MDG # 7

BROADBAND SERIES

MILLENNIUM DEVELOPMENT GOALS

ENVIRONMENTAL SUSTAINABILITY

SEPTEMBER 2012

A REVIEW OF ENVIRONMENTAL SUSTAINABILITY IN NATIONAL BROADBAND POLICIES

– GLOBAL OVERVIEW AND CASE STUDIES ON AUSTRALIA AND RWANDA

A CONTRIBUTION TO THE

BROADBAND COMMISSION

FOR DIGITAL DEVELOPMENT

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ABOUT

This case study is part of a series of studies being undertaken by the International Telecommunication Union (ITU) in partnership with the *Broadband Commission* to take an in-depth look at the state of broadband development. This series of case studies underlines the importance of broadband and ICTs in accelerating the achievement of the Millennium Development Goals (MDGs) by 2015, and aims to assist countries in meeting the Broadband Challenge and Targets adopted by the Broadband Commission in October 2011.

The studies are available online and free of charge at www.itu.int/broadband

The *Broadband Commission for Digital Development* is an initiative set up by ITU and the United Nations Educational, Scientific and Cultural Organization (UNESCO) in response to UN Secretary-General Ban Ki-Moon's call to step up efforts to meet the MDGs. Launched in May 2010, the Commission comprises government leaders from around the world and the highest-level representatives and leaders from relevant industries and international agencies and organizations concerned with development, providing a fresh approach to UN and business engagement. To date, the Commission has published two high level policy reports, as well as a number of best practice documents and case studies.

More information about the Commission is available at www.broadbandcommission.org

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For additional information on the initiatives presented in this case study, visit the ITU ICT Eye regulatory database (available at http://www.itu.int/ITU-D/icteye/) and the Broadband Commission's on-line repository of information (available at www.broadbandcommission.org/sharehouse). All are welcome to access this content, and to submit further contributions.

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EXECUTIVE SUMMARY

This study is part of a series of studies being undertaken by the International Telecommunication Union (ITU) in partnership with the Broadband Commission to take an in-depth look at the state of broadband development. This series of case studies underlines the importance of broadband and ICTs in accelerating the achievement of the Millennium Development Goals (MDGs) by 2015, and aims to assist countries in meeting the Broadband Challenge and Targets adopted by the Broadband Commission in October 2011.

This case study complements previous work in the area of ICTs and sustainability by looking at the potential and existing contributions of broadband towards the achievement of MDG7, which targets environmental sustainability, including reducing CO2 emissions, improving access to water and sanitation, reversing biodiversity loss and improving the lives of slum dwellers.

Target A of MDG7 is the integration of the principles of environmental sustainability into national policies and programmes. The review of progress towards this target highlights the limited progress in this regard – particularly in non-environmental sectoral policies. The third chapter of the study presents a global overview of the inclusion of references to environmental sustainability in national broadband policies, in essence providing an assessment of the achievement of Target A within the information and communications technology (ICT) sector. Of the 193 countries reviewed, 119 were found to have a broadband policy, 34 per cent of which contained a reference to environmental sustainability. The assessment presents the nature of inclusions of environmental sustainability that governments are prioritising and establishes two broad areas of action:

- Improving the environmental sustainability of the ICT sector by, for example, improving the energy efficiency of broadband infrastructure –as well as the power source, or by tackling the growing concern of e-waste;
- Promoting broadband and ICT-enabled applications to increase the environmental sustainability of other sectors by, for example, reducing resource consumption –in particular energy consumption- through the use of smart grid technologies, promoting environmental monitoring or reinforcing education about environmental sustainability.

The review conducted in this study indicates that, in general terms, when it comes to leveraging the potential of broadband to promote environmental sustainability, high-income countries tend to focus on carbon abatement strategies, whereas developing nations envisage the use of broadband to reinforce the preservation of biodiversity and promote eco-friendly development. In particular, countries within the European region are taking the lead in the use of teleworking (also known as telecommuting) and smart technologies whereas the most referenced broadband-enabled solution promoted in the African region is the distribution of content to manage the environment and to educate about environmental sustainability. This could provide a reference for countries who are preparing, or reviewing, their broadband policy as to the type of applications that can be promoted through policy-making to advance environmental sustainability in each national context.

The review conducted also indicates that many policies have not advanced in defining metrics, targets and implementation strategies to measure the success and effectiveness of their policies. On this regard, many of the references described are presented in a descriptive narrative of “good-to-have” initiatives. In the context of MDG7, the improvement of sustainability includes reversing environmental and biodiversity losses and improving basic sanitation and access

to drinking water. These principles have not been addressed in a holistic context in any of the plans analysed.

The final two chapters of the study review in detail two countries, Australia and Rwanda, who have featured environmental sustainability as a key element in their national broadband policies. These two countries have complemented these references with further relevant references to ICTs within their national environmental policies, showcasing the type of collaboration across governmental agencies that is required to leverage the unique opportunities that broadband can provide to accelerate the achievement of MDG7 at a national level.

To maximize the potential of broadband for progressing MDG7 and environmental sustainability, next steps require a concerted effort by all stakeholders. Long term monitoring of the outcomes of the projects outlined in this case study will provide a wider scale opportunity for tracking progress and identifying tools that encourage the implementation of plans and policies, promote investment and overcome barriers. Finally, the adoption of a standardized set of methodologies to measure the overall impact of ICTs and broadband on the environment could be considered for new and future revisions of these policies.

1 ICTS, BROADBAND AND ENVIRONMENTAL SUSTAINABILITY

Environmental sustainability has had a prominent role in the global political agenda since 1972, the year of the United Nations Conference on the Human Environment. 40 years later significant progress has been achieved in defining a set of agreements that further define the concepts and principles that should be incorporated into sustainable national policies and practices (see Figure 1a). During that period the impact of technology on the environment was demonstrated[1] and though initially technology was seen as a threat, that view was reversed though the 1990s[2].

In this context the World Bank defines environmental sustainability as ensuring that the overall productivity of accumulated human and physical capital resulting from development actions more than compensates for the direct or indirect loss or degradation of the environment[3]. Productivity and technological change being closely connected, the consensus is now that technology should be promoted to decouple economic growth and environmental degradation. In doing so, technological progress can both aid and guarantee that this evolutionary process will continue in favour and not at the expense of the physical environment.

FIGURE 1a TIMELINE OF ENVIRONMENTAL SUSTAINABILITY IN THE UNITED NATIONS

	Conference/Body	Key outcome(s)
1972	UN Conference on the Human Environment	Declaration on the Human Environment (Stockholm Declaration) Creation of the United Nations Environmental Programme (UNEP)
1982	48th plenary of the UN General Assembly	World Charter for Nature
1983 - 1987	World Commission on Environment and Development (WCED or Brundtland Commission)	Report Our Common Future[4] (1987)
1992	UN Conference on Environment and Development (UNCED or Earth Summit 1992)[5]	Rio Declaration on Environment and Development Agenda 21 Rio Conventions opened for signature Statement of Forest Principles United Nations Framework Convention on Climate Change (UNFCCC) United Nations Convention on Biological Diversity (CBD) United Nations Convention to Combat Desertification (UNCCD)
1997	Special Session of the UN General Assembly to Review and Appraise the Implementation of Agenda 21 (Earth Summit 1997 or Rio+5)[6]	Programme for the Further Implementation of Agenda 21
2000	UN Millennium Summit[7]	United Nations Millennium Declaration Launch of the process to define the Millennium Development Goals
2002	World Summit on Sustainable Development (WSSD, Earth Summit 2002 or Rio+10)[8]	Johannesburg Declaration Johannesburg Plan of Implementation (JPOI)
2012	United Nations Conference on Sustainable Development (UNCSD 2012 or Rio+20)	The Future We Want

The relationship between environmental sustainability and information and communication technologies (ICTs) has been discussed extensively at the policy level as well as in the academic community over recent years, in particular with regards to climate change. Two relevant reports covering this are: *ICTs and Climate Change*[9]*,* published in 2007 by ITU, which presents an overview of the role that ICTs can play to monitor, adapt to and ultimately mitigate climate change, and the report *Smart 2020: Enabling the low carbon economy in the information age*[10], commissioned in 2008 by the Global e-Sustainability Initiative (GeSI), and conducted by the Climate Group and McKinsey, which undertook a preliminary assessment of the amount of global greenhouse gas (GHG) emissions that could be depleted through the use of ICTs and identified some of the biggest and most accessible opportunities to achieve these reductions as well as the economic gains thereof.

The main achievement of these two reports was to complement previous work on sustainability and raise awareness at the global level of the role played by the ICT sector to promote environmental sustainability and address climate change. By achieving this goal both reports engaged telecommunication /ICT and environmental policy makers in the identification and implementation of initiatives, standards, regulations and policies that could be launched or adopted to improve the environmental performance of the ICT sector itself through optimized resource consumption -in particular reducing energy consumption and the generation of electronic waste (or e-waste), as well as maximize the benefits that could be achieved through the use of ICTs to reinforce environmental protection and assist other economic sectors to become more resource efficient[11].

After 2008, additional studies (*see Box 1.1*) complemented the two aforementioned reports by documenting lessons learned and covering new angles, such as expanding the evidence of the use of ICTs to address climate change as well as other environmental challenges (e.g. improving water management and reducing deforestation), and identifying further actions, standards and methodologies that could be implemented to reduce the environmental footprint of the ICT sector, among others.

BOX 1.1 SELECTION OF LITERATURE ON ICTS AND ENVIRONMENTAL SUSTAINABILITY

Report (year)	Organization	Key issues highlighted
Global Information Society Watch, Focus on ICTs and Environmental Sustainability (2010)	Association for Progressive Communications (APC)	Overview on ICTs and environmental sustainability. Thematic issues, indicators for Green ICTs and regional and country reports.
Linking ICTs and Climate Change Adaptation: A Conceptual Framework for e-Resilience and e-Adaptation (2010)	CDI - The University of Manchester	Use of ICTs for climate change adaptation. E-resilience and e-adaptation.
Evaluating the Carbon-Reducing Impact of ICT: An Assessment Methodology (2011),	GeSI	Methodology to assess the ICT enabling effect, case studies to demonstrate application of the methodology to specific services
Measuring the Energy Reduction Impact of Selected Broadband-Enabled Activities Within Households (2012)	GeSI	Investigates link between broadband usage and energy reduction with respect to online activities like teleworking and online shopping.
Technology Roadmap. Smart Grids (2011)	International Energy Agency	Smart grids for energy security, economic development and climate change mitigation.
ICTs as an enabler for Smart Water Management (2010)	ITU	Smart water management, Standards for smart water initiatives.
ICTs for e-Environment. Guidelines for Developing Countries, with a Focus on Climate Change. (2008)	ITU	ICTs for monitoring, information sharing, education on environmental issues, mitigation. Recommendations for developing countries,
Using ICTs to tackle climate change (2010)	ITU, GeSI	Use of ICTs to monitor the global environment and ecosystems, mitigate climate change and adapt to its effects. Focus on smart technologies and on the need to develop methodologies for assessing the environmental impact of ICTs.
Greener and Smarter ICTs, the Environment and Climate Change (2010)	OECD	Definition of green ICTs, Assessment of the environmental impact of ICTs (direct impacts, enabling impacts and systemic impacts),
Recycling – From e-waste to resources (2009)	UNEP	Challenges and opportunities of e-waste, Recycling technologies, market potential and potential obstacles.
The Potential Global CO2 reduction from ICT use (2008)	WWF	ICT solutions to reduce CO2. Focus on smart technologies, dematerialization, Integrated renewable solutions and intelligent transport systems.

Note: Further references are available at ITU's dedicated site to ICTs, the environment and climate change (www.itu.int/climate)

The Broadband Commission for Digital Development published the report *The Broadband Bridge, linking ICTs with climate action for a low carbon economy*[12] in April 2012. The report built on the existing analysis on the impact of broadband deployment on economic output, labour productivity and consumer welfare by taking a closer look at the role of broadband networks, services and applications in driving the transformation towards a low-carbon economy. The report specifically looks at how to best leverage investments in broadband to address climate change, highlighting the transformative potential of broadband and ICTs as a solution to mitigate and adapt to climate change. It highlights pioneering projects and innovation from the private sector, international organizations and a selection of government best practices.

The report puts forward a set of recommendations that aim to promote the adoption and delivery of environmentally focused broadband policies that can accelerate global progress towards a low-carbon economy. In particular the document highlights the need for visionary leadership and long-term broadband plans coupled with applications of ICT services for energy, health, education and environmental protection. From an institutional standpoint, regulatory certainty, integrated decision-making and cross-ministerial flexibility should

contribute to overcoming the barriers that currently hinder the adoption of broadband-enabled applications that can promote environmental sustainability. Incentivizing the uptake of such low carbon solutions, funding or facilitating scalable pilots, forming partnerships among the private sector and government agencies, promoting the dissemination and findings and boosting measurement and standardization are all parts of this holistic broadband regulatory framework promoted by the Broadband Commission (*see Figure 1b*).

This case study departs from the analysis made in *The Broadband Bridge*, looking at the specific contribution that national broadband plans, strategies, policies or agendas can have in promoting environmental sustainability. The analysis presented in the following chapters is centred on the framework of the Millennium Development Goals (MDGs)[13] and especially MDG7 -*ensuring environmental sustainability.* Its purpose is to stimulate an in-depth examination of this area, looking at the countries that are leading with vision and enhancing attention to the type of environmental impacts that can be addressed through telecommunication/ICT policy. The document also introduces some of the new principles adopted at the 2012 United Nations Conference on Sustainable Development (Rio+20)[14], underscoring how the inclusion of sustainability principles in ICT policies and strategies can further promote the integration of the three pillars of sustainable development: environmental, economic and social.

The analysis starts by presenting the MDG7 framework in chapter 2 that displays the multiple contributions of broadband in achieving the targets defined within this goal. Chapter 3 presents a global overview of national broadband policies that have stipulated environmental sustainability as a potential area of benefit, highlighting the actions, applications and solutions promoted by these policies in this domain. This overview serves as the basis for chapters 4 and 5, which introduce two specific case studies of governments that are leading in advancing environmental sustainability through broadband: Australia and Rwanda. Chapter 6 closes the case study with a summary of the findings and conclusions of this analysis.

FIGURE 1b RECOMMENDATIONS FROM THE BROADBAND COMMISSION TO PROMOTE A LOW CARBON ECONOMY THROUGH THE USE OF BROADBAND

1 **Lead with vision** Adopt a long-term National Broadband Plan/Strategy based on universal affordability and accessibility, open markets and innovation, and consciously connect this to your climate goals.	**2** **Bring convergence** Bring convergence to ICT policy formulation so that it aligns with other policy areas such as energy, health, education and climate in order to maximize impact.	**3** **Ensure regulatory certainty** Ensure regulatory certainty with regards to policy and regulations on climate and broadband to create a good framework for investment.	**4** **Be an example** Drive cross-ministry collaboration and integrated decision-making to align climate and digital goals and use government procurement to send the right market signals.
5 **Foster flexibility** Identify and remove the regulatory and policy barriers currently hindering research and investment in 21st century ICT-based broadband-enabled infrastructure and low carbon solutions.	**6** **Provide incentives** Encourage uptake of low-carbon solutions and support market change by rewarding or incentivizing desired consumer behaviours. Spur innovation among individuals, companies and sectors.	**7** **Build the market** Fund and facilitate scalable pilots to demonstrate feasibility and effectiveness of broadband as an enabler of low-carbon solutions and build a strong business case to attract private investment.	
8 **Form partnerships** Cultivate 'connectivity' and 'co-creativity' across public, private and non-governmental sectors and industries to help develop a collaborative mind-set, shared goal, common language and break down silos.	**9** **Measure & standardize** Develop harmonized metrics and measurements and common standards for calculating both ICT's environmental impacts and the positive contribution it can make to other sectors—from individual products to systems, and from individual households to city or national levels.		
10 **Share knowledge & raise awareness** Actively disseminate project findings, share best practice and learn from mistakes to identify success factors and facilitate leapfrogging, especially among lesser developed markets. Communicate the opportunities and synergies that can be achieved through an integrated, trans-sector approach to digital development. Infrastructure and low carbon solutions.			

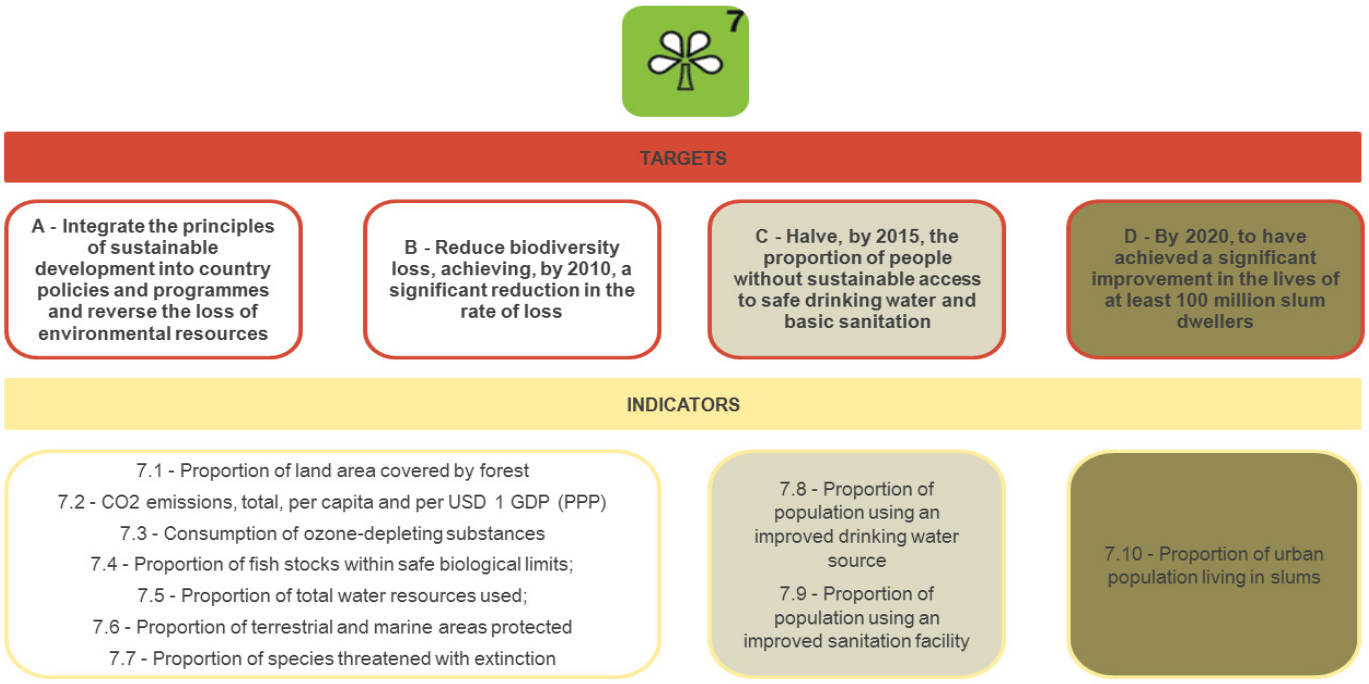
Source: The Broadband Bridge. Broadband Commission for Digital Development

2 ACCELERATING MDG7 THROUGH BROADBAND

2.1 Environmental sustainability within MDG7: Progress to date

Ensuring environmental sustainability is one of the eight Millennium Development Goals (MDGs). Within this framework, MDG7 is broken down into four targets and further into ten indicators to be met by 2015 and addresses issues such as integrating the principles of sustainable development into country policies, reversing the loss of biodiversity and environmental resources, improving sustainable access to safe drinking water and basic sanitation and improving living conditions in slums (see Figure 2a).

FIGURE 2a. MDG7: TARGETS AND INDICATORS



Source: Authors, based on the Millennium Development Goals Indicators. http://mdgs.un.org

Progress to date indicates mixed achievement of MDG7. Two of the targets have been met partially, well ahead the 2015 deadline: improving access to safe drinking water (target 7C, indicator 7.8) and improvement of the lives of 100 million slum dwellers (target 7D). Between 1990 and 2010, over two billion people gained access to improved drinking water sources, with the proportion of people using an improved water source rising from 76 per cent to 89 per cent. Similarly, the share of urban residents in the developing world living in slums declined from 39 per cent to 33 per cent in the last decade. More than 200 million slum dwellers gained access to either improved water sources; improved sanitation facilities or durable, less crowded housing, exceeding the target defined within MDG7. In addition to these achievements there has been significant progress towards meeting other targets and indicators, such as the integration of sustainable development into country policies and programs (target 7A) and the

reduction of the consumption of ozone-depleting substances (target 7B - indicator 7.3).

Despite the progress towards meeting MDG7 there are still disparities across regions and occasionally even within countries. For example, access to improved water resources remains an on-going issue in many rural areas. Regarding improving the lives of slum-dwellers, despite the reduction in the percentage of urban slum dwellers the total number of people living in slums has actually increased and continues to grow, due to the overall increase in urban dwellers[15]. This diminishes the impact of the achievement of target 7D. Figure 2b presents an overview of the disparities by region of the targets previously discussed.

FIGURE 2b PROGRESS TOWARDS MEETING MDG7, FOCUS ON REGIONAL PROGRESS

Goals and targets	Africa		Asia				Oceania	Latin America and Caribbean	Caucasus and Central Asia
	Northern	Sub-Saharan	Eastern	Southeastern	Southern	Western			
Halve proportion of population without improved drinking water	High coverage	Low coverage	High coverage	Moderate coverage	High coverage	Moderate coverage	Low coverage	High coverage	Moderate Coverage
Proportion of population without sanitation	High coverage	Very low	Low coverage	Low coverage	Very low coverage	Moderate coverage	Low coverage	Moderate coverage	High coverage
Improve the lives of slum-dwellers	Moderate proportion of slum-dwellers	Very high proportion of slum-dwellers	Moderate proportion of slum-dwellers	High proportion of slum-dwellers	High proportion of slum-dwellers	Moderate proportion of slum-dwellers	Moderate proportion of slum-dwellers	Moderate proportion of slum-dwellers	-

Words box indicate degree of compliance with the target, while colours show progress towards meeting each target:

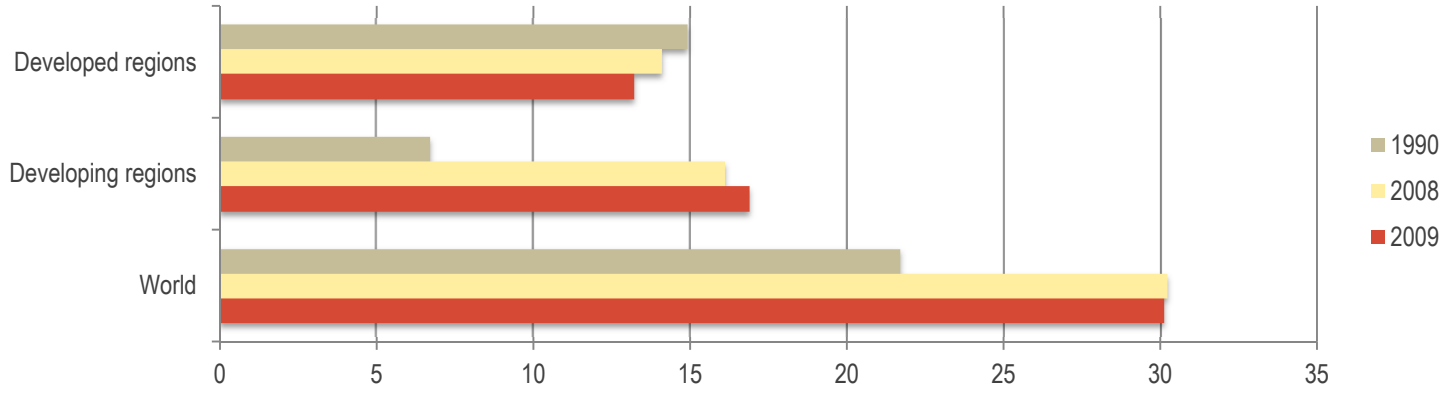
- Target already met or expected to be met by 2015.
- Progress insufficient to reach the target if prevailing trends persist.
- No progress or deterioration
- Missing or insufficient data.

Source: Compiled by Statistics Division, Department of Economic and Social Affairs, United Nations based on statistics available as of June 2012. MDG Report 2012

In addition, conditions are not improving, and in some cases are deteriorating, for a number of indicators. The world has already missed the 2010 target for biodiversity conservation. Nearly 17,000 species of plants and animals are currently at risk of extinction, and the number of species threatened by extinction is growing daily, leading to potentially grave consequences. Over-exploitation of marine fisheries reached a new peak in 2008, and the rate of deforestation, although declining, is alarmingly high, especially in Africa and Latin America. Access to sanitation remains a global challenge, with half of the world population still lacking basic sanitation.

Finally, GHG emissions –in particular carbon dioxide (CO2)- have continued to increase almost every year, with a current level of CO2 emissions 39 per cent above the 1990 levels[16] (see figure 2c).

FIGURE 2c - EVOLUTION OF CO2 EMISSIONS SINCE 1990



Source: MDG Report 2012. CO2 emissions in billions of metric tonnes

In the last 40 years progress has been made in incorporating sustainability into international agreements and national policies. According to UNEP most countries have signed at least 9 of the 14 main multilateral environmental agreements[17], with a total of 60 countries signing them all[18]. This is a positive indicator of the relevance of the environmental agenda at the international level. Despite this global framework of agreements the reality indicates that more effort is still needed to incorporate sustainability into national policies, in particular into non-environmental sectoral policies. This is an angle that will be covered from the broadband perspective in chapter 3.

But the most pressing issues regarding target 7A is the limited implementation of the country policies and international agreements that have been put in place during the last decades. The gaps in the implementation of environmental policies are directly affecting the lack of progress towards meeting MDG7, in particular as the fast pace of development and population growth is putting further pressure on an already delicate environmental balance, introducing additional environmental challenges (see Box 2.1).

The good news in this context, is that today there is a set of tools available that can assist the global community by giving real-time information that allows improved accountability and decision making and, specifically, a platform for progress that can assist in the transformation required for a greener and more inclusive economy. This set of tools is ICTs, and in particular broadband networks, services and applications.

The recent Rio+20 conference recognized in its outcome document -"*The Future We Want*"[19]- the unique contribution of ICTs to promote knowledge exchange, technical cooperation and capacity building for sustainable development, highlighting the need to work towards improved ICT access, in particular to broadband networks and services as an action required to advance the sustainable development agenda. *The Future We Want* also highlights the role of ICTs to facilitate the flow of information between governments and the public, improve agricultural productivity and sustainability through the voluntary sharing of knowledge and good practices, empower farmers, fishers and foresters to choose among diverse methods of achieving sustainable agricultural production, improve the capacity of education systems to prepare people to pursue sustainable development and empower women to access economic resources.

The following section will present an assessment of how ICTs and broadband can support the achievement of MDG7, highlighting how broadband-enabled solutions can help to accelerate progress towards achieving a number of these targets.

BOX 2.1 – ADDITIONAL ENVIRONMENTAL CHALLENGES

The number of environmental issues the world is facing today extends beyond those identified in the MDG framework. In particular, continuing population growth and economic development are exerting increasing pressures on the environment, dramatically increasing unsustainable production and consumption patterns, exploiting the environment as a source of raw materials and as a sink for waste.

The continued increase of CO2 emissions has accelerated the negative effects of climate change on the environment, such as increased sea levels and extreme weather events, which include heavy rains and droughts, which rose by 38 per cent between the 1980s and the 2000s. Climate change is also predicted to alter the quality and productivity of natural resources and ecosystems, some of which may be irreversibly damaged, further decreasing biological diversity and negatively impacting human health and economic development. These new challenges put at risk the overall achievement of the MDGs[20].

As discussed previously MDG7 includes a target on access to safe drinking water. However, water scarcity is becoming the more delicate issue, with an estimated fifth of the global population living in areas with physical water scarcity, presenting a significant and increasing threat to the environment, human health, development, energy security and the global food supply. Over the past 50 years water supply has remained fairly constant, however withdrawals have tripled and in many places demand far exceeds sustainable supply[21]. The increase in global groundwater withdrawal from 312 km3 to 734 km3 per year between 1960 and 2000 has resulted in a 125 per cent increase of groundwater depletion per year. In addition, groundwater is threatened by contamination from agricultural and urban areas, solid waste, on-site wastewater treatment, oil and gas extraction and refining, mining manufacturing and other industrial activities. This trend could reverse current progress towards the attainment of MDG7, target C.

Biodiversity is also facing new threats. Principal pressures on biodiversity include habitat loss and degradation, overexploitation, invasive alien species and pollution. Additional threats to biodiversity include changes in the patterns, frequency and intensity of fires in different habitats, problematic native species and negative influences from human activities, such as artificial illumination, genetically modified organisms, micro-plastics, nanotechnology and geo-engineering, all of which are not included in the MDGs.

Finally, other important issues threatening the environment include chemicals and waste. While the availability and quality of data on these topics is limited, the mismanagement of chemicals is resulting in increased pollution levels, contaminated soil, water and air threatening human health and development. On this regard, another important negative trend is the acceleration in the generation of e-waste, the fastest growing waste stream world-wide, according to the Basel Convention[22].

Initiating a process to address these and other challenges was one of the most relevant outcomes of the Rio+20 conference. This process will redefine the post-2015 international development agenda around a new set of *Sustainable Development Goals* (SDGs) that, building on the lessons learned from the current MDG process, will pursue focused and coherent action on sustainable development through an action-oriented approach. The process to define and agree on these new goals will be discussed within the United Nations General Assembly.

Source: UNEP - Global Environmental Outlook 5 (GEO-5)

2.2 Broadband-enabled solutions to address gaps in MDG7

Broadband has a unique potential to accelerate the achievement of the MDGs and help tackle environmental challenges. This topic has been partially covered by the literature presented in chapter 1, which details broadband-enabled solutions being used around the world to assist in the transformation towards a low-carbon economy. This section complements these findings with a more focused approach on MDG7, in particular regarding the targets and indicators requiring more progress by the agreed 2015 deadline (see Figure 2d). The analysis is based on the findings of the MDG Report 2012[23].

According to this analysis, the use of broadband-enabled solutions can support the achievement of each of the targets and indicators included in MDG7, mainly through four broad groups of actions:

- By promoting *urban sustainability through broadband*-enabled e-applications (see Box 2.2);
- By reducing resource consumption through the use of *smart technologies,* such as smart grids, smart buildings and intelligent transport systems (see Box 2.3);
- By reinforcing the *monitoring of environmental conditions and goals* through the use of satellite imagery and wireless applications (see Box 2.4);
- By supporting *information exchange on sustainability*, allowing better decision making and improved assessment of progress towards meeting environmental targets (see Box 2.5).

Chapter 3 analyzes the inclusion of this vast potential of broadband applications for environmental sustainability in national policy. The analysis is based on a global assessment of national broadband policies, identifying policies that are already promoting broadband-enabled solutions to achieve MDG7.

FIGURE 2d – PROGRESS TOWARDS MEETING MDG7, FACTS AND BROADBAND-ENABLED/ ENHANCED SOLUTIONS

Targets (*)	Indicators (*)	Progress	Key facts	Broadband-enabled solutions
Integrate principles of sustainable development into country policies and programmes	*No indicators defined*	**Insufficient progress**	Good progress at the international level, with 14 multilateral environmental agreements in place. More effort needed to incorporate sustainability into national and sectoral policies, and to increase collaboration across different government areas.	Inclusion of principles of sustainability in national broadband policies
Reverse the loss of environmental resources	Land area covered by forest	**Insufficient progress**	Decrease in rate of deforestation, slowed down by forest area increase in Asia, however still alarmingly high, especially in Africa and Latin America.	Satellite monitoring of deforestation
	CO2 emissions	**Insufficient progress**	From 1990 through 2008, CO2 emissions increased almost every year. 2009 emissions, despite a 0.4% decrease due to the economic crisis were still 39% above the 1990 level.	Reduction of energy consumption through the use of smart technologies Reduction of commuting through teleworking Dematerialization of goods and optimization of processes
	Consumption of ozone-depleting substances	**Good progress**	Reduction of over 98% in the consumption of ozone-depleting substances.	Satellite monitoring of the ozone layer
	Fish stocks within safe biological limits	**Insufficient progress**	Overexploitation of marine fisheries reached a new peak in 2008.	Satellite monitoring of fishing activities and of oceanographic habitats conditions
	Total water resources used	**Insufficient progress**	Groundwater depletion per year increasing at 125%.	Smart water management through smart grids
	Terrestrial and marine areas protected	**Insufficient progress**	The most important sites for species conservation remain unprotected.	Satellite monitoring of protected natural habitats
Reduce biodiversity loss	Species threatened with extinction	**Missed**	Conservation action is slowing the rate at which species are moving towards extinction. However the number of species facing extinction is growing.	Satellite monitoring of natural habitats
Halve the proportion of people without sustainable access to safe drinking water and basic sanitation	Population using an improved drinking water source	**Met**	The world will meet or even exceed the drinking water target by 2015 if current trends continue. Access to water in developing countries has increased from 71% in 1990 to 86% in 2010.	Smart water management through smart grids
	Population using an improved sanitation facility	**Insufficient progress**	Sanitation coverage increased from 36% in 1990 to 56% in 2010 in developing countries. Despite progress, almost half of the population in those regions—2.5 billion in total—still lack access to improved sanitation facilities	Smart planning of sanitation infrastructure through the use of digital mapping solutions
Improve the lives of at least 100 million slum dwellers	Urban population living in slums	**Met**	Since 2002 more than 200 million slum dwellers have gained access to improved water, sanitation or durable and less crowded housing, greatly enhancing their prospects of escaping poverty, disease and illiteracy.	Improving access to public services through e-applications *(such as e-health, e-government or e-education)*

Source: Authors, based on assessment of progress by MDG Report 2012

Note: (*) Adaptation from authors

BOX 2.2 PROMOTING URBAN SUSTAINABILITY THROUGH BROADBAND

Urban areas –*which host 52.1 per cent of the world population*- currently account for more than 70 per cent of energy-related GHG emissions[24]. If all production and consumption based emissions are included, urban residents and their associated affluence likely account for more than 80 per cent[25] of the world's GHG emissions. Buildings account for 38 per cent of these needs. These figures make urban areas the single largest source of GHG emissions and the context in which more emissions reductions could be achieved.

This contribution is expected to continue increasing in the coming years, as the proportion of the urban population is expected to reach 70 per cent by 2050[26]. Broadband can achieve GHG reduction and improved citizen welfare within urban areas, which is particularly key for the 33 per cent of urban dwellers that currently live in slums. Broadband offers the potential to help increase citizen welfare through improved water and power supply and education and in doing so can help to achieve target D of MDG7. The table below presents a selection of policy tools already being implemented to achieve sustainability in cities, for which broadband-enabled solutions are being introduced to achieve further reductions. The use of broadband can directly support the implementation of these policies.

In addition to providing sustainability solutions for urban populations, broadband-enabled applications can aid in achieving more environmentally sustainable rural communities through the remote provision of services such as education, health care and remote working, all of which can reduce the need to travel. Broadband monitoring of long distance cables can also help reduce the instances of power and communications black outs that are often experienced in remote communities and provide the efficient, consistent energy supply required to make distance services reliable. Work on this line is being undertaken as part of the *Smart grid, Smart city* initiative in Australia (see chapter 4) to place sensors along power distribution cables that service remote communities with the aim of being able to monitor use and quickly identify supply problems such as cable damage.

Policies to reduce emissions in cities for which broadband-enabled applications are available

Category	Policy goals / instruments	Broadband-enabled applications
Reduce emissions from transportation	Reduce trip lengths	The promotion of teleworking and teleconferencing[27] reduces the need to commute, enabling rural and suburban regeneration. Intelligent transport systems (ITS) can optimize transit routes, assist in navigation around busy centers and avoid congestion.
	Increase mass transit use and employee transport plans	Broadband solutions provide live information to users of public transportation, encouraging mass transit use.
	Driving and parking restrictions in certain zones	Use of broadband-enabled solutions to enforce driving and parking restrictions
	Support non- motorized means of travel	Use of smart systems to promote new forms of individual transportation (e.g. shared bicycle systems[28])
	Increase vehicle efficiency and alternative fuels use	Real time freight management through RFID, telemetry and mobile broadband networks can contribute to increase vehicle efficiency
Reduce emissions from buildings	Increase building energy efficiency	Use of smart sensor networks, smart meters and grids, remote management of appliances
Improve resilience to climate change	Reduce vulnerability to flooding and increased storm events	Use of early warning systems to alert on extreme weather events

Source: Adapted from Cities and greenhouse gas emissions: moving forward Environment and Urbanization (see footnote 41)

BOX 2.3 SMART TECHNOLOGIES TO REDUCE RESOURCE CONSUMPTION

Definitions of smart technologies vary, however for the purpose of this case study, smart technologies comprise tools that gather and act on information, such as the behavior of suppliers and consumers, to improve the efficiency, reliability, economics, and sustainability of the network they are monitoring. Reducing CO2 emissions is arguably the MDG7-related area in which these applications can be most effective and, according to the analysis presented in chapter 3, one of the broadband-enabled solutions related with sustainability that are being promoted through national broadband policies.

The *Smart 2020* report highlights that while the ICT sector's own contribution to carbon emissions is around 2 per cent, transformative broadband enabled solutions, primarily smart technologies, allow other sectors to significantly reduce the remaining 98 per cent of global emissions. The study provides examples of how the use of broadband enabled smart technologies can reduce CO2e emissions, including smart motor systems, smart logistics, smart buildings and smart grids. This analysis is complemented by the joint ITU-GeSI report *Using ICTs to tackle climate change*[29], which provides further information on the use of these technologies to reduce emissions and maximize the use of renewable energy sources.

Some examples of common broadband enabled applications include e-health, e-government, e-commerce and e-banking. These applications have the potential to provide the population with information regarding environmental sustainability (*for example, recommended practices regarding protection of bio-diversity*) and contribute to a reduction in emissions through, for instance, the reduction of the need to use transportation, particularly in urban and suburban environments. For example, the use of electronic health records improve the delivery of personalized health services and reduce unnecessary medical visits. Similarly, e-Government applications reduce the need to travel to public administration offices. Similar efficiencies can be achieved through e-commerce and e-banking applications.

A recent study commissioned by GeSI[30] showed how the increased use of simple and convenient online activities like teleworking and online shopping can reduce carbon emissions by millions of metric tons and deliver significant energy savings. With a goal of investigating the link between broadband Internet usage and energy reduction, the study entitled "Measuring the Energy Reduction Impact of Selected Broadband-Enabled Activities Within Households" looked specifically at eight household-level activities that are enabled or enhanced by the use of broadband Internet access. Replacing more energy-intensive conventional activities, the studied areas were teleworking, using the Internet as a primary news source, online banking, e-commerce, downloading and/or streaming media (music and video), e-education, digital photography and e-mail.

Assuming reasonable adoption of all eight activities, the six countries featured in the study could achieve net energy savings equivalent to 2 per cent of their total energy consumption. The U.S. could generate annual net energy savings of approximately 336 million barrels of oil, equivalent to 2 per cent of its total energy consumption. France, Germany, Italy, Spain and the U.K. could generate annual net energy savings of approximately 164 million barrels of oil, also equivalent to 2 per cent of the total energy consumption in these countries. Teleworking provided the largest energy benefit across the EU-5 and U.S., generating approximately 83 to 86 per cent of net energy savings respectively.

At household level, smart meters engage users to opt for various 'live' pricing schemes for managing energy use, thus reducing their carbon footprint and identifying the home appliances that consume excessively. A similar effect could take place by deploying more energy-efficient enterprise IT architectures, enabled by data networks. Further examples of these applications are also presented in the report *The Broadband Bridge: linking ICT with climate change for a low-carbon economy*.

BOX 2.4 MONITORING ENVIRONMENTAL CONDITIONS AND GOALS

Addressing the causes and effects of development requires ongoing monitoring of environmental and climatological conditions. Real-time information and monitoring of ecosystems can significantly improve our capacity to assess progress towards achieving MDG7, as well as other environmental goals, adapt to the effects of climate change and improve decision making to promote environmental sustainability.

Current systems to monitor environmental conditions comprise a set of networking infrastructure, together with data collection and analysis elements. With regards to connectivity, most common approaches involve the use of wireless technologies and earth exploration satellite systems which require dedicated use of radio frequencies and satellite orbits, respectively[31]. One of the newest approaches to complement these technologies includes the use of submarine cables to monitor the climate[32], in particular ocean conditions[33].

Additional examples of broadband-enabled technologies include the use of wireless tools such as leaf wetness and nitrate sensors, multi-spectral video imagers, acoustic sensors, gas analyzers, and other high-performance instruments which expand understanding of patterns of global change and levels of water and air pollution. Similarly, other sensors allow for the measurement of marginal changes in the sea level and temperature, atmospheric concentrations and spatial distributions of GHGs, soil moisture, CO2 concentration and temperature, all signs of climate change.

Monitoring ecosystems to assess changes in biodiversity is key to achieve target B of MDG7. More commonly this is undertaken by the physical collection and sharing of data through databases. However, this process is time and labor intensive and can limit the areas covered. A more recent approach is the remote monitoring of ecosystems to assess changes in habitat overtime. Although species identification through remote sensing is limited, earth observation data can provide valuable information on disturbance, topography, and land cover data in a systematic, repeatable, and spatially exhaustive manner.

Beyond simple data collection, broadband-enabled applications are a fast way to collect and transmit relevant information that then allows scientists and environmentalists to better understand fundamental climatological and ecosystem processes with real-time (or almost real-time) information as well as to remotely control equipment. The creation of platforms that combine multiple processors and wireless network modules together with energy control systems allows the nodes and their sensor devices to operate only on demand, thus conserving energy for long-life operations[34] .

Inexpensive broadband network components can facilitate the deployment of both short (1-5 kilometers) and long distance (10-100 kilometers) links with remote sensor platforms. Self-powered (via photovoltaic cells or small wind turbines) micro servers can help monitor different micro sensing variables of almost any place of interest. The use of wireless technologies can be leveraged to provide these sensors with different ranges of connectivity.

Moreover, broadband networks can help collect, distribute, synthesize and visualize high-quality data. Historical and real time data can contribute to the development of predictive models, and serve to understand ecological complexities and their reciprocal implications. The application of new approaches across multiple spatial and temporal scales, and knowledge transfer will allow resource managers and land use planners to take advantage of these advances in a collaborative manner. An example of this is the use of distributed computing to process and analyze the huge volumes of data captured by these sensors, and to collaborate with other experts across the globe.

BOX 2.5 SUPPORTING INFORMATION EXCHANGE ON SUSTAINABILITY

Information sharing systems on climate change, biodiversity and other environmental data have the potential to improve decision making based on real-time information. In addition, these technologies can improve public awareness and foster environmentally friendly practices. Furthermore, the improved real-time collaboration that can be obtained through the use of high-speed connectivity allows researchers and organizations to further develop knowledge and research.

Chapters 4 and 5 present examples on how Australia and Rwanda, respectively, have implemented information sharing projects as part of their strategies to address MDG7. While Australia has focused on the use of databases to reverse the loss of biodiversity, Rwanda is in the process of implementation of the Climate Change Observatory project, which aims at becoming the main hub in which all stakeholders will exchange knowledge and share initiatives related to mitigation and adaptation to climate change.

3 INCLUSION OF ENVIRONMENTAL SUSTAINABILITY IN NATIONAL BROADBAND POLICIES

3.1 Global overview

In its previous work, ITU[35] and the Broadband Commission[36] identified the development of national broadband policies as a positive framework for action from the telecommunication/ICT public policy side to promote the deployment and adoption of broadband networks, services and applications (*see Box 3.1*). The term "national broadband policy" in this context refers to a country-wide document that discusses the deployment and/or uses of high-speed, high-connectivity Internet connections and includes digital, ICT and broadband plans, strategies, agendas, policies and laws.

In a nutshell, national broadband policies have the potential to be key instruments to promote *broadband inclusion for all*. Based on this evidence the Commission agreed in 2011 to recommend the adoption of national broadband policies on a global scale. This led to the inclusion of "*Making broadband policy universal*[37]" as one of the four advocacy targets defined by the Commission at the 2011 Broadband Leadership Summit[38] to accelerate progress towards meeting the MDGs by 2015.

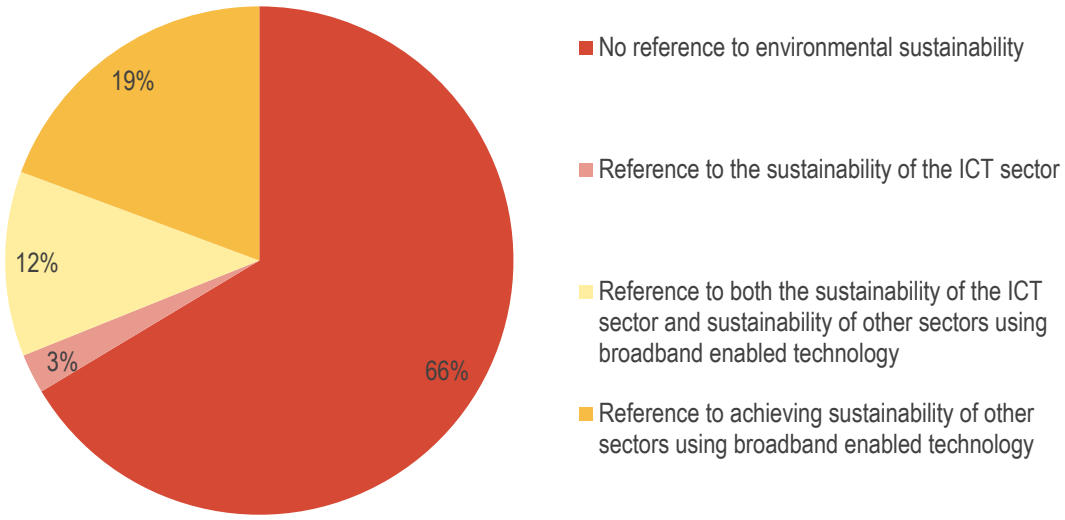
As referenced in Chapter 2, there is limited progress regarding the integration of the principles of environmental sustainability into national policies and programmes (target A of MDG7), in particular with regards to non-environmental sectoral policies. The result is poor coordination between government agencies and ministries in promoting environmental sustainability. This chapter presents an overview of the contribution that telecommunication/ICT policy makers have made to such inclusions in existing national broadband policies, identifying countries and regions leading in this domain, key principles included and main solutions promoted through the policies.

According to the ITU *ICT Eye regulatory database*[39] and additional research conducted by ITU, to date 119 countries[40] have adopted a national broadband policy. Of these, 40 (34 per cent of policies analysed) reference environmental sustainability in their broadband policy and particularly 37 (31 per cent of policies analysed) identify the potential of broadband and ICTs to increase the environmental sustainability of other sectors, establishing two broad areas of action:

- *Improving the environmental sustainability of the ICT sector* by, for example, improving the energy efficiency of broadband infrastructure –as well as the power source, or by tackling the growing concern of e-waste[41];
- *Promoting broadband and ICT-enabled applications to increase the environmental sustainability of other sectors* by, for example, reducing resource consumption –in particular energy consumption- through the use of smart grid technologies, promoting environmental monitoring and reinforcing education about environmental sustainability.

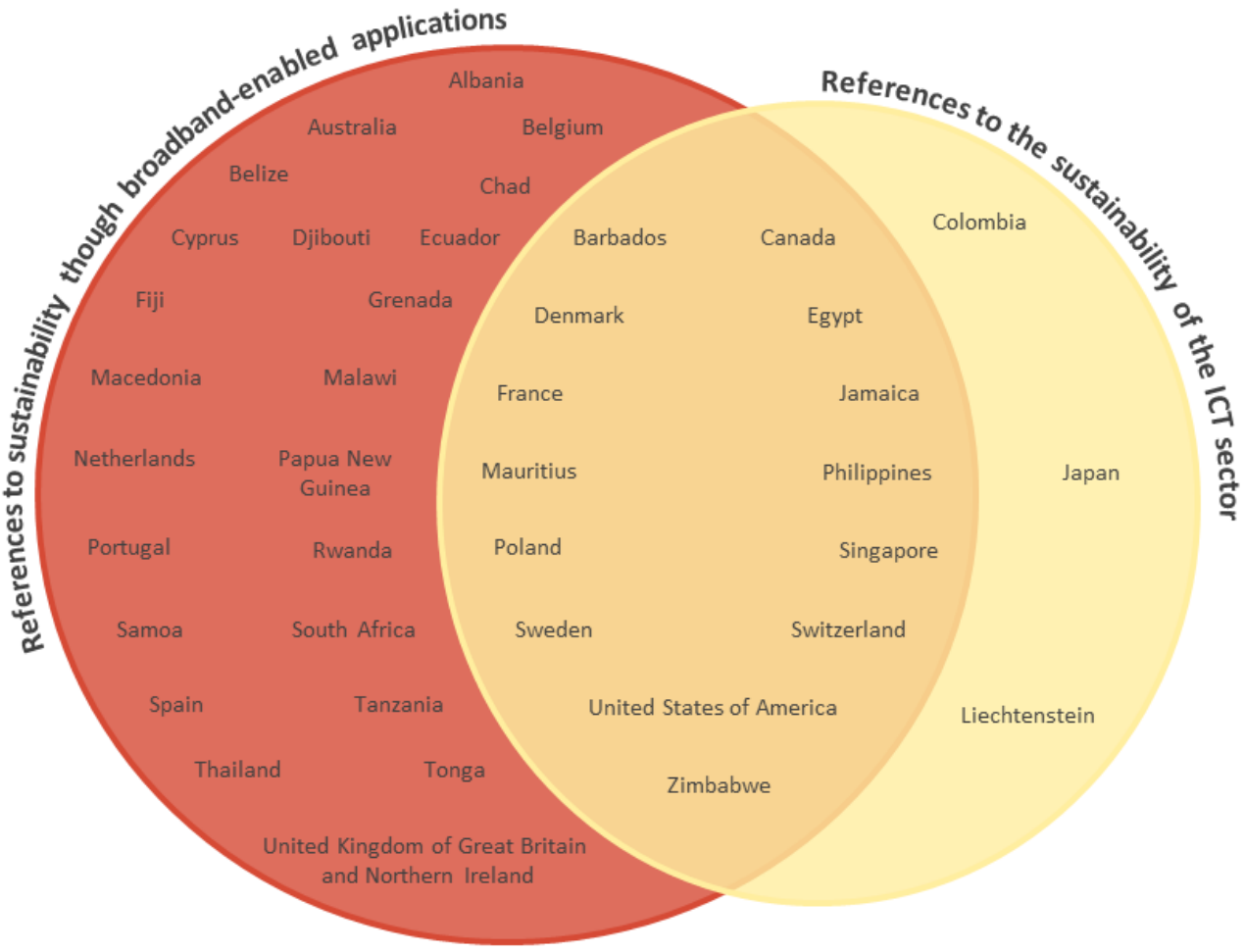
Figure 3a summarizes the result of this analysis, while Figure 3b presents the countries identified during the analysis grouped into the categories identified. Figure 3c presents a global snapshot looking at how environmental sustainability is featured by region.

FIGURE 3a INCLUSION OF ENVIRONMENTAL SUSTAINABILITY IN EXISTING NATIONAL BROADBAND POLICIES



Source: Authors, based on ITU ICT Eye regulatory database

FIGURE 3b COUNTRIES THAT HAVE INCLUDED REFERENCES TO ENVIRONMENTAL SUSTAINABILITY IN THEIR NATIONAL BROADBAND POLICIES



Source: Authors, based on ITU ICT Eye regulatory database

BOX 3.1 INTRODUCING NATIONAL BROADBAND PLANS

Since approximately 2008 the introduction and implementation of broadband plans as tools to stimulate broadband deployment has blossomed around the world. Approaches include measures such as: legal and regulatory policies, universal access policies and policies supporting private sector broadband network build-out, as well as strategies, plans, programs aiming to develop broadband networks and services. The majority of these documents have been produced by the relevant government ministry, but some have been produced by the independent regulatory authorities established in countries in which the telecommunication market is open to competition. In some cases these plans have been produced with the support of external bodies and international organizations such as ITU or the United Nations Economic Commission for Africa (UNECA)[42].

From 2010 to 2011 there has been more than 20 per cent growth of broadband policy adoption, driven by growing recognition of the impact of broadband on national goals, including its positive contribution to GDP (through productivity gains and employment) and a resource for economic recovery.

ITU flagship reports on ICT regulation: *Trends in Telecommunication Reform 2011 and 2012*[43] describe general elements that government officials and others should be aware of as plans are designed. However, a "*one size fits all*" policy solution for broadband roll-out could have negative implications for the ICT market and therefore each broadband plan should be tailored to the national circumstances, economic and political situation, legacy structures, incumbent strengths, liberalization and competition status of the country. Summing up, the following components should be considered when developing a broadband plan[44]:

- Establish specific plans and policies that define broadband development and contain concrete, measurable objectives, including different goals to be addressed;
- Ensure that plans address mechanisms for improving the supply of broadband through infrastructure build-out as well as for promoting demand for broadband services and applications;
- Allow ample opportunity for stakeholders input in developing the plan and cross-sectoral considerations, include top-down versus bottom-up considerations to setting targets;
- Be realistic when establishing objectives, recognize and take into account that the implementation of a plan will take time and persistence;
- Focus on long-term success by developing sustained, focused efforts (with continual updates) over a number of years;
- Avoid seeking a "one-shot" or "one size fits all" solution that can be achieved with minimal time and resources;
- Assign one coordinating agency responsible for the implementation of the plan and other entities involved;
- Models of financing the implementation and means;
- Promote technology neutrality to avoid restrictive or technology biased policy solutions.

Source: ITU; The World Bank

3.2 Selected policy elements

The national broadband policies analysed included several relevant elements that showcase how governments are currently taking account of and addressing environmental sustainability within these policies (see Figure 3c). These references provide concrete elements and solutions that ministries of communications/ICTs and/or regulators could take into account when preparing or reviewing their own national broadband policies. A further breakdown is presented in Figure 3d.

Overall, smart technologies are the most referenced broadband-enabled solution to aid in achieving environmental sustainability, with a total of 20 references in the plans analysed. These references include smart traffic monitoring, individual home monitoring and city-wide energy management through smart grids, power generation and distribution monitoring. With regards to addressing the environmental sustainability of the ICT sector the most referenced solution is the identification of measures to promote energy-efficient ICT infrastructure. This reference has been included in 11 national broadband policies across 6 geographic regions.

High-income countries tend to focus on carbon abatement strategies, whereas developing nations envisage environmental sustainability through the preservation of biodiversity and eco-friendly development. In particular, countries within the European region are taking the lead in promoting the use of teleworking and video conferencing[45] through their broadband policies whereas countries in the African region lead in the promotion of content to manage the environment (databases) and to educate about environmental sustainability. Other solutions identified during the analysis include the use of broadband to improve disaster management, and measures to deal with e-waste.

With regards to the omissions identified in these plans, analysis indicates that across the wide range of broadband policies reviewed few mention establishing measureable goals either for the environmental sustainability of the ICT sector itself or for measuring the effectiveness of promoting broadband-enabled solutions to achieve efficiencies in other sectors. Additionally the adoption of specific metrics in varying socio-economic contexts would require a strong empirical research component and additional effort or funds. This lack of metrics is certainly a call for action on the part of international and regional organizations to help incorporate specific targets and to establish tools and processes to support the assessment of progress towards meeting these targets.

Estimates of how much ICTs, in particular broadband, can reduce global GHG emissions and estimates of the emissions generated by the ICT sector itself still vary widely in part due to the application of different measurement methodologies. To address this issue ITU has been developing a set of standardized methodologies to assess the environmental impacts of ICTs, both in terms of GHG emissions produced by the ICT sector as well as the potential CO2 emissions-savings obtained through green-ICT applications in other industry sectors (see Box 3.2). The use of this set of methodologies will allow a better understanding of the positive contribution that ICTs can contribute to the achievement of MDG7, as well as the actions to be undertaken by the ICT sector to reduce the environmental footprint of the ICT sector as a whole. The adoption and application of this set of methodologies is in line with the recommendations developed by the Broadband Commission in the publication *The Broadband Bridge: Linking ICT with climate action for a low-carbon economy*.

After introducing this global overview, chapters 4 and 5 will present, respectively, the concrete examples of two countries, Australia and Rwanda, who have featured environmental sustainability as a key element in their national broadband policies. These two countries have complemented the references to environmental sustainability in their broadband policies with relevant references to ICTs within their national environmental policies, showcasing the type of collaboration across governmental agencies that is required to leverage the unique opportunities that broadband can provide to accelerate the achievement of MDG7 at a national level.

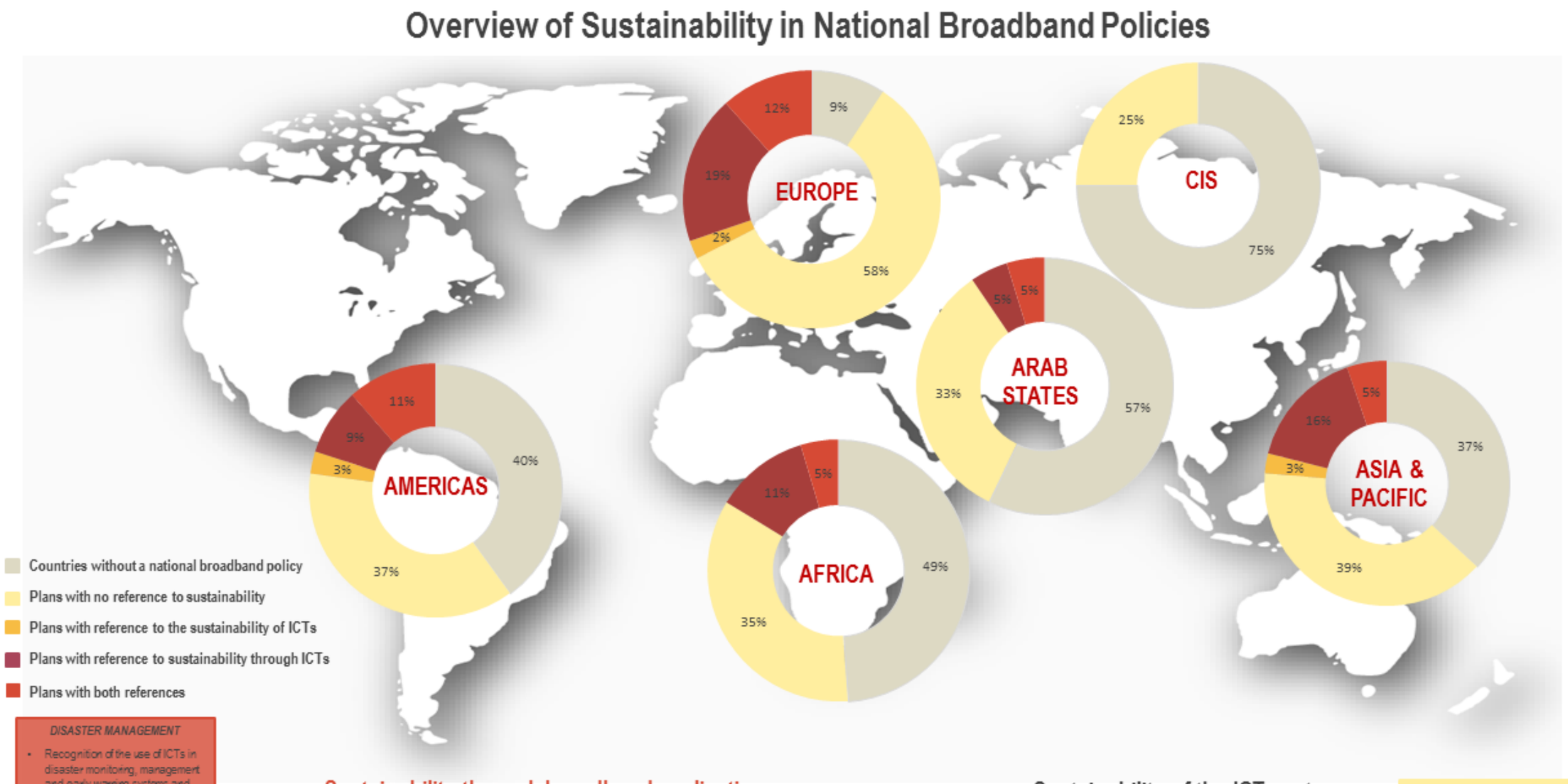
BOX 3.2 – METHODOLOGIES FOR ASSESSING THE ENVIRONMENTAL IMPACT AND GAINS OF ICTS

Methodologies developed within ITU-T Study Group 5, in cooperation with over 60 organizations including major ICT private sector participants, the UNFCCC and UNEP.[46]

Recommendation	Description	Details
ITU-T L.1400	Overview and general principles of methodologies for assessing the environmental impact of ICTs[47]	General principles on how to assess the environmental impact of ICT. Presentation of different methodologies being developed to assess the environmental impact of (a) ICT goods, networks, and services; (b) ICT projects; (c) ICT in organizations; (d) ICT in cities; and (e) ICT in countries or group of countries
ITU-T L.1410	Methodology for environmental impacts of ICT goods, networks and services[48]	Standardized way to assess the direct environmental impact of ICT goods, networks and services, as well as their indirect impact on GHG emissions of non-ICT industry sectors[49]
ITU-T L. 1420	Methodology for energy consumption and GHG emissions impact assessment of ICTs in organizations[50]	Requirements that an organization should comply with when assessing energy consumption and GHG emissions

Source: ITU

FIGURE 3c OVERVIEW OF ENVIRONMENTAL SUSTAINABILITY IN NATIONAL BROADBAND POLICIES. SOURCE: AUTHORS, BASED ON ITU ICT EYE REGULATORY DATABASE



Sustainability through broadband applications

DISASTER MANAGEMENT

- Recognition of the use of ICTs in disaster monitoring, management and early warning systems and their use in improving the response to climate change related natural disasters.

Examples:
Thailand, Poland

PROMOTING TELEWORKING/ VIDEO CONFERENCING

Creation of the necessary conditions for the deployment and use of ICTs for the development of teleworking with the aim of relieving congestion on the transport infrastructure and thereby reducing traffic emissions and infrastructure repairs.

Examples:
Switzerland

SMART TECHNOLOGY

Highlighting the use of ICTs to enable other economic sectors to manage resource utilisation through smart buildings and smart grids.

Identifying investments to fund ICT infrastructure that supports efficient energy generation, distribution and consumption.

Requesting electric utilities to provide consumers access to, and control of, their own digital energy information from smart meters.

Examples:
US, Ecuador, Singapore

MONITORING AND ONLINE DATA ACCESS

Identifying national and district levels projects designed to protect natural resources, the environment and the natural wealth through the creation of Geographical Information System (GIS) databases, in some cases based on remote monitoring.

Promoting use of ICT networks for increased access to information on natural resources.

Examples:
Rwanda, Macedonia,

EDUCATION ABOUT ENVIRONMENTAL SUSTAINABILITY

Raising awareness of environmental reporting authorities and encouraging citizens to take action in the face of environmental crimes.

Designing projects to showcase solutions for intelligent energy management, smart grid technology and video conference facilities.

Examples:
Papua New Guinea, Denmark

Sustainability of the ICT sector

EDUCATION ABOUT THE SUSTAINABILITY OF ICTs

- Promoting sustainable use of ICTs (in particular devices) and awareness raising of their impact on the environment.

Examples:
Poland, Philippines

ENERGY EFFICIENT ICT INFRASTRUCTURE

- Promoting the adoption of ICTs to allow more energy efficient equipment, greening of data centres and ICT infrastructure.
- Working with private and public sector partners to identify areas of collaboration and spearhead the adoption of Green ICTs.
- Researching the optimization of the energy consumption of data centers and the reuse of energy.

Examples:
Spain, France, Egypt

MANAGEMENT OF E-WASTE

- Creating a comprehensive policy frameworks and implementation plans to address e-waste
- Promoting public education on the challenge of e-waste.

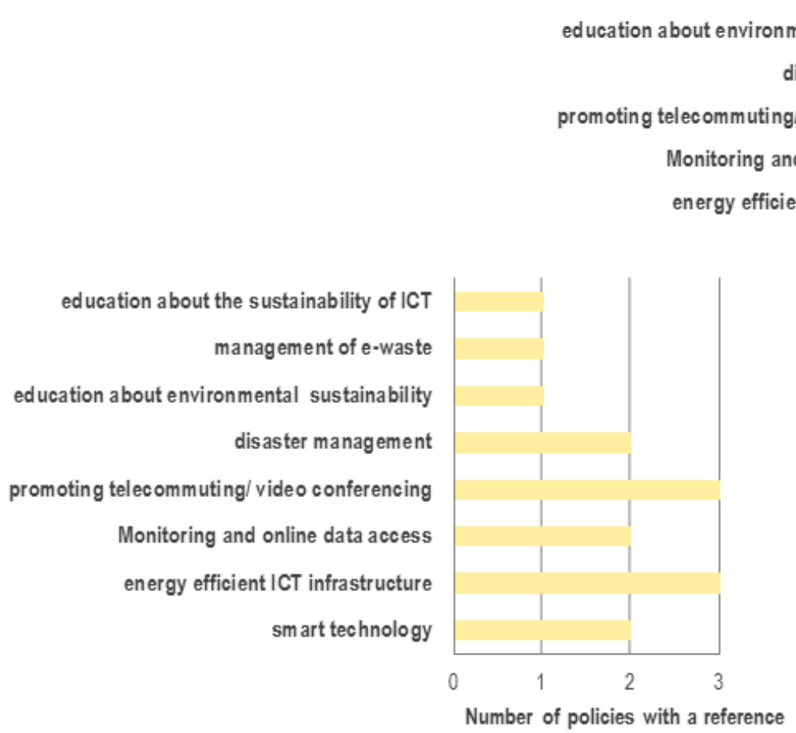
Examples:
Philippines

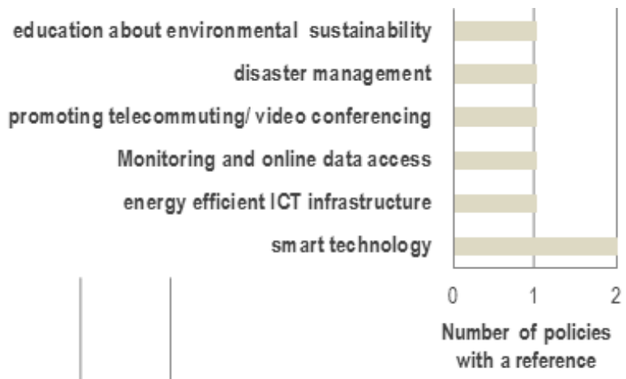
GREEN POWER SOURCE FOR ICT INFRASTRUCTURE

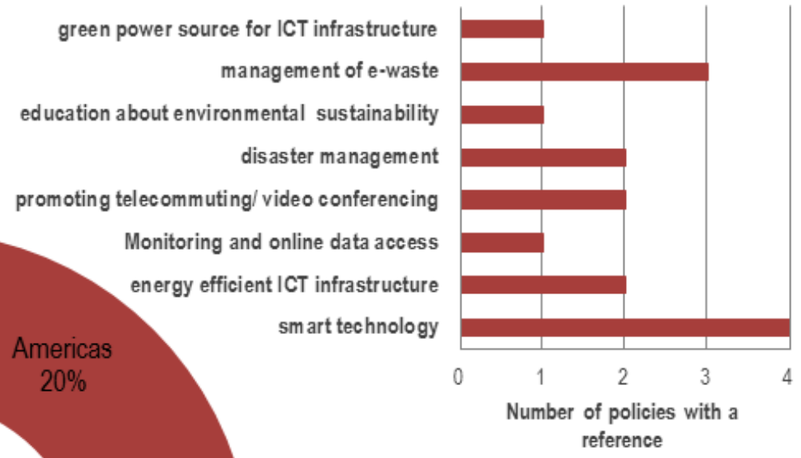
- Highlighting and identifying sustainable, renewable, environmentally friendly energy to power ICT infrastructure technologies.

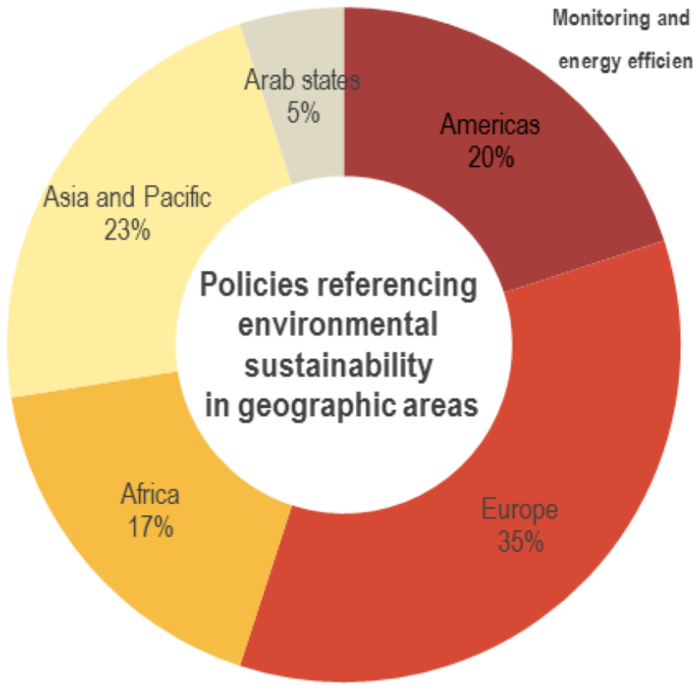
Examples:
Barbados, Mauritius

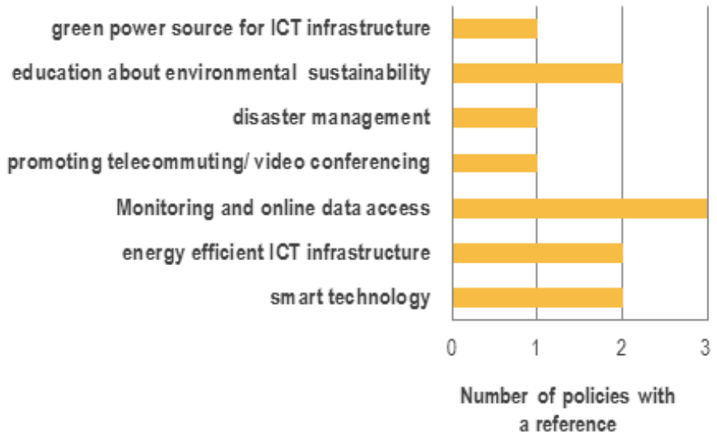
FIGURE 3d POLICY ELEMENTS RELATED TO ENVIRONMENTAL SUSTAINABILITY INCLUDED IN NATIONAL BROADBAND POLICIES

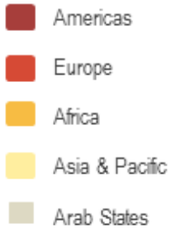


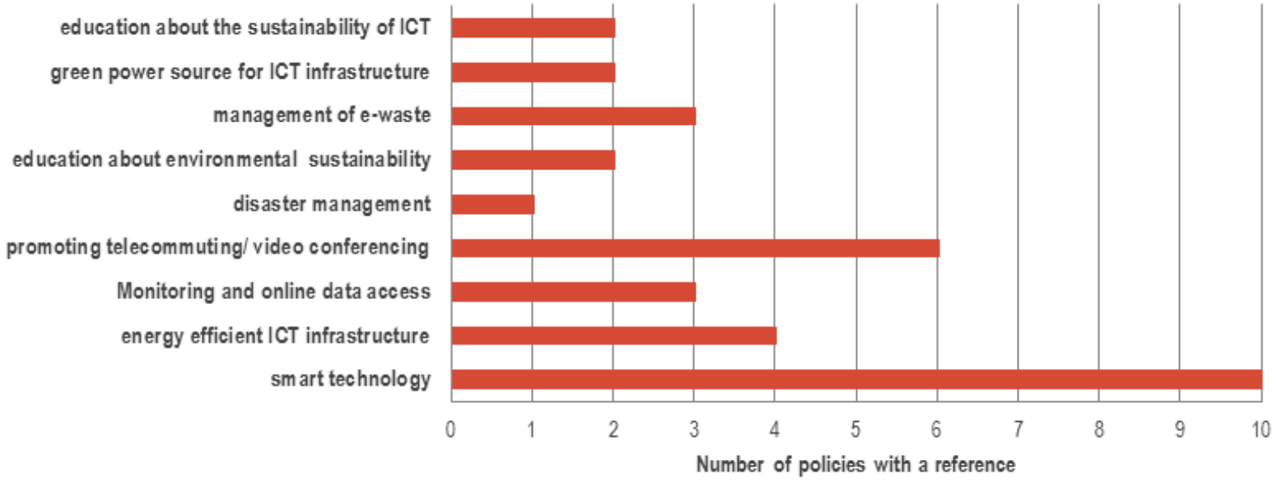












4 AUSTRALIA: LONG TERM ICT AND ENVIRONMENTAL SUSTAINABILITY STRATEGIES

In many respects Australia is a unique country experiencing a solid growth in a time of near global recession. However, like many nations it is affected by the challenges presented by a carbon intensive economy, which have been amplified by extreme natural conditions and particularly fragile ecosystems, placing the long term environmental sustainability of the country at risk. As a response to the various pressures of anthropogenic activities on the long term economic development and the social and environmental stability of Australia, the government has adopted a range of adaptation and mitigation strategies aimed at addressing issues such as GHG emissions, biodiversity loss and natural resource depletion.

With regards to the ICT sector, Australia has exhibited remarkable progress in the past few years in terms of broadband deployment. In spite of the country's geographical asymmetry and its initial lag in broadband adoption and speeds [51], its government-led efforts have focused on providing households with high-speed broadband connections and fuelled economic growth. A 2010 report by the Allen Consulting Grou [52] estimated the economic benefits of broadband for Australia at 0.44 per cent of GDP for every 10 percentage point increase in broadband penetration.

This chapter reviews the policy approach adopted by Australia to achieve its sustainability objectives, with particular focus on the integration of sustainability within Australia's national broadband plan for progressing environmental actions.

4.1 Australia's broadband policy: the NDES and the NBN

In order to realise the potential of broadband in Australia, the enouncement of the National Broadband Network (NBN) was followed up with the launch of the government's *National Digital Economy Strategy (NDES)*[53]. The NDES sets out the vision for Australia to attain the full benefit from the government's investment in the National Broadband Network (NBN) and position Australia as a leading digital economy by 2020. To achieve this vision, the strategy outlines eight Digital Economy Goals (*see Box 4.1),* as well as a set of government and industry initiatives.

The *National Broadband Network (NBN)*[54]*,* was announced in 2009 and final legislation was passed in early 2012. This new high-speed broadband network will provide access to high-speed broadband to 100 per cent of Australian premises using a combination of optic fiber, fixed-wireless and satellite technologies. The NBN will provide 93 per cent of premises with access to high-speed fiber network capable of providing broadband speeds of up to one gigabit per second (Gbps). The remaining premises will have access to the NBN through next-generation fixed-wireless and satellite technologies providing peak minimum speeds of 12 megabits per second (Mbps).

The legal framework and model of implementation chosen by the Australian Government are to keep network ownership and operation at arm's length from retail service provision to promote fair and effective competition. With the introduction of this structural form of separation through a publicly owned wholesale-only company, the Australian Government has superseded more traditional accounting and functional separation implemented in other national contexts. Australia's NBN Co[55], a publicly owned company, has been charged with building and operating a wholesale-only, open access, high-speed broadband network, with an estimated investment of AUS$ 37.4 billion to connect the majority of premises with fiber-to-the-premises (FTTP) technology, capable of providing broadband speeds of up to one Gbps[56]. In doing so, the country aims at significantly improving the quality and availability of broadband services. NBN Co designs and rolls out the network, only selling wholesale services to providers who in turn offer retail services to consumers. This is a significant structural change in Australia's telecommunications industry, aimed at encouraging further retail competition into the country. Box 4.2 presents a summary of current progress in the deployment of the NBN.

BOX 4.1 THE 8 GOALS OF THE NDES

- Increase Australian households' online participation
- Increase Australian business' and not-for-profit organisations' online engagement
- Smartly manage our environment
- Improve health and aged care
- Expand online education
- Increase teleworking
- Improved online government service delivery and engagement
- Increase digital engagement in regional Australia.

Source: NBN Co

BOX 4.2 – PROGRESS TOWARDS THE DEPLOYMENT OF THE NBN (AS OF AUGUST 2012)

Fiber rollout. In June 2012 Telstra, the incumbent Australian telecommunications operator, agreed to allow NBN Co to use its infrastructure for AUS$ 11.6 billion. Under this deal the project will use Telstra's existing fiber backbone network and national system of ducts to roll out fiber premises across the country as the basis of the high-speed network[57]. A similar arrangement followed with the country's second operator SingTel Optus worth $800 million. By July 2012 commercial services were already available in twelve Australian communities, with construction of the network underway or complete to more than 400,000 premises in more than 50 communities. NBN Co will roll out the network in a series of modules, covering between 2000- 3,000 premises in each location. On the retail side of the project, by mid-2012, 41 retail service providers had contracted to provide services using the NBN. Pre-launch customer research has shown predicted uptake rates of 80% plus, with already close to 40% real take-up in some of the first release sites.

Fixed wireless and satellite rollout. NBN Co has begun announcing the national fixed wireless rollout, which it expects to complete in 2015. Trial fixed wireless services are now available in three communities.. There is currently an interim satellite service in use until the launch of the long-term service in 2015. Over 11,400 users were accessing this service in regional and remote areas as of 27 July 2012. The NBN long-term satellite service, which is expected to be launched in 2015, includes the delivery of two new Ka-band satellites and associated tracking, telemetry and control systems.

Regional Backbone Blackspots Programme (RBBP). The government has already invested AUS$ 250 million to fill in backbone black spots throughout Australia. Enhancing backbone competition assists broadband and other telecoms providers to improve the range, quality and price of the services they offer in regional areas. This programme has had an immediate economic effect, reduced the cost of broadband services and deployed key infrastructure for the NBN. Construction along all five RBBP links[58] is now complete. and 6,000 km of fiber optic backbone has been rolled out under this initiative. Internet service providers are offering new and improved services in these communities.

4.2 Review of sustainability principles in Australia's broadband policy

The NDES identifies increasing population pressure, together with a changing climate, as two challenges that will alter Australia´s natural environment, and that will have a significant impact within the country. To address these issues, the plan concentrates on using broadband applications to mitigate negative environmental effects through improving Australia's environmental sustainability. The approach adopted in the plan is to support smart technology applications that will allow for a more efficient use of water and energy resources, as well as of infrastructure (in particular transport). The plan also encourages more sustainable consumption patterns through the use of broadband technologies.

Two of the eight goals defined by the NDES relate directly to the environment (*see box 4.1*). In particular Goal 3, "*smartly manage our environment*" states that by 2020, the majority of Australian households, businesses and other organisations will have access to smart technology to better manage their energy use. The two leading government initiatives discussed in the plan under this goal are the *Smart Grid, Smart City* and *Sustainable Australia –Managed Motorways*- initiatives. Boxes 4.3 and 4.5 present the key elements of these two initiatives. The second of the NDES goals relevant to MDG7 is Goal 6 "*increase teleworking*", which has the aim of increasing the number of people teleworking to 12 per cent by 2020, an initiative that has a significant potential to reduce emissions resulting from transportation (*see Box 4.4*).

The following smart uses of technology are highlighted in the plan as elements to assist in the management of environmental challenges:

- Improving productivity and efficiency in use of energy infrastructure to assist maintaining energy needs and minimise environmental impact;
- Promoting increased adoption of teleworking, including within the government sector, assisted by the availability of ubiquitous high-speed broadband to all premises and businesses;
- Using sensors to enable more efficient use of existing infrastructure and transport systems and reduce pressure for new infrastructure;
- Reducing pressure on capital cities by allowing businesses to establish and conduct their operations online in regional and rural Australia, as easily as in a metropolitan area.

The Australian Government is also demonstrating some of the opportunities of the NBN to support and enhance the variety of jobs available in suburban areas through the AUS$ 45 million Suburban Jobs Program. The program will support employment hubs in suburbs of Australia's major capital cities, reducing travel times for residents between work and home and easing congestion on major transport routes in peak periods.

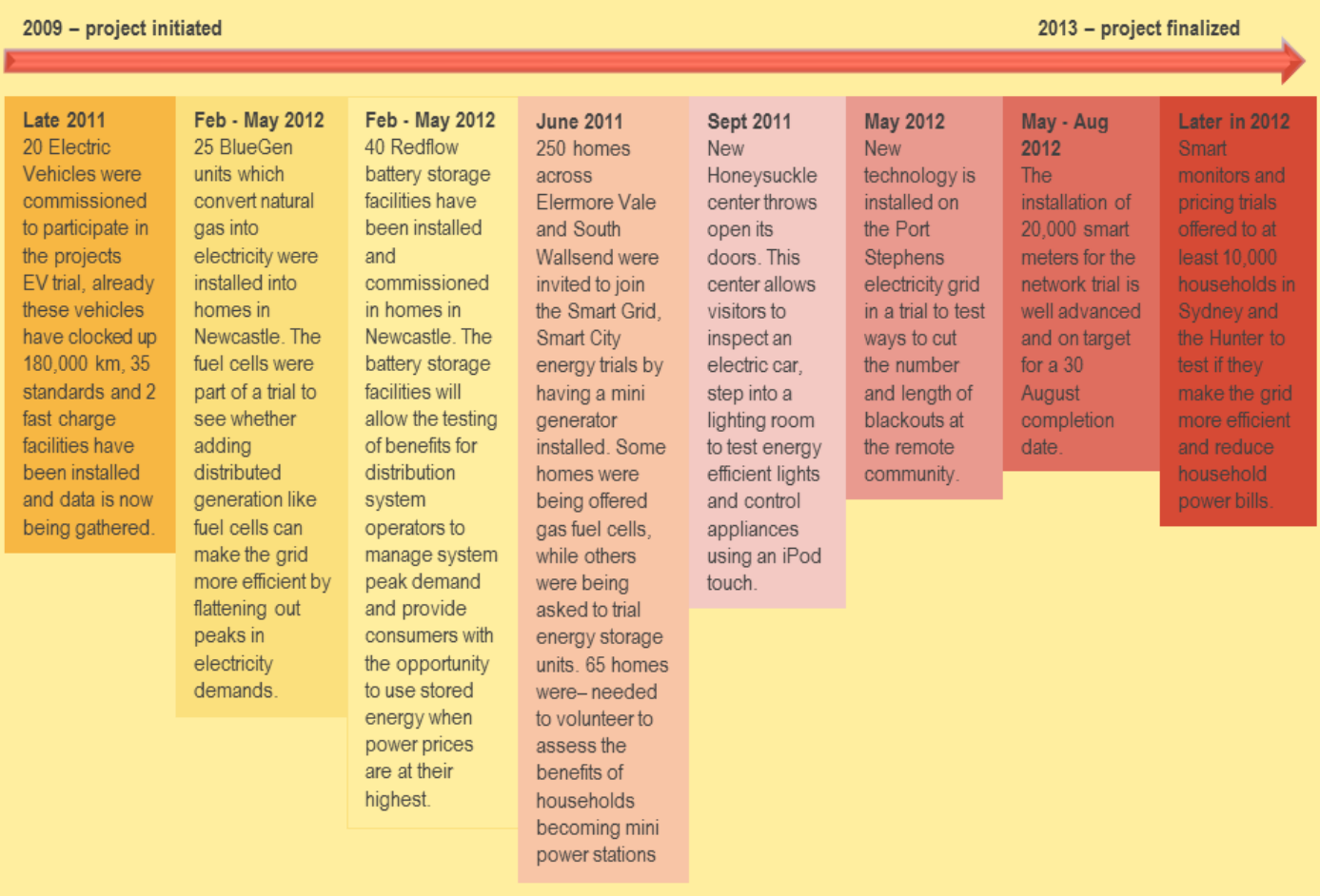
BOX 4.3 – SMART GRID, SMART CITY[59]

The Australian Government's *Smart Grid, Smart City* initiative, is a pre-deployment report completed by McKinsey and Co in August 2009 made a recommendation to Government to undertake this initiative — the project commenced in late 2009.

Following a competitive process, the Australian Government chose Ausgrid to lead the AUS$565 million project across five sites in Newcastle, Sydney and Hunter. The initiative creates a testing ground for new smart energy technologies and may change the way energy is used in Australia in the future. The project gathers information about the benefits and costs of different smart grid technologies in an Australian setting. As highlighted in chapter 2, smart grids combine advanced communication, sensing and metering infrastructure with the existing electricity network and have enormous potential to improve the efficiency of the electricity sector and transform the way Australians use energy in their homes and businesses.

To date the initiative is progressing well; the original targets have been surpassed and it is estimated that a significantly larger number of households than expected will be connected by 2013 when the project is finalised. It is anticipated that the results will be used for the government's plan for a national smart grid rollout.

To date the initiative is progressing well and significant progress has been made in regards to the selection and installation of specific technologies and applications. A large number of households have now been contacted to participate in the project, and acquisition of the expected 30,000 customers is well advanced.



BOX 4.4 TELEWORKING

Promoting increased adoption of teleworking is one of the key sustainability elements in the NDES, which defines the goal of achieving that 12 per cent of Australians telework by 2020. Despite the significant potential social, economic and environmental benefits of teleworking, the take-up of mainstream, formalised telework arrangements in Australia has been relatively low. This is partly due to the poor quality of broadband connectivity in Australia which has restricted the ability of employees to use tools such as video conferencing. By providing confidence in high-capacity communications the NBN provides an ideal opportunity to increase the level of telework in Australia.

One of the actions described in the NDES is the organisation of a forum to discuss the benefits of teleworking. The forum *Bringing Home the benefits of telework using the NBN*[60], held on August 2011, was the result of a partnership between the Department of Broadband, Communications and the Digital Economy and the Australian Information Industry Association. Its purpose was to provide a showcase of organisations that are using telework arrangements to make their businesses more successful and explore the possibilities for increased telework that the NBN will create and the environmental, economic and workforce participation benefits that would flow from that. It was also an opportunity to identify actions governments and industry could take to make these possibilities a reality.

Teleworking has become important in the broadband infrastructure debate and the information workers of Australia's economy. Over 100 enterprises across Australia, including large companies, industry organisations, not-for-profits and government agencies have responded to Senator Stephen Conroy, the Minister for Broadband, Communications and the Digital Economy's invitation to become Telework Partners with the Government, to promote the benefits of telework as part of flexible work arrangements.

The 2010 *State of Australian Cities* report[61] estimated that in 2005 the avoidable cost of road congestion for Australia's capital cities was AUS$9.4 billion, and this was projected to rise to AUS$20.4 billion by 2020. In the three largest cities (Sydney, Melbourne and Brisbane), all expected to grow rapidly, people living in the outer commuter regions are already spending more than four hours each day commuting to work. As Senator Stephen Conroy has noted: "*…with a 10 per cent increase in the number of people teleworking 50 per cent of the time, we could save 120 million litres of fuel per year, thus avoiding 320,000 tonnes of carbon dioxide—the equivalent of six million dollars' worth of emissions— and reduce traffic at peak periods by five per cent. This would result in a reduction of AUS$ 470 million in congestion costs*." The uptake of telework will not only reduce the carbon footprint of cities through reduced commuter traffic it will also reduce the demand for energy-consuming city offices, while supporting the productivity of the workforce. The Government's Telework Partners report savings in CBD office requirements of over 30%.

The social benefits of telework resulting from the reduced time, stress and cost of commuting and better work-life balance will promote the health and wellbeing of the workforce and increase the social capital of their residential communities.

4.3 Addressing the sustainability of the ICT sector in Australia

The NDES does not cover the sustainability of the ICT sector. However this area has been previously addressed in the *Australian Government ICT Sustainability Plan 2010-2015*[62], a specific ICT sustainability plan dealing both with the negative impacts associated with the use of ICTs, and the reductions in GHG emissions that can be achieved through broadband-enabled applications (see Box 4.6). In so doing, the Australian government is leading by example by addressing the broad range of environmental risks associated with the use of ICTs while also emphasizing the strengths of the sector. This sends a strong signal across the sector regarding the necessity to develop low carbon innovative solutions, one of the 10 key recommendations included in the report *The Broadband Bridge, linking ICT with climate action for a low carbon economy*.

The *Australian Government ICT Sustainability Plan 2010-2015* was prepared based on the recommendations of the 2008 Review of the Australian Government's use of ICTs (Gershon Review)[63], which recommended the government to align its ICT operations with its overall sustainability agenda, and to improve its ability to understand its energy costs and the carbon footprint of its ICT estate. Consistent with this view, the Government decided that the ICT sustainability plan should identify which of the available environmental standards should be adopted as mandatory; identify steps to develop a whole-of-government ICT energy consumption target, establish ICT energy intensity measures and/or targets and take into account potential implications of other ICT sustainability initiatives.

BOX 4.5 SUSTAINABLE AUSTRALIA – MANAGED MOTORWAYS[64]

Another of the government strategies highlighted in the NDES is the *Sustainable Australia – Managed Motorways initiative*. In the 2011-12 Budget, the Australian Government committed AUS$ 61.4 million to develop smart infrastructure technologies on Australia's motorways with the aim of reducing congestion and improving traffic demand management and the overall efficiency of the transport network in major cities. The National Smart Managed Motorways Program will operate from 2011-12 to 2014-15.

Managed motorways use system control through integrating data collection sensors and control tools to improve real time management of motorways to secure a higher and more consistent level of motorway performance. This results in travel time savings, improved reliability and reduced GHG emissions.

An initial set of projects eligible for funding have been identified by Infrastructure Australia. To date, funding has been approved to upgrade the existing managed motorway system on the M1 West Gate Freeway (Western Ring Road to Williamstown Road) in Victoria and to commence planning for a new managed motorway system on the M4 (Western Motorway) in Sydney; and the Gateway Motorway (Nudgee to Bruce Highway) in Queensland. In addition to upgrading existing infrastructure the Australian Government has started to require all new major urban road projects to incorporate a level of intelligent transport system technology in their design.

BOX 4.6 KEY ELEMENTS OF THE ICT SUSTAINABILITY PLAN 2010-2015

The *Australian Government ICT Sustainability Plan* 2010-2015 complements previous policies, guidelines and infrastructure in relation to climate change and improved environmental performance. The plan reinforces agency obligations under the Environment Protection and Biodiversity Conservation (EPBC) Act 1999, Energy Efficiency in Government Operations (EEGO) policy, e- Government strategy and other greening of government initiatives. It also takes into account other relevant Government and industry initiatives relating to product stewardship, in particular the National Packaging Covenant (NPC) and the National Waste Policy (NWP).

Environmental standards in ICT procurement. Australian Government agencies manage over 350,000 PCs, 14,000 servers, and 37,500 imaging devices, as well as a significant volume of ICT-related consumables, such as toner cartridges and copy paper. This volume raises significant environmental management concerns over the life cycle of products, their energy use, as well as their proper disposal and recycling. In this context, the plan introduces sustainable ICT procurement principles and practices. Such principles aim to promote more environmentally responsible products and services, improve product stewardship, avoid unnecessary demand and consumption, and assess ICT products on a life cycle impact basis. These principles are introduced through the use of mandatory environmental standards incorporated into procurement policies, which set a minimum level of environmental performance for relevant ICT acquisitions.

Energy and carbon emission management. The Australian Government is committed to improving energy efficiency, GHG emission management and environmental performance in the ICT operations of the government. To this end, large agencies are required to implement an ICT energy management plan that will facilitate improvements in technology, infrastructure and practice. These plans will include improvements from the *Green ICT Quick Wins* and the *Australian Government Data Centre Strategy 2010-2025*, which will have a considerable impact on energy efficiency and carbon emission performance across government[65].

Agency targets. The plan sets targets for agencies across their ICT operations, set at ambitious levels that can trigger significant changes. Agencies will implement ICT sustainability initiatives to improve performance equal to or beyond the targets indicated, which excludes the performance of regional and remote offices with less than 20 employees.

Using ICT to enable broader sustainability. The plan requires agencies to incorporate in their decision-making processes consideration of the effective use of technologies to promote sustainability across its economic, social and environmental dimensions. The vision of the plan is to promote transformational change at both organisation level and system level. Its initiatives are, therefore, linked to an agency's non-ICT operations as well as the policies and programs of the overall Australian Government.

4.4 Conclusions

Australia has provided an example of a country that is addressing both supply and demand policies for its national broadband network. It wants to use this infrastructure for a range of digital developments in the country and has included environmental sustainability as a key element within its national broadband policy (the NDES). As a developed country, the broadband-solutions promoted through this plan are focused on resource efficiency and the development of innovative new models through the use of smart policies and smart technologies that will lead to business and industry transformations aimed at providing economic and social benefits to the country, as well as to reduce the environmental footprint of ICTs. The references to MDG7 are not direct, but the policies and projects described above will aid to achieve some of the independent targets and indicators included in this goal for example target 7.2

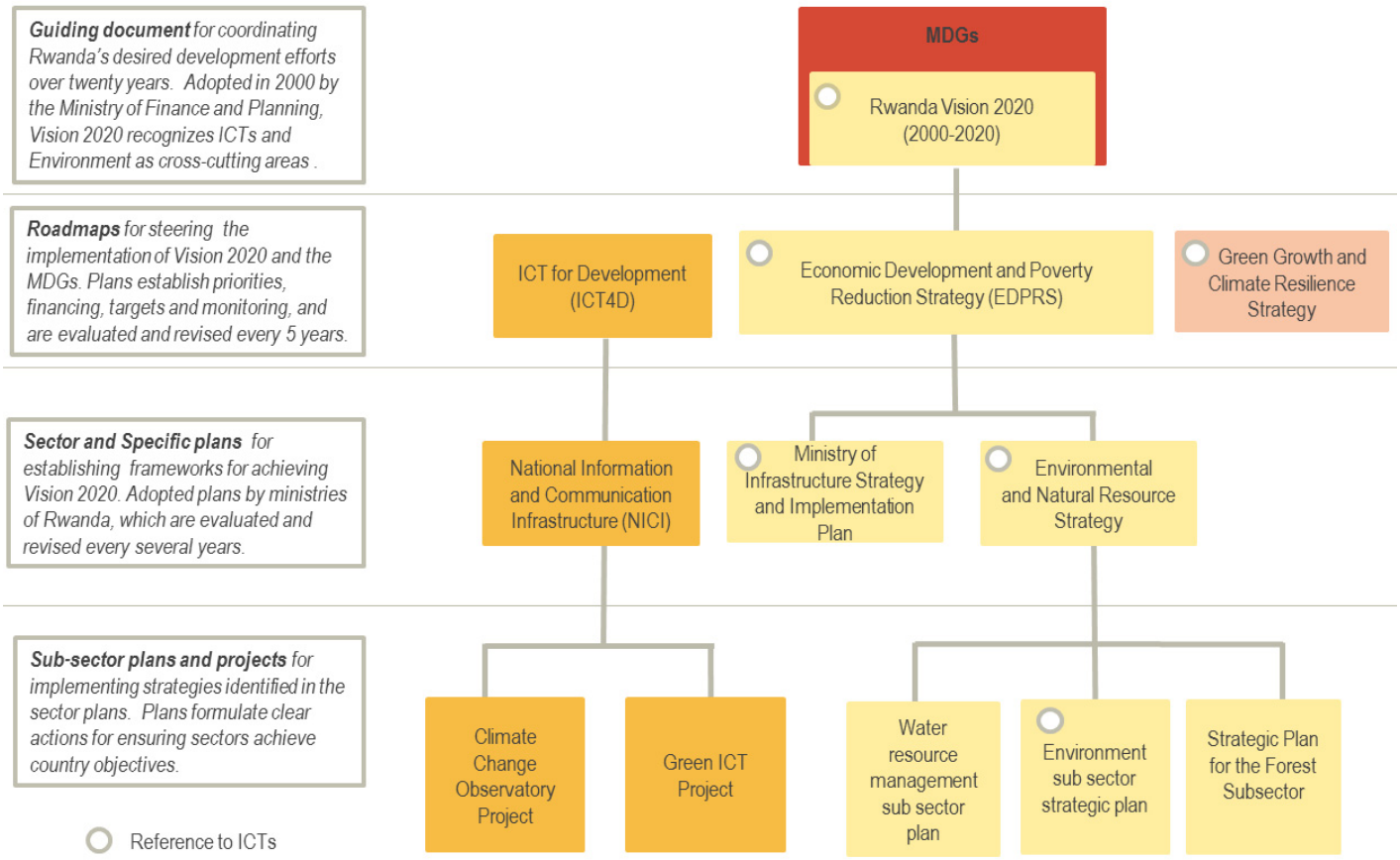
5 RWANDA: LONG-TERM ICT AND SUSTAINABILITY STRATEGIES FOR ACHIEVING DEVELOPMENT

Rwanda's approach to development has been based on the multi-disciplinary, cross-sectoral strategy adopted by the Government of Rwanda. Recovering from the 1994 civil war, Rwanda launched a national consultative process over 12 months that would lay the foundation for Rwanda's strategy to sustainably transform the country to a knowledge based, middle income country through long-term growth, prosperity and achievable socio-economic goals. The outcome was *Vision 2020*[66], a plan that has unified the country's transition under visionary goals and priorities, including ICT and environmental aspirations for a 20-year period. Practical implementation of the vision is steered by medium term sector strategies that establish a framework for achieving development, environmental and ICT objectives, as well as tracking progress towards achieving the MDGs.

Rwanda's approach seeks to foster the country's economic growth while combatting challenges of environmental degradation attributed to a growing population largely dependent on natural resources and placing increasing pressures on land, ecosystems and natural resources, through the deployment of broadband and ICTs. *Vision 2020* and the subsequent sector plans try to address most of the barriers that impeded past efforts of environmental conservation, which included unclear-long term strategies for environmental mainstreaming, as well as lack of capacity and strategy within environmental institutions. Figure 5a presents a summary of the different levels of public policy in Rwanda highlighting how these policies link environmental sustainability, ICT development and the achievement of MDG7.

Rwanda has been selected as a case study for a number of reasons. First, it highlights the importance of political determination in shifting the national focus from the traumas of post war conflict to a rapidly changing technological landscape with global effects. Second, Rwanda's long-term version has anchored and integrated ICT and environmental strategies and policies, steering investment and uniting sectors around a common goal. Through the National Infrastructure and Communication (NICI) plan and Economic Development and Poverty Reduction Strategy (EDPRS) the country has moved from project specific to target oriented milestones that allow for the recalibration of objectives and targets within the existing socio-economic context. Fourth, Rwanda has understood its global position and manifested the importance of acting in a local policy-making manner with a global understanding and appeal. These reasons are critical in shaping the current and future broadband strategies in the country and mitigating the benefits from its use to the population and environmental welfare.

FIGURE 5a GOVERNMENT OF RWANDA ICT AND SUSTAINABILITY FRAMEWORK



5.1 Vision 2020: Guiding 20 years of development through integration of ICTs and sustainability

Vision 2020 is the blueprint adopted by Rwanda to become a modern, strong and untied nation. In view of the country's shortcomings related to development, environmental protection and ICT uptake, the twenty-year vision comprises six main pillars and three cross-cutting issues (see Figure 5b). Environmental protection and sustainable natural resource management and science technology -including ICTs-, are recognized as two of the cross-cutting issues, development priorities and key catalysts for achieving the country's economic transformation. Guiding the implementation of the pillars and cross-cutting areas, the vision includes short, medium and long term priorities, targets, indicators and a roadmap for financing and planning.

The Government of Rwanda has translated *Vision 2020*'s focus on ICTs and environmental protection translated into achievable programs, including ICT for Development (ICT4D) process and the Economic Development and Poverty Reduction Strategy (EDRPS).

FIGURE 5b PILLARS OF VISION 2020 AND ITS CROSS CUTTING ISSUES

Pillars of Vision 2020	Cross-cutting areas of Vision 2020
1. Good governance and a capable state	1. Gender Equality
2. Human resource development and knowledge based economy	2. Protection of environmental and sustainable natural resource management
3. A private sector-led economy	3. Science and technology, including ICTs
4. Infrastructure development	
5. Productive and Market Oriented Agriculture	
6. Regional and International Economic Integration	

Source: Vision 2020

BOX 5.1 VISION 2020 ICT AND SUSTAINABILITY GOALS AND TARGETS

As related to the country's aspirations to transition to a knowledge-based economy with a vibrant class of entrepreneurs, Vision 2020 recognizes the critical role of policies that promote investment in ICT infrastructure. The vision also considers that stimulating the participation of private sector in the country is not achievable without providing the work force with a high level of education in science and technology, as well as providing them with better access to ICTs.

To achieve this, Rwanda envisages by 2020 achieving access to Internet at all administrative levels, for all secondary schools and for a large number of primary schools. In addition the plan aims at expanding telephone service in rural areas and introducing further e-government services and principles to improve the efficiency in the delivery of public services.

In regards to sustainability, Rwanda recognizes that good governance includes efficiency in deploying scare resources and utilization of land in a sustainable manner. Regarding energy, the State seeks to increase energy production, whilst diversifying into alternative energy sources, including renewable methane, direct solar energy. Related to Target C of MGD7, Rwanda seeks for all citizens to have access to drinkable water by 2020, requiring an increase to the rate of access by 2.5 percentage points annually from the current rate of 52 per cent, and all rural and urban areas to have sufficient sewage and disposal systems.

5.2 ICT4D: Rwanda's ICTs and Broadband Strategy

ICTs are recognized in *Vision 2020* as a catch up mechanism and enabler for "*leapfrogging the key stages of industrialization*"[67]. Consequently, the government launched the ICT4D process in 1998. Key outputs of the ICT4D process include the establishment of the ICT-led Integrated Socio-economic Development Framework for Rwanda [68] (Framework), the ICT for Development (ICT4D) policy in 2001, and four five-year rolling National Information and Communication Infrastructure (NICI's), as summarized by Figure 5c.

The Framework serves as a cornerstone of Rwanda's strategy for accelerating the development of ICTs and provided the basis for the development of the subsequent Policy document and Plan. ICT4D policy establishes specific policy commitments for the Government of Rwanda, based on the needs and aspirations of *Vision 2020*. NICIs are the guiding plans for steering the country's deployment of ICTs and run parallel to *Vision 2020*.

FIGURE 5c EVALUATION OF ICT4D PROCESS, FOLLOWING IMPLEMENTATION OF NICI-2005

Goal	To engineer an ICT-led socio-economic development process with the potential to transform Rwanda into a middle-income, information-rich, knowledge-based and technology-driven economy and society.
General Question Being Addressed	How to address Rwanda's developmental challenges and accelerate the nation's socio-economic development process to improve the people's socio-economic well-being.
Basic Premise	Rwanda's development process can be accelerated through the development, deployment and exploitation of ICTs within the economy and society.
Basic Motivation	Rwanda's accelerated development within the emerging information and digital age will not be possible without an ICT-enabled development agenda.
Key Process Outputs	• The Framework • The ICT4D Policy (based on a Framework) • A Number of Rolling (ICT4D/NICI) Plans • Implementation Structures and Institutions
Key Drivers (Policy and Plans)	• ICT as a social enabler (education, health, poverty-reduction, income-distribution); • ICT as an enabler of rapid economic and industrial development; • ICT as an enabler of Government, administration and service delivery; • ICT as an enabler of the agriculture sector; • ICT as a driver of private sector development; and • ICT as an agent for wealth creation.

Source: NICI-2010

BOX 5.2 - ICT4D POLICY

Key areas of the ICT4D policy include, to:

- Create and facilitate an enabling environment for the development of the national information society and economy and develop and deploy the necessary human resources to support the such society and economy;
- Develop standards, best practices and guidelines to guide the deployment, exploitation and development of ICTs, in particular in educational centers and to support the operations of the civil and public services;
- Set up adequate national ICT structures and bodies, including enacting necessary cyber laws and legislative provisions;
- Facilitate and promote the implementation of national ICT applications, involving key national stakeholders and civil society in the process of developing a local ICT industry;
- Implement special tax packages, instruments and incentive programs to create an investment climate in the ICT sector to promote the development of the information economy;
- Promote and support research and development (R&D) initiatives directed at the development and exploitation of the opportunities of the information society and economy;

Promote universal access to ICTs.

5.3 NICI PLANS

The NICI's define the implementation of Rwanda's ICT goals and strategy. Figure 5d highlights the timeframe and rollout of the NICI's, which are envisaged to run in parallel to *Vision 2020*. In Rwanda's quest to become an ICT hub, the plans seek to promote an enabling environment, deploying world-class ICT infrastructure and a highly skilled human resource base. The NICI planning process comprises four NICI plans and is premised on the principle of building upon on the achievements of previous iterations. These four plans are not distinct, mutually exclusive, self-contained plans but rather rolling plans – with one plan rolling into another.

FIGURE 5d MAIN PILLARS FOR RWANDA´S NATIONAL ICT AGENDAS

	2000	2005	2010	2015	2020	2030	2040	2050
	Vision 2020				Vision 2050			
Plan	**NICI-2005** *(or NICI-I)* 2001-2005	**NICI-2010** *(or NICI-II)* 2006-2010	**NICI-2015** *(or NICI-III)* 2011-2015	**NICI-2020** *(or NICI-IV)* 2015-2020				
Focus	Infrastructure	Education	Services & Environmental Focus		Low Poverty/ Unemployment			

Source: Authors

The second National ICT Plan of Rwanda (NICI-2010) was the first plan to include references to environmental sustainability. The plan focused on the use of ICTs in everyday activities, introducing several elements to maximize the opportunities that the country could get from further exploiting the capabilities of these technologies.

In terms of its links to environmental sustainability, as one of its activities the plan included the deployment of an on-line repository for biodiversity information exchange within the e-Rwanda [69] initiative. This activity also included the development of an extensive and frequently updated environmental knowledge base. The description of this action and a detailed project management, risk and feasibility plan are all detailed within the NICI-2010.

The website has been running for a few years and its content has been significantly expanded. While not generally departing from the provision of location specific information it now expands to visitor and tourist updates and social media updates. It also extends to other environmental reserves in the wider region of Burundi, Uganda, Tanzania and Kenya, thus highlighting the importance of preservation of national parks, lakes, as well as the tourist zones of the Serengeti Park.

The review of the NICI-II achievements in 2011 showed that its implementation has enabled Rwanda to strengthen the foundation laid during the NICI-I. It further improved the country's progress towards sustaining its economic development and growth.[70]

The ICT4D process is currently in its third phase, the NICI-2015 [71], which moves away from project specific actions towards more results-orientated goals, allowing the monitoring of project progress and timely evaluation, thus giving the potential for corrective actions. In principle, NICI-2015 aims to accelerate service development through ICTs. The next five years will be the most critical to Rwanda's transformation into a knowledge-based economy as the plan aims to accelerate service development and advance Rwanda's development agenda. The implementation of NICI-2015 will have annual and biennial project cycles to ensure that the initiatives adapt to socio-economic changes and

emerging technologies. This phased approach ensures that projects are executed with clear outcomes that are aligned with the overall focus area mission and objectives of the plan.

Related to environmental sustainability, NICI-2015 recognizes that opportunities of Green ICTs, highlighting the need to increase stakeholder awareness, introduce environmental regulations, address rising energy costs and provide incentives for "greening" businesses. Through the reduction in CO2 emissions, the IT industry can save billions of dollars and garner more money in electric utilities rebates. Additionally, ICT refurbish programs, in which refurbished computers are distributed to countries around the world, can greatly increase ICT penetration in Rwanda.

As Rwanda strives to increase access to energy and electricity generation, the plan recognizes that ICTs, specifically Smart Grid and Energy Market design, can be leveraged to consolidate Rwanda's energy sources in order to enable sustainable energy generation. In efforts to involve the private sector, NICI-2015 has identified several private sector development plans related to the nation's global trends. An example of this is the Project 8, *SMART Electricity Grid and Energy Market Design*, which seeks to consolidate Rwanda's energy sources to enable sustainable energy generation, transmission and distribution. Activities of the project include conducting a feasibility study, developing a blueprint for the introduction of smart grids in Rwanda, piloting the project for buildings, decentralized systems, micro grids and energy billing systems. It is anticipated that the project will result in a more reliable and efficient energy supply and increased investments in green energy.

Related to land use, Community Development Project 1, Land Use Management and Information Systems (LUMIS), seeks to improve land management through utilization of geographic information systems (GIS) and a national land use master plan. The plan is a rollover project from NICI-2010 and is expected to result in cost savings in addition to improved decision making. Furthermore, two projects connecting ICTs to sustainability are identified in the plan: the *Green ICT project* and the *Rwanda Climate Change Observatory*. Both are presented in boxes 5.4 and 5.5, respectively.

BOX 5.4 – GREEN ICT PROJECT

The *Green ICT Project* is one of the cross-cutting actions outlined in the NICI-2015 plan. The project is built around the potential risks associated with e-waste resulting from the accumulation of outdated ICT equipment. Rwanda has vast amounts of legacy mainframes and terminals, which may pose serious environmental consequences unless properly disposed. Furthermore the delay in the digitization of national administration and a paper-based bureaucracy for the majority of government and private sector procedures may result in higher operational costs and significant repercussions to the environment.

To tackle both issues and leverage the opportunity that ICTs and broadband can provide in environmental management conservation, the *Green ICT Project* defines a set of activities aimed at reducing e-waste, enabling efficient energy generation, consumption, and promoting access to broadband-enabled services and applications. The project also includes actions to further support Rwanda's environmental management policies.

A relevant aspect of the *Green ICT Project* is that it includes the implementation and enforcement of a policy requiring all public servants to utilize deployed e-Government tools and applications. It also aims to establish mechanisms to recycle and refurbish old computers and other ICT hardware that can be used in schools and local government offices countrywide.

Other actions included in the project include the adoption of smart grids and smart building policies to promote occupancy based lighting and heating solutions in commercial buildings, the formation of partnerships with global green institutions, and the undertaking of awareness raising and sensitization campaigns around this initiative.

The expected outcomes of the *Green ICT Project* are the reduction in GHG emissions and energy consumption, as well as the adoption of green ICT best practices. The medium and long-term benefits of this action can significantly improve Rwanda´s position in achieving MDG7 and implementing sustainable development plans. Besides, the digitization of government services can further facilitate the potential of ICTs through private-public partnerships and intergovernmental activities.

BOX 5.5- CLIMATE CHANGE OBSERVATORY

The Climate Change Observatory project is a cross-cutting project identified in the NICI-2015. The purpose of the project is to create a climate change observatory that will contribute to address GHG emissions in the country and respond to the challenges of climate change. The project is aimed at collecting atmospheric observations to contribute to meteorological forecasting, monitor climatic conditions and build scientific and engineering capacity within Rwanda. The center is also meant to be a reference point where all stakeholders can exchange knowledge and share initiatives related to mitigation and adaptation to global warming.

In 2009, the local government in collaboration with the IT sector ministry, and in partnership with the Massachusetts Institute of Technology and the Common Market for Eastern and Southern Africa (COMESA), decided to position its center – the first of its kind in Africa – on Mt. Karisimbi[72]. The site was chosen on the basis of scientific evaluation from a number of sites. Among its features, the center will include: a weather center, seismic monitoring unit, hydrology unit, geothermal unit, atmospheric emission and a precipitation monitoring unit. The activities of the project include the mobilization of resources, the installation of a cable car to the remote location, the recruitment and training of engineers and technicians and the development of university education programs in climate science.

The observatory will improve the capacity of the countries in the region to monitor climatic conditions and meteorological forecasting, enhance regional and international cooperation on climate change and increase the capacity to respond to climate change challenges. The implementation timetable for the Observatory foresees the beginning of the project from mid-2011 to the Observatory becoming operational in early 2013.

5.2 ICT4D: Rwanda's ICTs and Broadband Strategy

Rwanda has provided an example of a government strategy that has been developed and implemented over a relatively short period of time. A clear progression from the long-term vision (Vision 2020) through to the rolling-medium term plans through to the implementation by sub-sector and project specific plans. Made possible by this clear structure, is the good coordination of different ministries allowing the cross cutting issues, such as ICTs, to be present in many government plans.

ICTs are identified as having the potential to assist in the achievement of the country's numerous targets and priorities, including those related to MDG7, and are enabling the sustainable transition of Rwanda to an ICT hub and knowledge based economy.

6 Conclusions

Broadband infrastructure is a catalyst for economic growth, a driver of innovation and a prerequisite for the development and operation of digital economies. Previous work of the Broadband Commission, more specifically, the report *The Broadband Bridge: Linking ICT with climate action for a low-carbon economy*, put forward a set of recommendations to promote the adoption and delivery of environmentally focused broadband policies. Building on these recommendations, this case study complements previous work in the area of ICTs and sustainability by looking at the contributions of broadband with a focus on MDG7, which targets environmental sustainability, including reducing CO2 emissions, improving access to water and sanitation, reversing biodiversity loss and improving the lives of slum dwellers.

The analysis presented in this case study indicates that already 34 per cent of national broadband policies make reference to environmental sustainability: specifically, reducing energy consumption through broadband-enabled applications and by promoting sustainability within the ICT sector. These countries provide relevant information that other countries can refer to for material on references to environmental sustainability when writing or reviewing their own national broadband and ICT policies.

The analysis also indicates that many policies have not advanced in defining metrics, targets and implementation strategies to measure the success and effectiveness of their policies. On this regard, many of the references described are presented in a descriptive narrative of 'good-to-have' initiatives. In the context of MDG7, the improvement of sustainability includes reversing environmental and biodiversity losses and improving basic sanitation and access to drinking water. These principles have not been addressed in a holistic context in any of the plans analysed.

To maximize the potential of broadband for progressing MDG7 and environmental sustainability, next steps would require a concerted effort by all stakeholders. Long term monitoring of the outcomes of the projects outlined in this case study will provide a wider scale opportunity for tracking progress and identifying tools that encourage the implementation of plans and policies, promote investment and overcome barriers. Finally, the adoption of a standardized set of methodologies to measure the overall impact of ICTs and broadband in the environment could be considered for new and future revisions of these policies.

These case studies are a first step in the direction of assessing the current contribution of broadband policies to environmental sustainability and should mark the beginning of an on-going process to monitor progress and change of these policies over time. It is presented as a contribution to the Broadband Commission to advance in the achievement of *broadband-driven sustainable policies for all* in the global digital economy.

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[14] Further information about Rio+20 is available at http://www.uncsd2012.org

[15] The number of urban residents living in slum conditions is now estimated at some 863 million, compared to 657 million in 1990 and 767 million in 2000.

[16] Reference year established within the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC).

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[32] ITU, Using Submarine Communications Networks to Monitor the Climate, ITU, 2011. http://www.itu.int/en/ITU-T/techwatch/Pages/submarinenetworks.aspx

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[37] The target indicates that by 2015, all countries should have a national broadband plan or strategy or include broadband in their Universal Access / Service definitions. Further information about the targets defined by the Broadband Commission is available at http://www.broadbandcommission.org/Documents/Broadband_Targets.pdf

[38] Further information about the 2011 Broadband Leadership Summit is available at http://www.broadbandcommission.org/LeadershipSummit.aspx.

[39] Further information about the ITU ICT Eye regulatory database is available at http://www.itu.int/ITU-D/icteye/.

[40] *In this document a country comprises the 193 ITU Member States i.e. a State which is considered to be a Member of ITU in application of Article 2 of its Constitution. Further information on ITU Member States available at http://www.itu.int/en/membership/.*

[41] *The sustainability of the ICT sector includes the environmental impacts across all stages of the life-cycle: design and architecture of services; procurement of software and equipment; construction of infrastructure; operations and end-of-life management.*

[42] *The adoption of the majority of ICT strategies in Africa was facilitated by the creation by the Economic Commission for Africa (ECA) in May 1996 of the African Information Society Initiative (AISI). To achieve the goal of the AISI which is to promote regional development in the field of ICTs, the ECA assisted 37 African countries to develop ICT national strategies for accelerating their socio-economic development. National Information and Communication Infrastructure plans (NICI plans) are the response of Africa to the challenges posed by a growing digital world and globalization effects with the overall objective of contributing to poverty eradication and to the achievement of the Millennium Development Goals (MDG) through the progressive promotion of the role of ICT in national strategies and plans of action.*

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[45] *Teleworking and video conferencing are just one example of the spectrum of broadband-assisted tools which support collaboration / productivity across geographically diverse locations*

[46] *Further information about ITU-T Study Group 5, Environment and Climate Change is available at http://www.itu.int/ITU-T/studygroups/com05/index.asp*

[47] *Further information about ITU-T Recommendation L.1400 is available at http://www.itu.int/rec/T-REC-L.1400-201102-I*

[48] *Further information about ITU-T Recommendation L.1410 is available at http://www.itu.int/rec/T-REC-L.1410/en*

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