

## Executive Summary

### High Tech: Low Carbon The Role of Technology in Tackling Climate Change

Energy efficiency is at the heart of the three biggest environmental problems that we now face: climate change, resource degradation and pollution. Energy efficiency reduces pollution and greenhouse gas emissions (in particular CO<sub>2</sub>) and makes better use of limited resources. The ICT sector has a critical role to play in optimising the use of existing energy resources and in facilitating the transition from fossil fuels to renewable generation.

#### Introduction

The ICT sector is a relatively new industry and has developed at extraordinary speed over the last few decades, and on a scale far beyond early predictions. It has evolved in response to the market pull of an environment where energy was not a major issue, where the sleeping giants of China and India were still snoozing, and where the kind of mass adoption we see today was no more than a pipe dream.

ICT now underpins most aspects of our daily lives and has transformed the way we interact with each other, the way we shop, access public services and run our businesses. But these developments come with associated costs: the vast majority of ICT and CE products and services use electricity, and as they become more and more pervasive, gross energy demand continues to rise.

In April 2007, Gartner estimated that the ICT sector was responsible for around 2% of global CO<sub>2</sub> emissions<sup>1</sup>, approximately the same as the airline industry<sup>2</sup>. This statement was accompanied by a barrage of press coverage emphasising the growing energy demand of our sector and its products. What received less attention were the beneficial environmental effects of technology across the whole economy, which are reducing energy consumption and emissions whilst improving productivity and competitiveness: a positive contribution that is too often forgotten or simply taken for granted.

The ICT sector is therefore in a unique position – whilst on the one hand our products consume energy, on the other hand we provide technologies that help other sectors become more energy efficient. ICT enhances existing processes, enables new ways of working and transforms behaviour, helping to create a lower-carbon economy.

Moreover, ICT is one of the fastest developing and innovative industry sectors, and will help to provide the alternative technologies that will be needed to underpin this new, low carbon economy; technologies that need to be developed and implemented sooner rather than later to give us a chance of limiting climate change.

#### Energy efficiency – problems and solutions for the technology sector

ICT products and services have an energy impact. The boom in technology is therefore both a benefit and a challenge. Energy efficiency measures that we implement will have to be robust enough to outweigh the kind of rapid growth and increasing proliferation that we have seen over the last decade and which look set to continue.

The way that ICT products and services use energy is not yet optimal. Particular issues include proliferation (through mass ownership and duplication of devices), standby (where energy is wasted when products are inactive), peripheral energy use (where only a fraction of the energy used is for core functions) and rapid obsolescence (where products are discarded and replaced at frequent intervals). This means that we need to make dramatic improvements in the energy efficiency of devices and services just to counterbalance current market developments.

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<sup>1</sup> Gartner Symposium/IT Expo, 26 April 2007 (<http://www.gartner.com/it/page.jsp?id=503867>)

<sup>2</sup> These sectors are, however, of dramatically different size - the aviation industry contributes about 1 % of UK GDP and employs around 180,000 people; the ICT sector contributes 6.4% of UK GDP (ONS, 2006) and employs over five times as many people. Furthermore, atmospheric and other factors connected with aviation mean that the effect on climate change is between two and four times the emission level.

This is challenging but achievable: in the ICT sector, orders of magnitude improvements in product efficiency are already a reality. A quick look at some everyday devices like mobile phones, (now around 100 times more efficient than in 1990) demonstrates that dramatic efficiency improvements are being made over relatively short timescales. We are also tackling the problem of standby losses by reducing power consumption down to fractions of a Watt, and by providing power management tools that turn devices off. Peripheral energy use is a problem which has not yet been solved, particularly in the data centre environment, but solutions do exist, and now need to be implemented.

The unprecedented speed of innovation within the ICT sector has a downside – rapid obsolescence as products are superseded by new and better models. Although the waste issue is being tackled successfully through regulation in many parts of the world, there is a significant energy impact. Eco-design and voluntary agreements are providing some solutions and the technology industry is taking a leading role in such initiatives.

Technology businesses are also leading the field in manufacturing efficiency, as a result of internal corporate initiatives, intensive R&D, and the application of voluntary standards to business processes. Companies like Intel, Fujitsu and Sharp are demonstrating some of the things the sector is doing to optimise efficiency in the manufacturing phase.

### **What technology does for other sectors – enhance, enable and transform**

Three classes of technology can contribute to an overall reduction in energy demand: enhancing technologies let us do what we do already, only more efficiently, enabling technologies produce evolutionary change in everyday processes, and transforming technologies let us do different things altogether

To date, attention has been focused on the energy requirements of ICT and CE devices themselves - for instance, the amount of energy used to operate a desktop computer or a TV. These impacts are easy to measure and analyse – hence all the media attention. However, we keep forgetting the beneficial effects of technology: the innovative, low-carbon, ICT-enabled applications that are being adopted in almost every industry sector, improving efficiency and at the same time, increasing productivity and competitiveness.

Often unnoticed, once they have been absorbed into everyday life, there are thousands of ways in which technology is being exploited to reduce energy demand across other sectors, such as energy generation and distribution, transport and manufacturing. Logistics technologies reduce vehicle miles, remote monitoring reduces travel, energy management tools turn off computers, sensors switch off lights, and advances like technological convergence and broadband change the way we do things and lead to de-materialisation<sup>3</sup>, to new, low carbon, business models. We need to focus on these wider opportunities because although they are harder to measure and harder to understand and predict, they are the ones that have the potential to decouple economic growth from energy use.

These include technologies that **enhance** existing processes, technologies that **enable** new ways of working and technologies that **transform** what we do altogether.

**Enhancing technologies** make things better: they make us more efficient while allowing us to continue doing the things we normally do. Enhancing technologies include monitoring and analytical tools which enable users to identify when energy is being wasted. Logistics systems optimise the supply chain and streamline fleet operations and intelligent transport systems improve vehicle efficiency. Smart building technologies minimise energy use and user management technologies intervene intelligently to minimise energy wastage.

Improving efficiency, however is not sufficient to achieve what we really need:- to decouple economic growth from energy use. Enabling technologies do have exactly that capability. This is because enabling technologies change the way we do things: they enable new processes, new ways of working.

**Enabling technologies** include energy-related applications that facilitate renewable generation and a whole series of technologies based on virtualisation, including in-silico testing and modelling and paperless office technologies.

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<sup>3</sup> De-materialisation means minimising the physical properties of a product or process.

**Transforming technologies** change fundamental behaviour and lead to the creation of new business models. Whereas enhancing technologies help the transport sector become more efficient, transforming technologies remove the need for transport altogether – or at least reduce it to a fraction. Transforming technologies do not just save energy, preserve resources and reduce waste, they change what we do, stimulate innovation and spawn new industries.

Transforming technologies include broadband (which has completely changed the telecoms market and underpins evolving technologies like videoconferencing) and space-related technology. With access to solar reserves one billion times greater than those that reach the earth, space and satellite applications are truly disruptive technologies that offer dramatic potential for replacing traditional terrestrial processes with low energy alternatives.

Technologies that change behaviour as radically as the ones we have discussed above do, inevitably, involve considerable uncertainty. Moreover, energy demand may increase temporarily during transitions from one technology to another. It will take time and research to establish conclusively which technologies are the real winners.

### **So why are our emissions still going up?**

The core problem facing the ICT sector is that whilst equipment is getting more efficient, our gross energy demands are still rising.

Electricity use by ICT equipment is still on the increase, despite the fact that our products are getting more energy efficient. So why is this happening? What is preventing the downward trend in gross energy use that we all want to see?

We have already looked at issues like proliferation, standby losses and peripheral consumption. There is no doubt that these problems drive up energy use, but the usual suspects are not the only culprits. There are other, more complex and pervasive issues that either exacerbate existing problems, or act as barriers to developing and implementing solutions. These include procurement, policy and perverse incentives, user behaviour and carbon accountability.

Traditional procurement processes are often cited as a barrier to implementing energy efficient ICT, particularly in large organisations, where up-front costs can dominate decision making. Things are changing but not quickly enough. Policy measures can also have unforeseen consequences on energy use or may create split or “perverse” incentives.

User behaviour has a dramatic influence on the energy efficiency of ICT products – firstly in purchasing preferences and secondly in actual use. Just like the efficiency of a car depends on the way it is driven, the efficiency of ICT equipment depends on the way it is used and this is true at every level, from businesses running huge data centres to the domestic consumer in a studio flat. We are providing interim solutions like power management tools, but there is still a long way to go.

These problems are actually symptoms of a bigger issue – what economists call the “market failure” in carbon. Market failure happens when the price of goods or services does not reflect the true cost to society – in this case, not factoring in the long term costs of carbon mitigation in the short term price of energy. The lack of carbon accountability means that there are no clear price signals to differentiate energy efficient products from cheaper but less environmentally friendly ones.

### **Why technology matters**

The timely adoption of low carbon technologies is a critical success factor in tackling climate change.

Research suggests that the rapid implementation and uptake of new energy-efficient technologies can produce much greater energy savings than policy measures. It is an obvious fact that the earlier we implement these new technologies, the better. This is because the longer we take to reduce emissions, the greater the accumulation of greenhouse gases in the atmosphere, and it is the concentration of those gases that influences climate change.

Recent work by the UK's Tyndall Centre emphasises this problem of cumulative emissions. Their findings are bleak: the UK Government has set ambitious emissions reductions of 60% over 1990 levels by 2050, but meeting these targets will not prevent disastrous concentrations of CO<sub>2</sub> building up in the atmosphere unless the rate of abatement increases – soon, and dramatically. The early implementation of low carbon technologies will play a critical role here, so we must do everything we can to identify those technologies as quickly as possible, to accelerate their development and support their adoption.

### **What the ICT sector needs to do**

The issues may be complex, but the actions are clear. We in the ICT sector have a lot to do.

We need to develop a more systematic approach to monitoring and measuring the energy demand of our own products and services. We need to improve environmental performance within our own supply chain by sharing best practice. We need to stimulate and encourage behavioural change. Most importantly, we must find ways to identify those technologies that have the greatest potential to tackle climate change, and accelerate their development and adoption.

### **Conclusions**

“In the long run, technology needs to be the central element of response strategies to climate change”

It is clear that there is considerable scope for improving the energy efficiency of ICT products. However, it should also be clear that as a sector we understand and acknowledge the challenges we face; we are working extremely hard to address them and are producing better, faster, lighter devices that use less and less energy. Moreover, we are taking a leading role in the development of alternative, low carbon technologies that will help to decouple economic growth from energy consumption.

Already, ICT is helping businesses and individuals to do things in different ways, replacing traditional, high impact processes with low carbon, low-impact alternatives which are integrated into everyday life at an unprecedented speed. These technologies do not just change the way we do things. They change what we do, creating whole new business models and stimulating innovation.

But there are barriers to progress. Although research shows that a wholesale adoption of best available technologies could dramatically reduce energy use, robust policy instruments are required to make this a reality and create the necessary market pull. Under current circumstances there is little incentive for individuals to seek out the most energy efficient products, or to change behaviour and adopt energy efficient lifestyles.

The recent publication “Avoiding Dangerous Climate Change” compiled by leading international scientists concludes that “In the long run, technology needs to be the central element of response strategies to climate change”<sup>4</sup>. We believe that there are two, interdependent solutions to the problem of climate change - the intelligent use of technology, and innovation.

However, this is not the time to sit back, relax and wait for technology to take care of it all: the low-carbon technologies that the new economy will rely on need active stimulation and support. And timing is a critical success factor, so we need to do everything we can to accelerate their development and adoption.

The important actions are clear. We need to understand the energy implications of our products and processes better, we need to spread best practice through our own supply chain, we need to stimulate behavioural change, and we need to identify the best low-carbon technologies and accelerate their development and implementation. The first two actions are up to us. The last two actions have to be shared with everybody.

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<sup>4</sup> Avoiding dangerous Climate Change, Ed. J Schellnhuber, Cambridge University Press 2007

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