

THE RELATIONSHIP BETWEEN DIGITAL AND GREEN ECONOMICS

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ABSTRACT

This article focuses on the relationship between two parallel tendencies. On the one hand, since the 1990s the internet has been playing an increasingly important role in the everyday life of organizations, individuals, and governments. On the other hand, since the early 1980s different organizations' and individuals' environmental consciousness has been continuously rising. It seems there is a wide range of relationships between these tendencies. Economic, social, and environmental forces define the global, sustainable development process and drive innovation in the ICT sector. At the same time ICTs will play a critical enabling role in meeting the challenges of sustainability. This article will show how ICT policies impact sustainable development and the growth of the green economy and how the internet can help firms and individuals to improve their environmental consciousness. A literature review will be conducted in order to identify opportunities for creating strategic synergies between digital and green economy strategies, and Corporate Social Responsibility.

Keywords: ICT, digital economy, sustainability, green economy

INTRODUCTION

The challenge of sustainability and the perspectives of information and communications technology are at the centre of current thinking on the development of global economies and societies. The green economy, green IT, a sustainable digital society – these are hugely popular keywords in newspapers and at conferences today. They are not only fashionable expressions, but they are, in themselves, considerable research areas and the centre of policy-makers' thinking. There is no debate: all efforts in respect of the 'greening' and digitalisation of our world aim at achieving a liveable and safe environment and try to plan a viable future. We need to recognise, however, that there are two sides to the two topics: they both offer challenges and provide opportunities for economies and societies.

The processes of current development and growth are based on ground that are not sustainable because of irresponsible resource depletion and the negative impacts of environment and greenhouse gas emissions. We have to find the different ways of "green growth" and adaptation to the climate change. The latter has a crucial impact on people's lives, livelihoods and the economies as well.

It is also evident that new information technologies, ICTs, are having a basic impact on economic and social relationships among individuals, communities and governments. The Internet has transformed the methods of communication, the availability of information and has modified traditional social and economic structures.

Against a background of the penetration of mobile 'phones, the importance of this tool in terms of immediate communications at a distance is obvious. High-speed telecommunications ensure a solid platform for electronic commerce - for e-business supporting globalisation in capital, labour and product markets.

The efforts made in the areas of sustainability and ICT have their impacts at global, national, local and individual level and representatives of both fields drive us to change the ways in which we think and act as citizens and members of different communities. This paper is concerned with the relationship between these two critical and global dimensions of economies and societies.

SUSTAINABLE DEVELOPMENT

Definitions of sustainability

- The expression/theme of sustainability emerged in the late 1980s and early 1990s. There are many different definitions of sustainability (See some examples in *Table 1*), but four factors which most have in common are:
 - Limitation
 - Interdependence
 - Equity in distribution
 - Deliberation
 - Principles for Sustainable Development:

"Business as usual is no longer an option - for government, private sector or individual citizens. Our soils, waters, forests and minerals are not inexhaustible. Farms, industries, homes and lifestyles must become more sustainable in every community on our planet. To be sustainable, development must improve economic efficiency, protect and restore ecological systems and enhance the well-being of all peoples." (*ISSD a*)

"Sustainability is the [emerging] doctrine that economic growth and development must take place, and be maintained over time, within the limits set by ecology in the broadest sense - by the interrelations of human beings and their works, the biosphere and the physical and chemical laws that govern it ... It follows that environmental protection and economic development are complementary rather than antagonistic processes" (*Ruckelshaus, 1989, 367. p.*)
 - "Sustainability is an economic state where the demands placed upon the environment by people and commerce can be met without reducing the capacity of the environment to provide for future generations. It can also be expressed in the simple terms of an economic golden rule for the restorative economy: Leave the world better than you found it, take no more than you need, try not to harm life or the environment, make amends if you do" (*Hawken, 1993, 139. p.*)
 - "Development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" (*WCED 1987, 1.2.1.*)
- "(...) under the assumption of no major change in the present system, population and industrial growth will certainly stop within the next century – at the latest." (*Meadows et al., 1972, 2. p.*) This was one of the most important statements of the report "The Limits of Growth", published by the Club of Rome in 1972. This

observation drew attention to the environmental problems which people would face in the years to come.

In the same year, the United Nations (UN) held the first international Conference on the Human Environment in Stockholm, at which representatives of industrialized and developing nations discussed the right of all mankind to a productive and healthy environment. The conference resulted in an action plan which made recommendations to national governments on how to influence societies' impact on the environment. The UN Environment Programme was developed from this event. (<http://www.unep.org>, 2011)

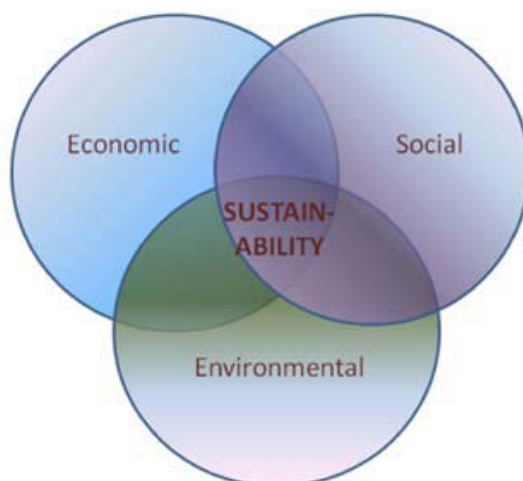
The widely used and accepted concept of sustainability was promulgated and popularised by the report "Our Common Future" of the World Commission on Environment and Development. The Brundtland Commission and the subsequent United Nation Summit (held in Rio de Janeiro in June 1992 and known as the Earth Summit) focused on opportunities for sustainable development. They defined the three main aspects of development as:

- economic development – in which the main goal is to reduce and eliminate income poverty, achieve higher levels of wealth and prosperity and enhance economic welfare;
- social development – whose purpose is to reduce and remove other dimensions of poverty by improving the quality of education, healthcare, housing and other factors of welfare;
- environmental protection – since it is crucial to reduce pollution and other negative impacts on the environment, diminish the harmful effects of industrialisation and to achieve a sustainable level of use of resources.

These three factors are interdependent and mutually reinforcing pillars of sustainable development, as shown in the *Figure 1*. (UN General Assembly, 2005, 48.§).

Figure 1

The three pillars of sustainable development



Source: *Barbier*, 1987

Recognition of the importance of sustainability has grown rapidly since the Earth Summit took place.

Over 100 heads of state or of government attended the Earth Summit and 170 nations sent delegations. As part of the Summit, these national leaders signed conventions on climate change and biodiversity, a “Declaration on Environment and Development” and an Agenda for the 21st Century (known as Agenda 21). Agenda 21 which is considered the most important agreement relating to UNCED (UN Conference on Environment and Development) was adopted by more than 178 states. It covers almost all topics considered important for a sustainable future, ranging from consumption patterns to the role of education, from agriculture to biodiversity and from hazardous waste to eco-tourism (*Agenda 21*, 1992).

The Commission on Sustainable Development, a UN body, was established in late 1992 to pursue the implementation of Agenda 21’s directives. In 1997 the “Earth Summit + 5”, a special session of the UN General Assembly, was held to review and assess the implementation of Agenda 21.

In December 1997, more than 150 nations adopted an agreement known as the Kyoto Climate Agreement to protect the earth’s atmosphere and climate. For the first time, nations agreed to place legally binding limits to their emissions of greenhouse gases. 37 industrial nations and the European Community decided to reduce their emissions of six such gases to 5% below the 1990 emission levels by the year 2012 (*Kyoto Protocol*, 1997).

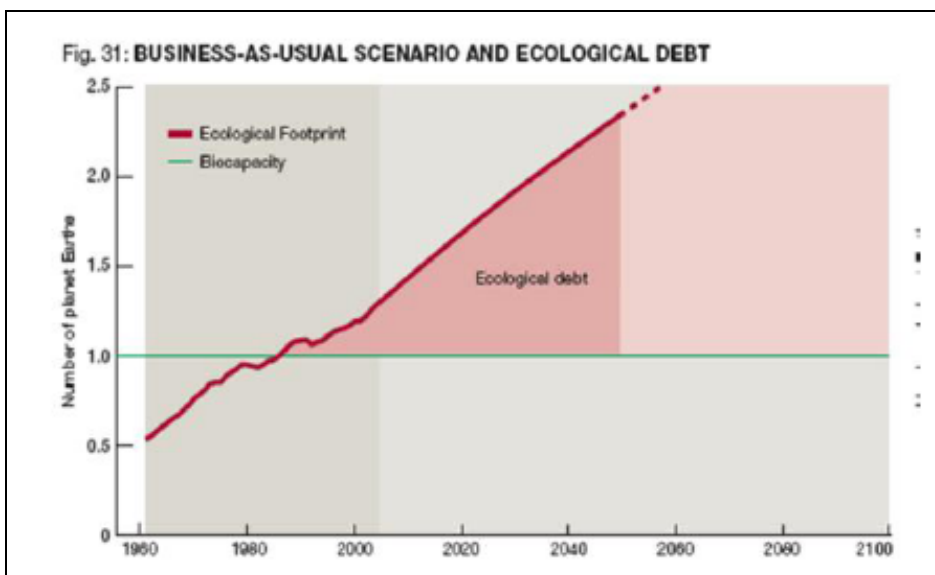
The next main stage was The Johannesburg Summit 2002 (Earth Summit +10) which collected thousands of participants, national delegates and leaders from governments and non-governmental organisations, businesses and other major groups to focus the world’s attention on meeting difficult challenges, such as improving people’s lives and conserving natural resources. (www.johannesburgsummit.org, 2002)

The 2005 UN World Summit continued the process. Further huge efforts are required to achieve sustainability – as the 2009 Climate Change Conference in Copenhagen so clearly demonstrated. This conference emphasised that this process requires both international coordination and action by individual governments, businesses and citizens. A third UN Earth Summit will be held in Brazil in 2012. It will focus on two major areas: the green economy in the context of poverty eradication and sustainable development and the institutional framework for sustainable development. (www.cc.int, 2005; www.un.org, 2009)

As illustrated by the following figures (*Figure 2, Figure 3 and Figure 4*) from the WWF 2008 and 2010 Living Planet Report, it is crucial that we reduce our ecological debt and footprint. “This debt results from the fact that the planet’s resources are being consumed at a greater rate than they can be replenished. It would take the resources of 1.5 planets to support our current lifestyle, and, under a business-as-usual scenario, two planets by mid-century.” (WWF, 2008) Long-term balance can only be achieved through technological, economic and social innovation.

Figure 2

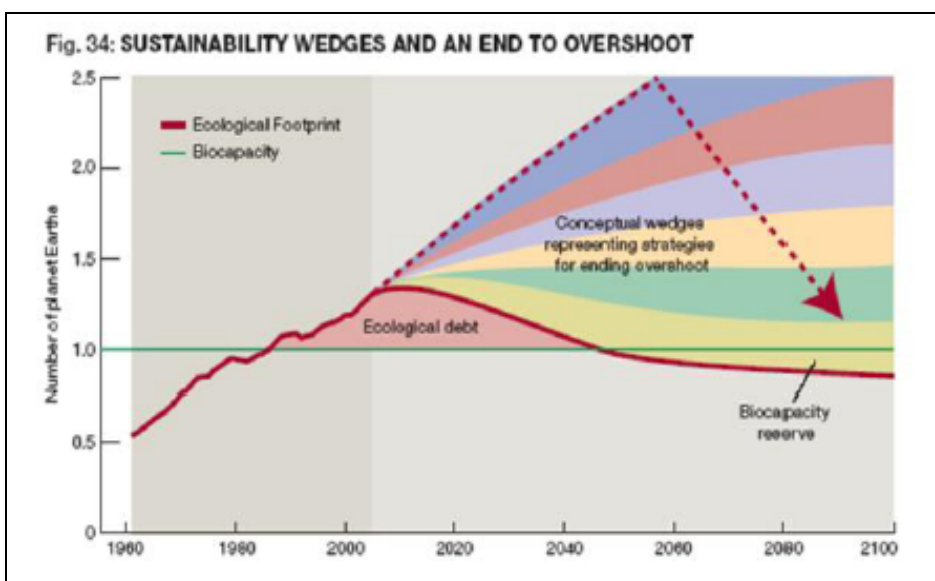
Business-as-usual scenario and ecological debt



Source: *WWF*, 2008

Figure 3

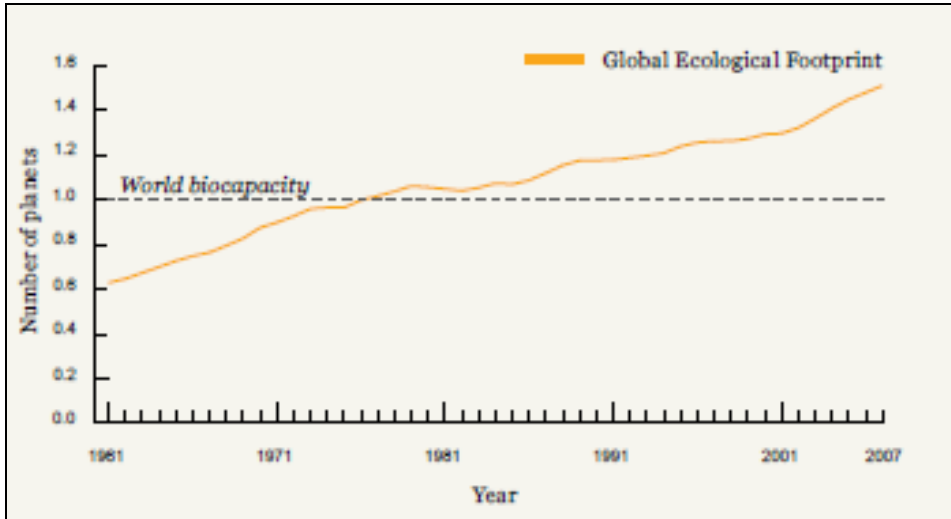
Sustainability wedges and an end to overshooting



Source: *WWF*, 2008

Figure 4

Global Ecological Footprint: Human demand on the biosphere more than doubled between 1961 and 2007



Source: *WWF*, 2010

It is clear that Information and communication technologies are increasingly important in the context of sustainability, but there has been too little interaction between sustainability and ICT areas. However the Earth Summit in 2002 in Johannesburg acknowledged the value of ICTs “as tools to increase the frequency of communication and the sharing of experience and knowledge.” (*WSSD*, 2002, 112. §)

THE GREEN ECONOMY

The concept of the “green economy” is much newer than that of the digital economy. After the 2008–2009 financial and economic crises, this topic has moved beyond the narrow environmentalist community. Since then, many authors and institutions have tried to describe what constitutes a green economy, although there is, as yet, no agreed and distinct definition.

Some authors use ‘green economy’ as a synonym for ‘sustainable economy’ or they base their definition on sustainability. “Simply put, the ‘green’ economy can be considered synonymous to a ‘sustainable’ economy. However, the Green Economy concept often carries a more distinctive meaning, one that focuses specifically on the fundamental changes that are required to ensure that economic systems are made more sustainable” (*Huberman*, 2010, 9. p.).

“Green economy is based on sustainable business practices as opposed to those which function based on non-renewable resources and inefficient methods. It seeks to promote financial, business and other economic transactions without depending on or damaging the environment” (*Ciocoin*, 2011, 38. p.).

In 2008 the United Nations Environment Programme (UNEP) released a Green Economy Initiative. UNEP defines the green economy as “the process of reconfiguring businesses and infrastructure to deliver better returns on natural, human and economic capital investments, whilst, at the same time, reducing greenhouse gas emissions, extracting and using less natural resources, creating less waste and reducing social disparities” (UNEP, 2010).

Also in 2008, the OECD began work on the Green Growth strategy, in which it defines the green economy as “a way to pursue economic growth and development, while preventing environmental degradation, biodiversity loss, and unsustainable natural resource use” (Visser, 2010, 9. p.).

President Roosevelt’s programme (a comprehensive response to the Great Depression) represents an inspiration in respect of two initiatives. Since 2007 the Green New Deal Group has proposed new solutions to the current financial, energy and environmental crises. The Green New Deal Group calls for a sustained programme to invest in and deploy energy conservation and renewable energies, coupled with effective demand management (Elliott *et al.*, 2008).

The President Roosevelt programme also inspired UNEP, which called for a “Global Green New Deal” and encouraged governments to support economic transformation to a greener economy. The green economy report of UNEP demonstrates that greening of economies will not hinder growth but will rather be a new engine of growth; it will generate new jobs, and it is also a possible strategy for the elimination of persistent poverty (UNEP, 2010).

One of the objectives of the third UN Earth Summit in 2012 is also to define the green economy. The conference “would offer an historic opportunity to define the contours of a “green economy” and consider whether the existing institutional framework could adequately address all the cross-cutting issues affecting human well-being... (UN Earth Summit, 2011).

THE DIGITAL ECONOMY

The digital economy is one name given to the phenomenon known as “the information economy” in the ‘70s, the “knowledge economy” in the ‘80s, the “new economy” in the ‘90s and “the Internet economy” in the first decade of the new millennium. “The basic idea underlying the digital economy is that the development, diffusion, application and use of ICTs—including computers, telecommunications, digital media and the Internet—has underlain and enabled the changes that have taken place over recent decades in global economic, social and political structures, including the distribution of wealth and power within and between countries, the nature of work and the location of employment, social interaction, cultural expression, and structures of governance in the public and private sectors. ... ICTs are seen as the latest GPT (General Purpose Technologies), following electricity, steam and a small number of earlier technologies that have had transformative effects on economies and societies.” (Souter *et al.*, 2010, 16. p.)

In accordance with its name, the concept of the digital economy focuses explicitly on the economic impact of ICTs, but we also need to see the social and even the environmental dimensions of the digital economy’s influence.

Although there is, in fact, no widely accepted definition of the ‘digital economy’, the following main characteristics can help us to grasp its essence:

- The ICT sector plays a major role in the global economy. It produces ICT and computer goods, services (including databases and applications software), telecommunications equipment, networks and services, broadcasting and other electronic content media and Internet services. The sector generates 5-10 per cent of GDP, accounts for a significant proportion of R&D and provides a substantial proportion of jobs.
- ICTs and the Internet have supported the globalisation process. The Internet has provided a platform for multinational businesses to build and manage global value chains for production and distribution.
- ICTs make a substantial indirect contribution to the development of economies, but these indirect benefits of ICT investment are only realised if other business and organisations make effective use of them.
- ICTs contribute to high degrees of innovation in developed countries, helping to enhance productivity and competitiveness. Virtualisation and dematerialization play a key role in this, creating new products and jobs, and virtual markets.
- Individuals are becoming the source of this new type of innovation with the help of the Internet. An increasing amount of innovation is generated by individuals, either directly – for example, through various forms of user-generated content (such as blogs and social networks) – or indirectly (through “crowdsourcing,” open innovation).
- The role of government regulation is limited in the digital economies.

THE IMPACT OF ICTS AND THE INTERNET ON SUSTAINABLE DEVELOPMENT AND THE GREEN ECONOMY

Technology has always played a crucial role in economic and social development and technological innovations have often led to economic and social transformation. However the relationships among technology, the economy and society are not deterministic.

The Brundtland Commission in 1987 emphasised, in defining sustainable development, “the idea of limitations imposed by the state of technology and social organisation on the environment’s ability to meet present and future needs.” (*WCED*, 1987, 1.2.1.). It is clear that technological developments have had both positive and negative impacts on the economy, society and environment, on the three pillars of sustainability. Based on the spectrum and intensity of the impacts of these technologies, we may add a fourth circle of sustainable development to the three in the diagram presented in *Figure 1*. (*Souter et al*, 2010, 11. p.)

If we consider the definitions and essence of these two areas analysed, it is evident that they are strongly related and influence each other intensively. The latest expressions such as ‘Green Digital Economy’, ‘Sustainable Digital Networks’, ‘Green Knowledge Society’ show the convergence and overlapping of the digital and green or sustainable economies.

ICTs pervade the whole of the economy and society and they can affect the natural environment in many ways and at many levels (*Berkhout and Hertin*, 2001, 4. p.).The ICT

as a significant economic sector impact directly, in its own right and indirectly on sustainability and green economy. „Sustainable development thinking needs to be revised to accommodate the increased and still increasing impact of ICTs and the Internet” (*Souter et al.*, 2010, 5. p.).

On the other hand the economic, social and environmental challenges of sustainable development are forcing innovation in the ICT sector.

This section of the article investigates the different dimensions of the relationship between the digital and green economies.

International development institutions such as UNESCO and the World Bank started to deal with ICTs in the mid-1990s, and the UN system dedicated two events to this topic (*World Summits on the Information Society*, 2003, 2005).

The European Union began to pay special attention to the economic role of ICTs in the mid-1990s and developed the line of eEurope programmes. Many governments have since introduced national ICT strategies which seek to exploit the economic and social value of information technology.

From the beginning of the century many international institutions and forums have released studies and analyses focusing on the opportunities and challenges of the digital economy and sustainable development. The most important are:

- 2008: OECD: Seoul Declaration on the future of the Internet Economy (*OECD*, 2008a)
- 2008: OECD: Declaration on Green Growth (*OECD*, 2008b)
- 2008: ITU Telecommunication Development Bureau: ICTs for e-Environment (*ITU*, 2008)
- 2009: ITU Telecommunication Standardisation Focus Group: ICTs and climate change (*ITU*, 2009)
- 2009: OECD: The Impact of the Crisis on ICTs and their Role in Recovery (*OECD*, 2009)
- 2010: The UNEP Green Economy Initiative (GEI): Green Economy Report (*UNEP*, 2010)
- 2010: OECD: Recommendation on Information and Communication Technologies and the Environment (*OECD*, 2010)

The environmental impact of the digital economy has been in the centre of scientific research since the late '90s. (*Coben et al.*, 2000; *Geels and Smit*, 2000; *Berkhout and Hertin*, 2001; *Sui and Rejeski*, 2002; *Forge et al.*, 2009). The research on the environmental impact of the digital economy investigates the direct and indirect influences: the impact of the ICT sector itself, and the impact of their use (the internet as a platform and ICT's electronic applications such as e-commerce and social networks).

Miller and Wilsdon (2001) claimed that the digital economy modifies the relationship of human beings with the environment and changes the business models in economies. They propose the concept of the “sustainable digital economy” as an answer to the environmental problems.

The Forum for the Future developed a very simple framework for analysing the different impacts on sustainability (*Table 1*). (*EITO*, 2002)

In this matrix, “first order effects” refers to the immediate and direct effects of a given factor on sustainability (in our case of ICTs); “second order effects” refers to indirect impacts, and “third order effects” to long term societal influences. The matrix can be used for analysing relationships between any sector and sustainable development.

Table 1

Framework for analysing the different impacts on sustainability

	First order effects	Second order effects	Third order effects
Economic sustainability			
Social sustainability			
Environmental sustainability			

Source: *EITO*, 2002

Berkhout and Hertin (2001) used this matrix to describe the main positive and negative effects of ICT on the environment (*Table 2*).

Table 2

ICT impacts on the environment

	Positive impacts	Negative impacts
First order effects	environmental ICT applications e.g. environmental monitoring	environmental impacts of production and use of ICTs e.g. electronic waste
Second order effects	dematerialisation & structural change e.g. electronic directories	incomplete substitution e.g. ‘white vans’ ¹ in addition to private shopping trips
Third order effects	life-style changes e.g. green consumerism	the ‘rebound effect’ e.g. growth of long distance travel

Source: *Berkhout and Hertin*, 2001, 4. p.

This model was later expanded by adding a fourth effect. (*Forge et al.*, 2009; *European Commission*, 2009) The fourth is that ICTs can improve society’s overall decision-making capacity to implement sustainability policy, with metrics to measure impacts in real time. We can use ICTs to measure climate change, energy consumption and emissions in real time.

Although I shall now describe ICTs’ effects on the environment and the green economy, I do use different terminology; instead of “first, second and third effects”

¹ Delivering internet- ordered goods to consumers’ home; vans were also responsible for the greatest increase in traffic.

I have opted for the more expressive labels of “direct, indirect (or enabling) and systematic effects”. (*Souter et al.*, 2010)

Direct effects

The ICTs have direct effects on the environment through their own sector’s production, distribution, operation and disposal, but these effects are mainly negative from the perspective of environmental sustainability. Two main types of direct effect require rapid and effective solutions. The first is the problem of electronic waste, whose volume continues to grow annually, and there are difficult question associated with informal and illegal disposal, particularly in developing countries. The second concern is related to the greenhouse gas emissions generated by the ICT sector in the production and distribution of its products and services. According to a report published by GeSI (the Global e-Sustainability Initiative), the contribution of ICTs to greenhouse gas emissions is currently between 2 per cent and 3 per cent, and will grow at an annual growth rate of 6 per cent between now and 2020. Total greenhouse gas emissions resulting from ICTs will rise from 0.53 gigatonnes (of CO₂ equivalent) to 1.43 gigatons between 2002 and 2020. This increase derives primarily from the extension of networks, from the increased availability and more frequent use of ICT devices and resources. The data centres required to manage Internet traffic are also responsible for a given proportion of this increase (*GeSI*, 2008).

Personal devices (mobile phones, laptops etc.) have never before used so much electricity and, normally, the relatively low cost of energy does not deter users from keeping their equipment running when not actually in use. ICT products and services consumed some 7.8 percent of EU electricity in 2009 - which may grow to 10.5 percent by 2020 (*European Commission*, 2009).

It is generally agreed that the main contribution of the ICT sector to the transition to a greener economy could be that the ICT sector improves its own environmental performance.

Enabling effects (indirect effect)

ICTs have indirect or enabling effects on the development of a green economy. They enable improvements in the efficiency of production, supply chains, distribution and consumption of other goods and services. The efficiency of energy production and distribution and of transport logistics can be improved by ICTs; by reducing demand for energy and materials through virtualisation; and through the dematerialisation of specific human activities and interactions. ICTs can help to reduce greenhouse gas emissions through the development of “smart” energy grids, transportation systems, buildings, and production/distribution processes in the different sectors. GeSI’s Smart 2020 study (*GeSI*, 2008) estimated that the deployment of smart systems in these sectors could reduce greenhouse gas emissions by 15 per cent by 2020 and result in an economic benefit of US\$950 billion. However, this forecast is highly optimistic; the result will depend on the extent and scale with which managements in these other sectors take up opportunities provided by ICTs.

GeSI estimates that the potential positive impact of such ICT-enhanced resource management could considerably exceed the negative first order effects described above (GeSI, 2008).

ICTs may reduce the demand for energy and materials through “dematerialisation” - the whole or partial replacement of physical and ‘real’ products, services and processes for their virtual equivalents in the case of e-commerce, digital media, e-government, e-education, e-health, etc. Dematerialisation does not eliminate energy requirements and significant rebound effects are likely to affect the extent of greenhouse gas emission and carbon savings. “The ‘rebound effect’ (or ‘take-back effect’) is the term used to describe the effect that the lower costs of energy services, due to increased energy efficiency, has on consumer behaviour both individually and nationally. Put simply, the ‘rebound’ effect is the extent of the energy saving produced by an efficiency investment that is taken back by consumers in the form of higher consumption, either in the form of more hours of use or a higher quality of energy service” (Herring, 2008, 1. p.) Telecommuting, for example, may reduce direct energy consumption, by substituting home working for travel to work. Home working may result in higher energy consumption in the home or to a greater use of personal transport for shopping and leisure. These processes do not necessarily lead to a net reduction in greenhouse gas emissions.

The clearest indirect effects arises from the fact that the Internet and digital devices provide business, individuals and communities with access to information, communication and knowledge resources that they can use to be informed about the challenges of sustainability.

Souter and his co-authors (Souter *et al.*, 2010) treat the next effect as an enabling effect, whilst Forge and his co-authors (Forge *et al.*, 2009) discuss it separately as a fourth effect. We favour the latter approach, since the measuring of influences is absolutely crucial in respect of the future. ICTs play an important role in monitoring, measuring and managing the natural, human and built systems of the physical environment, often through the many supporting devices and services such as remote sensing systems, embedded sensor networks, radio-frequency identification (RFID), and networking technologies.

These effects are mainly positive from the perspective of environmental sustainability, although their assessment and measurement is made more difficult by the uncertainty of surrounding rebound effects.

Systemic effects

ICTs may have systemic effects within society which transform the behaviour, attitudes and values of citizens and consumers, of economic and social structures, and of governance processes. These effects may be either positive or negative from the perspective of environmental sustainability.

Innovations such as social networking, home-working and home shopping do not just have immediate direct impacts on individual behaviour. They also influence directly and indirectly the ways in which societies and organisations work; the patterns of consumption; the interactions among citizens and their governments, employers and other businesses; the border between work and leisure.

Since it is difficult to establish and measure what long-term systemic impacts may result, very little research has been conducted into this type of effect on the economy, society and the environment.

CONCLUSIONS

Both the digital economy and the green economy are global phenomena. “Their growth is enabled by the borderless nature of both ICTs and the natural environment.” (IISD, 2010b, 9. p.) The ICT sector has a responsibility to consider its own impacts: it has to maximize the opportunities that it provides and to minimize negative impacts.

The sustainability challenge is too complex to be solved solely and primarily on a top-down basis. “Achieving sustainable development requires economic and social innovation, which, as the experience of recent decades strongly suggests, can most effectively be generated on a bottom-up, decentralised and widely distributed basis – through market mechanisms operating within an enabling environment – as well as through social entrepreneurship among individuals and communities. The digital economy plays a critical role in supporting these fundamental, bottom-up capabilities.” (IISD, 2010b, 12. p.) Governments, businesses, non-business organisations, user communities and individuals all have an important part to play in this process. These stakeholders ultimately determine the way of innovation and will influence how efficiently their equipment is used, and when, and how frequently, it is replaced.

There are many important questions which require serious analysis regarding the relationship of digital and green economies. Policymakers, leaders of government and research institutions and agencies will play a crucial role in capturing the essence and in measuring the development of this connection.

Based on the studies referred in this article, we can determine the some specific *dimensions of the mutual influence of green and digital economies*:

- the level of impact (global, national, local; organisations, communities, individuals)
- the method (direct- indirect)
- time period (short-term or long-term)
- certainty/assurance (predictable – non-predictable)
- measurement (measurable non-measurable)
- direction of the impact (positive-negative)

The investigation of opportunities for greening and digitalising the economy at the same time must involve the exploration of these dimensions.

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