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nadia.ciocoiu@man.ase.ro***Abstract**

Digital economy and green economy are the most important subjects on the environmental policy agenda in the last years. The first section of the paper examine the current state of thinking on the environmental impact of digital economy, especially of ICT, while the second section looks at what is known as the green economy and the most recent initiatives in this area. Both are paradigms that have become proeminent in the separate worlds of ITC policy and sustainable development. The integration between them leads to new paradigms and creates opportunities for sustainable development, also for economic recovery in the context of recent crises.

Keywords: green economy, digital economy, sustainable development, green knowledge society.

1. INTRODUCTION

The current thinking about the development of global economies and societies focuses on two issues: the potential of information and communication technology (ICT) and the challenge of environmental sustainability.

The importance of sustainability has been recognized in development policy – making since the Earth Summit took place in 1992 in Rio de Janeiro. The sustainable development was defined by World Commission on Environment and Development as „development that meets the needs of the present, without compromising the ability of future generations to meet their own needs” (WCED, 1987, part 1, sec. 2, para.1).

It contains within it two key concepts: the concept of *needs*, in particular the essential needs of the world's poor, to which overriding priority should be given; and the idea of *limitations* imposed by the state of technology and social organization on the environment's ability to meet present and future needs.

The concept of sustainable development has been elaborated and refined in the next years. The goal of sustainable development policy is human well-being for people everywhere, measured in terms of factors such as security, satisfaction of material needs, health, social relations and freedom of choice

and action. To meet this goal, it is necessary to generate and distribute wealth in ways that reduce poverty and provide a decent standard of living to people everywhere. This can only be done in the long run through policies and strategies that balance economic growth and social development with environmental sustainability.

Technology plays critical role in achieving the long-term balance between human development and the natural environment that is essential for sustainable development (Souter, MacLean, Okoh and Creech, 2010). Comparable attention to ICT (Information and Communications Technology) in development arose in the late 1990s and the first years of this century.

The profound changes in technologies and economics of communications mark the transitions to a post-industrial economy, in which knowledge and networks play a more preeminent role than capital, named *digital economy*.

It is widely accepted that new technologies are having major positive and negative impacts on economic and social relationship and, especially, on environment. But, the sustainable development cannot be expanding without global communications and knowledge exchange (MacLean, Andjelkovich and Vetter, 2007). In this context, ICT and Internet are seen as opportunities to cross the development constraints and as threats for the sustainable development.

Although concepts such as "green products", green investments", green energy" were used in recent decades, the concepts of green economy, green growth and green society was triggered on the international agenda by the financial and economic crises of 2008-2009. Green economy is seen as a framework for restoring economic growth meanwhile responding to the climate change and other subjects of environmental sustainability.

2. THE ENVIRONMENTAL IMPACT OF DIGITAL ECONOMY

The "digital economy" is a relatively new concept in policy-making replacing terms such as "the information economy" (1970s), "knowledge economy" and "e-economy" (1980s), "new economy" (1990s), or "network economy" and "Internet economy" (2000s). Although there is no single definition of digital economy, there is general agreement on certain fundamental principles.

The basic idea of the digital economy is that the manufacturing of products, services, lifelong learning and innovation are made possible by modern technology support transmission and processing in the context of market globalization and sustainable development.

Beside the economic and social impact, the environmental dimension of the digital economy deserves special attention because it is one of the important aspects of sustainable development.

The environmental impact of digital economy is documented with a wealth of research papers from '90s and 2000s (Cohen et al., 2000; Berkhout and Hertin, 2001; Sui and Rejeski, 2002; Forge et. al, 2009).

The researches on environmental impact of digital economy are divided in four categories: the impact of ICTs sectors, the impact of electronic applications, the impact of electronic commerce, and social and economic effects.

Cohen et al. (2000) underlies the presence of digital economy in every important domains of the society and suggests the reconstruction of political agenda, integrating the issues of environmental impact of digital economy. Geels and Smit (2000) try to demonstrate that the oversimplification of researches on environmental impact generates failed technology futures. Miller and Wilsdon (2001) sustain that digital economy modifies the relation of human being with environment, changing the business models. They propose the concept of „sustainable digital economy” as a solution for the environmental issues and consider the possibility to use the creativity and dynamism of digital economy for the good of economy, environment and society. Berkhout and Hertin (2001) draw a distinction between the first, second and third-order effects of ITC on environment, each one classified in positive and negative effects. Sui and Rejeski (2002) see the Internet as being risky and uncertain more than a solution of environmental problem. Forge et al (2009) categorise ICT sustainability impacts on four different orders as shown in Table 1.

TABLE 1 - CLASSIFYING ICT SUSTAINABILITY IMPACTS

Order of effect	Impact	Effect type
1st order effects: production & use	Impacts due to the physical existence and use of ICT plus the manufacturing processes involved (eg. pollution and energy to manufacture and for disposal, etc.)	Negative
2nd order effects: ICT to cut energy/ pollutants/ water consumed	Impacts and opportunities created by the application of ICT to optimise unsustainable consuming processes (i.e. power saved by use of ICT in applications).	Positive overall usually
3rd order effects: substitution for lifestyle practices	Impacts due to the aggregated effect of large numbers of people using ICT over medium to long term as ICTs can have substitution effects (eg. for physical travel, saving on travel, road congestion, with repercussion effects, in road construction, etc.).	Positive
4th order effects	Improve society's overall decision-making capacity to implement sustainability policy, with metrics to measure impacts in real time.	Positive

Source: Adapted from Forge et al. (2009), p. 29

Evolution of digital economy and their environmental impact remain an important research theme.

On the other hand, international institutions, forums and bodies elaborate reports with respect to the opportunities and treats of the digital economy (especially the ICTs industries) and the sustainable development, propose approaches to analysis the relationship between them, and make recommendations for improving dialogue and cooperation (ITU, 2008; ITU, 2009; Huberman, 2010).

Whatever approach is used for analyzing the environmental impact of technological development the following aspects are noteworthy:

1. At each stage in their evolution, technological developments have had both positive and negative impacts on the economy, society and environment, the three pillars of sustainable developments;
2. The digitalization is present now in every economic sector and every important domain of society, changing our everyday life (such as: shopping, communications, transportation, entertainments, education, level and style of consumption), the business models, the way to think and act in policy and practice;
3. Given the central role of ICTs in the economy the impact of the economic crisis on ICTs is two-fold, *i.e.* direct and indirect impacts on the ICT sector itself, but also on the productive and innovative use of ICTs across the economy and society. The digital economy grew more slowly during the crisis, but their future development is considered one of the factors that can help the countries to face the crisis (OECD, 2009).

ICT policies need re-examination and refinement in the crisis and recovery. Understanding the environmental impact of the digital economy is important because it provides valuable insights to identify and coordinate environmental policy research, strategic objectives and various instruments in domain.

3. THE NEW DEAL – “GREEN ECONOMY”

In 2008, the world was confronted with multiple crises (fuel, food and financial). As a response at negative effects of economic development on environment, but also at the financial crisis, the international community seek solutions for sustaining a sustainable economy and society. In this context the concept of “green economy” became more present on the international level and in the developed countries.

The first challenge in the exploration of this new theme consists in understanding what the Green Economy concept is about. 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.

Ecological economics, industrial ecology and environmental/resource economics are the three closely related disciplines to the notion of the Green Economy (Huberman, 2010).

Green economy purposes are human welfare and reduce environmental risks over the long term.

Many of the national economic stimulus plans proposed or adopted in late 2008 and early 2009 had a "green" component, for example in the United States, Japan and South Korea, New Zealand and Australia.

In 2008 the United Nations Environment Programme (UNEP) launched a Green Economy Initiative that will culminate in the publication later in 2010 of a major Green Economy Report. In this report UNEP defines the green economy as *"the process of reconfiguring businesses and infrastructure to deliver better returns on natural, human and economic capital investments, while at the same time reducing greenhouse gas emissions, extracting and using less natural resources, creating less waste and reducing social disparities."* (UNEP, 2010, p.5)

UNEP (2010) has provided some of the fundamental elements defining and explaining the core principles and concepts underlying a green economy. The main tenants of this green economy initiative are: investing in natural capital; de-carbonizing the economy; and creating green jobs. The sectors analyzed in the UNEP report are: agriculture, cities, forests, renewable energy, transport, water, buildings, fisheries, industry, tourism, and waste management.

The green economy is a much newer policy model than of the digital economy, but they coexist at present.

The green economy has rapidly evolved from the theoretical and global, to the national and practical. According Barbier (2009) the worldwide recession requires an initiative and vision on a global scale. He consider that a Global Green New Deal is the necessary response to these challenges.

As in past times of crises, disparate groups have come together to propose a new solution to an epochal challenge.

Since 2007 the Green New Deal Group, drawing inspiration from the tone of President Roosevelt's comprehensive response to the Great Depression, propose a modernised version named "Green New Deal".

The Green New Deal that the group are proposing consists of two main lines. First, it outlines a structural transformation of the regulation of national and international financial systems, and major changes to taxation systems. And, second, it calls for a sustained programme to invest in and deploy energy conservation and renewable energies, coupled with effective demand management. The Green New Deal is international in attitude, but requires action at local, national, regional and global levels (Elliott et al., 2008).

The President Roosevelt's programme represents an inspiration source also for UNEP. In the midst of the global economic crisis, UNEP called for a "Global Green New Deal" according to which governments were encouraged to support its economic transformation to a greener economy. The Global Green New Deal is a set of policy proposals that aims to address global warming (the current climate change), and financial crises (UNEP, 2008).

The UNEP argues that today's multiple crises demand the same kind of government leadership, but at the global scale and embracing a wider vision. A Global Green New Deal is proposed as a manifestation of that leadership. It refers to a set of globally coordinated largescale stimulus packages and policy measures that have the potential to bring about global economic recovery in the short term, while laying the foundation for sustained economic growth in the medium- and long-term (UNEP, 2009).

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

The OECD (2009) report on *The impact of the crisis on ICTs and their role in the recovery* provides a useful overview of the investments that OECD member countries have made in broadband infrastructure, smart electricity grids, buildings and transportation systems, and e-health and e-education applications as part of the stimulus packages they adopted to restore growth in the aftermath of the 2008–2009 financial and economic crisis.

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.

The idea of this economy is to promise environmental protection, while being profitable. Aside from using energy responsibly, it has a focus on global warming, use of resources, deforestation and reforestation, and overall prevention of environmental pollution and damage.

Many of the initial costs needed to start businesses in the green economy are high, especially those that are related to energy production. Green energy research and development is very expensive and is still in its early stages. It is not perceived as being entirely economically viable to the public.

Gunter Pauli in the book "*Blue Economy. 10 Years, 100 Innovations, 100 Million Jobs*" considers that green economy requires too much investments and only works for the rich (Pauli, 2010). As an alternative he propose the "Blue Economy" as a project to find 100 of the best nature-inspired technologies that could affect the economies of the world, while sustainably providing basic human needs - potable water, food, jobs, and habitable shelter.

3. GREEN OPPORTUNITIES IN THE DIGITAL ECONOMY

Opportunities for synergy between digital economy and green economy strategies have been recognized in the developed countries. Meanwhile the role of green economy as a solution for economic recovery is a topic under debate at international level.

Traditionally, environment policy and strategy was considered separate from economic and social development policies. Over last years the perspective of sustainable development and environmental issue has become more comprehensive.

Over the past 5–10 years a consensus has emerged that ICTs can support the development of the green economy in three principal ways (IISD, 2010):

1. by decreasing *direct effects* on the environment of the production, distribution, operation and disposal of ICTs through improved energy and materials efficiency, increased use of renewable energy sources, reduced use of toxic materials and improved recycling and end-of life disposal of ICTs;
2. by increasing the *enabling effects* of ICTs on the development of the green economy through improvements in the efficiency of production, distribution and consumption of goods and services throughout the economy and society; by reducing demand for energy and materials through the whole or partial substitution of virtual products and services for their physical equivalents; and through the dematerialization of human activities and interactions. Thus the largest influence of ICT is likely to be in enabling energy efficiencies in *other* sectors. These

could deliver CO₂ emissions savings five times greater than the total emissions from the entire ICT sector in 2020 (Climate Group, 2008). Up to 30 percent of energy savings worldwide are possible through better monitoring and management of electricity grids (Climate Group and the Global eSustainability Initiative, 2008).

3. by supporting *systemic effects* that result in the transformation of behaviour, attitudes and values of individuals as citizens and consumers; economic and social structures; and governance processes. The ICT industry, in partnership with other sectors, has a key role to play in helping to make society's impact visible and to demonstrate the demand for new ways of reducing that impact.

The policy-makers recognize the need to put policy in place to address problems of climate change, which act globally rather than just regionally or locally.

The European Union policy answer is increasingly being seen as some strong combination of the Knowledge Economy and a Green New Deal. It means putting together economic recovery, by the creation of new ICT markets that address the environmental crisis, with the need to move up the value scale, to a knowledge economy. Essentially the vision is of a *Green Knowledge Society* – a Europe in which citizens and enterprises are empowered through ICT in an inclusive, innovative, secure and sustainable knowledge society (Forge et al., 2009).

In order to create the *Green Knowledge Society* the following policy issues should be included in an ICT policy agenda for Europe to 2015 (Forge et al., 2009):

- A stimulation programme for application of ICTs in energy saving roles across all relevant industry sectors;
- Ensuring ICT is used in more sustainable behaviour patterns by citizens and business;
- EU production of a next generation of green ICTs with new technologies and usage patterns – as an opportunity for Europe.

The rigorous assessments of direct, indirect and enabling effects of ICT sectors made by Climate Group and the Global eSustainability Initiative (2008) underlines that the world can realise a green economy and make the transition to a low carbon economy.

This opportunity can be broadly categorised into three roles for ICT: standardising, monitoring and therefore increasing accountability of energy consumption; rethinking how we live, play, learn and work based on those data; and transforming existing value chains and integrating infrastructure processes

and systems across all sectors of the economy (Climate Group and the Global eSustainability Initiative, 2008).

The conclusion of the report is that the ICT sector has both a profitable opportunity and a critical role to play with other sectors to design and use solutions needed to create a green economy and society.

4. CONCLUSIONS

The last decade are characterized by triple threats: the worst economic crisis since the Great Depression, continuing food and fuel price fluctuations, and the effects of climate change. Climate change and the digitalization of economies are fundamental changes affecting the relationship between individual, countries, societies and economies. Both domains are subject to rapid change and require quickly responses from policy makers.

The investigation of synergies between green and digital economy may offer a common solution with long-term effects. One of the responses to the challenge of climate change and ensuring sustainable development is the Knowledge Green Economy. By and large, green economy could be the answer to the prophesized climate change and global warming, as it promotes sustainable economic and social development.

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