]

Besides the large projected wind parks and solar plants, we will see a growing number of business premises, shopping centres and homes also becoming small energy producers.

This will require a transformation to a smart grid, capable of integrating millions of varying renewable supplies and dynamic demand management in collaboration with users. Leading the world in this sector will provide Europe with competitive global standards for, for example, smart meters. It will boost investment in Europe, increase European skills and employment, and enable Europe to export smart grid solutions to a changing world.

From traditional to smart grids

A traditional electrical grid distributes power from large fossil-fuel or nuclear power stations to hundreds of millions of consumers. A smart grid interconnects communities which can both generate and consume electrical power, integrates millions of variable wind and solar power contributions to energy supplies, and enables users to monitor and manage their energy use in response to demand and/or price signals.

To move from centrally-generated distribution of power to managing a smart grid, the network utilities must make the same transformation as the telecoms sector has undergone in recent decades from telephony to management of the Internet.

A regulatory framework to stimulate and sustain investment

Investments in smart grid innovations will only flourish when the regulation of electrical power distribution generates a sound business case for investment by all players: energy producers, grid operators, and the millions of businesses and individuals who can contribute to energy security and diversity by generating some of the power required to meet their own energy needs and participating in active demand management.

To achieve this, regulatory change at the EU level is urgent. The investment in smart-grid infrastructures will need to be amortised over several decades. An early and determined start and a stable regulatory framework are therefore essential if the EU's 2020 targets are to be met.

Regulations must give grid operators incentives to realise energy efficiencies through the optimum operation and effective integration of large numbers of variable renewable supplies, and must provide incentives for millions of business parks, shopping centres, and individual home-owners to become generators of at least some of their electrical power needs, to participate in active demand-management and to realise cost-savings from energy-efficiency improvements.

Encouraging investment in smart meters

In this regulatory change, smart meters (or smart metering technologies) are essential and deserve special policy attention, as they provide a genuine two-way information gateway and communication infrastructure between the meters and energy producers/suppliers and distribution grid operators and consumers.

Smart metering provides the grid operators with real-time data on residential energy use, gives consumers real-time feedback about their actual energy consumption, enables new energy services for improving energy efficiency (such as building automation systems or Demand Side Management), and measures the energy produced and exported back into the grid from those households or businesses producing renewable energy.

A smart meter must therefore allow for two-way communication of information and, in particular, consumption data, bi-directional energy-flow measurement, and feedback on energy consumption/production in real time to energy producers/suppliers, distribution grid operators and consumers, as well as third parties offering new and innovative energy services.

A smart meter therefore has the potential to become as important to a business or household as a computer for Internet access, and need not cost more than about €100-150 – a cost that can be easily amortised by energy-efficiency savings in most households and businesses within a few years. Several recent studies estimate that smart metering can reduce energy consumption by at least 10%.[30]

Currently, energy producers/suppliers and the distribution grid operators only get a limited return on investments in smart meters. Business-users and households are also unfortunately sometimes prevented by regulatory restrictions from investing in, or demanding, the installation of smart-metering

technologies and other demand- and energy-management systems. Electrical power meters are often the property of the electrical power utility or distribution grid operators and still today often simply record cumulative power use, which is usually read manually once a year as the basis for settling the bill at the end of each term. This must change.

Cost-conscious and energy-aware end-users should be empowered to become energy managers and to play an active part in an liberalised energy market as producers ('prosumers') by having smart meters installed to better monitor their own energy use and to change their behaviour and move towards sustainable consumption patterns.

European policy recommendations

To meet the ambition of 35% of electrical power supplies coming from renewables by 2020, as a major contribution to meeting the overall 20% renewables target, the EU needs to accelerate the timetables for pilot projects and large-scale investments.

It needs to make widespread deployment of smart grids part of the recovery-package investments, with targeted policy-support for smart-grid development, setting target dates for the key regulatory reforms without which investments will not flow. It also needs to mobilise Structural Funds and other investment resources (the European Investment Bank, etc.) for coherent smart-grid deployments.

Regulatory reforms need to ensure that two-way interfaced smart meters use open and interoperable standards, that smart metering is broadly rolled-out so that innovation is stimulated in an open market, and that access to data is secured. We therefore recommend:

To the ICT sector:

- To accelerate the development of open standards for the interfaces between smart meters, the smart grid and users' energy-management systems. These are a prerequisite for a pan-European smart grid and the roll-out of smart-metering technologies. The work of the standardisation organisations needs to be accelerated to ensure open ICT interfaces for all utility meters (gas, water, and electricity). Open standards will allow for a pan-EU market and give Europe a competitive world position by setting the global standard (as was done for the GSM mobile telephony system).[31]

- To develop, market and roll-out interoperable smart metering and energy-management systems. In most businesses and households, an integrated smart meter/smart energy-management system needs less processing power than, for example, a 3G mobile phone. Broad, fast roll-out and interoperability would be of enormous value as an enabler for smart-building and smart-grid developments.

To Member States and the European Commission:

- To urgently enforce the regulatory framework for energy distribution to ensure that the agreed ten-year timetable for full deployment of smart meters by 2022 (following an assessment by 3 September 2012) is met, with 80% of consumers equipped with smart-metering systems by 2020.[32] If the pace of deployment is not on track by 2015, if may be necessary to look again at electrical power meter ownership, to enable consumers to integrate smart meters of their own choice with their energy-management systems.
- To clearly stipulate who owns and who has access to energy consumption data from the smart meters. As the discussion in the Netherlands suggests, safeguards to ensure that private data is kept secure are essential to gain consumer acceptance.[33]
- To liberalise electrical power tariffs to enable real-time demand-based tariffs as a price signal to users' demand-management systems. Varying prices according to demand will empower price-conscious consumers to save money.

A high-performance, pervasive ICT infrastructure

Employment and green growth depends more and more on ICT infrastructures (for example, broadband at home) and services provided by ICT companies. There are now more than one million small- and medium-sized enterprises (SMEs) in the EU which provide and develop ICT services,[34] and broadband access to Internet infrastructures is crucial to further optimise and transform our society and economic fabric. Few ICT-enabled innovations can be deployed without high-speed communications' infrastructures.

Embedded microprocessors have given us more energy-efficient cars, washing machines and lighting systems. Mobile telephony and the Internet have provided access to more energy-efficient retail services. ICT systems can now help manage energy more efficiently in our homes and offices, and help integrate renewable energies into the electrical power grid.

Beyond this, ICT systems offer greener and smarter ways of meeting our needs. Energy-intensive products can be replaced with energy-efficient services: for example, replacing office-based public services with eGovernment services, DVDs and CDs with online media, face-to-face meetings with videoconferencing, or commuting to an office with teleworking. For all this, broadband access to Internet-based services is essential.

Europe is well-placed in the deployment of first (dial-up) and second (DSL) generation access, but enormous new investments are now needed to ensure that it leads in the deployment of the next generations of high-speed wireless and fibre infrastructures.

European policy recommendations

A new phase of investment will be required for Europe to retain its competitiveness as an attractive base for new smart green services. We therefore recommend:

To Member States and the European Commission:

- To keep the regulatory framework under review now that ICT infrastructures are largely in the hands of the private sector, to ensure that there are adequate incentives and capacity for new investment by both established and new companies in innovative high-speed access systems.
- To facilitate public-private partnerships where market conditions do not provide sufficient incentives for investment, without constraints from state aid regulations.
- To sustain RTD investment in next-generation Internet infrastructure technologies and interoperability protocols for smart services, buildings grids and cities.
- To better integrate the European innovation system, with tighter links between the RTD framework, the competitiveness and innovation programme, Structural Funds, investment frameworks (both public investments by the European Investment Bank, etc. and venture capital frameworks) and public procurement rules.

III. Mobilising ICT-based innovations in three inter-related areas

The European Policy Centre's Task Force also identified three key opportunities to transform and grow our economy: transport and logistics, buildings, and cities.[35] ICT-enabled energy-efficiency savings in smart transport and logistics, smart buildings and smart green cities could cut energy use by 5-10 times as much as the required ICT equipment uses, and is economically viable.

The *Smart 2020 Report* by The Climate Group estimates that if ICT solutions are implemented, this could improve global energy efficiency by 15% by 2020 – five times the ICT footprint.[36] This would represent an energy- and cost-saving greater than China's current energy use. The European Commission-funded *Bio Intelligence Study* estimates that by 2020, ICT-based innovations could save up to 53% of total electricity consumption in an eco-scenario.[37]

Smart transport and logistics

Production and distribution networks depend on high-quality, efficient logistics to optimise the transport of raw materials and finished goods across the EU and beyond. The logistics industry in Europe represents about 14% of GDP[38] and is essential to European competitiveness and to achieving Europe's climate goals. Transport accounts for about 26% of energy end-use in the EU[39] and freight transport accounts for one-third of carbon emissions.

In Europe, 44% of goods are now moved by trucks, 41% via short sea shipping, 10% by train and 4% via inland waterways.[40] Between 1970 and 2003, the share of the goods' market carried by rail in EU-15 fell from 20% to 8%.

It is time for Europe's road, rail and waterways to move fully into the information age to further improve the eco-efficiency of each mode of transport and facilitate a modal shift to eco-friendly alternatives to road transport, more efficient inter-modal transport and a greener use of existing road infrastructure.

ICT tools for more efficient logistics

ICTs play a crucial role in optimising the flow of goods from origin to consumption.[41] 'Smart logistics' comprise a range of software and hardware

tools that monitor, optimise and manage operations. They help to reduce the storage needed for inventory, fuel consumption, kilometres driven and the frequency of vehicles travelling empty or partially loaded.[42] The *Smart 2020 Report* estimates that ICT-enabling smart logistics could cut carbon emissions by 27% by 2020 in Europe alone.[43]

The greening of road transport of goods and passengers should be a priority, as it accounts for 84% of the transport sector's carbon emissions.[44] Investments in green technologies can be encouraged by, for example, providing priority lanes for green freight vehicles or introducing smart anti-congestion policies targeted at high-emitting lorries.

Larger logistics companies can optimise their lorry fleet by timing departures and arrivals optimally (to reduce waiting times), avoiding partial loading, and optimising routes to avoid traffic congestion.

Oracle Transportation Management System cooperated with *Kraft* to optimise their US logistics, which have over 500 shipping points and 6,000 end destinations. This resulted in a reduction of 750,000 kilometres a year, and was both cheaper (with a three-year payback time) and greener.

Deutsche Post DHL partnered with Bremen City Council in the Parfum project to establish the first loading zone in Germany reserved for commercial clean vehicles. Authorised vehicles are identified through radio-frequency identification (RFID) tags to ensure compliance.

Deutsche Post DHL, which operates the Heathrow Consolidation Centre that manages the airport's supply chain, reduced delivery mileage and CO_2 emissions by 75%. Soon, a 9-tonne electric vehicle will enter into operation – the first electric retail delivery vehicle operating within an airport environment.

P&G set the goal of reducing road freight by 10% within 2-3 years and by 30% within 5-10 years using the rail network for most freight journeys of more than 200 kilometres in Europe. This is made possible by using ICT systems for real-time container tracking in the freight trains.

However, smaller companies still represent the majority of vehicle operators: for example, 80% of UK operators have less than five trucks.[45]

These SMEs cannot match the fleet optimisation of larger operators because of the small scale of their operations, and a lack of skills and capital for investment in fleet optimisation. They therefore need to be able to collaborate in larger associations.

Although European *cabotage* rules block substantial improvement, ICT systems can deliver important gains in optimising loads, vehicles and routes. For these ICT tools to take hold in SMEs, it is important for them to be easy to use, low-cost and with sufficient controls on who can access them. To allow for communication between different companies' loads and lorries, and modes (for example, roads, trains or maritime transport), interoperable ICT systems are crucial. A wider use of open standards would allow for easier data exchange for logistics optimisation, tracking and operational support systems.

Despite an opening up of the rail freight market in 2007, the sector is failing to deliver satisfactory reliability for cross-border services, which prevents a larger use of rail freight. Furthermore, the European Commission has pointed out that "rail freight transport suffers from a lack of reliability and efficiency, caused, amongst other things, by insufficient technical and administrative interoperability".[46] It will be necessary to accelerate the pace of innovation in rail freight services to enable cross-border operators to offer next-day delivery for tracked container loads. Investments need to be made in the most up-to-date equipment for real-time container tracking.

The EU supports a wide variety of initiatives for cleaner transport. For example, the e-Freight initiative for the development of integrated ICT applications will enable paperless monitoring of goods moving into, out of, and within the Union, within and across different modes of transport.

However, Research and Technological Development (RTD) management is traditionally very fragmented between three different Commission Directorates-General and does not connect quickly enough with market deployment and initiatives supported by the EU's Structural Funds. The current delays of about 3.5-4.5 years in total for EU RTD projects make them of little value. It takes 18 months from RTD concept to partnership projects, then 2-3 years for RTD to deployment, with no assurance from the Commission that the project will be supported. This contrasts with many private operators and their ICT partners, who are developing and deploying proprietary and regional systems within two years.

European policy recommendations

To the ICT sector:

- To ensure open interoperability of logistics' optimisation systems in order to enable the rapid deployment of open interfaces for data exchange.
- To develop cheap, simple and interoperable software to enable SMEs to overcome capital, skill and scale constraints, and realise opportunities for logistics' optimisation in larger business networks and clusters.

To Member States and the European Commission:

- To accelerate completion of the internal transport market and review regulatory frameworks in the context of the liberalisation of services in the Single Market, to ensure that associations of SME fleet operators can take full advantage of ICT-based optimisation tools.
- To invest in open ICT infrastructure in Europe's transport network to provide green incentives and make greener modes of transport more attractive. Traffic management systems need to be integrated in all modes of transport, in particular in cross-border intermodal corridors and for urban logistics solutions.
- To accelerate the liberalisation of rail freight services to enable cross-border operators to offer next-day delivery for tracked container loads by 2012.
- To speed up timescales for EU projects to 12 months from concept to contracted development, with commitments to widespread deployment within 2-3 years, to fit with business timescales.

Smart green buildings

Buildings account for approximately 40% of EU energy end-use (33% in commercial buildings and 67% in residential buildings) and produce 36% of EU CO_2 emissions.[47] However, with modern design, insulation, efficient energy management and passive energy capture, most buildings could have near-zero carbon emissions. The potential for energy savings and emission reductions is therefore enormous – estimated at 30% by 2020, or an 11% reduction in relation to total EU energy consumption.[48 - 49 - 50]

However, the pace of building renewal is slow. More than 50% of EU buildings were constructed before 1970, and around 27% before 1945.[51] New-building turnover is a mere 2%, so around 80% of current buildings will still exist in 2020.[52] The renovation cycle is also long: typically 20-25 years for residential buildings and 15 years for commercial buildings.[53]

The buildings' market is also highly segmented and plagued by several market failures, such as lack of information, different incentives for owners and users of buildings and the negative externalities[54] of energy use on climate change, which call for government action.

Moreover, European action should support a competitive European green buildings' sector on the global level, boosting competitiveness and employment.

EU action on buildings' energy performance

The EU has taken a leading role in this area. The Energy Performance of Buildings Directive (EPBD), which is currently the main EU framework for energy efficiency in buildings, covers both residential and non-residential buildings, and came into effect in January 2006.[55] It provides a common methodology for calculating buildings' energy performance and sets minimum energy performance standards. However, implementation in the Member States has been slow and its effectiveness has been reduced by ambiguous interpretations of the requirements.[56]

To strengthen implementation and move up a gear, the Directive is being recast for 2012[57] to be clearer, more ambitious,[58] more relevant to Member States,[59] and more demanding for the public sector.[60] However, incremental improvements in the energy efficiency of some buildings will not be enough to reach the 2020 emission reduction targets and make Europe a world leader in very low-emission building technologies. It will not be enough to force marginal improvements in some of the building stock.

The Commission estimates that full implementation of the recast Directive will cut final energy use by 5-6% by 2020, and reduce EU CO_2 emissions by 4-5%.[61] The recast Directive will therefore only contribute 50% of the energy-efficiency savings from buildings that must be realised by 2020.

The remaining 50% will need to come from innovation and investments in near zero-emission smart buildings. Major new initiatives are therefore required to shift 15-20% of the building stock to near-zero emissions by 2020, as a step on the way to making most buildings near-zero emission by 2050.

By pioneering the construction of zero-emission buildings and the transformation of older buildings to near-zero emissions, Europe can ensure

the development of the skills, technology and business basis for the transformation of the whole building stock in the following three decades.

Some Member States are starting down this track, but more needs to be done at the EU level to realise the economies of scale in technologies for near-zero emission buildings, exchange experience and best practices between Member States, and provide world leadership in their deployment.

ICT solutions for low-carbon buildings

Near carbon-neutral buildings need to be smart. They require the full range of energy-management systems to contribute to energy generation as well as optimum energy use.

Smart buildings utilise ICT-based systems to optimise heating, ventilation, air conditioning, lighting and electrical and electronic appliances, and to manage their own energy capture[62] and power generation systems.[63] Their full potential will only be realised in synergy with a smart electrical power grid and with an integrated building- and energy-management system. The European Commission-funded *Bio Intelligence Study* estimates that ICT-based innovations could reduce EU energy consumption in residential buildings by 35% and in service-sector[64] buildings[65] by 17%. Numerous examples already exist in Member States of very low-emission buildings.[66]

ICT-based building-management systems maintain a comfortable working or living environment with the most efficient use of energy. Temperature and movement sensors allow automatic control of the temperature, ventilation and lighting.[67] Energy-management systems optimise energy use in larger facilities, such as hospitals, factories or even towns. They also need to connect all applications and sensors, and to be able to control local and grid supplies and all energy-using appliances safely, reliably and predictably.[68]

Connection models and protocols need harmonisation and standardisation, and there is insufficient standardisation of communication between proprietary platforms and networks.[69] The market for ICT-based sensors, controls and electrical appliances is European: people need to be able to integrate equipment bought in different countries. EU standardisation initiatives for communication and interoperation protocols therefore need to be strengthened and accelerated.

The *Solaire building* in New York was the US' first 'green' residential tower. It contains a comprehensive building-management system, which is continuously updated and undergoes an annual re-commission. It provides real-time monitoring and adapts as the weather changes. The *Solaire building* is 35% more energy efficient than building code requirements and uses 67% less energy than other similar buildings in peak hours. Since it opened in 2002, energy consumption has decreased by 16% and, as a result of its green credentials, the developers have been able to charge a 10% rental premium.[70]

Smart meters are crucial to efficient energy management in smart buildings. They not only provide the real-time energy-use data for energy-management systems, but can also adapt energy use in response to demand or pricing signals from the utility and enable feed-in of surplus renewable power from a building's solar panels at peak times.

Smart buildings must also include smart lighting: lighting currently consumes nearly 20% of electrical power in the EU, but can be up to ten times more energy-efficient. About 75% of installed lighting is old, and renovation rates are slow: 3% per year for street lighting and 7% for office lighting. In Europe, only 1% of lighting systems use presence detection and daylight controls. In the US, approximately 65% of new construction and renovation projects feature lighting automation.

Natural light can be used more efficiently and complementary artificial lighting can be optimised by building-management systems. ICT-based occupancy or motion sensors, ambient light sensors and timer-based lighting controls are now widely available at low cost.

IT and telecommunications research has also spun off new forms of energy-efficient lighting, including Light Emitting Diodes (LEDs) which glow when a small electrical current is passed through them. They can be ten times more efficient as traditional incandescent bulbs and last longer (10,000-50,000 hours compared to 1,000 hours for conventional bulbs).[71] Their energy consumption is so low (a few watts) that they can operate on the power from solar panels (already widely commercialised for garden lighting). In homes, offices and shops, where lighting levels need to be high, they can reduce energy costs and related carbon emissions by around 75%.[72] However, take-up is too slow. More investment is needed in high-luminosity systems and innovative lighting design.

The *Bullring* centre in Birmingham, UK, introduced LED lighting systems to promote the centre's public image and create a unique shopping experience, and has cut energy use by 85%.

The *Rundbau*, a 40-year-old landmark building in Cologne, Germany, uses LED lighting with presence detection and daylight regulation to achieve 75% cuts in energy use.

Electrical equipment (e.g. elevators, alarm systems, refrigerators, washing machines and ICT/consumer electronics) account for more than 7% of residential and nearly 20% of commercial buildings' energy use. Embedded ICT-based sensors and control systems have already enabled radical improvements in their energy efficiency, but individual appliances cannot yet be easily integrated into energy-management systems for whole buildings and respond to demand-based power pricing. Networked controls linked to energy-management systems and to a smart grid through a smart meter could enable significant further improvements in overall energy efficiency.

European policy recommendations

To the ICT sector:

- To ensure open interoperability of controls on all electronic appliances to enable their networking into energy-management systems and smart grids through smart meters.

To Member States and the European Commission:

- To accelerate the development and deployment of near zero-emission building technologies, and clarify and strengthen incentives for investment. Currently, the owners of rented offices or homes do not pay the energy costs and renters have no opportunity to improve their building's energy efficiency. New tax incentives and financing models for smart-building transformations are needed.
- To set a target date of 2015 by which all new public buildings should be near zero-emission smart buildings; and strengthen exchanges of experience between Member States. The www.buildup.eu EU initiative website is of great value, but more determined action is needed at all levels.
- To accelerate the deployment of innovations from EU RTD projects to 12 months from concept to contracted development, with commitments to widespread deployment within 2-3 years.

Smart green cities

The city is the first and essential scale at which all the smart green infrastructures and applications need to work together. Cities therefore need to be the pioneers of integrated smart green investments. They provide the scale and opportunity for the synergies to be realised between the smart infrastructures of broadband Internet access, smart grids and carbon accounting, and therefore the platforms for wider transformations to smart transport and smart buildings.

Smart green investments will bring economic, social and environmental benefits: stimulating a smarter society and economy, increasing competitiveness and productivity, and creating jobs. They can improve public services and promote more efficient use of energy and resources.

Cities also have the local management structures and public investment resources required for more ambitious investments. The public sector at the city level can set the example for households and businesses in promoting greener, smarter, more cost-efficient ways of doing things.

As the owner and user of local office buildings, and as a landlord of social housing, much can be done within the city government structure itself. By leading smart green growth within its organisation, the public sector at the city level provides the example and the market. Green public procurement guidelines play an important role in directing public funds to the right procurements.

Not all cities can be transformed at the same pace. Some will need to be the pioneers, and various partnerships and collaborations with major ICT and service companies are now emerging. However, the level of ambition needs to be raised.

As for smart buildings, Europe needs some showcases of near zero-emission cities of the future by 2020. It will be more effective to concentrate innovation and investment in some tens of showcase cities than to support marginal and incremental improvements everywhere.

The network of 25-30 European cities foreseen in the Strategic Technology Action Plan needs to be expanded and their level of ambition raised so that they can all demonstrate a combination of energy efficiency and near-zero carbon emissions by 2020.

Opportunities for leadership

Cities can take initiatives in all the areas covered in this report, on both infrastructures for a smart green city and for smart transport, housing and public buildings.

Broadband infrastructure is a key infrastructure of the future. Households and innovative SMEs need these high-speed information highways. Accelerate Nottingham, for example, provides broadband to foster innovation in creative industry SMEs.

Where the market fails, governments can step in: there is a special role for city authorities in linking up less prosperous or able citizens. City governments are the key to e-inclusion. Local infrastructure in social housing development and public buildings such as schools, hospitals and local government offices are the responsibility of the owner anyway.

Smart transport is essential to smart green cities. With smart transport systems, commuting can be improved and better information can be provided to citizens. Smart car-share schemes can enable radical improvements in energy efficiency when users can select the right car for each journey, but require partnerships between operators and city authorities. They also have potentially important synergies with the introduction of electrically-powered cars, enabling the fast development of recharging infrastructures, alternative financing to traditional models of individual car ownership, and a potentially vital electrical power storage facility for smart grids.

The city of *Amsterdam* has set a target to make all new public buildings and all Council offices 'carbon neutral' by 2015. It is also a pioneer of the introduction of smart grids in 'smart districts' to enable one-third of energy use to come from renewables by 2025.

The *CosmoPolis* scheme in the London borough of Redbridge has cut street-lighting energy use by 50% compared with the old mercury lighting.

In *Madrid,* energy savings of 47% have been realised compared with yellow 'sodium' lighting.

The city of *Berlin* is implementing an Energy-Saving Partnership Programme based on partnerships with Energy Service Companies. They were responsible for financing energy-efficiency upgrades (retrofit) in about 1,400 buildings over a period of 8-12 years. The annual savings arising from the energy upgrades were used to finance the retrofit investments. The immediate impact was an annual reduction in CO_2 emissions of about 60,000 tons and annual financial savings of €10,000,000 in 1,400 buildings.[73]

The city of *Dayton,* Ohio has awarded Honeywell a $3.2-million energy conservation and building modernisation contract to decrease utility expenses and greenhouse gas emissions at targeted facilities by more than 30%. Funded through a ten-year performance contract, the programme includes a variety of infrastructure upgrades that are expected to cut energy and operating costs by $420,000 a year. The city will use the energy savings, which are guaranteed by Honeywell, to pay for the improvements.

The city of *Manchester* and *EUROCITIES* are launching a Green Digital Charter, a practical way for major European cities to demonstrate leadership and to create a new focus for promoting the use of digital technologies to support smarter cities. The participating cities will demonstrate how they can use ICTs in new and innovative ways to increase energy efficiency. The Charter includes proposals for action relating to emissions from ICT itself, and, more significantly, on the restructuring role that ICT can play in enabling greater energy efficiency and, as a result, more low-carbon activities. The Green Digital Charter was launched at the EUROCITIES annual conference on 25-28 November 2009 in Stockholm. The Charter has already been signed by the mayors of 14 major European cities.[74]

The city of *Hamburg* has adopted a Climate Action Programme to cut carbon emissions by two million tonnes by 2012 and by 40% by 2020. It includes the retrofitting of public buildings, solar-photovoltaic power generation in schools, 'green ICT' investments in online services, and local combined heat and power initiatives.

The city of *Bristol,* in the South West of England, is committed to reducing CO_2 emissions by 40% by 2020. With funding from the Carbon Trust, Bristol City Council calculated Bristol's ICT carbon footprint and developed a Green ICT solutions' database. Emissions from non-domestic ICT use totalled 67,258 tonnes of CO_2 in 2006 – 3% of city-wide emissions or 7% of industrial and commercial emissions. The Council is now working with organisations to reduce their ICT carbon footprint and also leads the South West Sustainable Procurement Network.

The city of *Rouen,* in France works with Vinci and Philips to design, build and finance modernisation of street lighting and traffic management.

City authorities are often the owners and users of many major buildings. They need to be transformed to near-zero emissions as part of an integrated strategy for a smart green city and to show the rest of the community what can be done. Larger public buildings can be retrofitted to be more energy-efficient under energy performance contracts, without up-front investment costs.

Street lighting can also be made much more energy efficient. The latest technologies offer savings of near 60%: cheaper, greener and brighter lighting saves money and brings benefits in safety and security.

However, even though energy- and cost-savings could be possible, the payback period is often a few years. This can become a barrier to energy-efficiency investments.

Energy Service Companies (ESCOs) provide the solution to financing renovations of larger buildings and public facilities in cities. They contract to upgrade energy management in buildings or public spaces for a guaranteed cost, which is paid for over time by guaranteed energy cost-savings. The building's owner therefore does not have to make any up-front investment and pays no more than the current energy costs for a fixed period of a few years. The energy service company meets its investment cost from the energy savings over the contracted period, and the building's owner realises the energy savings in ongoing expenditure after the contract terminates.

All these initiatives need to be put together into a coherent and synergetic programme of city-wide transformation, with city governments working in partnership with the private sector. The role of cities is thus also to create partnerships between stakeholders such as governments, the private sector (energy, transport, etc.) and community organisations (neighbourhoods, local NGOs).

European policy recommendations:

To the ICT sector:

- To extend their partnerships with pioneer cities and regions to showcase smart green innovations.

To city authorities:

- To raise the level of ambition in the synergetic combination of smart green transformations to near-zero carbon emission cities by 2020. The

initiatives in the leading cities are not yet sufficiently ambitious: it will not be enough for the most dynamic and capable cities in Europe's most prosperous regions to aim only to match the overall ambition of the EU for 20-30% cuts in carbon emissions by 2020. They must be the pioneers for much more substantial cuts, with near zero-emission public buildings and transport to create the models for mainstream investments by all cities in the following decades.

- To pioneer green public procurement by following, for example, the UK DEFRA guidelines on green public procurement.[76]
- To support behaviour change at community level through, for example, new and innovative public services.
- To develop strategic partnerships on ICT and energy efficiency across the private, public and voluntary sectors.

To the Member States and the European Commission:

- To facilitate the use of public-private partnerships and budget-neutral energy performance contracts within Structural Fund measures.
- To strengthen the frameworks for exchange of best practice, building on EU websites[77] and networks of pioneering cities such as those in EUROCITIES and signatories to the Covenant of Mayors.
- To work closely with cities and city partnerships in identifying opportunities for large-scale actions in the fields mentioned in this report, for example under the Commission's new 'smart cities' initiative.

IV. The ICT sector itself

The Information and Communications Technology (ICT) sector itself now accounts for more than 6% of GDP. It consists of more than a million companies (mainly SMEs), and is increasingly difficult to define narrowly. It has transformed and absorbed much of the media and photographic industries, and is encroaching on the retail sector, notably in travel and entertainment reservations.

Managing the footprint of ICT equipment and services

ICT equipment and services and household electronics[78] were responsible for about 8% of EU electricity use and around 2-3% of EU carbon emissions in 2005.[79] Forecasts suggest that by 2020, the ICT sector will represent 10% of EU electricity consumption and 3-4% of emissions under a business-as-usual scenario, but electrical power consumption could be stabilised at about 7% in an 'eco-scenario'.[80]

ICT-related power consumption is still rising in Europe and globally as a result of three growth dynamics:

- the increase in numbers of users of PCs, mobile equipment (phones and cameras, etc.) and the Internet;
- the increase in frequency and intensity of use;
- the increase in the sophistication of services, which places greater power burdens on data centres.

These growth dynamics are partly compensated for by the shift to battery-powered mobile equipment, which is intrinsically more energy-efficient, and steady improvements in the power-efficiency of micro-processors and systems for data-centres, including improvements to software which makes more efficient use of the hardware. As growth in the number of users reaches saturation point in Europe (at nearly 80%), the energy use of ICT equipment and services could stabilise in the EU,[81] although it will continue to rise globally.

More sustainable business models also contribute to reducing the carbon intensity of the ICT sector. Sales strategies based on getting customers to renew their equipment as often as possible are unsustainable. New business strategies are appearing which focus on renewing software without having to buy new

hardware. Another example is the shift from personal computer hardware and software to Internet-based services. Personal computers and software use a great deal of energy; Internet-based services are more energy-efficient due to economies of scale in large data centres, with ICT companies internalising green growth through the direct payback on investments in energy efficiency and product durability in their data centres.

These market trends will be strengthened by the application of green procurement principles to ICT-based systems for service delivery. Some Member States are already implementing measures which move in this direction, and action may be needed at the EU level to strengthen and widen these approaches, preserve the integrity of the EU's Single Market and realise the economies of scale it offers.

The ICT sector as a pioneer of smart green growth

Although the leading companies that develop and market ICT equipment and services are leading the way, it will not be sufficient simply to continue at the current level of ambition. If carbon emissions from the ICT sector grow, the benefits for the climate of ICT-enabled carbon reductions in other sectors would be starkly reduced.[82]

Several major ICT companies and telecommunications operators have high ambitions to be pioneers of green growth. However, the ambitions of the top 20 ICT players are confusingly different and there is a problem of comparability between different ICT companies' carbon measurement and carbon-reduction targets.[83] To be credible in marketing ICT equipment and services as green, ICT companies need to be more transparent about their carbon emissions and efficiency measures.

> The *ICT for Energy Efficiency Forum* has been set up as a platform for cooperation between the European Commission and the ICT industry. The Forum's objective is to link digital technology more closely to EU climate and energy policies and economic development. One of its concrete aims is to demonstrate more clearly the ICT sector's commitment to, and leadership in, managing its own energy use and delivering energy and carbon savings in other sectors of the European economy.

To convince the public of the benefits of green ICT, ICT equipment and service providers must also pioneer the use of renewable energies to

become near-zero carbon emission businesses. Because the sector provides high-value services in which energy use is a minor contributor to costs, companies in this sector are less sensitive to the current higher price of renewable energy supplies. However, several of the major firms are among the largest or pioneering users of 'contracted green electrical power'.

With a combination of determined energy efficiency through the use of smart buildings and logistics, and pioneering use of low-emission renewable power, the most ambitious companies aim to cut carbon emissions from their own activities by 80% by 2020, and could become 'carbon neutral' if emissions which cannot be avoided are off-set (by, for example, financially supporting projects which reduce carbon emissions or remove greenhouse gases from the atmosphere).

Not only do companies need to limit their own carbon footprints, but ICT equipment and services also need to be greener. Consumers need to be empowered to be able to choose the product or service with the lowest carbon footprint. ICT companies should therefore pioneer carbon[84] or environmental sustainability labelling of their products and services.

European policy recommendations

To be credible in marketing ICT equipment and services as enablers of a smart green transformation of Europe's economy and society, leading ICT companies need to demonstrate their own commitment to such a transformation. All members of the Task Force agreed on this, but there were differences of opinion on some of the issues raised in this chapter.[85] We therefore recommend:

To the ICT sector:

- The leading ICT companies should measure and report their own organisations' GHG emissions based on common standards[86] by 2011, as recommended by the European Commission, and pioneer consistent carbon or environmental sustainability labelling of their products and services.[87]
- Leading ICT companies should aim to be carbon neutral in their own business activities[88] and to offer near-zero-emission services by 2020. If leading ICT companies are to be the smart green pioneers, as they have been for online services, they should aim to be near-carbon neutral, and to offer zero-emission services by 2020.[89] Carbon emissions could be cut more radically if greater use were made of local and renewable power.[90]

- The use of ICT equipment and services could – and should – be more climate-friendly. Leading ICT companies should play a greater role in informing and mobilising their five billion customers around the world to use energy more carefully by enabling green purchasing and making more energy-efficient use of equipment and services.[91]

To Member States and city authorities:

- To mainstream 'green ICT' procurement in relation to online service delivery and use ICT equipment in public authorities.

To Member States and the European Commission:

- To harmonise 'green ICT' procurement in the framework of the EU's green procurement rules to preserve the integrity of the Single Market, in support of the more sustainable business models of the future.

V. Getting the time-line right: priorities for 2010 and an indicative timetable to 2020

The target date of 2020 for meeting the current goals of EU energy and climate policies is an important milestone, but not the end-point of the smart green transformation. The ambition to cut global carbon emissions by 50% by 2050 will require cuts of about 80% in Europe and the US. Since some transport and essential security services will never be carbon neutral, this means that most buildings and businesses will need to be near-zero carbon emissions by 2050.

The transformation to 2020 must be a step on this road. The pioneers of the smart green transformation need to show the way, not just to 20-30% cuts in their emissions, but also to the new business models and technologies that can virtually eliminate carbon emissions.

The transformation to a smart green economy will affect all aspects of our lives and all businesses. It will take decades, but some key infrastructures must be put in place rapidly to be effective and for these broader benefits to emerge. The interdependence of ICT-enabled innovations for a greener economy also means that there is a necessary sequence for deploying most innovations on a wide scale. Infrastructures come first.

Policy priorities for 2010

2010 is a crucial date in the EU's political and economic development. The new European Commission and Parliament must kick-start the real transformation of Europe into a smart green society. The follow-up to the Lisbon Strategy must put smart green growth at the heart of transformative economic recovery and climate and energy security.

The follow-up to the i2010 framework for ICT research and technological development (RTD), innovation and regulation must recognise that ICT is an enabler of smart green growth, not an end in itself. A new direction must be set, with fast development and deployment of next-generation infrastructures and interoperable systems for smart buildings, cities and grids, and an acceleration in the deployment of smart near-zero-emission services.

To kick-start transformational change, key actions must already be taken in 2010, but in the context of a credible timetable for implementation of radical change by 2020.

The policy priorities for the EU institutions identified by the EPC Task Force are:

- To formulate regulatory proposals for carbon reporting by companies and public authorities, and proposals for carbon-accounting standards and carbon labelling of products and services.
- To formulate regulatory proposals for smart grid operation. Investments in smart grids will flow when the regulatory framework is right, and there is a sound business case for investment in smart meters and energy-management systems by grid operators and by all users, including householders.
- To review the regulatory framework to accelerate investment in high-speed (>10 Mb/sec) wireless and fibre access and widespread deployment of next-generation services by 2015.
- To review and invest in the incentive structure for green road transport and interoperability with less carbon-intensive modes of transport via real-time container tracking in, for example, cross-EU rail freight.
- To recast the European Buildings Performance Directive to include a target date of 2015 by which all new public buildings should be near zero-emission smart buildings.
- To widen the network of smart green cities as showcases of near zero-emission cities of the future, with ambitious public targets for 2015 and 2020.

An indicative timeline to 2020

The experience of the last decades has demonstrated that the first step to achieve mid-term policy goals is to set targets and a timetable for their realisation. No such timetable yet exists for achieving the 2020 energy and climate goals. The realisation of smart green growth will therefore require an indicative timetable for the key infrastructures to be put in place, and for radical improvements then to be made in the efficiency of transport, buildings and cities.

The following target dates are suggested for the implementation of the ideas discussed by the EPC Task Force:

Carbon accounting:

2011 Consistent carbon-emission reporting by leading ICT companies and easily available consistent carbon-accounting ICT tools for all businesses

2012 Consistent carbon-emission reporting by EU companies and public authorities

2015 Fully operable standard metrics for carbon or environmental sustainability labelling of most products and services, with a view to consistent carbon or environmental sustainability labelling of goods and services in the EU and worldwide

Smart grids:

2012 Regulatory framework for pan-EU smart-grid interoperation

2012-15 City-scale pilots for smart-grid demonstrations

2015-17 Cross-border interoperation trials

2020 Full interoperability of smart grids across the EU

Next generation Internet infrastructures:

2015 All public offices and over 90% of businesses and 80% households with high-speed access to online services.

Smart transport and logistics:

2012 Associations of SME truck-fleet operators enabled to take full advantage of ICT-based optimisation tools, and operators of cross-EU rail freight enabled to offer next-day delivery for tracked container loads

Smart buildings:

2015 All new public buildings to be smart and green, with near-zero emissions

2020 10-15% of all buildings to be smart and green, with near-zero emissions

Smart green cities:

2015 50 pioneer cities with near-zero carbon emissions in some neighbourhoods

2020 10%-15% of the European population living in pioneer cities with near-zero carbon emissions

Annex I. Members of the Task Force

This Working Paper summarises the discussions which took place within the EPC's Task Force on ICT for a Green Economy and sets out its recommendations. The EPC would like to thank all the members of the Task Force very much for the time and energy they devoted to this work.

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Annex II. Contributors to the Task Force discussions

The themes addressed in this Working Paper were initially discussed at a range of events organised by the EPC's Task Force on ICT for a Green Economy over the course of the last year. The EPC would like to thank all those who spoke at these events. As well as those marked with an asterisk in Annex I, the speakers were:

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The EPC would like to thank the following staff from the European Commission for their attendance at, and participation in, the events preceding this Working Paper organised by the ICT for a Green Economy Task Force:

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Glossary of terms

Broadband: wide band of frequencies used to transmit telecommunications information.
Building Automation System (BAS): a computerised, intelligent network of electronic devices, designed to monitor and control the mechanical and lighting systems in a building.
Building Management System (BMS): an ICT-based system in buildings that controls and monitors the building's mechanical and electrical equipment such as ventilation, lighting, power, fire and security systems.
Cabotage: transport of goods or passengers between two points in the same country.
Carbon accounting: measurement of carbon dioxide emissions at all stages in a product's lifecycle or the provision of a service.
Carbon Disclosure Project (CDP): an organisation based in the UK which works with shareholders and corporations to disclose the greenhouse gas emissions of major corporations.
Carbon footprint: impact of human activities on the environment measured in terms of GHG produced, measured in CO_2e (see below).
Carbon labelling: tracking carbon emissions through supply chains to label products and services with their carbon footprint at the point of sale or use.
Carbon neutrality (or net-zero carbon footprint): achieving net-zero carbon emissions by making more efficient use of energy; using low-carbon renewable energies, and balancing residual carbon emissions with an equivalent amount captured and sequestered.
Carbon reporting: reporting of carbon emissions by companies or other organisations.
Carbon Trust: a not-for-profit company created by the UK government to help businesses and public organisations to reduce their carbon emissions.
Cloud computing: a system of computing in which the computing resources being accessed are typically owned and operated by third-party providers on a consolidated basis in data centre locations.
CO_2: carbon dioxide (used as a synonym for GHG emissions).
CO_2e: carbon dioxide equivalent.
Covenant of Mayors: a commitment by signatory towns and cities to go beyond the objectives of EU energy policy in terms of reducing CO_2 emissions through enhanced energy efficiency and cleaner energy production and use.
Data centre: a facility used to house computer systems and associated components.

DEFRA: UK government Department for Environment, Food and Rural Affairs.
Demand-based pricing of power: higher pricing at times of peak usage.
Demand Side Management (DSM): actions that influence the quantity or patterns of energy consumed by end users, such as actions targeting a reduction of peak demand during periods when energy-supply systems are constrained.
Dematerialisation: substitution of high-carbon activities or products with low-carbon alternatives.
Dynamic demand management: semi-passive technology for adjusting load demands on an electrical power grid.
Eco-efficiency: competitively-priced goods and services that satisfy human needs and enhance quality of life while progressively reducing the environmental impacts of goods and resource intensity throughout the entire life-cycle.
eCommerce: buying and selling of products or services over electronic systems such as the Internet and other computer networks.
Eco-scenario: a scenario in which there is a market or technology push for more energy-efficient solutions.
eGovernment: use of ICT to provide and improve government services, transactions and interactions with citizens, businesses, and other arms of government.
e-inclusion: a term used to encompass activities related to the achievement of an inclusive information society.
Embedded microprocessor systems: computer chips that are incorporated into products such as cars, fridges, traffic lights, industrial equipment, etc.
Embodied carbon: total carbon emissions associated with a product, including manufacture, transport and disposal.
Energy intensity: ratio of energy use to economic or physical output.
Energy Management System (EMS): a system of computer-aided tools used by operators of electric utility grids to monitor, control, and optimise the performance of the generation and/or transmission system.
Energy Service Companies (ESCOs): professional businesses providing a broad range of comprehensive energy solutions.
EUROCITIES: a network of local governments of more than 130 large cities in over 30 European countries.
European Investment Bank (EIB): EU's long-term lending institution established in 1958. A policy-driven bank, the EIB supports the EU's priority objectives.
GHG emissions: greenhouse gas emissions.
GHG Protocol: an international accounting tool for government and business leaders to understand, quantify, and manage greenhouse gas emissions.
Green public procurement guidelines: guidelines designed to ensure contracting authorities and entities take environmental issues into account when tendering for goods or services.

i2010: EU's policy framework for the information society and media. It promotes the positive contribution that ICT can make to the economy, society and citizens' quality of life.
IAASB: International Auditing and Assurance Standards Board.
IAS: International Accounting Standards.
ICT: Information and Communications Technology – a combination of devices and services that capture, transmit and display data and information electronically.
ICT company: GeSI constitution definition – "Any company or organisation which, as a principal part of its business, provides a service for the point-to-point transmission of voice, data or moving images over a fixed Internet, mobile or personal communication network, or is a supplier of equipment which is an integral component of the communication network infrastructure, or procedures equipment or software associated with the electronic storage processing or transmission of data".
Intelligent Transportation System (ITS): application of information and communications technology to transport infrastructure and vehicles to manage vehicles, loads and routes to improve safety and reduce vehicle wear, transportation times, and fuel consumption.
Interoperability: refers to the ability of diverse systems and organisations to work together (inter-operate).
Intergovernmental Panel on Climate Change (IPCC): a scientific intergovernmental body set up to assess the scientific, technical and socio-economic information relevant to understanding the scientific basis of risk of human-induced climate change, its potential impacts and options for adaptation and mitigation.
ISO 14064: ISO standard specifying principles and requirements at the organisation level for quantifying and reporting on greenhouse gas (GHG) emissions.
ISO 14067: ISO standard currently being developed as a new international standard for product carbon footprinting and labelling, due for completion in 2011.
LCA: life-cycle analysis (also known as life-cycle assessment).
LCD: liquid crystal displays screen (see also Cholesteric LCD screen); composed of LCDs, one per pixel, which darken or change colour when activated.
LED: light-emitting diode.
Lisbon Strategy: an action and development plan for the EU aimed at making the EU "the most dynamic and competitive knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion, and respect for the environment by 2010".
Load control: practices undertaken by electrical utilities to ensure that electrical load is less than what can be generated.
Load management: process of balancing the supply of electricity on the

network with the electrical load by adjusting or controlling the load rather than the power station output.

Modal shift: reallocation of transport flows to other modes of transport (such as road, rail or water).

Non-residential building: buildings where less than half of the gross floor area is used for dwelling purposes, including industrial, commercial, educational and health buildings.

Open standard: a standard that supports full competition in the marketplace for suppliers of a technology and related products and services.

PAS 2050: a Publicly Accessible Specification from the British Standards Institution (BSI), providing a standard method for measuring the embodied GHG emissions from goods and services across their lifecycle.

Residential building: a building where more than half of the floor area is used for dwelling purposes.

Radio-frequency identification (RFID): an automatic identification and data-capture method, relying on storing and remotely retrieving data using devices called RFID tags.

Research and Technological Development (RTD): European research projects under the supervision of the European Commission's Directorate-General for Research.

Scope 1: following the GHG Protocol's specifications, this covers carbon emissions resulting from activities directly owned or controlled by an organisation.

Scope 2: following the GHG Protocol's specifications, this covers carbon emissions attributable to electricity use.

Scope 3: following the GHG Protocol's specifications, this covers carbon emissions produced by the supply chain.

Smart building: a group of embodied ICT systems that maximise energy efficiency in buildings.

Smart city: a city with a facilitating policy towards a knowledge-based society and economy.

Smart grid: integration of ICT applications throughout the grid, from generator to user, to enable efficiency and optimisation solutions.

Smart logistics: a variety of ICT applications that enable reductions in fuel and energy use by enabling better journey and load planning.

Smart meters: advanced meters that identify consumption in more detail than conventional meters and communicate via a network back to the utility for monitoring and billing purposes.

Smart transport: use of advanced ICT to help increase efficiency, improve security and reduce the impact of transport on the environment.

Strategic Technology Action (SET) Plan: a comprehensive plan proposed by the European Commission which aims to establish a new energy research agenda for the EU.
Traffic Management Systems (TMS): innovative solutions for the dynamic supervision, regulation and control of traffic.
Two-way interfaced smart meters: smart meters that can communicate energy data to both the electric utility and the consumer.
Zero-emission building: a building with zero carbon emissions from its use.

Endnotes

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    The GHG Protocol provides a more detailed framework for International Standards. It allows consistent measurement of all GHG emissions from operations within the direct control of a company. It is currently under review and a new standard for product- and supply- chain GHG accounting and reporting is scheduled for 2010. Scope 1 covers those resulting from activities directly owned or controlled by an organisation.

Scope 2 covers those attributable to usage of electricity. Scope 3 covering product- and supply-chain GHG accounting and reporting is in development.
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79. *Op. cit.* Bio Intelligence Service, 'Impacts of Information and Communication Technologies on Energy Efficiency', p.128.
80. Eco-scenarios assume there is a market or technology push for more energy-efficient solutions.
81. Energy efficiency is becoming a key marketing parameter, notably for data centres.
82. *Op. cit.* Bio Intelligence Service, 'Impacts of Information and Communication Technologies on Energy Efficiency', p.407.
83. Appendix 4 of the *SMART 2020* Report gives a good overview of the multitude and variability of green targets in the ICT sector. BT has set a target of 80% cuts in CO_2 emission in its EU activities by 2020, baseline 1996. Nokia targets a 6% cut in energy consumption by 2020, baseline 2006.
Op. cit. The Climate Group, *SMART 2020*, pp.75-78.
84. As a pro-active contribution to the ISO 14067 carbon reporting and labelling standard.
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86. GHG Protocol Scope 1 and 2; and ISO 14064 (see above 'making energy use and carbon emissions visible to everyone').
87. Already done by the Carbon Trust and currently being standardised in the upcoming ISO 14067.
88. By improving energy efficiency (often cutting carbon emissions by 50-80%), making greater use of renewable, low-carbon energies, and off-setting the emissions associated with residual use of fossil fuels against equivalent carbon sequestration (for example, in re-forestation or bio-sequestration).
89. By 2050, all businesses may need to be near-zero carbon emissions in their own activities.
90. BT and Deutsche Telecom are some of the largest contracted users of 'green' power.
91. The EPC's Task Force on the Rational Use of Energy identified five ways to stimulate a more rational use of energy – M. H. Fandel and F. Zuleeg 'Gain without pain: towards a more rational use of energy', *Working Paper No.29*, European Policy Centre, March 2008.
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Mission Statement

The European Policy Centre is an independent, not-for-profit think tank, committed to making European integration work. The EPC works at the 'cutting edge' of European and global policy-making providing its members and the wider public with rapid, high-quality information and analysis on the EU and global policy agenda. It aims to promote a balanced dialogue between the different constituencies of its membership, spanning all aspects of economic and social life.

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