

## *ICTs as Enablers of the Green Economy: A brief on Internet policy issues*

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### *A Transformative Technology*

Over the past two decades, the Internet and other information and communication technologies (ICTs) have enabled significant transformations of economic and social structures, human activities and governance processes. To a greater or lesser degree, this has happened in virtually every country and at every level of development. Policy-makers have recognized the significance and extent of these changes by speaking about the rise of the “Internet economy” and the “digital economy”—comprehensive policy visions equivalent in scope to the visions of “green growth” and “green economy” developed by organizations such as the Organisation for Economic Co-operation and Development (OECD) and the United Nations Environmental Programme (UNEP).

More than a quarter of the world’s people now use the Internet and more than two thirds have mobile phone subscriptions. Networked ICTs have helped democratize access to information, facilitate freedom of expression, enhance cooperation, extend participation, promote creativity, and fuel innovation in every area of science, technology and human life. Today, the global economy could not function without secure, reliable ICTs. Nor could the financial, transportation and energy infrastructures that underpin economic and social development. Nor could businesses in every sector. Nor, increasingly, could the governmental and public agencies that are tasked with serving the common good.

Reflecting the increasingly central role of ICTs in economies and societies, a recent study found that Internet-related consumption and expenditure is bigger than agriculture or energy and that the Internet’s total contribution to global GDP is bigger than the GDP of Spain or Canada (McKinsey Global Institute, 2011). In many countries, ICT industries grow at rates exceeding most other sectors, are magnets for talent, and motors of economic and social innovation. In some countries, a strategic policy focus on growing ICT capabilities has created new sources of comparative advantage and significantly accelerated development.

## *ICTs and the Green Economy*

The changes enabled by ICTs have brought many benefits to people everywhere. At the same time, these changes have given rise to new kinds of sustainability challenges.

- The “creative destruction” unleashed by ICT-enabled innovation has generated economic and social turbulence in both developed and developing countries by undercutting traditional economic and social structures, challenging established norms and expectations, and creating new kinds of opportunities for criminals and terrorists.
- In addition, some of the directly positive economic and social effects of ICTs have had the indirect effect of helping to reinforce development trends that are not environmentally sustainable in the longer term—for example, by increasing overall demand for non-renewable energy and material resources and facilitating their exploitation.
- As a consequence of its rapid growth, the ICT sector itself has become a major source of toxic pollution through e-waste and greenhouse gas emissions.

Over the past decade, ICT sector stakeholders and policy-makers, with the support of experts in sustainable development, have begun to identify opportunities for using ICTs to help enable the development of the green economy.

- Studies done for the Global e-Sustainability Initiative (GeSI), an ICT industry consortium, have estimated that the deployment of “smart systems” that increase the efficiency of production and consumption in the energy, transportation, building and manufacturing sectors could reduce global greenhouse gas emissions by 15 per cent by 2020, compared to a business-as-usual scenario with a 2002 baseline (The Climate Group, 2008).
- Studies done by environmental consultancies for telecommunications network operators in Europe, Australia and Canada have shown that the use of ICTs to wholly or partially “dematerialize” physical products, services and processes could result in significant reductions in energy and materials consumption, with consequent reductions in greenhouse gas emissions. Examples of low-hanging fruit include the substitution of electronic bills sent by email for paper bills sent through the post; greater use of tele-work arrangements and virtual meetings in the public and private sectors; more efficient use of personal vehicles through ICT-enabled pooling and shared ownership; and personalized public transport as an alternative to traditional commuting practices (Mallon et al., 2008; Pamlin & Szomolanyi, 2008; WWF-Canada, 2008).
- In addition to the short- to medium-term opportunities for ICTs to contribute to green growth through climate change mitigation and adaptation identified in this body of research, other studies done by interdisciplinary futures forecasting teams in Europe, North America and elsewhere have identified larger-scale, longer-term opportunities for ICT-enabled transformation of economic structures, consumer behaviour and societal values. These opportunities will directly and indirectly contribute to the growth of the green economy and the achievement of sustainable development (European Information Technology Observatory, 2002; Pamlin, 2002; Erdmann et al., 2004; Madden & Weissbrod, 2008; Creech et al., 2009).
- International organizations concerned with the development and application of ICTs have begun to systematically study the potential contribution of ICTs to green growth and to recommend lines of action to their members (International Telecommunication Union [ITU], 2008; OECD, 2009b, 2010)

In addition to the policy research and analysis presented in these studies, practical work is now underway in a number of countries and international organizations to develop the technologies, standards and public policies needed to support the design and implementation of new kinds of networks collectively known as the “Internet of Things.” These networks will extend the reach of the current Internet—which connects people and the information resources they have created—to include objects in the natural environment as well as those made by humans. These “ubiquitous networks” will be based on satellite and terrestrial communication systems, largely wireless. They will use radio frequency identification technologies and smart sensors to enable communication among people, objects and information resources everywhere in the world, at any time, at scales ranging from global to nano (ITU, 2005).

The services and applications provided by the Internet of Things will support the development of the green economy by enhancing the capacity of public and private actors to monitor all manner of natural and human systems in real time, as well as to manage the operations and impacts of these systems in more sustainable ways—for example, through increased energy and material efficiency and by enabling the substitution of renewable resources for their non-renewable equivalents. Areas of opportunity for developing applications and services based on the Internet of Things technologies include: natural systems that provide ecological goods and services; agriculture, forestry and other primary industries; infrastructure for generating, distributing and consuming energy; transportation networks and vehicles, particularly automobiles; buildings and their facilities, including factories, offices and residential dwellings (OECD, 2009).

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## *ICT Enabling Conditions*

Against this background, one of the key challenges and opportunities facing green economy policy-makers is to begin working collaboratively with ICT stakeholders and policy-makers towards the common goal of harnessing the transformative potential of ICTs for the development of the green economy (MacLean et al., 2007; International Institute for Sustainable Development, 2010; Souter et al., 2010).

The capacity of the ICT sector to contribute to the long-term development of the green economy will depend on two main factors. Ultimately, it will depend on how successfully green economy policy-makers facilitate the integration of ICT-enabled green innovation into their policies and programs. More immediately, it will depend on how successfully ICT policy-makers address a number of major Internet policy issues that must be resolved to prepare the ground for ICT-enabled green growth, as well as to achieve other policy objectives.

### **The transition to IPv6**

To enable the deployment of smart systems and the development of the Internet of Things, policy-makers need to help facilitate a major transition that is underway in the system for assigning unique numerical addresses to each device connected to the Internet.

The addressing resources of the system used since the 1980s—which is known as Internet Protocol version 4 (IPv4)—are almost exhausted. A new system, which was developed more than a decade ago—known as Internet Protocol version 6 (IPv6)—provides the virtually unlimited number of addresses that will be needed to support the deployment of smart systems and the Internet of Things, key technological enablers of the green economy. However, since the two versions are not compatible, the deployment of IPv6 has been slow because of financial and other costs. This has

created concern that the Internet will be fractured, with some older systems still running IPv4, newer systems running IPv6, and some running both, with inefficiencies and disconnects as a result. Since government departments and agencies are among the largest institutional users of the Internet and ICTs, **public procurement** can have a powerful effect in enabling a smooth transition to IPv6 by stimulating demand for IPv6 products and services.

## Universal affordable access to broadband networks and services

To maximize the contribution of ICTs to the development of the green economy, affordable access to broadband networks and services must be available to as many people as possible for two main reasons: (1) to enable dematerialization of physical products, services and processes, for example, through e-commerce, tele-work, and the electronic delivery of education, health care and other public services and (2) to provide the widest possible scope for bottom-up, user-generated green innovation. Innovation should be focused on the types that are enabled by the Internet more effectively than by any other economic or social structure, or communications medium.

The strategic importance of this objective is such that some countries now recognize universal broadband access as a right, and a high-level global commission has been struck to advise policy-makers on how to achieve this objective.

The experience of the past two decades has shown that, to a large extent, this objective can be achieved through **enabling regulatory frameworks** that encourage private investment, promoting competition among broadband service providers, ensuring open network access to creators of broadband applications and content, and protecting the rights of consumers to access broadband services, applications and content of their choice—a policy generally known as “net neutrality.” However, this experience also shows that, in every country, the cost of providing access to broadband networks in some geographic areas is uneconomic, and that broadband service is unaffordable for some segments of the population, even if networks are available. In such circumstances, many governments have subsidized broadband network deployment and service access through various forms of **public investment, subsidies, and regulatory requirements**.

## Confidence and trust in the online environment

To enable the development of the green economy by dematerializing products, services and processes, as well as by creating an environment in which green innovation can flourish, it is necessary for individuals and organizations to have confidence in the reliability of ICT-based networks and services. Users must trust other individuals and organizations they deal with online, and to be assured that their privacy and other rights will be protected in the virtual world of cyberspace, just as they are in the physical world.

To establish these conditions, ICT policy-makers need to develop robust **legal frameworks, regulatory arrangements and enforcement mechanisms** that will protect personal privacy and the rights of citizens and consumers, combat cybercrime, ensure the security and stability of electronic networks, and balance the rights of users and creators of information products and services.

Other stakeholders also have important roles to play in creating confidence and trust—for example, by creating industry codes of practice that will help protect consumers against cybercrime and other forms of online abuse, and by creating tools that will allow Internet users to manage their online identities.

## Annex 1. A Note on Concepts and Definitions

Concepts and definitions intended to capture the transformative impact of information and communication technologies on economies and societies have played a central role in ICT policy discourse since the 1970s. The “Internet economy” and the “digital economy” are contemporary successors to a conceptual lineage that includes previous notions such as the “information revolution,” the “information economy,” the “e-economy” and the “global information society.”

In the aftermath of the 2008–09 global financial and economic crises, the concepts of “green growth” and the “green economy” have begun to occupy a similarly central role in economic and sustainable development policy discourse.

Although there are no single definitions of any of these terms, the following statements capture their fundamental features.

### The Internet economy and the digital economy

A background paper prepared for the 2008 OECD Ministerial Meeting on the Future of the Internet Economy noted that “the Internet is transforming our economies and societies. It provides an open, decentralised platform for communication, collaboration, innovation, productivity improvement and economic growth. Along with information and communication technologies (ICTs) it promotes closer integration of the global economy and interactions that increase general well-being” (OECD, 2008, p. 4). The report went on to state that, “as the services it supports become pervasive, ubiquitous and more essential in everyday life, the *economy* is increasingly the *Internet economy*” (OECD, 2008, p. 4).

Somewhat more simply, in a 2009 report on *Australia’s Digital Economy: Future Directions*, the Australian government defined the digital economy as “the global network of economic and social activities that are enabled by information and communications technologies, such as the Internet, mobile and sensor networks” (Department of Broadband, Communications, and the Digital Economy, Government of Australia, 2009, p. iv).

### Green growth and the green economy

In *Towards Green Growth*, a report launched at its May 2011 Ministerial Meeting, the OECD defined its green growth strategy as being “about fostering economic growth and development while ensuring that natural assets continue to provide the resources and environmental services on which our well-being relies. It is also about fostering investment and innovation which will underpin sustained growth and give rise to new economic opportunities” (OECD, 2011, p. 18).

In its 2011 report *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication*, United Nations Environment Programme (UNEP) defines a green economy as one that results in “improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities” (p. 16). It goes on to say that “in its simplest expression, a green economy is low carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services” (UNEP, 2011, p. 16).

## References

- Department of Broadband, Communications, and the Digital Economy, Government of Australia (2009). *Australia's digital economy: Future directions*. Retrieved from: [http://www.dbcde.gov.au/\\_\\_data/assets/pdf\\_file/0006/117681/DIGITAL\\_ECONOMY\\_FUTURE\\_DIRECTIONS\\_FINAL\\_REPORT.pdf](http://www.dbcde.gov.au/__data/assets/pdf_file/0006/117681/DIGITAL_ECONOMY_FUTURE_DIRECTIONS_FINAL_REPORT.pdf)
- Creech, H, Andjelkovic, Vetter, T., MacLean, D., Rothman, D. & Vergragt, P. (2009). *Mapping the future of the Internet onto global scenarios: A preliminary view*. Winnipeg: International Institute for Sustainable Development. Retrieved from: [http://www.iisd.org/pdf/2008/internet\\_global\\_scenarios.pdf](http://www.iisd.org/pdf/2008/internet_global_scenarios.pdf)
- Erdmann, L., Hilty, L., Goodman, J. & Arnfalk, P. (2004). *The future impact of ICTs on environmental sustainability*. Seville: European Commission Joint Research Centre Institute for Prospective Technological Studies. Retrieved from: <http://ipts.jrc.ec.europa.eu/publications/pub.cfm?id=1208>
- European Information Technology Observatory (2002). The impact of ICT on sustainable development. In *European Information Technology Observatory Yearbook 2002*, pp. 250-283. Retrieved from: [http://homepage.cs.latrobe.edu.au/sloke/greenIT/eito\\_forum\\_2002.pdf](http://homepage.cs.latrobe.edu.au/sloke/greenIT/eito_forum_2002.pdf)
- International Institute for Sustainable Development (2010). *The digital economy and the green economy: Opportunities for strategic synergies*. A submission to the Government of Canada Digital Economy Consultation. Retrieved from: [http://www.iisd.org/pdf/2010/com\\_digital\\_economy.pdf](http://www.iisd.org/pdf/2010/com_digital_economy.pdf)
- ITU (2005). *The Internet of Things*. Geneva: ITU. Retrieved from: [http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings\\_summary.pdf](http://www.itu.int/osg/spu/publications/internetofthings/InternetofThings_summary.pdf)
- ITU (2008). *ICTs for e-Environment: Guidelines for developing countries with a focus on climate change*. Geneva: ITU. Retrieved from: <http://www.itu.int/ITU-D/cyb/app/docs/itu-icts-for-e-environment.pdf>
- MacLean, D., Andjelkovic, M. & Vetter, T. (2007). *Internet governance and sustainable development: Towards a common agenda*. Winnipeg: IISD. Retrieved from: [http://www.iisd.org/pdf/2007/igsd\\_common\\_agenda.pdf](http://www.iisd.org/pdf/2007/igsd_common_agenda.pdf)
- Madden, P. & Weissbrod, I. (2008). *Connected: ICT and sustainable development*. London: Forum for the Future. Retrieved from: <http://www.forumforthefuture.org/files/Connected.pdf>
- Mallon, K., Johnston, G., Burton, D. & Kavanagh, J. (2008). *Towards a high-bandwidth, low carbon future: Telecommunications-based opportunities to reduce greenhouse gas emissions*. A report by Climate Risk Pty. Ltd. Retrieved from: [http://www.climaterisk.com.au/wp-content/uploads/2007/CR\\_Telstra\\_ClimateReport.pdf](http://www.climaterisk.com.au/wp-content/uploads/2007/CR_Telstra_ClimateReport.pdf)
- McKinsey Global Institute (2011). *Internet matters: The Net's sweeping impact on growth, jobs and prosperity*. Retrieved from: [http://www.mckinsey.com/mgi/publications/internet\\_matters/index.asp](http://www.mckinsey.com/mgi/publications/internet_matters/index.asp)
- OECD (2008). *Shaping policies for the future of the Internet economy*. A background report prepared for the Ministerial Meeting on the Future of the Internet Economy, Seoul, June 17-18, 2008. Retrieved from: <http://www.oecd.org/dataoecd/1/29/40821707.pdf>
- OECD (2009). *Smart Sensor Networks: Technologies and applications for green growth*. Retrieved from: <http://www.oecd.org/dataoecd/39/62/44379113.pdf>

OECD (2010). Recommendation of the Council on Information and Communication Technologies and the Environment. Retrieved from: <http://webnet.oecd.org/oecdacts/Instruments/ShowInstrumentView.aspx?InstrumentID=259&InstrumentPID=259&Lang=en>

OECD (2011). *Towards green growth*. A report launched at the Ministerial Council Meeting, Paris, May 25–26, 2011. Retrieved from: <http://www.oecd.org/dataoecd/37/34/48224539.pdf>

Pamlin, D., ed. (2002). *Sustainability at the speed of light*. WWF Sweden. Retrieved from: [http://assets.panda.org/downloads/wwf\\_ic\\_1.pdf](http://assets.panda.org/downloads/wwf_ic_1.pdf)

Pamlin, D. & Szomolanyi, K. (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). Retrieved from: <http://www.etno.be/Portals/34/ETNO%20Documents/Sustainability/Climate%20Change%20Road%20Map.pdf>

Souter, D., MacLean, D., Akoh, B. & Creech, H. (2010). *ICTs, the Internet and sustainable development: Towards a new paradigm*. Winnipeg: IISD. Retrieved from: [http://www.iisd.org/pdf/2010/icts\\_internet\\_sd\\_new\\_paradigm.pdf](http://www.iisd.org/pdf/2010/icts_internet_sd_new_paradigm.pdf)

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). Retrieved from: <http://www.smart2020.org/publications/>

UNEP (2011). *Towards a green economy: Pathways to sustainable development and poverty eradication*. Advance copy for online release. Retrieved from: [http://www.unep.org/GreenEconomy/Portals/93/documents/Full\\_GER\\_screen.pdf](http://www.unep.org/GreenEconomy/Portals/93/documents/Full_GER_screen.pdf)

WWF-Canada (2008). *Innovating toward a low-carbon Canada: Using technology to transform tomorrow*. A report sponsored by Bell Canada. Retrieved from: [http://www.bce.ca/data/documents/responsibility/innovating\\_toward\\_a\\_low\\_carbon\\_canada.pdf](http://www.bce.ca/data/documents/responsibility/innovating_toward_a_low_carbon_canada.pdf)

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