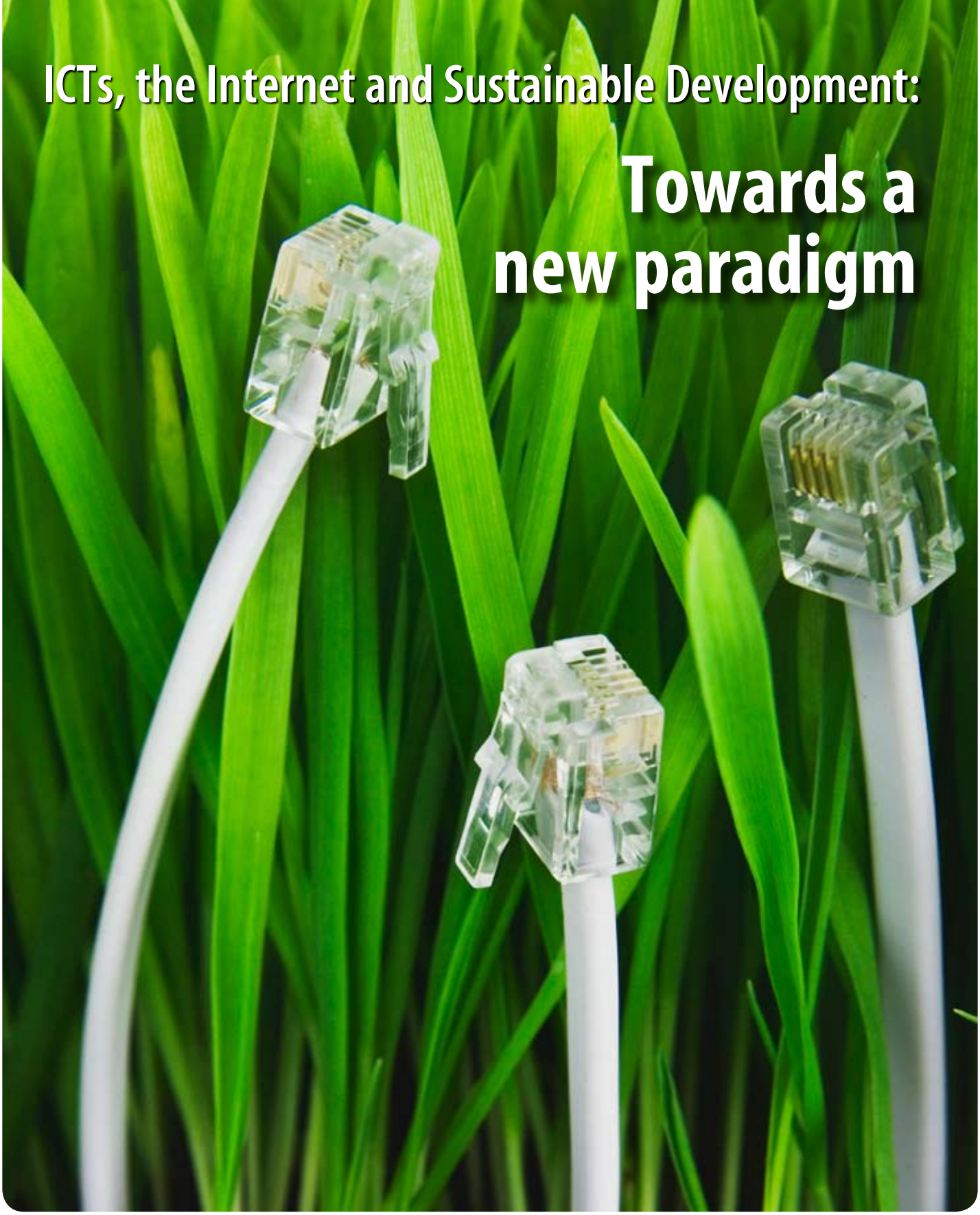
ICTs, the Internet and Sustainable Development:

Towards a new paradigm



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1 Introduction

Two issues of profound importance lie at the heart of current thinking about the development of global economies and societies: the challenge of environmental sustainability, and the potential of information and communications technology.

In the late 1980s and early 1990s, the World Commission on Environment and Development and the subsequent UN Summit on that theme, held in Rio de Janeiro and popularly known as the Earth Summit, focused the world's attention on sustainable development. They recognized that growth that depended on short-term depletion of natural resources could not lead to long-term prosperity or welfare. They defined sustainable 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).

The importance of sustainability has been increasingly recognized in development policy-making since the Earth Summit took place. Although it is concerned with economic and social as well as ecological sustainability, environmental issues—and particularly climate change—have continued to sharpen this emphasis.

Comparable attention to information and communication technologies (ICTs) in development arose in the late 1990s and early years of the present century, and also focused around a UN Summit; in this case, the two-part World Summit on the Information Society held in 2003 and 2005. Dramatic changes in the technology and economics of communications enabled rapid and far-reaching expansion of communications access and the range of communications services, including the advent and spread of the Internet. At the least, these changes in communications have had profound effects on economic and social structures and on individual behaviour. For many in the field, these—and potential changes yet to come—represent the transition to a post-industrial Information Society, in which knowledge and networks play a more prominent role than capital and hierarchy. This paper is concerned with the relationship between these two critical dimensions of change in global policy in the early years of the twenty-first century, and their impact on global development policy and practice.

It is now generally—if not yet universally—recognized that the world's present approach to growth is built upon foundations that are not sustainable because of resource depletion and the negative impacts of pollution and greenhouse gas emissions on the relationship between people and the planet. Climate change in particular is having an impact not only on people's lives and livelihoods, but on the increasingly urgent search for "green growth," that is to say for alternative economic strategies that meet the needs of the present without compromising the opportunities of future generations.

It is also widely recognized that new technologies, particularly ICTs, are having a major impact on economic and social relationships among individuals, communities and nations. High-speed telecommunications have been a major driving force of globalization in capital, labour and product markets. Mobile telephones have, for the first time, made immediate communications at a distance available to the majority of individuals worldwide. The Internet has transformed the availability of information and disrupted traditional social and economic structures, from intellectual property and trade in goods and services to privacy, political debate and social mores.

Sustainable development is widely seen as a challenge that must be met. ICTs and the Internet are widely seen as opportunities to bypass historic development constraints. Both have impacts at global, national and local levels. Both are already changing the way we think and act as citizens and in communities, in policy and practice. Both will have radical impacts on economic and social change in all countries over the next two to three decades—indeed, they are likely to have more impact than any other long-term changes that we see around us. These impacts will be general, affecting developed and developing countries; industrial, post-industrial and agrarian economies; and nations and regions in the global North and South.

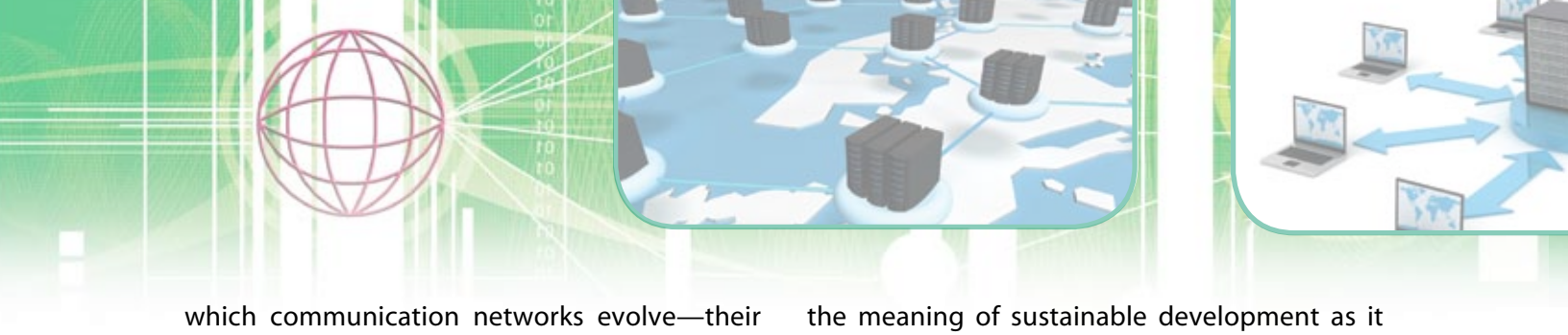
There has, however, been surprisingly little interaction between policy-makers and activists concerned with sustainable development and with ICT/Internet public policy. This is not because there are few linkages: as this paper will illustrate, there are many complex linkages between them. In the words of an earlier IISD report on sustainable development and the Internet:

In a broad view, sustainable development cannot be conceived without global communications and knowledge exchange. The closer we consider today's communications channels, the more aware we become of the paramount importance of the Internet to the flow of information and knowledge around the world. The Internet governance debate, which includes issues of access, multistakeholder participation, openness and security, among others, is essential for global communication and knowledge exchange, in that its outcomes will affect our ability to manage the social, environmental and economic aspects of sustainable development. (MacLean, Andjelkovich & Vetter, 2007, p. 1).

The problem in leveraging this linkage lies more with the different interests of those concerned with sustainable development and with ICTs and Internet public policy, and with the fact that the issues tend to be dealt with in different forums, among which there has been little interchange. IISD believes this gap in understanding and worldview between sustainable development and the ICT/Internet world is detrimental to both, and to the developmental outcomes with which both are concerned. Information and communication technologies and the Internet play an increasingly important part in production and exchange, in social organization and in individual behaviour. As a significant economic sector, they impact directly, in their own right, on economic and environmental sustainability. As agents of change in society, economy and culture generally, they disrupt many of the assumptions that have been made about the sustainability of current economic, social and environmental structures and alter projections that have been made about these for the future. Sustainable development thinking needs to be revised to accommodate the increased and still-increasing impact of ICTs and Internet.

This paper summarizes some of the main issues concerned here, and calls for greater dialogue and interaction between sustainable development and ICT/Internet public policy-makers and activists, based upon a greater understanding of these different domains and of their complexities.

The ICT and Internet sector also needs to reflect on the importance of sustainability within its own development. ICTs are increasingly fundamental to the organization of economic production and exchange, to social dynamics and to the exchange of information and other resources. The ways in



which communication networks evolve—their governance, technology and economics—and in which services and information resources are made available over them affect both the quality and the sustainability of economic, social and environmental development. The ICT sector has a responsibility to consider that impact: to maximize the opportunities that it provides (e.g., for poverty reduction, economic opportunity and personal empowerment) and to minimize negative impacts (e.g., in waste generation and greenhouse gas emissions). Governments, businesses and other stakeholders, including standard-setting agencies and user communities, all have an important part to play in this reconsideration.

This paper summarizes some of the main issues concerned here and calls for greater dialogue and interaction between sustainable development and ICT/Internet public policy-makers and activists, based upon a greater understanding of these different domains and of their complexities.

Sections 2 and 3 of the paper seek to define the ground for future dialogue. Section 2 summarizes the meaning of sustainable development as it has evolved since the World Commission on Environment and Development in 1987. Section 3 summarizes the changes that have occurred in and as a result of the evolution of ICTs and Internet and outlines the impact these have on our understanding of sustainable development.

Sections 4 and 5 examine the current state of thinking on the relationship between these policy domains in the crucial area of economic transition. Section 4 considers what has become known as the "digital economy," while Section 5 looks at what is known as the "green economy"; both are paradigms that have become prominent in the separate worlds of ICT/internet policy and sustainable development.

Finally, Sections 6 and 7 consider the implications of the discussion for both sustainable development and ICT/Internet policy domains, propose an approach to furthering analysis of the relationship between them, and make recommendations for improving understanding, dialogue and cooperation.

Internet governance and Internet public policy

The term "Internet governance" has been widely used since the World Summit on the Information Society to describe not just the technical management and coordination of the Internet itself (which is sometimes called "narrow Internet governance"), but also the relationship between the Internet and mainstream public policy issues that are affected by it (sometimes called "broad Internet governance"). Both of these types of issues are discussed, for example, in the Internet Governance Forum.

IISD believes that the use of the term "Internet governance" for this wide range of issues is increasingly inappropriate, particularly where issues fall primarily in other public policy arenas. IISD therefore prefers to use the term "Internet public policy" for this wider range of issues.

2 Defining Sustainable Development

The World Commission on Environment and Development—the Brundtland Commission—defines sustainable development in its 1987 report as follows:

Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. 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. (WCED 1987, part 1, section 2, para. 1).*

Although the definition of sustainable development emerged from an international enquiry into the relationship between environment and development, it is not concerned primarily with the environment but with the sustainability of the overall developmental context. This usually comprises three main elements:

- **economic development** – reducing and seeking to eradicate income poverty, achieving higher levels of prosperity and enabling continued gains in economic welfare;
- **social development** – reducing and seeking to eradicate other dimensions of poverty, improving the quality of education, health, housing and other aspects of the welfare of individuals and communities, and enhancing the quality of social interaction, engagement and empowerment;
- **environmental protection** – reducing pollution and other negative impacts on the environment, mitigating the effects of industrialization and human activity, and seeking to achieve sustainable use of resources in the interest of future generations (WSSD, 2002a, ch. 1, para.2).

This relationship is sometimes illustrated either as pillars or through a Venn diagram as here:

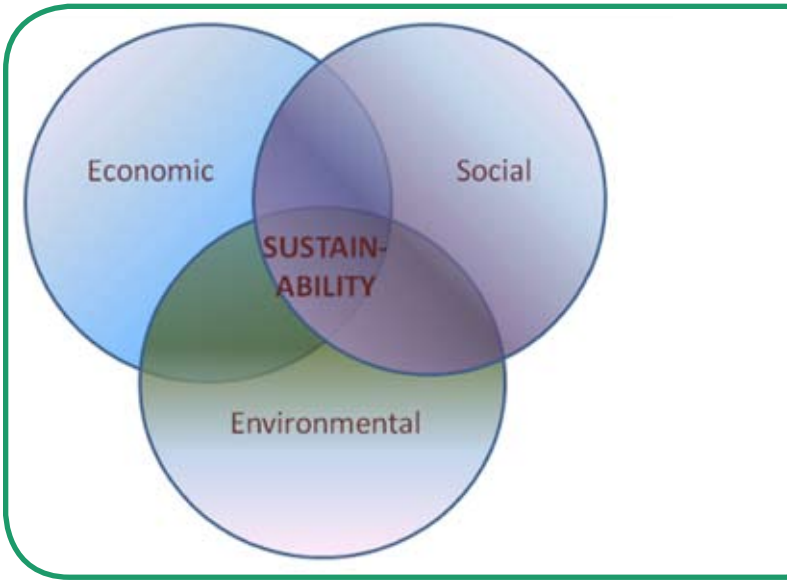


Diagram adapted from Barbier, E. (1987). *The concept of sustainable economic development. Environmental Conservation,* 14(2): 101–110.

Development, in this context, is not a matter merely for developing countries, as the term is sometimes used. It is about development at all levels, from the family, through local communities, regions and nations, to the planet as a whole. Sustainability needs to be a priority in all countries—post-industrial and industrial as well as developing countries—and in the international system that links them.

The 2005 UN World Summit, which reviewed the Millennium Development Goals, described the

three pillars or circles of "economic development, social development and environmental protection" as three "interdependent and mutually reinforcing pillars" of sustainable development (United Nations General Assembly, 2005, para. 48). Some analysts of sustainability add one or two additional aspects of development to this tripartite framework. These are:

- **cultural diversity** – the continuance of diverse human cultures from past to future within a context of the globalization of communications, economy and society and the more intensive intercultural interactions that result; and

- **governance** – the institutional mechanisms, rules and norms that encompass decision-making and behaviour by governments, businesses and citizens, the interactions among these stakeholders and among different policy domains.

The sustainability of development results not from any individual part of this framework—from economic growth, for example—but from the framework as a whole: from the cumulative impact of all three (or five) components, from the interactions among them and from the system-wide outcomes that result from these. Sustainable development, in other words, looks at development holistically, rather than from one dimension of the development ecosystem. This is often misunderstood.

The Brundtland Commission (1987) recommended seven critical actions needed to ensure good quality of life for people around the world (WCED, 1987, ch. 2, para. 28):

- revive growth;

- change the quality of growth;

- meet essential needs and aspirations for jobs, food, energy, water and sanitation;

- ensure a sustainable level of population;

- conserve and enhance the resource base;

- reorient technology and manage risk; and

- include and combine environment and economic considerations in decision making.

These factors place a demand on us to:

- **Produce differently** by increasing efficiency and reducing material used in production. The goal is to quadruple resource productivity so that wealth is doubled, and resource use is halved.

- **Consume differently** by developing policies that promote consumption patterns that reduce the ecological footprint of development while meeting the needs of all people so they enjoy a good quality of life.

- **Organize differently** by engaging all stakeholders and improving public participation in all steps of planning, implementation and evaluation of policies and actions; reducing global subsidies and applying some of these to sustainable development.

The Brundtland Commission's definition of sustainable development has been elaborated over the years into a set of fundamental principles, notably at two UN Summits, the Earth Summits, held in Rio de Janeiro in 1987 and in Johannesburg in 2002. The consensus arising from these global forums can be summarized as follows (IISD, 2010):

- The goal of sustainable development policy is human well-being for people everywhere, measured in terms of factors such as secur-

ity, satisfaction of material needs, health, social relations, freedom of choice and action, and following a principle of equity and fairness. 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 with social development and environmental sustainability, as well as applying principles of global systems thinking in policy and strategy development with a view to mitigating unpredictable and drastic consequences that may result from triggers in other parts of the system.

- Technology and social organization play critical roles in achieving the long-term balance between human development and the natural environment that is essential for sustainable development.

In 1992, the Earth Summit in Rio adopted Agenda 21, a global plan of action for sustainable development that incorporated environmental, economic and social concerns into a single policy framework. Agenda 21 contains proposals and recommendations for action on a wide range of issues, including resource management, wasteful consumption, poverty mitigation, biodiversity, protecting the oceans and atmosphere and promoting sustainable agricultural practices.

Since the Earth Summit in Rio, there have been several expansions and strengthening of its outcomes at several UN sessions, notably at the two Earth Summits. Sustainable development was a significant theme in the 2005 review of the Millennium Development Goals, and is reiterated in other UN summit declarations. The United Nations General Assembly has continued to reaffirm the objectives of Agenda 21, emphasizing the importance of five thematic clusters, including transport, chemicals, waste management, mining and changing patterns of production and consumption. Climate change has also come to the fore, as the most crucial environmental challenge facing the world community.

Progress towards sustainability, however, remains difficult to achieve—as the 2009 Climate Change Conference in Copenhagen so clearly demonstrated. It 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 themes: the green economy in the context of poverty eradication and sustainable development and the institutional framework for sustainable development. The Summit will seek to balance economic, social and environmental dimensions of sustainability, at local, national, regional and international levels. In the meantime, the challenges involved are being addressed by a High-Level Panel on Global Sustainability appointed by the UN Secretary-General.

Progress towards sustainability, however, remains difficult to achieve—as the 2009 Climate Change Conference in Copenhagen so clearly demonstrated.

Information and communication technologies are increasingly important in this context, but there has been too little interaction between sustainability and ICT domains. The 2002 Johannesburg Earth Summit, for instance, acknowledged the value of ICTs "as tools to increase the frequency of communication and the sharing of experience and knowledge," (WSSD, 2002b, para. 112) but discussion about ICTs in sustainability forums and about sustainability in forums concerned with ICTs remains limited and shallow. Section 3 explains why that needs to be addressed.

3 The Impact of New Technology, ICTs and the Internet on Sustainable Development

A sustainable development approach, as described above, is necessarily holistic. Analyzing the impact of economic, social and environmental trends, and the interactions between them, is only possible from a basis of thorough, researched understanding both of present circumstances and of likely changes in those circumstances.

Technology has long played a crucial part in economic and social development. The level of technology has always limited what is technically possible or economically viable, while the evolution of technology has continually raised those thresholds of possibility and viability.

One of the principal concepts contained in the Brundtland Commission's 1987 definition of sustainable development is "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, part 1, Sec. 2, para. 1). It is widely accepted that there is a strong linkage between technology and social organization, and that development has taken place through stages in which technological innovation has led to economic and social transformation; this is sometimes described as a succession of transitions from hunter/gatherer, to agricultural, to industrial, to information/knowledge societies.

Refinements of this perception have called attention to the role throughout history of general purpose technologies (GPTs)—technologies that affect all aspects of economies, such as the steam engine, electricity and the automobile—in transforming economic and social organization. ICTs—telecommunications, computing and the Internet—are clearly recognizable as general purpose technologies within this definition. Some analysts have also focused on the specific role of communication technologies in shaping social organization, norms and even laws.

These perceptions of the relationship among technology, economy and society are not deterministic. They do not imply that technological change necessarily leads to certain outcomes. However, it is clear that the state of technology offers possibilities and creates limitations that shape the choices available to societies—and the actors within them—for creating and distributing the various forms of wealth that are enabled by them and by the other economic sectors they affect.

It is also widely accepted that at each stage in their evolution and of consequential social and economic change, technological developments have had both positive and negative impacts on the economy, society and environment. In particular, they have had both positive and negative impacts on the foundation of sustainability, that is, the environment's ability to meet present and future needs. In the case of industrial technology and the forms of economic and social organization that developed around it, it is clear that many of these impacts on sustainability have been negative on balance and that the current outcomes of industrialization as it has evolved are not sustainable.

For the past four decades, much discussion about sustainable development has centred on the question of what new forms of economic and social organization are needed to ensure that the environment is able to meet present and future needs of a world population that is expected to reach nine to ten billion by 2050, a substantial portion of which will live in poverty. Over the past two decades, there has been particular interest in new technologies that may have the potential to enable environmentally sustainable forms of economic and social organization, in the context of a growing world population, without requiring an end to growth.

These technologies include new forms of renewable energy, technologies for cleaning existing carbon-based energy technologies, materials technologies, biotechnologies, nanotechnologies and information and communication technologies (ICTs).

The potential of these technologies suggests that it may be time to add a fourth circle of sustainable development to the three circles in the Venn diagram presented in Section 2—a technological circle that recognizes the role of ICTs (alongside other technologies) in economic and social transformation. Sections 4 and 5 of this paper explore in more detail why this may be the case.

Communications in their widest sense—the exchange of information and resources between individuals and groups—has long been understood to have a central role in social and economic development. The extraordinarily rapid development of information and communication technologies and services since the 1990s, however, has revised the way in which development economists and agencies have viewed communications. Development agencies such as UNESCO and the World Bank began to pay explicit attention to ICTs in the mid-1990s, and the UN system recognized them through two World Summits on the Information Society held in 2003 and 2005. Many governments, in both industrial and developing countries, have since introduced national ICT strategies that seek to exploit the economic and social value that they perceive lies in information technology. The Internet has increasingly been at the heart of these approaches.

The impact of ICTs on the ways in which economies and societies work is profound and visible at all levels, from global trade and culture to relationships within the family. For example:

- Information technology has enabled and increasingly enables major changes in the production of goods and services, including the globalization of product development, manufacturing and labour markets; the displacement of labour by technology; and the expansion of service sectors.

- It increasingly enables the digitalization and virtualization of some traditional goods (such as books and music) and the individualization of some traditional services (such as banking, travel and insurance).

- It has enabled the creation of a new range of business opportunities within the ICT sector itself, from software design to street corner resale of telephone airtime.

- It disrupts traditional governance arrangements among state, business and consumer, including those relating to taxation and intellectual property. It also provides opportunities for new forms of administration, marketing and service delivery through which governments and businesses can interact with citizens, and through which citizens engage with them when they wish to do so.

- It greatly increases the extent to which individuals can access information, entertainment and other resources, including those which have been restricted by law—but also enables new forms of tracking of individual behaviour by the state, businesses and non-governmental actors.

- It enables individuals to publish material of all kinds—from personal information to political comment, "citizen journalism" to rumour-mongering and defamation, music-making to pornography—without the economic, political and social constraints that have hitherto prevailed.

- It has enabled and increasingly enables the capacity to communicate immediately at a distance—facilitating the exchange of information and maintenance of social

contact within families, social networks and diasporic communities, greatly increasing the pace with which news (and rumour) spread and influence behaviour.

- It facilitates networking between individuals and organizations, within and beyond national boundaries, enabling more extensive and diverse forms of organizational partnerships—from new forms of marketing to new forms of solidarity amongst the marginalized, from social networking forums such as Facebook to criminal organizations.

All of these trends shift the landscape that underpins our thinking about sustainability. For some commentators, these trends amount to the reconfiguration of society—to the establishment of a post-industrial Information Society, and/or of a Network Society in which new forms of social relationship displace historic relationships among citizens and between citizens and the state. While most commentators regard the balance of outcomes as positive, many are concerned by aspects of the economic, social, cultural and political changes that are taking place.

These trends have been enabled by rapid changes in the costs and capabilities of underlying communications technologies and networks. Within the past twenty years, the emphasis of telecommunications has shifted from voice to data and from fixed to mobile services. Similar changes are underway from PSTN (public switched telephone network) to IP (Internet Protocol) transmission and from narrowband to broadband networks and access. Communications networks that once offered a small range of basic services to most consumers now offer a very wide range of services, including some such as shopping and banking in which the consumer experience has been historically distinct from communications media. The provision of communications services has also largely moved from the public to the private sector.

The advent, growth and spread of the Internet have been particularly important here, and has received most attention in analysis of future prospects. For many, it is the Internet that encapsulates the capacity of new technology to disrupt historic ways of doing things and alter balances of power between rich and poor, state and citizen, business and consumer. Not only that, its development has taken place largely outside the control or management of governments, its standards being set by autonomous groups of experts operating through consensus, its commercial development being led by a wide range of businesses from traditional telecommunications operators to innovative start-ups that can grow from backroom enterprise to stock market leadership in a handful of years. Increasing access to the Internet on mobile devices seems almost certain to accelerate the growth in its importance—and society's dependence on it—over the next decade.

These technological developments have had and continue to have profound impacts on human behaviour and social and economic organization. Most importantly, they continue to change rapidly and unpredictably. Very few observers in the 1980s would have predicted the extent to which mobile devices now dominate telephony or the way in which the Internet has evolved from a niche resource for academics and computer scientists to the leading global source of information and entertainment that it is today. Phenomena like social networking—now very widespread—were only beginning to appear at the time of the World Summit on the Information Society in 2005. As well as shifting the ground beneath sustainability, therefore, ICTs are also shifting the way in which the ground is shifting. Understanding their impact on sustainability requires constant observation and analysis.

Yet there is a real paradigm gap between individuals and institutions that are concerned with sustainability and those which are concerned with ICTs. Expertise is insufficiently shared; international

discourse is insufficiently open; and there are few opportunities to explore the interface in any depth. This must change. The impact of new technology needs to be integrated much more thoroughly in our understanding of sustainable development. And sustainable development principles also need to be included in thinking about the ways in which ICTs affect economic, social and environmental change. The question here is how this might be best achieved.

A valuable framework for analyzing impacts on sustainability was developed by the Forum for the Future in its 2002 report on T*he impact of ICT on sustainable development* for the European Information Technology Observatory. At the heart of this framework is a simple matrix that can be illustrated thus:

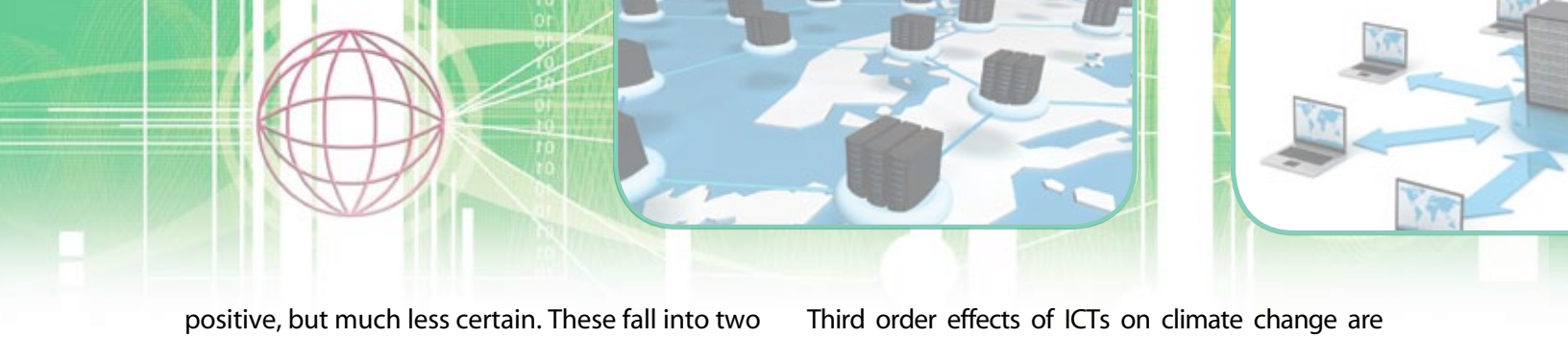
	1st order effects	2nd order effects	3rd order effects
Economic sustainability			
Social sustainability			
Evironmental sustainability			

In this matrix, " first order effects" refers to the immediate and direct effects of a particular factor on sustainability (in this case of ICTs); "second order effects" to indirect impacts; and "third order effects" to societal impacts taking place over a longer period of time. The matrix can be applied to the interface between any sector or policy domain and sustainable development, but is particularly helpful to understanding the impact of ICTs on sustainable development. The table as a whole can be applied to ICTs in general, broad areas of ICT development such as the Internet or broadband networks, specific innovations such as cloud computing, or applications such as social networking. Individual cells can also be analyzed in depth, while the results of analysis can also be summarized, cell by cell, as a balance between positive and negative outcomes. It also enables analysis of changes, at each of these levels, over time. We will return to this matrix in Section 6.

There is not space here to go into each of the three pillars of sustainable development in depth, though it is important to emphasize that each is equally important in understanding sustainability. The relationship between ICTs, the Internet and climate change, however, can be used to illustrate the complexity of this set of relationships—and in particular, the way in which ICTs can contribute both positively and negatively to sustainability.

The first order effects of ICTs on climate change are both strong and negative. According to a report published by the industry lobby group GeSI (the Global e-Sustainability Initiative), the contribution of ICTs to greenhouse gas (greenhouse gas) emissions is currently between 2 per cent and 3 per cent, and will grow faster than that of any other economic sector, at a compound 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 CO_2 equivalent) to 1.43 gigatonnes between 2002 and 2020. This increase arises primarily from the extension of networks, from the increased availability and more frequent use of devices: that is to say, from increased access and from increased reliance on access and use of ICT resources. A significant proportion of the increase is also due to data centres required to manage Internet traffic. This growth in greenhouse gas emissions resulting from ICTs is effectively certain, though it can be partly addressed by mitigation—for example, by changes in equipment standards that make networks and devices more energy-efficient (see Section 6).

The second order effects of ICTs on climate change are more often publicized, generally considered



positive, but much less certain. These fall into two main categories.

First, ICTs can be used to increase the efficiency of other industries, most notably power generation and distribution (through the introduction of what are known as "smart grids") and logistics in sectors such as transport. GeSI estimates that the potential positive impact of such ICT-enhanced resource management could considerably exceed the negative first order effects described above. However, these emissions savings are very far from certain, and depend on decisions to invest in such approaches being taken outside the ICT sector itself, by the managements of major utilities, manufacturing and service businesses. Only a proportion of these gains are therefore likely to be realized. In addition, as they result from decisions taken by a few large businesses that already have the necessary ICT infrastructure, they cannot properly be juxtaposed against first order effects that result from increased access and usage by individual citizens and other businesses.

The second category of second order effects is more directly related to wider access and usage. This is the impact of dematerialization, that is, the displacement of physical with virtual activity. While dematerialization has been significant in some areas—such as music distribution—it has been less significant to date in others, notably telecommuting, and it is difficult to predict how extensive it will be in future.

Dematerialization also illustrates the complexities of environmental impact assessment of ICTs. While telecommuting, for example, may reduce direct energy consumption, by substituting home working for travel to work, this does not necessarily result in a net reduction in greenhouse gas emissions. Home working, for example, may lead to higher energy consumption in the home or to greater use of personal transport for shopping and leisure at the expense of public transport previously used for commuting. Complex modelling is needed here, rather than simplistic assumptions about what might happen.

Third order effects of ICTs on climate change are those that result or will result from the kind of large-scale behavioural and social structural changes that were described earlier in this section. Innovations such as social networking, home-working and home-shopping do not just have immediate direct impacts on individual behaviour. They also have longer-term direct and indirect impacts on the ways in which societies and organizations work, for example in patterns of expenditure and consumption; in interactions among citizens and between those citizens and their governments, employers and other businesses; and in the relationship between work and leisure. Large-scale social trends of this kind have profound long-term implications for economic, social and environmental sustainability. However, third order effects of this kind are difficult to predict.

The next two sections look in more detail at some of the ways in which economic structures are changing in response to ICTs and the Internet, and to the need for greater environmental sustainability. These sections are concerned, first, with the development of the "digital economy," and second with what has become known as the "green economy." Policy-makers in some international forums (including the Organisation for Economic Co-operation and Development [OECD]), governments and academic institutions are beginning to analyze the conjunction between these two trends in economic development. They see significant potential gains arising from greater engagement between them. IISD shares the view that there are substantial gains that can be made. However, these gains are only likely to be realized through much greater interaction in policy development and governance, and greater awareness of potential synergies and conflicts within the business community and civil society. Identifying the gains that can be achieved and the institutional mechanisms required to bring them to fruition are important challenges to be addressed in the run-up to the third Earth Summit in 2012.


The complex cloud

The data centres, which enable content on the Internet, consume large amounts of electricity. Because much of this is generated by burning fossil fuels, they also produce significant quantities of greenhouse gas. A study for the U.S. Environmental Protection Agency estimated that, in 2006, U.S. data centres consumed 61 B kwh of electricity—1.5 per cent of all the electricity used in the country (EPA, 2007). A 2008 study of the environmental impacts of ICTs written for the Global e-Sustainability Initiative estimated that in 2002 the global footprint of data centres was 76 megatonnes of CO_2 equivalent, and that this amount would more than triple to 259 megatonnes by 2020, the fastest rate of emissions growth in the ICT sector as a whole (GeSI, 2008, p. 02/20).

Two main strategies have been employed to reduce the carbon footprint of data centres: a shift to the use of renewable energy sources and a shift away from individually owned and operated centres toward shared facilities where information processing and storage are provided virtually by "cloud computing" operators—which, it is hoped, will achieve greater efficiency and reduced cost to the environment. Recently, there has been growing interest in a third approach that combines these two strategies in the concept of "green clouds." This interest has been particularly strong in countries that have abundant sources of renewable energy and cold climates that help cool data centres at relatively low cost.

As part of a Green IT project undertaken by CANARIE, a Canadian high-capacity research and education network operator, IISD examined different options for creating zero-carbon data centres at a number of Canadian universities by relocating their existing facilities, which were on-campus and on-grid, to remote sources of renewable energy. The different options were assessed in terms of the business case for relocation, assuming that carbon credits could be used to offset relocation costs, and of the policy issues raised by relocation.

The results of the study (IISD, 2010) suggest that the "green cloud" option provides the strongest business case. However, it also raised the most complex set of policy issues for university administrators, researchers, funding agencies and public policy-makers. In Canada, as in other countries with advanced digital economies, there is a well-defined legal and regulatory framework for providing access to information, protecting the privacy of individuals, ensuring information and security, and protecting intellectual property rights that will need to be extended and applied to cloud computing. Even when these challenges are fully addressed, relocating data centres may not be the best way of reducing emissions. Building new facilities in remote areas is itself carbon-intensive, while surplus heat in urban areas can be reused, for example to heat classrooms and office buildings. The IISD/CANARIE study suggests that all of these factors will need to be examined and that new issues will need to be considered, as the Internet moves into the age of cloud computing. This illustrates the complexity of sustainability where ICTs are concerned, and the importance of subjecting assumptions and expectations to full impact analysis.

4 The Digital Economy

The "digital economy" is a relatively new term in policy discourse, having come into vogue in the past few years in countries such as Australia, the U.K. and Canada to refer to a phenomenon previously known as "the information economy" (1970s), the "knowledge economy" (1980s), the "new economy" (1990s) and "the Internet economy" (2000s). These countries, and some others, notably in East Asia, have been engaged in developing digital economy strategies aimed at exploiting the value of ICTs for economic growth and/or placing ICT-enabled growth at the centre of their future economic aspirations. A small number of low-income developing countries, such as Rwanda, have also identified ICTs as the lead sectors in their economic development programs, though most national ICT strategies are concerned more with the contribution that ICTs can make to economies that will continue to be led by established agricultural, raw material, manufacturing and export sectors.

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. In this context, the digital economy, whether already current or anticipated, is seen as the post-industrial successor to the industrial era. 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.

The digital economy is therefore a subset of broader concepts, such as the "information age" or "the global information society," that attempt to comprehend the total set of transformations that have been enabled by ICTs and the interactions between and among them. The digital economy concept, however, focuses explicitly on the economic impact of ICTs: on the structures that generate wealth through the production and exchange of goods and services and the resources that are related to these. The nature of the digital economy is such that many of these resources—such as digital literacy—have social as well as economic dimensions. As a result, the relatively sharp boundaries that existed in the twentieth century between economic and social policy, and between the public and private spheres, are becoming fuzzy. Old ways of doing things, including governance, are not necessarily sustainable.

Although there is no single definition of the digital economy, policy discourse on it tends to focus on a number of defining characteristics. These characteristics appear to differentiate the digital economy from the industrial and service-based economies that typified industrial countries in the twentieth century, as well as from the predominantly agricultural and resource-based economies of non-industrial countries. The following points are typically found within this discourse:

- The sector that produces ICT goods and services can be broadly defined to include computer goods and services, including databases and applications software; telecommunications equipment, networks and services; broadcasting and other electronic content media; and Internet goods and services. In a digital economy, this is an important sector of activity in its own right, generating 5 to 10 per cent of GDP, accounting for a significant

proportion of research and development, and providing a substantial proportion of jobs (especially at the higher end of the labour market).

- In a digital economy, as well as being widely diffused throughout all economic sectors, ICTs make a substantial indirect contribution to national wealth. Economic analysis suggests that, in the last two decades, there has been a significant relationship in both North America and Europe between levels of investment in ICTs and gains in productivity and competitiveness at the level of firms, sectors and (over a longer time period) national economies. Two important provisos should be noted, however. These impacts are far from instantaneous: they take time to work through economic systems, particularly at a national level. And they are not inevitable: the benefits of ICT investment are only realized if other systems adapt to make effective use of them—for example, through the restructuring of management and employment in the firm and through the introduction of new educational curricula and labour market norms within society as a whole.

- In a digital economy, ICTs also tend to be widely diffused throughout society—not just in business, but also in government, in the provision of education, health care and other public services, and in the home. In some countries, ICTs have enabled the private provision of services that were previously provided by governments.

- Digital economies tend to have high degrees of innovation and creativity relative to other economies. ICT-enabled innovations are likely to foster gains in productivity and competitiveness, leading to improvements to the efficiency and quality of existing products, services and production processes, as well as to the development of new production processes and new products and services. Virtualization and dematerialization play a part in this, creating new product and service markets but also displacing some traditional economic sectors—as does the displacement of labour by technology. Achieving these impacts often depends on the restructuring of established management hierarchies and relationships among management, employees, suppliers and consumers.

- An important emerging feature of the digital economy is the increasing amount of innovation that is being generated by

individuals, including ICT/Internet users, who previously would have been considered customers, clients or subscribers of goods and service producers. These innovators now contribute to the digital economy either directly—for example, through various forms of user-generated content (such as blogging, social networking and "citizen journalism") or indirectly (through "crowdsourcing," open innovation and "citizen science").

- Digital economies tend to be open economies. Along with transportation, ICTs have been principal enablers of the globalization that has transformed the structure of the world economy over the past half century. ICTs have made it possible for multinational enterprises to build and manage global value chains for the production, distribution and management of goods and services, locating different activities within this value chain where these processes can be provided most efficiently or cost-effectively. New structures of global production have been facilitated by international, regional and bilateral agreements that have opened the markets of participating countries to trade and investment from other countries. Agreements regarding trade and investment in ICTs, particularly in telecommunication services, have been instrumental in supporting the growth of a digital economy at the global level.

- Finally, digital economies also tend to be open internally, in the sense that they are generally managed through policies that seek to promote innovation and competition by private companies and individuals, and to minimize the role of government regulation both in the ICT sector and elsewhere in the economy. Many within the Internet world identify its non-governmental—or perhaps post-governmental—governance framework as a prime factor in enabling creativity and innovation, and thereby enterprise and empowerment.

The established statistical frameworks and classifications used to measure economic activity were designed for industrial economies. While they do a good job of measuring production, trade and consumption in ICT goods and services, they have difficulty capturing the value added throughout the economy (and society) by ICTs as GPTS, in terms of efficiency, productivity and innovation. They also have difficulty quantifying the value resulting from flows and exchanges of various forms of digital content, particularly those that are non-rivalrous and non-excludable ("public goods" in the economic sense of the term), and in assessing the contribution of different factors of production in digital economy performance, particularly those that are intangible (such as culture and creativity).

Likewise, the indicators that have traditionally been used to measure the state of communications development in a country (such as the number of connections, pieces of equipment, or subscribers for different classes of services), while still a useful beginning, do not provide a satisfactory basis for measuring activity within the digital economy or for addressing issues such as employment, changes in domestic and leisure activity, the rebalancing (and hybridization) of work and leisure, or changes in social mores.

Over the past decade, a number of multi-indicator indexes have been constructed to try to measure and compare the digital economy performance of different countries. These indices combine indicators that measure such things as the availability and affordability of digital technologies; national capacity to use them, as measured for example by levels of educational attainment; the policy and regulatory environment governing the ICT sector; and the levels of use of digital technologies throughout the economy (and society). Examples of these digital economy indices include the Economist e-Readiness

Index, the World Economic Forum Networked Readiness Index and the ITU'S ICT Development Index. Work is ongoing, for example at the OECD, to construct better tools for measuring the digital economy and analyzing the impact of different policy options. However, more still needs to be done to establish links between this work and sustainable development analysis.

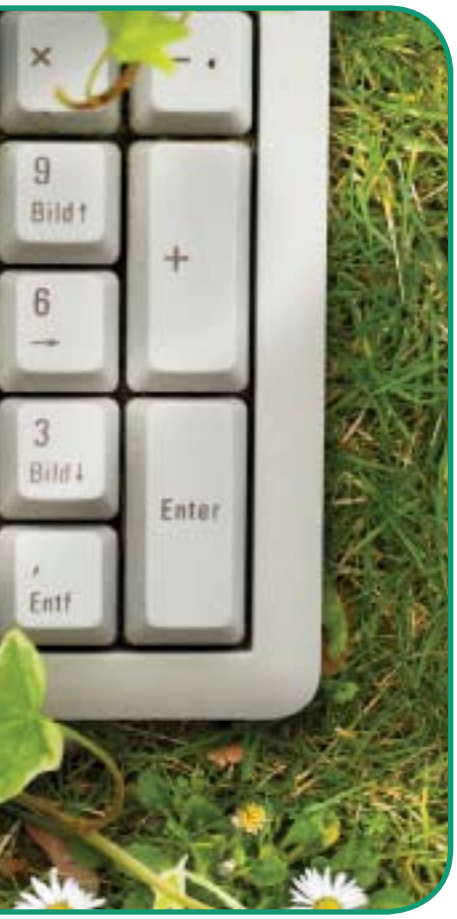
Although these measurement tools are imperfect, there is strong macro-level evidence that countries' levels of digital economy development correlate, to a significant degree, with their overall levels of economic and human development as measured by World Bank and United Nations indices. There are also sectoral studies that suggest a positive link between infrastructure investment and levels of GDP growth (for example, a recent World Bank report on the economic impact of broadband [Kim, Kelly & Raja, 2010], national examples (such as the role of the ICT producing sector in the rise of Asian economies), and micro-level studies that support the central notion of the digital economy concept, that ICTs are transformative technologies that support development everywhere, not just in industrialized countries.

These studies should still be treated with care. They are at present only partial and inconclusive. Correlations between infrastructure investment and GDP growth rates do not in themselves imply a causal relationship, or a causal relationship that runs from investment to growth rather than vice versa. Rapid digitalization of the economy of the kind seen in South Korea may not be replicable in societies that have very different types of government, levels of educational attainment or available capital. Nor is the experience of first movers such as South Korea necessarily replicable in countries where the relevant communications market develops much later. Microstudies are notoriously dangerous guides for macro-level policy, and positive experiences are much more likely to be reported than those that are negative. While there is good evidence to suggest that more digital economies are economically more dynamic and successful than more traditional industrial economies in the current world environment, we need to know much more about the contributory and contextual factors that foster or inhibit this if we are to have confidence in detailed policy prescriptions.

Over the past ten to fifteen years, international, regional and national bodies have adopted policies and implemented programs to support the growth of ICTs in developing countries. The adoption of national ICT strategies has been supported by multilateral and bilateral financing and development organizations, though it has often been poorly integrated into other aspects of national development planning. Both within and outside intergovernmental frameworks, non-governmental organizations have assisted in the development of digital economies—as have some private companies, even outside the confines of their direct commercial interests.

Over the past decade, a number of multi-indicator indexes have been constructed to try to measure and compare the digital economy performance of different countries.

The outcomes of these interventions are variable. While there is clear evidence and common conviction that the development of digital economy capacities should be part of the development policies and plans of developing countries, there is no "magic bullet," no "one size fits all" prescription for success. The challenges that developing countries face in the transition to becoming digital economies are relatively greater, on every relevant scale, than those facing industrial countries. Primarily agricultural societies cannot be transformed overnight into primarily service economies—nor can the world as a whole replace food production and manufacturing



with digital services. All economies will remain, to a greater or lesser degree, mixed. Responding to these challenges must begin with recognition that each society needs to respond to the opportunities of the digital economy in ways that are most appropriate for its economic and social context, enabling greater prosperity that is sustainable into the medium term and beyond.

The governance paradigm that has shaped the development of digital economy policies has emphasized the role of private investment and competitive market forces in creating efficiency, improving social welfare and generating innovation. It has sought to create an enabling environment in which producers and consumers are free to develop and use technologies, without being subject to the kinds of regulatory controls that typified traditional telecommunications and broadcasting. At the same time, the prevailing ethos within the digital industry, especially the Internet, has sought to protect personal rights and consumer interests, while still combating the new forms of crime that have grown with the digital economy; to promote information and network security; and to support public resources that are important sources of innovation in the digital economy (such as education and research).

The principles guiding policy-makers within this overall paradigm have tended to emphasize freedom of expression and access to information, consistent with the rights of others and with social order. When applied to the digital economy, these liberal democratic principles have provided a foundation for policies that have emphasized the creation by governments of a legal and regulatory environment that enables innovation in the production of ICT goods and services and consumer welfare through the operation of markets. This market-oriented approach, in turn, has shaped policy responses to critical issues for the digital economy, such as achieving affordable access to broadband infrastructure; developing digital skills and literacy; promoting the application of digital technologies throughout the economy, society and government; ensuring confidence and trust in the online marketplace; enhancing information and network security; updating intellectual property rights; and supporting research and innovation.

The issues on the digital economy policy agenda are complex, both individually and through the interconnections between them and other economic sectors. Because they are rooted in a relatively small number of fundamental social and economic approaches and structures that are widely accepted in countries with advanced digital economies, the framework policies that have been developed to manage this agenda have been relatively successful in balancing the needs and interests of different stakeholders—so far. However, this success has been achieved in a policy environment that has, until recently, been preoccupied with economic issues above all others, and with the quest for improvements to productivity and competitiveness in a rapidly changing global environment. The policy environment has begun to change, with issues of security, sustainability and social change now rising to prominence. It is an open question whether the framework policies that have guided the development of the digital economy to date are capable of meeting these new challenges, or whether the relationship between governance principles, stakeholder needs and interests, and the roles of governments and markets need to be reformulated.

5 The Green Economy

The concept of the "green economy" is a much newer policy construct than that of the digital economy. In the aftermath of the 2008–2009 financial and economic crises, it has moved beyond the environmentalist community into international prominence as a framework for restoring economic growth while at the same time responding to the challenge of climate change and other major issues of environmental sustainability.

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*. UNEP defines the greening of the 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). 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).

Although their emergence on the international agenda was triggered by the financial and economic crises of 2008–2009, the concepts of green growth and the green economy are products of paradigm shifts that have taken place in recent decades as economic, social and environmental issues have begun to converge in the contexts of globalization and the growing understanding of the challenge posed by sustainability, and in particular by climate change.

The impacts of economic and social development on the environment and the consequent need to conserve and protect its resources have played a significant part in global and (in some countries) national policy-making since at least the 1960s. Until recently, however, environmental policy was seen by many policy-makers as largely separate from—and sometimes opposed to—mainstream economic and social development thinking. Over the past 10 to 20 years, the perspective of sustainable development policy-makers on environmental issues has significantly broadened. In a sense, it has led to a position in which development is now understood to mean "sustainable growth" rather than "growth" per se—as growth that is not sustainable in terms of planetary resources is inherently unsustainable in terms of the prosperity for which the goal of growth is itself pursued. The following factors have been important in this rethinking of "development."

The impacts of economic and social development on the environment and the consequent need to conserve and protect its resources have played a significant part in global and (in some countries) national policy-making since at least the 1960s.

- Major shifts have taken place in understanding the relationship bet-ween economic and social policy. The traditional view that saw economic and social policy as essentially different domains—the one concerned with creating wealth, the other with its distribution—is giving way to one that sees them as two sides of the same human development agenda. For example, as well as addressing basic human needs, education and health care policies are increasingly regarded as

essential components of policies aimed at improving productivity, competitiveness and economic growth, and part, therefore, of national strategies for development within the global marketplace.

ICTs may have systemic effects within society as a whole that result in transformations of the behaviour, attitudes and values of individuals as citizens and consumers, of economic and social structures, and of governance processes.

- Environmental and resource management (ERM) is emerging as a significant area of economic activity, including traditional activities of the primary sector, such as agriculture, forestry, fishing and mining, and traditional government responsibilities for protecting and conserving the natural environment. It also reaches beyond these to engage all economic and social sectors in the pursuit of sustainability, thereby creating opportunities for entrepreneurship and innovation in the private, public and non-profit sectors. Waste management and recycling are growing industries of increasingly international dimensions. The environmental impact assessments that are now required in many countries before major capital projects can be undertaken have generated growing demand for specialized expertise. The introduction of cap-and-trade systems to mitigate greenhouse gas emissions has also created demand for expertise in carbon footprint analysis and led to the creation of carbon registries and exchanges. Environmental education has become part of the public education curriculum in many jurisdictions, and degrees in ERM are now available.

- Sustainable development policy-makers recognize that it will be impossible to achieve economic and social objectives of the kind set out in the Millennium Development Goals (MDGs) and at the same time maintain a healthy, sustainable environment without significant technological innovation. Innovation is needed not only in the production and consumption of energy and raw materials and in the management of the earth's major ecosystems, but also in the ways that economies function, societies are organized and individuals live their lives.

- Sustainable development policy-makers also recognize that all countries, from the poorest to the richest, face the challenge of achieving a healthy balance between the economic, social and environmental pillars of sustainable development through sound policy, technology-enabled innovation and socioeconomic transformation. This challenge is particularly daunting in the major emerging economies, where policy-makers must deal with the rising expectations of a rapidly growing middle class, and in low-income developing countries where large proportions of the population are still trapped in poverty. The challenges facing all countries will become even more difficult if, as forecast, the world's population grows from its current level of six to seven billion to nine to ten billion over the next forty years, putting additional pressure on environmental resources, economic relationships and social structures.

Just as sustainable development policy-makers have begun to focus on the role of innovation, market mechanisms, and social entrepreneurship in the achievement of environmental and other objectives, the ICT sector and ICT policy-makers

have begun to recognize the problems that the ICT sector itself poses for the environment and the opportunities that ICTs offer for contributing towards a green economy.

Over the past decade, a consensus has emerged that ICTs impact the green economy in three principal ways. These correspond to the first, second and third order effects discussed in the Forum for the Future framework described in Section 3 above. They have direct effects on the environment through the production, distribution, operation and disposal of ICTs. These effects are largely negative from the perspective of environmental sustainability. They can be mitigated by enabling greater efficiency in energy and materials production and use, increased use of renewable energy sources, reduced use of toxic materials, and improved recycling and end-of-life disposal of ICTs.

They have indirect effects on the development of a green economy where they enable improvements in the efficiency of production, distribution and consumption of other goods and services throughout the economy and society—for example, by improving the efficiency of energy production and distribution and of transport logistics; by reducing demand for energy and materials through virtualization; and through the dematerialization of some human activities and interactions. These effects are expected to be largely positive from the perspective of environmental sustainability, though assessment is made more difficult by the uncertainty surrounding rebound effects.

ICTs may have systemic effects within society as a whole that result in transformations of the behaviour, attitudes and values of individuals as citizens and consumers, of economic and social structures, and of governance processes. These effects may be positive or negative from the perspective of environmental sustainability.

Direct effects

It is generally agreed now that, to support the transition to a greener economy, the ICT sector has to improve its own environmental performance.

- The problems associated with electronic waste have been recognized for some time, and have begun to be addressed through improvements to product design and industry codes of practice, as well as through recycling programs and regulatory action at local, national and international levels. (Attitudinal changes among both suppliers and consumers that reduce obsolescence and thereby increase the lifetime of equipment would also be beneficial.) In spite of some progress, however, at present the volume of electronic waste continues to grow annually and there are substantial problems associated with informal and illegal disposal, particularly in developing countries and where waste from industrial countries is transferred to these.

- More recently, attention has shifted to the greenhouse gas emissions generated by the ICT sector in the production and distribution of its products and services. As noted in Section 3 above, it is estimated that the ICT sector currently generates around 2 to 3 per cent of global CO_2 emissions, an amount greater than the emissions of the airline industry and roughly equivalent to those of a country such as Canada. These emissions are expected to continue to grow at a 6 per cent compound annual growth rate, almost tripling by 2020 under a "business as usual" scenario.

Enabling effects

There is a significant level of international agreement concerning ways in which ICTs can support green growth by enabling more efficient

production and use of energy resources. This results from work over the past five to ten years by a number of international organizations, including the European Commission, the OECD and the International Telecommunication Union, by leading environmental agencies such as the World Wide Fund for Nature (WWF), and by industry partnerships such as the Global e-Sustainability Initiative (GeSI).

- ICTs can help to reduce greenhouse gas emissions by enabling increased energy efficiency—for example, through the development of "smart" energy grids, transportation systems, buildings, and production/distribution processes in the agricultural, resource and manufacturing 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 under a BAU scenario and result in an economic benefit of US$950 billion. However, this calculation rests upon highly optimistic estimates of the speed, extent and scale with which managements in these other sectors take up such opportunities.

- ICTs may reduce the demand for energy and materials throughout the economy as well as in government and the public sector through "dematerialization"—the whole or partial substitution of virtual products, services and processes for their physical equivalents through e-commerce, digital media, tele-work, e-government, e-education, e-heath, etc. However, dematerialization does not eliminate energy requirements and significant rebound effects are likely to affect the extent to which carbon savings are achieved in practice.

- The Internet and other ICTs can provide individuals and communities with access to information, communication and knowledge resources that they can use to respond to sustainability challenges through action at local, regional, national and global levels—for example, by reducing household energy consumption, substituting virtual products and services for their physical equivalents, improving re-use and recycling, adapting to the effects of climate change, and contributing to the development and implementation of sustainable development policies and practices through engagement in governance processes. However, the high value attached to these information resources does have its own energy costs, particularly where the low cost of energy encourages users to keep equipment running when it is not actually in use.

- ICTs can play an important role in monitoring, measuring and managing the natural, human and built systems of the physical environment through remote sensing systems, embedded sensor networks, radio-frequency identification (RFID), and ubiquitous networking technologies that together make up what has been called the "Internet of Things." Improved measurement can enhance early warning mechanisms as well as enabling more efficient utilization of facilities.

Realizing these potential synergies between the digital and green economies is not straightforward. As suggested by the discussion above, it requires action by all stakeholders involved in the deployment and use of ICTs. These stakeholders include governments and regulators, which set the framework within which ICTs are deployed and used; professionals involved in standard-setting and equipment design; manufacturers, network and service

providers and other businesses involved in making ICTs and the Internet available to users; and end-users—including major business users such as the financial service sector, government and social agencies such as universities and other public services, and individual consumers. These stakeholders ultimately determine how efficiently their equipment is used, when, and how frequently it is replaced. Many policy issues arise within this context, all of which have important implications for sustainability. These include:

- how to achieve universal, affordable access to open broadband networks and services, at minimal environmental cost;
- the promotion of digital literacy and development of the capabilities people need efficiently and effectively to access information, communicate, share knowledge and experience, generate content, adapt, and innovate in an increasingly digital economy;
- deployment of the new addressing and object-identifying resources, such as IPv6, that are critical for the development of the Internet of Things and its application to smart energy grids, transportation systems, buildings and production processes, as well as to environmental monitoring and the management of natural resources;
- development of standards and protocols for networking the Internet, Next Generation Networks and the Internet of Things as platforms for developing and implementing "green ICT" and "smart solutions" throughout the economy and society;
- the role of regulation, incentives, partnership programs and public procurement in supporting ICT-enabled green innovation; and
- public policy at the interface between ICTs, the Internet and other public policy domains, including issues such as identity, privacy, child and consumer protection, cybercrime, information and network security, digital media, and intellectual property — a range that is increasing as the Internet becomes more widespread and important in everyday life.

There is growing awareness that innovative governance approaches are needed to develop, implement and adapt policies and strategies in the fast-moving context of the digital economy, in ways that respect fundamental democratic principles of representation, responsibility, transparency and accountability. Both environmental and Internet policy spaces have proved interesting testing grounds for new ways of engaging diverse stakeholders in decision-making. These innovative approaches include:

- non-governmental and consensus-based approaches to decision-making of the kind originally developed for technical and coordination purposes within the Internet community, but which have wider potential applicability;
- self-regulatory and co-regulatory processes that have been adopted and adapted by governments to deal with Internet-related public policy issues—for example, in connection with spam, child protection and cybercrime;
- adaptive policy-making processes, based on principles, tools and practices such as those that have been identified by IISD through its comparative analysis of policy-making in the fields of climate change mitigation, water resources management, healthcare, energy, transportation, ICTs and development (see Box 3 on "Adaptive Policies" below); and

- multi-stakeholder governance processes of the kind pioneered internationally by the Internet Governance Forum, which seek to incorporate diversity of experience into policy debate and decision-making.

Systemic effects

While it is relatively easy to identify direct and indirect or enabling effects of ICTs and the Internet on economy and society, it is much more difficult to establish what long-term systemic impacts may result from their widespread adoption. Very little research has been conducted on the systemic effects of ICTs on the economy, society and environment, or on the policies and strategies needed to ensure that systemic outcomes of the digital economy support the transition to a green economy in the longer term. In addition, the very rapid pace of change in technology, services and markets that characterizes information and communication technology makes it difficult to predict what may happen beyond a three to four year time horizon. (It is interesting, in this respect, to compare the communications environment of 2010 with that at the end of the World Summit on the Information Society less than five years ago—a period in which the reach of mobile telephony and the Internet has extended greatly, in which social networking has emerged as a major social dynamic, in which broadband networks and mobile Internet have become prevailing trends, and in which new communications and Internet modalities, such as cloud computing, have emerged.)

There are many important policy questions that require serious analysis at this nexus between the digital and green economies. As suggested by the discussion above, those that have received attention in the literature on the relationship between ICTs and sustainable development include the following:

- Rebound effects: Will the increased energy and material efficiencies enabled by the use of ICTs result in increased consumption? Economic theory and practical experience suggest that this is likely to happen in the absence of measures to suppress supply and/or demand. If so, what are the relative merits of different policy options for dealing with rebound effects?

- Unintended consequences: What is the human impact of the openness and dematerialization enabled by the Internet? How and to what extent could unintended consequences for individuals, social relationships, communities, organizations, and countries limit the capacity of the digital economy to support the transition to a green economy? What policies, strategies and governance mechanisms are needed to deal efficiently and effectively with unintended consequences?

- Uncertainties and unforeseen events: What new kinds of threats and vulnerabilities arise in a world where human, material and natural systems are interconnected and hyperlinked in real time, particularly when artificial intelligences of one kind or another come to make decisions? What policies and strategies are needed to anticipate uncertainties and respond to the impact of unforeseen events? How can these policies and strategies be shaped so as to avoid creating barriers to the synergistic growth of the digital economy and the green economy?

6 Integrating ICTs and Sustainable Development

Integrating sustainable development into ICT/Internet public policy

The discussion in Section 3 of this paper emphasized the importance of drawing understanding of sustainable development and ICTs together into a common framework. At the heart of that discussion is the observation that ICTs and their use are having transformative impacts on all aspects of human behaviour (economic and political, social and cultural) and that these impacts are taking place at all levels, from the planet as a whole to the household and the family. Many of these impacts are highly disruptive of established ways of doing things, including laws, regulations and norms.

Such changes stem from the nature of ICTs as general purpose technologies (GPTs). They are important not just as particular changes in specific areas of activity but because together they have a cumulative impact on the structure and organization of human life—of culture and society, of politics and economics, of the relationships among the individual, the state and other actors.

These impacts are not merely fundamental; they are also unpredictable. The pace of change in ICT technology and markets today is exceptionally rapid. Large-scale changes in human behaviour—such as the adoption of new production and trade arrangements, the development of mass market mobile telephony (and so of immediate communications at a distance for all communities), the restructuring of media and information access resulting from the Internet and the advent of social networking—now happen very quickly indeed. It is very hard to anticipate which technological and market innovations will have comparable effects on society and economy, politics and culture in ten years' time, but it is certain that some such innovations will have such impacts.

These impacts have two crucial implications for sustainable development. The first is that ICTs are shifting the ground beneath assumptions that have historically been made about how societies and economies work and so about the implications of sustainability. For example, transition to smart grid energy management (computerized management of electricity generation and distribution in order to prioritize energy efficiency) will change the environmental sustainability outcomes of the energy sector in which it occurs. A shift to just-in-time production methods in manufacturing may change the viability and sustainability of a particular kind of product development. The ability of family members to communicate and transfer money instantly across continents has important implications for the sustainability of family relationships in both social and economic contexts. It is essential that sustainable development thinking understands and accommodates changes such as these in behaviour and in the socioeconomic structures that impact sustainability. Unless sustainable development analysis reflects the underlying changes in economy and society that are taking place as a result of ICTs, then it will be concerned with sustainability for the past rather than sustainability for the present and the future.

The second implication concerns the unpredictability of the sector. It is not just that sustainable development analysis needs to accommodate the impact of ICTs today, vis-à-

vis the past, but that it needs to accommodate the ongoing, continuous and unpredictable impact of ICTs in future. If some of today's assumptions about sustainability need to differ from those made in 1987, when the term was coined, so do some of tomorrow's assumptions need to differ from those that are made today. The impact of ICTs on society, economy and sustainability needs continual assessment to make sure that policy prescriptions continue to relate to changing circumstances. IISD's work on adaptive policy-making, which recognizes this challenge, is described in Box 3 later in this section.

At present, however, the adoption of this kind of environmental impact assessment is underdeveloped within ICT and Internet standards development.

Understanding the impact of ICTs on sustainable development, both today and in the future, requires an analytical framework. Section 3 of this paper described one such framework, which was set out in the Forum for the Future's 2002 report for the European Information Technology Observatory on *The impact of ICT on sustainable development.* Similar frameworks, and matrices like that in Section 3, have been used in other sustainability analysis.

The matrix illustrated in Section 3 is built around two crucial distinctions:

- that between the three main pillars of sustainability (economic, social and environmental);
- and that between first order (direct), second order (indirect) and third order (societal) effects.

By juxtaposing these, it provides a flexible framework for analyzing the relationship between ICTs and sustainability, and the changes that are taking place within that relationship. It enables analysis both of individual ICTs and of ICTs in general, of the sustainability of ICTs themselves and of the impact of ICTs on overall sustainability.

Systematic analysis along these lines can help to build up an overall picture that will have two key values:

- It will help to identify areas where economic, social, environmental and development agencies and actors can take advantage of the sustainability gains that ICTs can help deliver.
- It will help to identify areas where detrimental outcomes are certain or highly likely, in which steps to mitigate those outcomes are required either within the ICT sector or from wider agencies.

The World Summit on the Information Society included the declaration of the second Earth Summit—alongside the UN Charter, the Universal Declaration of Human Rights and the Millennium Development Goals—among those international agreements that should underpin thinking about the development of an Information Society. So far, that integration of ICTs and sustainable development has been largely absent from international discourse. As mentioned earlier, the third Earth Summit will be held in Brazil in 2012. This presents an opportunity for the international community to rectify that omission, and for sustainable development and ICT specialists to take stock: to assess the impact that ICTs already have on sustainability, the impact that they are likely to have, or the impact they might have, with suitable policy approaches over the next ten years.

The 2012 Earth Summit can therefore help to

bridge the paradigm gap that currently exists between these two fields, incorporating the ICT sector into sustainable development thinking. But this is an opportunity that could be missed if work does not begin now. IISD welcomes the fact that an expert from the ICT sector has been included in the High-Level Panel on Global Sustainability. Much more, however, is needed between now and 2012 to fill in the matrix above with genuine understanding. IISD is committed to working in this area in the run-up to 2012, and a proposal concerning this is made in Section 7.

Integrating sustainable development into ICT/Internet public policy

If there are weaknesses in the level to which ICT/Internet policy is integrated into sustainable development thinking (digitizing the green economy), there are similar weaknesses in the extent to which sustainable development thinking has penetrated ICT policy-making (greening the digital economy). Important work has been undertaken recently in several forums concerned with the environmental dimensions of sustainability, including the OECD, the International Telecommunication Union and the business community. This work has addressed the environmental impact of ICTs in an increasingly open way. However, it has achieved only limited traction in ICT discussion and decision-making spaces like the Internet Governance Forum and ICANN. Where attention is paid to sustainability in these, it tends to focus on environmental issues and on potential positives (second order effects) rather than current challenges (first order effects). A serious comprehensive analysis of the relationship between ICTs and sustainable development is still awaited, and much needed (see Section 7 for a proposal).

The challenge of integrating sustainability into ICT development arises in many different aspects of information technology, from design to disposal. The standard-setting process can serve here to illustrate the challenge. In many policy domains today, it has become commonplace to incorporate environmental impact assessment in the development of standards. Often it is possible to achieve similar technical, economic or social outcomes in a variety of ways, but these different approaches may have very different environmental implications—for example, requiring higher or lower levels of energy use. It makes sense in these contexts to make decisions about standards that promote sustainability, not just in environmental terms but also economically and socially.

At present, however, the adoption of this kind of environmental impact assessment is underdeveloped within ICT and Internet standards development. Internet professionals have (understandably) prioritized the stability and security of the Internet in their processes for agreeing upon protocols and standards. However, different standards options may well have substantially different impacts downstream on, for example, network configuration, traffic routing, access to and cost of services, and energy requirements. The ethos of Internet standard-setting does not currently accommodate environmental impact assessments that would identify such outcomes. As the Internet becomes increasingly important, however, and has an increased impact on economy, society, culture and sustainability, this needs to change.

Incorporating environmental impact assessment into standard-setting for ICTs and the Internet need not threaten innovation or creativity. Indeed, in other sectors, including sustainability in the criteria for standard-setting and equipment design has invigorated innovation by posing new challenges to technologists and entrepreneurs. Information technology can be highly disruptive of established norms, as it has been for example in intellectual property and some areas of fiscal

policy. Solutions to sustainability challenges may be just as radical.

Attention to sustainability in ICT/Internet policy and practice does not imply a shift away from consensus towards regulation in policy-making or standard-setting. Impact assessment of any kind, whether economic, social or environmental, implies consultation and engagement with the wider community, reaching beyond governments to citizens, beyond businesses to consumers, beyond professional experts to all stakeholder groups. It is not formal arrangements that are most important here. What matters most is the ethos of decision-making: an acceptance that sustainability is a criterion that should be part of the decision-making process alongside technological quality, efficiency, profitability and security.

Attention to sustainability in ICT/Internet policy and practice does not imply a shift away from consensus towards regulation in policy-making or standard-setting.

It is relatively easy to identify areas of environmental impact in which greater sustainability would be desirable. The significance of standards has already been mentioned. Here are four further examples:

- Much ICT equipment has a short lifespan. The pace at which businesses and individual consumers replace equipment is partly determined by the constant upgrading of hardware and software specifications in mobile communications, computing and the Internet, which results from increasing technical capabilities. Falling prices for ICT hardware also encourage rapid turnover of equipment, and the disposal of equipment that is still viable. Industry norms at present therefore favour short product lifecycles: hardware and software are highly obsolescent. Alternative approaches to hardware and software development, however, could extend the average lifespan of equipment, for example by making the upgrading of existing equipment more attractive to consumers than its replacement. Increasing the lifespan of computers and mobile phones from two to four years would have significant positive outcomes for sustainability, as well as economic benefits for consumers.

- Much ICT equipment is currently designed to remain in operation or on standby for long periods of time when it is not in actual use, consuming unnecessary electrical power. A number of factors encourage consumers to keep equipment powered up, including the length of time that it takes to boot up computers in order to use "always available" broadband access to the Internet. The ICT industry has paid significant attention to the supply side of this equation, through efforts to reduce power requirements of equipment and extend battery life, though more could (and will) be done on this. Less attention has been paid to the demand side, to ways of encouraging consumers to make more energy-efficient use of their equipment and discouraging them from behaviour that is wasteful.

- Significantly greater sustainability could also be achieved upstream from end-users, in data centres and in the development of new ways of managing

computing and communications. A high proportion of data centre costs, for example, result from requirements for air conditioning to keep equipment cool. Greater temperature tolerance within equipment could significantly reduce the economic and carbon costs of energy (another area to which the industry has paid significant attention). New ways of delivering information and communication services, such as cloud computing, pose further questions (some of which are discussed in Box 2 earlier in this paper). These options may enable significant energy savings. However, assumptions that cloud computing will be more energy efficient than current configurations need to be tested through rigorous prior impact assessment.

- The disposal of electronic waste is a significant and growing problem for all countries. In addition to the sheer volume of waste, ICT equipment includes components and chemicals that are toxic or otherwise hazardous. This is a challenge even where waste management is well regulated. However, the illegal routing of waste to countries with inadequate regulatory or enforcement regimes threatens lives and the long-term viability of land that is used for storage or disposal. Measures are needed not just to manage the disposal of unwanted equipment, but also to reduce toxicity, increase the recyclability of equipment and the ease with which recycling can take place, and encourage adaptation rather than replacement of equipment that is nearing the end of active life.

These examples are concerned primarily with the environmental dimension of sustainability, though similar illustrations could be made for its social, economic and cultural dimensions. The principal challenge here for those engaged in the development and use of ICTs—product designers, ICT businesses and major users, governments, regulators and individual citizens—concerns the need to encourage ways of thinking that appreciate the outcomes of choices made in product design, service delivery and consumer use, and assess those outcomes in terms of their long-term impact on social, economic and environmental sustainability.

Implications for governance

As discussed above, the relationship between sustainable development and ICT/Internet decision-making is poorly established at both global and national levels, in both sustainable development and ICT/Internet forums. Historically, these have been seen as distinct policy domains. Even where the outcome documents of international forums—such as the World Summit on the Information Society (WSIS) or the Millennium Development Goals—refer to the relationship between them, references have tended to be tokenistic and superficial. There was no meaningful dialogue between WSIS and the almost simultaneous Millennium Review Summit in 2005. Development specialists still seem to be divided between those who take a highly optimistic view of the transformative potential of ICTs and those who see them as marginal to poverty reduction and other priority development concerns. IISD believes that these gaps in paradigms and discourse must be addressed. In addition to the policy issues discussed above, three governance issues will be significant in taking this agenda forward.

First, the institutional frameworks for considering sustainable development and ICTs/Internet are too disparate. Sustainable development has been seen too much as an environmental issue within

the UN system and other intergovernmental agencies, rather than as a challenge facing all aspects of development. It needs to become more central to multilateral practice as well as rhetoric. The principal governance forums for the ICT sector, meanwhile, are primarily technical rather than developmental. The International Telecommunication Union (ITU) has a significant development program and seeks to achieve developmental as well as technical outcomes, but is still seen within the UN system and elsewhere as a source of technical rather than developmental input. The variety of looser (and generally non-governmental) standards and coordination arrangements for the Internet have developed within the Internet community, focusing primarily on the working of the Internet rather than its growing interface with society, economy, politics and culture. WSIS and the Internet Governance Forum (IGF) have provided spaces for more general discussion of the developmental impact of ICTs, but have had neither the time nor the resources to develop systematic analysis. There has been an understandable tendency to emphasize the positive impact of ICTs on economic growth and empowerment and to ignore downsides such as increased waste and greenhouse gas emissions.

We need to find spaces within the institutional frameworks for development and for ICTs in which the relationship between them can be analyzed, and appropriate agreements reached to maximize development and sustainability gains and mitigate negative impacts.

Second, international policy-making concerned with both sustainability and ICTs has broadened the scope of participation, enabling other stakeholder communities—especially the private sector and civil society—to participate in ways that have not been common in other policy domains. In the case of sustainable development, this results from the need to question and consult about the impact of environmental and other changes on diverse communities. Governments have learned through experience that policy in this area needs to be built around evidence and consent: sustainability is not something that can be imposed but must be based on the confidence of those affected by decisions. In the ICT/Internet space, multi-stakeholder participation has built upon the early experience of the Internet, where collaborative entities rather than government or intergovernmental agencies have been responsible for developing standards and coordinating networks, numbering and service delivery.

The implications of wider stakeholder participation are only beginning to be understood, and will take some time to work through. Some intergovernmental agencies and some governments are resistant to private sector and especially civil society participation. Nor is participation yet necessarily representative of society in the round. In the ICT field, more participation is certainly needed from private sector businesses that are consumers rather than suppliers of ICTs and Internet services, and from mainstream civil society organizations that are primarily concerned with issues such as development, rights and the environment rather than with information and communications. Nevertheless, multi-stakeholder approaches offer an opportunity to create more flexible decision-making spaces that may be able to respond more effectively to changing needs and demands than institutions in which only governments can play a part.

The third challenge, which is discussed here in more detail, concerns the types of specialized regulatory mechanisms that have been developed in many countries, and in international forums, to oversee the activities of the telecommunications and broadcasting sectors. These are proving inadequate to cope with the speed at which ICTs and the Internet evolve. In addition, specialized

programs that have been put in place to support the Internet's role in development have often failed to live up to expectations, often for the same reason: by the time a program is fully underway, its technology and market assumptions are already likely to have become outmoded.

When the Internet began to grow very rapidly following the invention of the World Wide Web, the governments of most industrialized countries took the view that any attempt to regulate it in the ways that other communications sectors had been regulated—by passing laws that applied specifically to it, issuing licenses to Internet Service Providers (ISPs), regulating services and tariffs and requiring cross-subsidies between different classes of Internet user—would stifle the growth of the Internet, inhibit economic and social innovation, and deprive the public of opportunities to access, create, communicate, and share information and knowledge. It was noted that the community of Internet developers and service providers had been self-governing from the beginning, working through consensus-based non-governmental entities like the Internet Engineering Task Force, and it was widely believed that the Internet might never have developed at all if it had been subject to traditional government policy-making and regulation.

Instead of adopting Internet-specific governance mechanisms, many countries therefore allowed the Internet community largely to continue administering itself, and to rely on general purpose laws and regulatory mechanisms, such as those governing competition, consumer protection, intellectual property and crime, which could be updated as necessary to deal with any public policy issues that arose in connection with the Internet. In addition, governments of many countries launched programs to extend public access to the Internet and to promote the development of Internet applications in areas as such education, health and the delivery of public services.

This same approach has been maintained internationally. Although some countries have sought to impose governmental or intergovernmental control on the Internet, there has been strong (and, to date, successful) resistance from others to any attempt to develop international governance mechanisms for the Internet similar to those that exist for telecommunications and broadcasting. There has also been engagement, varying over time, by multilateral and bilateral donors in stimulating Internet access and applications.

This two-pronged approach to Internet governance—a largely "hands off" approach to regulation combined with program support for infrastructure and applications development—has begun to break down as a result of several factors.

A number of trends in the regulatory arena have been influential. These include increasing convergence between the Internet, telecommunications, broadcasting and media

sectors; increasing concern about the security and stability of the Internet as it becomes a critical infrastructure for the functioning of national economies and societies; and the globalization of Internet-related problems, such as cyber-crime. As a result of these trends, governments have begun to engage more deeply in Internet regulation, both nationally and internationally.

In the development arena, many programs to support Internet access (for example through tele-centres) and the development of Internet-based applications have not had the scale of impact that had been anticipated. Instead, over the past decade the market-led development of the mobile communications sector has generally had a stronger impact on society and on individual lives in low-income countries than the growth of the Internet. The development of Internet access through mobile devices rather than computers is now increasingly important and likely to become the predominant mode of access in many countries in at least the medium term.

With mobile communications going broadband and intelligent sensor networks beginning to be deployed in the natural and built environments in the developed world, the challenge facing policy-makers is to prevent new digital divides from opening between developed and developing countries, just as the old divide in access to basic telecommunication services is closing. New kinds of governance may be required here. Ways of doing things that worked effectively when, for example, the Internet was unimportant, poorly distributed and had little impact on social and economic outcomes, are not necessarily sustainable into a future in which the Internet is highly influential across all social and economic domains.

This is a complex challenge, particularly because of the very rapid pace of change in information technology and markets, but it is not unique. Other areas of sustainable development are also characterized by complex adaptive systems in which there are high degrees of uncertainty. Box 3 outlines the results of a five-year research project on adaptive policy-making that IISD has undertaken in conjunction with The Energy and Resources Institute (TERI) and the International Development Research Centre (IDRC). The aim of this project was to identify principles and practices that could assist policy-makers in adapting to anticipated and unanticipated change, and in coping with the kinds of uncertainties that are found at the interface between ICTs, the Internet and sustainable development. The findings of the project are summarized in Box 3.

None of the adaptive policy-making principles and practices identified in this study is new. Their value lies in their systematic application. All of the elements of the IISD adaptive policy-making toolkit are found in the field of Internet governance/public policy but rarely, if ever, have they been systematically applied. Thus, for example, the Internet Governance Forum (IGF) has provided a venue for multi-stakeholder deliberation on many important Internet public policy issues. However, it has done so without the benefit of integrated, systematic, forward-looking analysis of the kind that can be generated by scenario-building and other foresight techniques. The IGF has also lacked effective means for enabling policy innovation in international, regional or national bodies concerned with Internet governance. IISD believes that the IGF and these other ICT/internet entities should examine how adaptive policy-making can be applied to their work over the next five years.


Adaptive policy-making

From 2005 to 2009, in conjunction with The Energy and Resources Institute (TERI) and the International Development Research Centre (IDRC), IISD conducted a multi-phase research project aimed at identifying the tools and processes needed to design and implement successful policies in the conditions of uncertainty that characterize the complex, dynamic and interconnected human and natural systems of sustainable development.

The Adaptive Policy Project (ADP) did not invent new policy tools, but rather used a case study and interview approach to find tools that had worked well in diverse circumstances. The contribution of the project is to bring these tools together in the context of policy-making under uncertainty, and to highlight the need for policy designers to take these issues into account as policies are amended or designed anew.

Creating adaptive policies: A guide for policy-makers in an uncertain world (Swanson & Bhadwal, 2009), the final report of the project, is available at http://www.iisd.org/publications/pub.aspx?id=1180. As discussed in the report, research for the project suggested that there are four types of activities that policy designers should undertake, and seven tools that are available to assist them. To create adaptive policies, policy-makers should:

- *Understand the policy environment.* They should clearly understand the intended goals of the policy, key factors affecting performance, and the expected future development of those factors. The tools of *Integrated and Forward Looking Analysis* and *Multi-Stakeholder Deliberation* are intended to help in understanding the policy environment.

- *Enable innovation.* Innovative policy instruments can provide useful inputs to policy design and development, both through the new approaches they excite and through the evidence they provide about factors facilitating success or failure. This can be facilitated through tools such as *Decentralization of Decision Making, Self Organization and Social Networking,* and *Variation.*

- *Monitor the context.* Policy developers must also monitor and assess the results of implementation, for two reasons: to ensure that the policies are doing what they were designed to do, and to be aware when circumstances (such as technology and markets) have changed so much that policies themselves need to be changed if they are to meet their goals. The tools for *Automatic Adjustment* and *Formal Policy Review and Continuous Learning*, address this challenge.

- *Improve outcomes.* As both the policy environment and knowledge of a policy's operation evolve over time, policy developers and program managers must use the warnings and opportunities provided to make necessary adjustments to ensure performance.

7 Conclusion and Recommendations

Climate change and the communications revolution are fundamental changes affecting the relationships between countries, within societies and economies, and between individuals. Both domains are subject to rapid change in context and understanding, and forward projections in both are uncertain and unpredictable. This paper has argued that both, and the changes that occur within them, are central to our understanding of sustainable development. Both require adaptive governance and wider stakeholder involvement in policy development and decision-making than is conventional in other policy domains.

What happens in the ICT and Internet contexts, in short, will affect what is sustainable and what can be done about sustainability in future. The nexus between these policy domains is crucial, complex and insufficiently understood. This paper ends with three proposals for next steps that can be taken to address the present gaps in thinking.

What happens in the ICT and Internet contexts, in short, will affect what is sustainable and what can be done about sustainability in future.

The first proposal is for the issues described in this paper to be analyzed in greater depth by both sustainable development and ICT/Internet communities, acting jointly. One way of doing this would be for a small commission of experts to review and analyze the evidence for consideration within international forums concerned with both sustainable development and ICTs. The analytical framework devised by the Forum for the Future and described in Section 3 would provide one important starting point for this work, and would also draw on evidence from a wider range of diverse stakeholders. The commission's report should feed into discussions ahead of the third Earth Summit in 2012, but should also contribute to the wider range of development and ICT decision-making forums, including the Internet Governance Forum. IISD would be prepared to provide the secretariat for such an initiative, though this would require commitment and support from a variety of stakeholders.

While this first recommendation is primarily global in intent, the concept would also be valuable at a national level. Single country or regional consideration of the link between sustainable development and ICTs/Internet would enable better targeting of national ICT and digital economy strategies. It would also contribute to the quality of any global assessment.

The second proposal made here follows from the discussion of standard-setting, network deployment, etc. in Section 6. Increased access to and use of ICTs by citizens, and ICTs' increased predominance in government and business communications, inevitably have detrimental environmental impacts, particularly in terms of waste and greenhouse gas emissions. Mitigation of these impacts would have a significant positive impact on sustainability.

Government and international regulation—for example, of emissions standards and waste disposal—clearly has a role to play in promoting mitigation, but the primary responsibility for this lies with the supply and demand side of the ICT/Internet sector, with the businesses that produce equipment, the service providers that enable access and with users, from large

corporations to individual households. The second recommendation of this report is that the industry and consumer organizations should work together to develop guidelines for environmental impact assessment and mitigation of negative environmental outcomes that can apply at different points along the supply chain. These points can include standard-setting, network configuration, the design of data centres and terminal devices, the ways in which services are routed to end-users, life-cycle choices concerning equipment (including addressing the challenges of obsolescence and disposal) and the responsible use of energy and ICT equipment by commercial and domestic users. The aim would be to help different actors reduce the negative environmental impact of their engagement with ICTs. IISD would welcome the opportunity to work with industry and consumer organizations to develop these ideas.

The third proposal of this report concerns the way in which policy processes in this field should develop for the future. As discussed above, the rapid pace of change in ICT technology and markets mean that the impact that they have on sustainability is in greater flux than those in other sectors. Traditional three- or five-year policy and program cycles are unlikely to be adequate to address the opportunities and challenges arising. This is clearly challenging for some governance bodies even within the communications field: national telecommunications regulations are often outdated, with regulators struggling to keep their interventions in tune with changing contexts. It is even more challenging in those areas where changes brought about by ICTs undermine legal and regulatory regimes that were once thought to be effectively permanent (for example, those for intellectual property).

The institutional framework for sustainability is, alongside the green economy, one of the main themes for the third Earth Summit in 2012. As well as addressing the substantive issues involved, there is a need for policy-makers to think more about process: about identifying ways in which policy approaches can be made sufficiently flexible to suit rapidly changing circumstances, so that they can meet broad objectives (such as universal access) without locking government, business or citizens into particular technologies or market mechanisms. Adaptiveness is crucial to this evolution in governance. ICTs also have much to offer changing governance frameworks. IISD would be happy to share its work in both these fields and develop that work further with stakeholders in government, business and civil society.

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