Let's Get Physical:
Methodologies for Framing Critical Internet Policy and Governance Issues from a Sustainable Development Perspective

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Introduction

Over the past fifty years there has been increasing interest among policy-makers in the impact of information and communication technologies (ICTs) on economies and societies. In the past decade and a half, much of this interest has focused on the Internet, a subset of ICTs. Today there is broad international consensus on the nature of these impacts and the framework policies needed to optimize their economic and social consequences. This consensus was reflected in the results of the 2003-05 United Nations World Summit on the Information Society (WSIS). This event drew together the results of discussions that had taken place over the previous quarter century in national, regional and international policy fora, including those concerned with telecommunications, trade, intellectual property, culture, and security. Following WSIS, the UN General Assembly established a follow-up process within the UN system on information society issues and created a new structure for multi-stakeholder discussion and cooperation on Internet-related policy issues, the Internet Governance Forum (IGF), on an experimental basis. Five years after WSIS, it appears that information society policy is on its way to becoming a standing item on the global governance agenda, with a renewal of the IGF mandate expected in the fall of 2010 and talk beginning about a WSIS + 10 in 2015.[1]

In the last five-ten years, a new set of issues has begun to appear on policy agendas at the national, regional and international levels. These issues relate to the impact of ICTs on the environment — both the direct impacts of the ICT goods and services producing sector, for example through the generation of toxic waste

[1] See http://www.itu.int/wsis for the results of the first and second WSIS phases and the WSIS follow-up process. See also http://www.intgovforum.org

and greenhouse gas emissions (GHG) — as well as the indirect impacts of the use of ICT goods and services throughout the economy and society, particularly those resulting from changes ICTs enable in production processes, consumption patterns, economic and social structures, and individual behaviour. The emergence of these issues coincided with the increasing attention being paid to climate change and other environmental matters. Interest in them has been given added impetus by policy responses to the 2008-09 financial and economic crises, particularly in developed countries, where ICTs are increasingly seen as important components of "green growth" recovery strategies being developed, for example, under the aegis of the Organization for Economic Cooperation and Development (OECD 2009b; 2009c; 2010b; 2010c).

The current interest in green growth is the most recent stage in the evolution of sustainable development policy. Over the past fifty years, through a process that parallels the evolution of information society policy, broad international consensus has evolved on the framework policies needed to reconcile economic growth and social development with environmental sustainability. Achieving this balance involves management of environmental issues related to matters such as pollution, climate change, biodiversity, natural capital and ecological services in the context of policies aimed at enhancing human wellbeing by promoting economic growth, improving education and health care, reducing poverty, combating crime and corruption, preserving diversity, and strengthening democracy. Major steps in the evolution of sustainable development policy have included the 1972 Stockholm Conference on the Human Environment, the 1992 Rio Earth Summit, and the 2002 Johannesburg World Summit on Sustainable Development. The forthcoming publication of the United Nations Environment Program (UNEP) *Green Economy Report* in the context of its Green Economy Initiative (GEI) will likely mark the next step in the evolution of the global sustainable development framework, by advocating the efficient integration of the goods and services provided by the environment into the global economy (UNEP 2008; 2010).

At a general level, there are obvious similarities in the scope and ambition of information society and sustainable development policy. Both seek to address a wide range of complex, interconnected issues in a holistic fashion, and they share similar goals for human improvement. However, in spite of connections that have been established between ICTs and development, as well as emerging recognition of their potential environmental benefits, there has been relatively little interest among sustainable development policy-makers in analyzing the impact of ICTs on the relationship between economy, society and environment, or in shaping policies to optimize the contribution of ICTs to sustainable development's "triple

bottom line".[2] Information society policy-makers also had paid relatively little attention to the environmental impacts of ICTs until they were seized by the coincidental rise to public prominence of issues related to the connections between ICTs, the Internet and climate change, as well as by the challenge of restoring global growth following the 2008-09 downturn.

In the past decade, bridges have begun to be built between the information society and sustainable development policy communities through the development of frameworks that conceptualize the relationship between ICTs and the economic, social and environmental dimensions of sustainability, and which provide a consistent foundation for policy research and analysis. In Europe and North America, much of this work originated in government or industry-sponsored ICT research institutions and non-governmental sustainable development organizations (EITO 2002; Erdmann et al. 2004; Hilty 2008; Pamlin 2002; Raskin et al. 2002). In these regions, it has been carried forward under the aegis of international organizations (ITU 2008; 2009; OECD 2009a) and by partnerships between sustainable development organizations, consultancies, and providers of ICT goods and services with the aim of influencing policy agendas at national, regional and global levels (Mallon et al. 2008; Pamlin and Szomolanyi 2008; The Climate Group 2008; WWF-Canada 2008). In the past two years, this work has begun to bear policy fruit, particularly in the decisions taken by OECD member states in relation to the Internet economy and ICTs and the environment (OECD 2008; 2010a).

As part of this bridge-building movement, the International Institute for Sustainable Development (IISD) began to explore connections between information society and sustainable development policies by engaging in the preparatory process that preceded the first phase of WSIS in 2003. The goal of this project was substantive — to identify the framework information society policies that are most likely to optimize the impact of ICTs on sustainable development, with a particular emphasis on the role of Internet governance (the Internet Governance and Sustainable Development or IGSD project). IISD continued this exploration and maintained this focus through ongoing engagement in the second phase of WSIS in 2005, the process that has been put in place to follow-up on the results of the summit, and the first five meetings of the IGF.[3]

[2] The phrase "triple bottom line", which refers to the economic, social and environmental pillars of sustainable development, was first coined in 1997 by John Elkington, director of the sustainable development consultancy SustainAbility (EITO 2002, 251)

[3] See http://www.iisd.org/infosoc/gov/ for an overview of IISD's involvement in WSIS and its activities in relation to Internet governance and sustainable development, including links to publications.

From 2005-09, 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 policy-making 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 addressed by sustainable development policies (the Adaptive Policy-Making or ADP project).[4] Although ICT policy-making was not a principal subject of research in the ADP project, its final report noted the role of ICTs in contributing to complexity and uncertainty across policy domains and identified ICT policy-making as one of the main areas relevant to sustainable development where the rate of change, combined with complex interconnections between technological, economic, and social factors, generates significant uncertainties about optimal courses of action and effective policy-making processes (Swanson and Bhadwal 2009).

Both the IGSD and ADP projects used methodologies common to many fields of policy research, including literature reviews, case studies, surveys, and expert analysis of key issues. In addition, these projects used methodologies that are standard practice in sustainable development policy research, but which have been relatively little used in information society policy research. In the case of the IGSD project, a scenario-building methodology was used to address the substantive question of how alternative framework policies for Internet governance could affect economic, social and environmental outcomes in the medium- to longer-term. In the case of the ADP project, a methodology based on the theory of complex adaptive systems and grounded in the practical experience of communities in Canada and India was used to help identify the policy-making principles and processes required to generate successful policy outcomes in conditions of dynamic uncertainty, as a complement to other policy research techniques.

Against this background, the purposes of this paper are:

- to identify Internet policy and governance research issues that are most critical from a sustainable development policy perspective, in terms of current knowledge gaps;

[4] It is important to note that the ADP project is about adaptive policy-making in conditions of complexity and uncertainty including, but not limited to, adaptation to the effects of climate change. See http://www.iisd.org/climate/vulnerability/policy.asp for an overview of IISD's work on adaptive policy-making and links to related publications

- to assess the results of the IGSD and ADP projects in terms of the extent to which the methodologies they employed could be adapted and applied to address these knowledge gaps;

- to conclude what further work needs to be done to close these gaps and recommend a research agenda on the relationship between Internet policy, governance and sustainable development.

To support this analysis, the paper will briefly describe the sustainable development policy perspective, compare and contrast it to the information society policy perspective, outline a conceptual framework that has been developed to connect these perspectives, and summarize the results of policy research undertaken to date on the relationship between one of the central issues of sustainable development policy, mitigation of climate change and adaptation to its effects.

ICTs and the Internet from a Sustainable Development Perspective

The classic definition of sustainable development is found in *Our Common Future*, the 1987 report of the United Nations World Commission on Environment and Development (the Brundtland Report).

> Sustainable development is 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.[5]

As noted in IISD (2010), the concept of sustainable development has been elaborated and refined in the years since the Brundtland Report was published. Although there is no single definition of sustainable development, just as there is no single definition of the information society, there is general agreement in the sustainable development policy community on certain fundamental principles.

- The goal of sustainable development policy is human well-being, measured in terms of factors such as security, satisfaction of material

[5] See http://www.un-documents.net/ocf-02.htm.

needs, health, social relations, and freedom of choice and action (MEA 2005, vi).

- 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 the economic, social and environmental dimensions of sustainability.

- Scientific research, technology development, the organization of economic and social activities, cultural values and governance processes play critical roles in achieving long term balance between human development and the natural environment.

The charts presented in Figure 1 illustrate the general perspective of the sustainable development policy community on the fundamental challenges they face (WWF 2008, 22). They also provide a general illustration of the kinds of roles ICTs can play in helping to achieve balance between economy, society and environment.

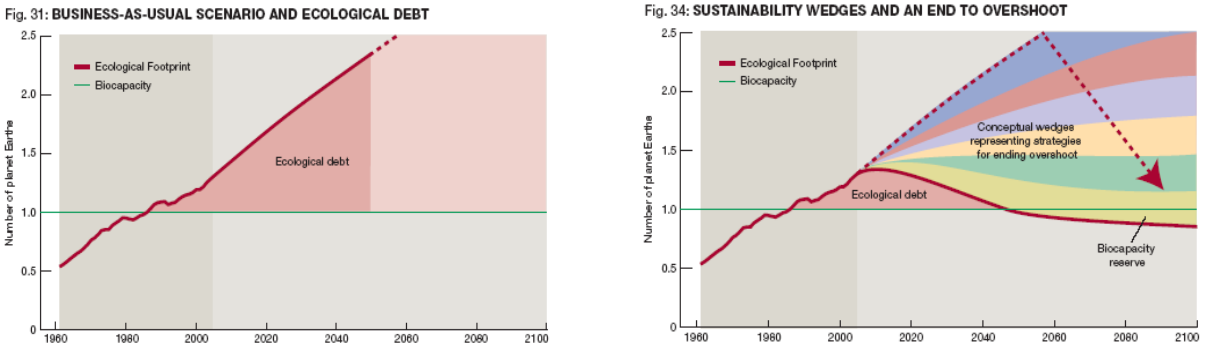
The first chart, "Business-as-Usual Scenario and Ecological Debt", is based on analysis done using the global footprint methodology.[6] It suggests that the planet's resources are being consumed at a much greater rate than they can be naturally replenished. On this analysis, it would take the resources of 1.4 planet earths to support humanity's current rate of resource consumption on a sustainable basis, and more than 2 planet earths to do this under a business as usual scenario by mid-21st century.

The second chart, "Sustainability Wedges and an End to Overshoot", suggests that long term balance can only be achieved through the development and implementation of sustainable development strategies that significantly reduce the rate at which ecological goods and services are being consumed. These strategies could involve increased scientific research on sustainable development issues; technological innovation that reduces the consumption of non-renewable energy and materials; new market mechanisms based on the monetization of ecological goods and services that would encourage conservation and efficient use; fiscal reforms, including the elimination of environmentally harmful subsidies and the creation of sustainability incentives; regulation of

[6] See http://www.footprintnetwork.org/en/index.php/GFN/page/footprint_science_introduction/ for an overview of the global footprint methodology and links to more detailed information.

environmentally harmful conduct; reform of international trade and investment regimes to incorporate sustainable development principles; public and private policies enabling dematerialization of goods, services, structures and activities; education and public awareness; and governance innovation at every level (OECD 2009b; 2010c; UNEP 2008).

Figure 1



Source: WWF 2008

Information society policies regarding ICTs and the Internet can play important roles in the development and implementation of many of these sustainability wedges — particularly those related to scientific and technological innovation, dematerialization, education and awareness, and governance reform. From a sustainable development perspective, the basic questions that therefore need to be asked about the relationship between ICTs, the Internet and sustainable development are the following:

- What are the current impacts of ICTs and the Internet on the different dimensions of human well-being — positive, neutral, and negative?
- What policies are needed to optimize their impact and ensure that the resulting benefits are fairly distributed, taking into account the needs of future generations?
- What processes are needed to develop and implement these policies?

These are not the kinds of questions information society policy makers have typically put at the centre of their research agendas. As MacLean and St. Arnaud (2008) point out, the sustainable development world view captured in these figures differs in important ways from the information society world view, which tends to see the world as a place where the physical constraints of time and space are being diminished by high-capacity, multi-media, real-time, any place communications, and which is filled with exponentially increasing opportunities — founded on Moore's and Metcalfe's Laws — for humans to learn, communicate, create, participate, and innovate for purposes ranging from personal growth, to entertainment and social interaction, to economic and social development. In contrast to the physically limited world currently at the centre of the sustainable development policy perspective, the world as seen by the information society policy community appears to be an expanding universe of merging physical and virtual realities. MacLean, Andjelkovic and Vetter (2007) compares and contrasts the views of the two communities on five key issues central to both their policy agendas.

The touchstones guiding information society policy-makers are values such as universal education, freedom of opinion and expression, and the greatest possible freedom to access, share and use information and knowledge that is consistent with respect for personal privacy and the rights of others. There is an assumption underlying information society policy that progress towards these goals is essential for achieving the kinds of improvements in human well-being that are the goals of sustainable development policy. There is clear evidence to support this assumption in relation to the goals of economic growth and social development. However, there is also clear evidence that this progress has come at an unsustainable environmental cost. Given the physical requirements and limitations of human life on earth, this evidence suggests that although economic growth and social development are necessary conditions for human wellbeing, they are not sufficient in the absence of environmental sustainability. From this perspective, it is therefore essential to ask what modifications need to be made to current information society policy frameworks and governance processes, so that they more effectively support environmentally sustainable human development.

A Framework for Connecting Information Society and Sustainable Development Policy Perspectives

The aim of this section is to set out a framework that connects information society and sustainable development policy perspectives by building on work done by IISD and others over the previous decade. This framework has four components.

1. The basic building block of the framework is the distinction between the first, second, and third order effects of ICTs on sustainable development. This distinction was made in EITO (2002) and variants have been widely used in subsequent policy research and analysis, particularly on the relationship between ICTs and climate change (Hilty 2008; Madden and Weissbrod 2008; Mallon et al. 2008; Pamlin and Szomolanyi 2008; The Climate Group 2008; WWF-Canada 2008). Recently, it has been adopted by the OECD as a framework notion in its policy recommendations on ICTs and the environment (OECD 2010 a). The distinction between first, second, and third order effects incorporates important subsidiary distinctions with respect to scope, time and certainty. First order effects include the direct effects of the production of ICT goods and services on sustainable development, which tend to be short-term and relatively well understood. Second order effects include the indirect effects on sustainable development resulting from the application and use of ICTs throughout the economy and society, which tend to be medium term and have some degree of uncertainty. Third order effects include the systemic transformations ICTs enable in economic and social structures, cultural values, individual behaviour, and governance processes, all of which tend to be longer term and have high degrees of uncertainty. While there is a dependence relationship between the first and second, and second and third, order effects, all of them will be developing simultaneously. So while first order effects are easier to understand and quantify, that does not imply that second third order effects are absent. Indeed, given their more pervasive nature, and the greater difficulty of quantifying them, research on the second and third order effects is probably both more important and more difficult than research on first order impacts. This point will be taken up in the final section of this paper, on research agenda issues.

2. The second building block of the framework is the distinction between three classes of actors that are both affected by and effect the direct, indirect and systemic impacts of ICTs on sustainable development — individuals, economic and social structures, and the physical and virtual communities that provide links between them, and which are viewed by both the information society and sustainable development policy communities as important agents of change within their respective frames of reference (Willard 2009).

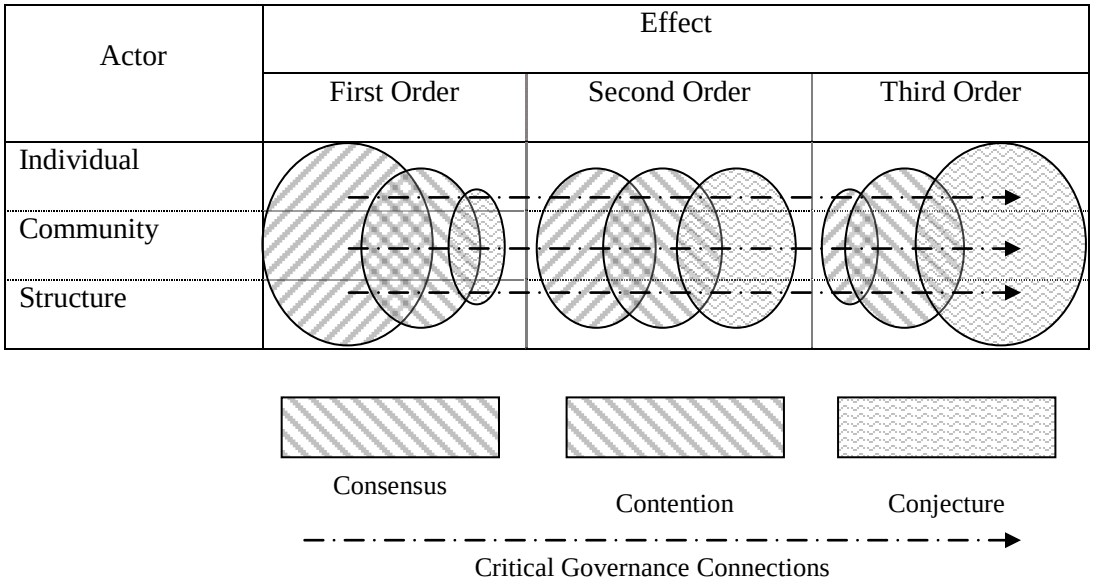
3. The third building block of the framework is the distinction between three classes of policy issues — those on which there is consensus, those where there is contention, and those that are subjects of conjecture. As in the case of first, second and third order effects, this distinction between classes of

policy issues incorporates important subsidiary distinctions with respect to scope, time and certainty. Issues on which there is consensus tend to be clearly enough defined in scope and time, well enough known and understood, and sufficiently valued by stakeholders to allow policy to be made with relative confidence. Issues where there is contention tend to exhibit significant degrees of uncertainty regarding definition, knowledge, understanding and stakeholder evaluation. Issues that are subjects of conjecture tend to exhibit high degrees of uncertainty on these dimensions.

4. The fourth building block is the notion that critical governance connections link together the short-, medium- and longer-term consequences of policy decisions made (or not made) with respect to the first, second and third order effects of ICTs on sustainable development. From a sustainable development perspective, this notion is meant to suggest that there is an "arrow of time" in the relationship between ICTs and sustainable development, and that the "precautionary principle" should be incorporated in information society policy-making. From an information society perspective, it is also meant to suggest that "code is law", and that decisions made about ICT and the "reconfiguration of access" they enable have long-term economic and social consequences that should be considered in the policy-making process.

The framework resulting from the combination of these four building blocks is displayed in the following figure.

Figure 2



The remaining parts of this section illustrate the application of this framework to analyse the relationship between ICTs and sustainable development, as well as its use to identify issues that are particularly relevant to Internet policy and governance. This is done by using the framework to summarize the results of research on the first, second, and third order relationships between ICTs and the environment, with particular emphasis on the role of ICTs in contributing to climate change by generating GHG emissions in their production, use and disposal, as well as their potential role in mitigating climate change by enabling reductions in GHG emissions throughout the economy and society.

It is useful to apply the framework to analyse the relationship between ICTs and the environment, with a particular focus on climate change, for a number of reasons. It is the area in which the most thorough research has been done on the relationship between ICTs and sustainable development. The results of research on this relationship can be leveraged in many other areas of information society and sustainable development policy because of the global, but locally differentiated, effects of climate change on the relationship between all the major human and natural systems.

Systematic analysis of the relationship between ICTs, the environment and climate change is also an area that highlights the potential role of the Internet in enabling systemic transformations, as well as the policy and governance issues that must be resolved to optimize this role. The final part to this section applies the framework's notion of critical governance connections to summarize the results of a scenario-building exercise undertaken as part of IISD's IGSD project, to illustrate the cascading consequences of policy decisions made with respect to first, second, and third order effects, and the difficulties involved in designing framework policies for areas of significant longer-term uncertainty.

First Order Effects

From a full life cycle perspective, there is consensus that the production, use, and disposal of ICT goods, and the production and consumption of ICT services and ICT-based applications and content have significant, negative environmental impacts, and that policies are needed to mitigate these impacts.

Initially policy-makers' attention focused on the amount of e-waste generated by the short life cycles of ICT goods, the toxic materials used in their production, and the environmental and human health hazards related to their recycling and disposal, particularly in developing countries. More recently, attention has turned to the volume of carbon dioxide emitted as a result of the amount of non-renewable energy used in the production, distribution and use of ICT goods, and in the production of ICT services, applications and content in business and consumer markets, in research and education, and in the public sector. Studies have estimated that ICTs generate 2% of global CO^2 equivalent emissions, that the volume is increasing at the rate of 6% a year, and will almost triple between 2002 and 2020. (The Climate Group 2008) The energy consumed and the GHG emitted by the server farms that power Internet services have become subjects of particular concern.

There is consensus that standards should be set to improve the energy efficiency of ICT goods and services throughout product life cycles (ITU 2009). There is growing interest in the use of renewable energy sources and new network architectures, such as cloud computing, to mitigate the energy requirements of ICT infrastructure and the GHG emitted as a result of the production and use of ICT products and services. Beyond these industry-led initiatives, however, there is at present very little discussion of the kinds of policies that are needed to encourage the continuing growth of the ICT sector, while mitigating its negative environmental effects. Policy options could include mandatory standards, incentives, regulation, and public procurement — or a mix of some or all these elements.

Although there is at present little structured discussion of the public policies that are needed to optimize the direct effects of the ICT sector, there is some amount of contention surrounding a number of Internet policy and governance issues that have significant implications for the environmental dimension of sustainable development in the medium- to longer-term. These issues include transition from the IPv4 to the IPv6 system for assigning numerical addresses to devices connected to the Internet; complements and alternatives to the current domain name system for assigning identities to these numerical addresses; the future evolution of the basic protocols and standards underlying the Internet; and the fundamental question of whether the Internet needs to be redesigned from the ground up to accommodate future networking requirements.

These issues have significant environmental implications in the context of a widely-shared vision of a technological future in which intelligent devices will be distributed throughout human, artificial and natural environments, at scales ranging from nano- to inter-planetary, and connected through ubiquitous networks that include networks of things as well as networks of people. Realizing this vision would require the Internet of the future to be able to connect and communicate information among unimaginably large numbers of devices, including devices embedded in the natural environment. The short- to medium-term decisions made with respect to issues such as the transition from IPv4 to IPv6, the development of intelligent sensor networks and RFID technologies, and new networking architectures such as cloud computing are likely to have significant longer-term implications for environmental sustainability.

Second Order Effects

In contrast to the generally negative view in the literature of the direct effects of ICTs on the environment, there is consensus that second order effects resulting from the application and use of ICTs throughout the economy and society have been largely positive.

In one of the first systematic analyses undertaken of the relationship between ICTs and sustainable development, Willard and Halder (2003) identified five categories of benefit: environmental information systems; eco-efficiency and innovation; modifying consumer demand and values; access to information and public participation; and poverty reduction. Subsequent research has focused mainly on the first two categories, where there has been the strongest interest in assessing and the clearest evidence for the actual and potential positive impacts of ICTs on environmental sustainability, particularly in relation to issues associated with climate change.

Thus, for example, ICTs provide tools that enable scientists to develop models of complex environmental systems and their interaction with human systems, of the kind that underlie the work of the Intergovernmental Panel on Climate Change (IPCC). For the past several decades, ICTs have been used to improve the energy and material efficiency of production processes in the private and public sectors. Attention is currently focused on the environmental benefits expected from the development of "smart" energy grids, transportation systems, buildings, and motors. It has been estimated that the development of smart systems in these four areas could reduce global CO^2 equivalent emissions by 15% under a BAU scenario by 2020, using 2002 as a baseline year (The Climate Group 2008).

As well as having a significantly positive impact in these four areas, there is consensus in the literature that ICTs can have a number of other positive impacts resulting from "dematerialization" — the whole or partial substitution of digital products and services for their physical equivalents throughout the private, public, and not-for-profit sectors, as well as the whole or partial substitution of virtual activities, structures, and processes for their physical equivalents in all these areas. Globally, it has been estimated that the various forms of dematerialization enabled by the introduction of smart energy, transportation, building, and motor systems could account for 6% of the total GHG emission reductions enabled by these technologies by 2020, or close to 1% of total GHG emissions under a BAU scenario (The Climate Group 2008).

Other studies done at the regional and national levels in the developed world have also generated estimates of significant environmental benefits resulting from dematerialization. However, there is also consensus that it is very difficult to estimate potential benefits because of the complex questions involved in dematerializing products, services, activities, structures and processes. Most of the studies done to date have relied on "what if" assumptions based on extrapolations from available literature about human and organizational behaviour and on expert opinion, rather than on direct empirical data.

At a more general level, Erdmann et al. (2004), which used a sophisticated research design that combined qualitative and quantitative modeling techniques, produced widely varying estimates of impacts ICTs would have on energy, transportation and waste management indicators in Europe by 2020. The study concluded that "as a great deal of uncertainty still exists, further research is necessary for a fuller understanding of the role of ICTs in meeting environmental policy goals."

Among the principal causes of uncertainty identified in the literature are rebound effects that result in increased consumption of goods and services as production efficiency increases unless measures are taken to constrain demand or supply — so that the development of smart grids and transportation systems could result in increased consumption of energy and transportation goods and services, in the absence of price constraints, supply management, regulation of use, or self-restraint on the part of consumers. However, the literature on ICTs and the environment has not systematically identified or analyzed other factors of uncertainty that may affect human capacities to reduce unsustainable consumption of ecological goods and services, or to adopt significantly dematerialized ways of working and living. Among the factors yet to be systematically examined are uncertainties surrounding the potential role of the Internet in supporting environmental sustainability, and the substantive policies and governance practices needed to optimize its role.

Third Order Effects and Critical Governance Connections

In 2008-09, IISD undertook a project to investigate the potential third order effects of the Internet on sustainable development, broadly defined to include its economic, social and environmental dimensions. The project used a methodology based on scenarios originally developed by the Global Scenarios Group (GSG) to assist public and private policy-makers in forecasting the future consequences for sustainable development of present policy options, in light of forecast technological, economic, social and geopolitical trends (Raskin et al. 2002). Four of GSG's suite of six scenarios were used in the project. They were chosen because they most closely matched the policy and governance paradigms that have shaped the evolution of ICTs and the Internet over the past three decades.[7]

Since previous work by GSG and other organizations that use futures forecasting and scenario-building as strategic planning tools had not included systematic analysis of the relationship between alternative Internet policy and governance choices, forecast trends, and the sustainability of outcomes, IISD identified a set of critical uncertainties related to the Internet's first and second order effects that were likely to significantly influence the sustainability of outcomes under different policy and governance scenarios. These uncertainties included policy and governance issues related to the scalability of the current Internet architecture, management of critical Internet resources, management of Internet's ecological footprint, universal access to infrastructure, user freedom of choice, security, intellectual property rights, and regulatory frameworks (Andjelkovic, Vetter and Creech 2008).

[7] See MacLean (2010) for an account of the policy and governance paradigms that have shaped the evolution of ICTs and the Internet in recent decades.

In the project, four scenario-building workshops were undertaken at different times and in different locales with groups of participants invited from four distinct constituencies — Canadian government policy advisors and industry representatives (Ottawa, October 2008); international Internet governance experts (Hyderabad. IGF workshop, December 2008); young people from developing countries (Hyderabad, Diplo Foundation workshop, December 2008); and a broad cross-section of Canadian Internet policy stakeholders (Vancouver, March 2009). Each group was asked to develop scenarios about how critical Internet policy and governance issues would be resolved and what the consequences would be for the future of the Internet and sustainable development, under policy frameworks that respectively emphasized unregulated market forces in a globalized world; government regulation of market forces in a world where nation states still count; security-centred regulation in a fragmented world; and a commons approach to multi-stakeholder regulation in a universalized world.

As reported in Creech et al. (2008), in spite of the differences among participants in the four groups, all came to similar conclusions — that alternatives are needed to the policy frameworks that have contended in national and international Internet governance fora for the past 10-15 years, since none of the existing paradigms in and of itself is likely to lead to economic, social and environmental outcomes that are sustainable in the long term. There was a clear sense in all the groups that advancement of the fundamental goals of information society policy, of the kind discussed earlier in the introduction to this paper, are integral to sustainable development and should be given greater recognition in the frameworks devised by sustainable development policy-makers. Although the project did not have resources to more systematically analyze the relationship between Internet policy choices and sustainable development outcomes, it did illuminate the importance of identifying and analyzing the critical governance connections that chain together the Internet's first, second, and third order effects on sustainable development over time — for better or for worse — by looking at how first order choices about Internet architecture and resources shape second order choices about access and use, which in turn shape third order choices about sustainability wedges.

The results of the scenario-building project illustrate the difficulty of applying a methodology that has been effective in analyzing the long term consequences of alternative policy choices with respect to issues that have relatively well defined physical parameters, on which there is an abundance of data, and where there are generally agreed techniques for modeling and analysis (e.g. the use of scenarios methodologies by the IPCC) to the much fuzzier set of problems posed by the relationship between ICTs, the Internet and sustainable development, an area where data is lacking and there are at present no generally

accepted techniques for modeling the interaction between economic, social and environmental variables, or analyzing the likely consequences of different policy options.

As a result of the scenario-building exercises — particularly the results of the March 2009 Vancouver consultations reported in Vetter, MacLean, and Creech (2009) — a new project is being developed to further multi-stakeholder dialogue of the kind that took place during the scenarios workshops, possibly through establishment of a Canadian Internet policy forum modeled on the global Internet Governance Forum. This result suggests that in conditions of policy complexity and uncertainty of the kind that surround questions about the longer-term relationship between the Internet and sustainable development, new approaches are needed to policy research and policy-making processes, in addition to better information on issues and options.

Although there has been growing interest among Internet policy-makers in recent years in innovative governance arrangements, particularly those involving multi-stakeholder cooperation, there has as yet been very little systematic analysis of the kinds of approaches that are likely to be most effective, particularly in conditions of uncertainty characterized by significant degrees of contention or conjecture. The next section describes the results of a multi-year research project undertaken by IISD in concert with other organizations to address this knowledge gap, and assesses the applicability of the policy-making toolkit developed by the project to some of the main uncertainties that characterize the relationship between Internet policy and governance and sustainable development.

Assessing the Results of the IISD Adaptive Policy-Making Project

The Adaptive Policy Project[8] that was undertaken by IISD and TERI, with the support of IDRC, started with the realization that public policy today is made in conditions of great uncertainties. From the future of the global economy to the evolution of technology to trends in local weather patterns, we really don't know what next year (let alone the next decade) will bring. But nevertheless, public policy must be made, in order to respond to important issues. The result is that many policy instruments do not accomplish their goals, or even obstruct the achievement of the goals they were designed to reach. There is another, more

[8] In the field of climate change research and policy making, 'adaptation" refers to policy that deals with the effects of climate change, like floods or droughts. Thus in a climate change context, "adaptive policy making" has a much narrower meaning than the use here, where the discussion is about adapting any kind of policy to any kind of uncertainty or unexpected change, not just those due to climate change.

subtle impact – policy log jam. Elected officials are understandably reluctant to commit to the implementation of policy tools where the outcome is not clear – voters like to understand the impacts of a new policy, and "I'm not precisely sure" is not a very satisfactory response. As a result, new policy instruments may not be implemented. However, the use of some of the adaptive policy design tools may help overcome these barriers be providing a structured way to deal with unexpected events or policy impacts.

The project did not invent new policy tools, but rather used a case study and interview approach to find tools that had worked well in various circumstances.[9] The contribution of the ADP is to bring these tools together in the context of policy making under uncertainty, and highlighting the need for policy designers to take these issues into account as policies are amended or designed anew.

The Internet governance community is faced with high degrees of uncertainty, and it does not have the luxury of put off policy decisions until things are clearer. The application of the tools discussed below may assist both in reducing the uncertainties and in the implementation of policies that will respond well to unforeseen circumstances.

Research undertaken for the ADP project suggested that there are four sorts of activities that the policy designer should undertake, and identified seven tools that are available to help with them.[10]

Adaptive Policy Activities

1. *Understand the policy environment* – Firstly this means clearly understanding the intended goals of the policy that is being amended or designed, because without this many of the tools discussed below will not be able to be implemented. Understanding the policy environment also requires an appreciation of the key factors affecting performance and their application, and the expected future development of the key factors. With these in hand, the designer can develop policy options that will meet the goals of the policy. The designer can also devise indicators of success in meeting the goals of the policy, which will be important for some of the tools described below. The tools of *Integrated and Forward Looking*

[9] The book reporting on the results of the project can be downloaded from: http://idrc.ca/en/ev-145152-201-1-DO_TOPIC.html

[10] This discussion draws on Barg and Tyler (2010)

Analysis and *Multi-Stakeholder Deliberation* will both be useful in understanding the policy environment

2. *Enable innovation* – Innovative policy instruments can provide useful inputs to a policy designer's development process, both through the new approaches they might excite and through the evidence they provide as to success factors. With appropriate design, innovation can be encouraged, giving the policy designer new examples to work with, as well as supporting the development of multiple solutions to policy challenges. This can be done through tools such as *Decentralization of Decision Making*, *Self Organization and Social Networking*, and *Variation*.

3. *Monitor* – The policy designer must also monitor the results of the implemented policies, for two reasons – to ensure that the policy is doing what it was designed to do, and to see when circumstances have changed enough so that the policy needs changing in order to meet its goals. Indeed, sometimes circumstances can change enough that the goals themselves are no longer valid. Stakeholder feedback and new information on emerging issues will also provide input to a monitoring process. The tools *Automatic Adjustment* and *Formal Policy Review and Continuous Learning* are very relevant in monitoring.

4. *Improve* – As both the policy environment and knowledge of a policy's operation both evolve over time, the policy designer must use the warnings and opportunities provided to make necessary adjustments to ensure performance.

Adaptive Policy Tools

Integrated and Forward Looking Analysis, also known as scenario planning, helps identify key factors that affect policy performance and also identify scenarios for how these factors might evolve in the future.[11] This helps the policy designer develop policies that are robust to a range of anticipated conditions, and indicators can be developed to help trigger important policy adjustments when needed. The process needs to be rigorous and to maintain internal consistency – thus it can be time consuming. It also needs good information about future possibilities so that scenario development will be firmly based.

[11] These sections on the adaptive policy tools draw on the appropriate chapters in Swanson and Bhadwal (eds), 2009

As discussed earlier, scenario-building techniques of the kind developed by energy and environmental policy-makers may not be directly applicable to Internet policy-making, principally because of issues related to quantification and modelling of critical uncertainties. However, the interim results of the European Commission's "Towards a Future Internet" project, which incorporate foresight techniques that include qualitative scenario-building, suggest the benefits of incorporating these kinds of tools in Internet policy-making.[12]

Multi-Stakeholder Deliberation is a collective and collaborative public effort to examine an issue from different points of view prior to taking a decision. This inclusiveness makes it more likely that divergent future possibilities will be considered, compared to the circumstance in which a narrower group of policy design professionals is involved. Deliberative processes strengthen policy design by building recognition of common values, shared commitment and emerging issues, and by providing a comprehensive understanding of causal relationships. In the process, participation is voluntary. Skilled facilitators are used to ensure that proper processes are followed and that viewpoints are fully aired and have an effect on the outcome of the deliberative process.

This tool has been used in a variety of ways to address issues of Internet governance at both national and international levels. The work of the UN Internet Governance Forum has drawn particular attention as an innovative experiment in multi-stakeholder deliberation. So far, however, the IGF's deliberations have been largely confined to the Internet technical and policy community. In a forthcoming proposal to the 2010 Vilnius IGF, IISD will suggest that extending the participant group to include the broader sustainable development community would add value to its deliberations.

Decentralization of Decision Making to the lowest effective and accountable unit of governance, whether existing or newly created, can increase the capacity of a policy to perform successfully when confronted with unforeseen events. This is because a local decision making structure has a direct feedback loop to local issues, which allows it both to react more quickly and to be creative in developing successful policies. If decentralization is to be successful, the decentralized body needs good linkages both to its local stakeholders and to the senior levels of government to which it must report. It will also need appropriate resources to carry out its mandate. When decentralization works well, there will be multiple decision making bodies each developing its own policy solutions to similar problems. The decision making bodies can learn from each other about successes

[12] See http://www.internetfutures.eu/ for an overview of the Towards a Future Internet project and access to its Interim Report.

and failures, and the policy designer at senior levels can use the lessons from their collective experience to address other design issues.

Decentralized decision making has been a hallmark of Internet governance from the beginning, and has resulted in an extremely complex governance landscape that includes private, public, and civil society actors as well as multi-stakeholder fora and partnerships. (MacLean 2004; Souter 2010). There is another aspect of decentralization that was not dealt with in detail in the public-policy oriented ADP – decision making by the private sector. Much of Internet governance has been undertaken by companies and other non-government actors. Indeed, internet governance may be the most salient example of an important economic sector globally, with important social implications, and largely non-government decision making processes.

Self Organization and Social Networking describes a natural tendency among people who share a community of interests and challenges. This can enable the group to develop innovative solutions to common problems. Because this self organization is, by definition, not a part of public policy, the policy maker can only facilitate it, or at least not discourage it, but public policy cannot mandate it. Glouberman et al. (2003), in developing a toolbox for improving health in cities, recognized that complex adaptive systems "often spontaneously generate solutions to problems without external input or formally organized interventions. This self-organizing capacity is a free good that can be valuable in producing innovative and novel approaches to problems."

The evolution of Internet governance is a very significant example of self organization, and the efforts to allow and encourage self organization rather than have organization imposed by public policy present an interesting case study in policy evolution.

Variation – Just as with a financial portfolio, policy remedies benefit from a diversified portfolio approach. For important policy goals, it is common that several instruments are applied. For example, in many countries technological innovation is promoted through research grants, tax treatments, patent policy, support for universities, etc. The policy design challenge is to ensure that the instruments act in concert, not in opposition, which implies that the setting of goals is a critical step in the design process. Another aspect of variation is the development of an enabling environment so that variation can occur. In essence, this is a generalization of the kind of result that decentralization is intended to accomplish, but in a much more open way.

The hands-off policy approach taken by developed country governments in the 1990s when Internet use began to grow very rapidly, and the emphasis

subsequently placed on creating enabling environments for e-commerce and Internet-based innovation, recognized that the benefits flowing from the economic, social and cultural variation made possible by Internet self-regulation would not have been realized by traditional communication governance mechanisms. The approach of maximizing the space available for innovation remains a cornerstone of Internet policy, even as governments have become more engaged in dealing with the less desirable forms of Internet-enabled variation.

Automatic Adjustment features can be built into a policy when the policy environment is well enough understood to allow an advance design to be built into the policy. For example, consider a hydropower development in the face of increasing drought potential caused by climate change. A risk management strategy in such a case might be to diversify the power supply by developing a source that is uncorrelated with the drought risk. Development of wind power could be a robust policy under such anticipated future conditions. It is an example of something that can be done now that would help the power supply system perform successfully in a range of anticipated future climatic conditions.

Regulatory proceedings about Internet traffic-shaping — the practice adopted by some Internet service providers of prioritizing some kinds of traffic and slowing down others when their networks become congested — have begun to clarify some of the complex questions surrounding the issue of "net neutrality" by designing policy frameworks governing the terms and conditions under which ISPs can make automatic adjustments to the services they provide.

Formal Policy Review and Continuous Learning is the most powerful tool in dealing with the truly unanticipated situation. While the other tools can provide better anticipation, or better sets of examples to draw from, when the really unanticipated happens, prior policy designs will no longer work as planned. The only solution then is to revisit the policy in light of the new circumstances, and apply the policy design tools in a redesign exercise. Of course, *ad hoc* policy review is always taking place. If policies don't work, ministers or newspapers get letters of complaint, or departmental staff bring problems to the attention of the government. But there is great value in building in a formal review process that will have as one of its goals the discovery and treatment of problems before they become political issues.

Formal reviews can be triggered by the passage of time (say, every two years), or by predefined values of the indicators of success discussed above. The review needs to consider whether the goals that the policy is intended to achieve need to be revised in the light of new circumstances, and whether the policy

instruments applied are still working well. The review will need both technical expertise and stakeholder input to ensure that it is comprehensive.

In the field of Internet governance, the process that led to the creation of the Internet Corporation for Names and Numbers (ICANN) and the periodic reviews of its relationship to the U.S. Department of Commerce are perhaps the most notable examples of the use of formal policy review tools.

As the foregoing summary of the ADP's main findings and the Internet examples suggest, a broader survey would demonstrate that all of the activities and tools identified by the project can be found in the Internet governance domain. However, it would also likely suggest that the principles and tools of adaptive-policy making have rarely, if ever, been systematically applied to design and implement Internet policy, either at a general level or with respect to specific issues. Thus, for example, the IGF has provided a forum for multi-stakeholder deliberation on a number of critical global Internet policy issues, but without systematic benefit of integrated, forward-looking analysis, and without effective means either for influencing the decentralized decision-making that characterizes Internet governance, or for connecting with other policy domains that are significantly affected by Internet policy-making.

To strengthen the connections between Internet policy and the goals of sustainable development, it would neither be necessary, nor desirable, nor possible to attempt to fully systematize the application of adaptive policy-making principles and tools to issues touching the relationship between the Internet and the pursuit of human well-being in general, or to specific questions about the relationship between Internet, economy, society and environment. However, the results of the ADP project suggest that it would be fruitful to apply these principles and tools, at least on an experimental basis, to the central policy uncertainties surrounding the first, second and third order effects of the Internet on sustainable development, and to the critical governance connections that link them together.

Conclusions and Recommendations Regarding the Internet Policy Research Agenda

Over the past decade there has been increasing interest among policy-makers and stakeholders in the direct impact of the Internet on the environment as well as in its potential to support sustainable development in the medium- to longer-term — particularly by enabling significant changes in patterns of production and consumption; economic and social organization; and individual values and

behaviour. However, there has been relatively little research done on issues related to these longer-term effects. Although there is growing evidence of the Internet's transformative impacts in a number of fields, the policies and practices required to realize the Internet's potential to support sustainable development most efficiently, effectively, equitably and inclusively remain subject to contention and conjecture, and surrounded by significant degrees of uncertainty.

The research results presented in this paper suggest that to begin dispelling the uncertainties surrounding the relationship between the Internet and sustainable development, the Internet policy research agenda should be expanded to include issues of policy and practice that emerge when a sustainable development perspective is used to frame critical Internet policy and governance issues. The following items should be part of this expanded agenda.

1. To provide a solid foundation for work on the relationship between the Internet and sustainable development, it would be useful to further the work begun in this paper — which has focused on the relationship between the Internet and the environment — to consolidate and assess relevant policy research on the relationship between the Internet and other dimensions of sustainable development policy. These additional dimensions would include economic, social, cultural, science and technology, and governance issues. This work could start with case studies of the evolution of actual policy to date, in a variety of social, economic and environmental circumstances, to see what general lessons can be learned and to form the basis for the development of theoretical frameworks.

2. To begin dispelling the critical uncertainties surrounding the second and third order effects of the Internet, a variety of methodologies (e.g. case studies, survey research, expert panels, systems analysis) could be applied to gain a better understanding of rebound effects and other factors affecting second and third order effects, and to identify and analyze policy options for dealing with unintended consequences and other forms of uncertainty. To support this, there is a need for *data* on:

    2.1 the impact of the Internet on the values, attitudes and behaviour of individuals with respect to sustainable development — one possible research strategy would be to begin to add relevant questions to the surveys conducted under the aegis of the World Internet Project;[13]

[13] See http://www.worldinternetproject.net/

2.2 the impact of the Internet on the relationship between economic and social structures and sustainable development — one possible research strategy would be to add this relationship to the research agenda of the OII's Global Network of Societies project.[14]

3. To begin to understand critical policy connections between first, second, and third order effects and the governance processes needed to manage them, there is a need for *case studies* on emerging sources of systemic transformation that may have major implications for the relationship between the Internet and sustainable development. Research areas could include:

3.1 the impact of the Internet, in particular through social networks, on communities and their role as intermediaries between individuals and economic, social and governance structures in relation to sustainable development — possible research strategies include building on work done by IISD on social networking and networked governance for sustainable development and adding this dimension to the OII's Fifth Estate project;[15]

3.2 the impact of the linkage and interpenetration of the human and natural environments that is occurring as a result of the development of environmental information systems, the "Internet of things", nanotechnologies and biotechnologies — one possible research strategy would be to add this question to the agenda of the Institute for Science, Innovation and Society.[16]

4. The information and analysis resulting from the foregoing inquiries into the second and third order effects of the Internet could be used to support two significant policy-making interventions:

4.1 a top-down project aimed at fundamentally re-thinking the relationship between the information society and sustainable development policy paradigms — key research objectives could include gaining a better understanding of the physical constraints bounding the information society at the levels of individuals, communities, and institutions, as well as the role of the Internet in the evolution of the relationship between economy, society and environment;

[14] See http://www.oii.ox.ac.uk/research/?id=46
[15] See http://www.oii.ox.ac.uk/research/?id=57 and http://www.iisd.org/networks/
[16] See http://www.sbs.ox.ac.uk/centres/insis/Pages/default.aspx

4.2 a bottom-up project aimed at applying adaptive policy-making tools to design and implement policies in areas where policy contention and critical uncertainties impede or sub-optimize the Internet's potential for improving human well-being.

References

Andjelkovic, Maja, Tony Vetter and Heather Creech. 2008. *Critical Internet Uncertainties: How will governance, evolution and growth of the Internet affect sustainable development?* Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2008/critical_internet.pdf

Barg, Stephan and Stephen Tyler. 2009. "Insights into Implementing Adaptive Policies". In *Creating Adaptive Policies: A Guide for Policy-making in an Uncertain World.* SAGE/IDRC. Available at http://idrc.ca/en/ev-147104-201-1-DO_TOPIC.html

Creech, Heather, Maja Andjelkovic, Tony Vetter, Don MacLean, Dale Rothman and Philip J. Vergraft. 2009. Mapping the Future of the Internet onto Global Scenarios: A preliminary view. Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2008/internet_global_scenarios.pdf

Erdmann, Lorenz, Lorenz Hilty, John Goodman, and Peter Arnfalk. 2004. *The Future Impact of ICTs on Environmental Sustainability*. Seville: European Commission Joint Research Centre Institute for Prospective Technological Studies. Available at http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1208

European Information Technology Observatory (EITO). 2002. "The impact of ICT on sustainable development". In *European Information Technology Observatory Yearbook 2002,* pp. 250-283. Available at http://homepage.cs.latrobe.edu.au/sloke/greenIT/eito_forum_2002.pdf

Glouberman, Sholom, Phillippa Campsie, Michael Gemar, and Glen Miller. 2003. *A toolbox for improving health in cities*. Ottawa, Canada: Caledon Institute for Social Policy. Available at http://www.caledoninst.org/Publications/PDF/553820363.pdf

Hilty, Lorenz. 2008. *Information Technology and Sustainability: Essays on the Relationship between ICT and Sustainable Development*. Norderstedt: Books on Demand GmbH.

International Institute for Sustainable Development (IISD). 2010. *The Digital Economy and the Green Economy: Opportunities for strategic synergies*. A submission to the Government of Canada Digital Economy Consultation. Available at http://www.iisd.org/pdf/2010/com_digital_economy.pdf

International Telecommunication Union (ITU). 2008. *ICTs for e-Environment: Guidelines for Developing Countries with a Focus on Climate Change*. Geneva: ITU. Available at http://www.itu.int/ITU-D/cyb/app/docs/itu-icts-for-e-environment.pdf

ITU. 2009. *ICT and Climate Change: Conclusions of the ITU-T Focus Group*. Geneva: ITU. Available at http://www.itu.int/dms_pub/itu-t/oth/0B/11/T0B1100000083301PDFE.pdf

MacLean, Don. 2004. *Herding Schrödinger's Cats: Some Conceptual Tools for Thinking About Internet Governance*. A background paper prepared for the ITU Workshop on Internet Governance, Geneva, 26-7 February, 2004. Available at http://www.itu.int/osg/spu/forum/intgov04/contributions/itu-workshop-feb-04-internet-governance-background.pdf

MacLean, Don, Maja Andjelkovic, and Tony Vetter. 2007. *Internet Governance and Sustainable Development: Towards a Common Agenda*. Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2007/igsd_common_agenda.pdf

MacLean, Don and Bill St. Arnaud. 2008. *ICTs, Innovation and the Challenge of Climate Change*. Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2008/ict_innovation_climate.pdf

MacLean, Don. 2010. "The Evolution of GMCP Institutions." In *The Handbook of Global Media and Communications Policy*, eds. Robin Mansell and Marc Raboy. Oxford: Blackwell. Forthcoming.

Madden, Peter and Ilka Weissbrod. 2008. *Connected: ICT and sustainable development*. London: Forum for the Future. Available at http://www.forumforthefuture.org/files/Connected.pdf

Mallon, Karl, Gareth Johnston, Donovan Burton, and Jeremy Kavanagh. 2008. *Towards a High-Bandwidth, Low Carbon Future: Telecommunications-based Opportunities to Reduce Greenhouse Gas Emissions*. A report by Climate Risk Pty. Ltd. Available at http://www.climaterisk.com.au/wp-content/uploads/2007/CR_Telstra_ClimateReport.pdf

Millennium Ecosystem Assessment (MEA). 2005. *Ecosystems and Human Well-being: General Synthesis*. Washington, D.C.: Island Press. Available at http://www.millenniumassessment.org/documents/document.356.aspx.pdf

Organization for Economic Cooperation and Development. (OECD). 2008. *Seoul Declaration on the Future of the Internet Economy*. OECD Ministerial Meeting on the Future of the Internet Economy, 17-18 June 2008. Available at http://www.oecd.org/dataoecd/49/28/40839436.pdf

OECD. 2009a. *Towards Green ICT Strategies: Assessing Policies and Programmes on ICT and the Environment*. Available at http://www.oecd.org/dataoecd/47/12/42825130.pdf

OECD. 2009b. *Declaration on Green Growth*. Meeting of the Council at the Ministerial Level, 24-25 June 2009. Available at http://www.oecd.org/dataoecd/58/34/44077822.pdf

OECD. 2009c. *The impact of the crisis on ICTs and their role in the recovery*. Available at http://www.oecd.org/dataoecd/33/20/43404360.pdf

OECD. 2010a. *Recommendation of the Council on Information and Communication Technologies and the Environment.* Available at http://webnet.oecd.org/oecdacts/Instruments/ShowInstrumentView.aspx?InstrumentID=259&InstrumentPID=259&Lang=en

OECD. 2010b. *Innovation to strengthen growth and address global and social challenges: key findings*. Ministerial Report on the OECD Innovation Strategy. Available at http://www.oecd.org/dataoecd/51/28/45326349.pdf

OECD. 2010c. *Interim Report of the Green Growth Strategy: Implementing our commitment to a sustainable future*. Meeting of the OECD Council at the Ministerial Level, 27-28 May 2010. Available at http://www.oecd.org/dataoecd/42/46/45312720.pdf

Pamlin, Dennis, ed. 2002. *Sustainability at the Speed of Light*. WWF Sweden. Available at http://assets.panda.org/downloads/wwf_ic_1.pdf

Pamlin, Dennis and Katalin Szomolanyi. 2008. *Saving the climate @ the speed of light*. A report prepared for the European Telecommunications Network Operators Association (ETNO) and the World Wide Fund for Nature (WWF). Available at http://www.etno.be/Portals/34/ETNO%20Documents/Sustainability/Climate%20Change%20Road%20Map.pdf

Raskin, Paul, Tariq Banuri, Gilberto Galapin, Pablo Gutman, Al Hammond, Robert Kates, Rob Swart. 2002. *Great Transition: The Promise and Lure of the Times Ahead*. Boston: Stockholm Environment Institute. Available at http://tellus.org/documents/Great_Transition.pdf

Souter, David. 2010. *Mapping Internet Public Policy*. A presentation to the APC Symposium on Networking Networks in Internet Public Policy, Ancona, July 2010. Forthcoming.

Swanson, Darren and Suruchi Bhadwal, eds. 2009. *Creating Adaptive Policies: A Guide for Policy-Making in an Uncertain World*. New Delhi: Sage Publications India. Available at http://www.iisd.org/publications/pub.aspx?id=1180

The Climate Group. 2008. *SMART 2020: Enabling the low carbon economy in the information age*. Report on behalf of the Global e-Sustainability Initiative (GeSI). Available at http://www.smart2020.org/_assets/files/Smart2020UnitedStatesReportAddendum.pdf

United Nations Environment Program (UNEP). 2008. *The Green Economy Initiative*. Available at http://www.unep.org/greeneconomy/LinkClick.aspx?fileticket=rN_rwy1dDW4%3d&tabid=1370&language=en-US

UNEP. 2010. *Green Economy Report: A Preview*. Available at http://www.unep.ch/etb/publications/Green%20Economy/GER%20Preview%20v2.0.pdf

Vetter, Tony, Don MacLean and Heather Creech. 2009. *Projecting the Evolution of the Internet, its Technologies, Communities and Management: Canadian stakeholders' understandings and perceptions of the issues*. Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2009/projecting_internet_evolution.pdf

Willard, Terri and Michael Halder. 2003. *The Information Society and Sustainable Development: Exploring the Linkages*. Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2003/networks_sd_exploring_linkages.pdf

Willard, Terri. 2009. *Social Networking and Governance for Sustainable Development*. Winnipeg: International Institute for Sustainable Development. Available at http://www.iisd.org/pdf/2009/social_net_gov.pdf

World Wide Fund for Nature (WWF). 2008. *Living Planet Report 2008*. Gland: WWF. Available at http://assets.panda.org/downloads/living_planet_report_2008.pdf

WWF-Canada. 2008. *Innovating toward a low-carbon Canada: using technology to transform tomorrow*. A report sponsored by Bell Canada. Available at http://www.bce.ca/data/documents/responsibility/innovating_toward_a_low_carbon_canada.pdf