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ICT, Climate Change and Green Growth

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Climate change constitutes a major threat to earth ecosystems as we presently know them. It is linked to the increase of greenhouse gas (GHG) in the atmosphere as a result of human activity. Information and communication technologies (ICTs) can be used to reduce GHG emissions (mitigation) and also to build people's resilience to climate change effects (adaptation). This briefing note examines the threats of global climate change, paying particular attention to the Asia Pacific region, and discusses how ICTs can be utilized in solutions to help countries mitigate and adapt to climate change. This briefing note also introduces Green Growth - an approach to economic progress that incorporates environmentally sustainable, low-carbon and socially inclusive development. ICTs facilitate the efficiency gains that many Green Growth initiatives depend on.

This briefing note is drawn from the tenth core module of the Academy of ICT Essentials for Government Leaders (Academy). The Academy is a comprehensive ICT for development training curriculum that aims to equip policymakers with the essential knowledge and skills to fully leverage opportunities presented by ICTs to achieve national development goals and bridge the digital divide. More information on the Academy is available at http://www.unapcict.org/academy.

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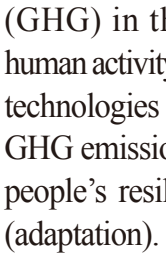
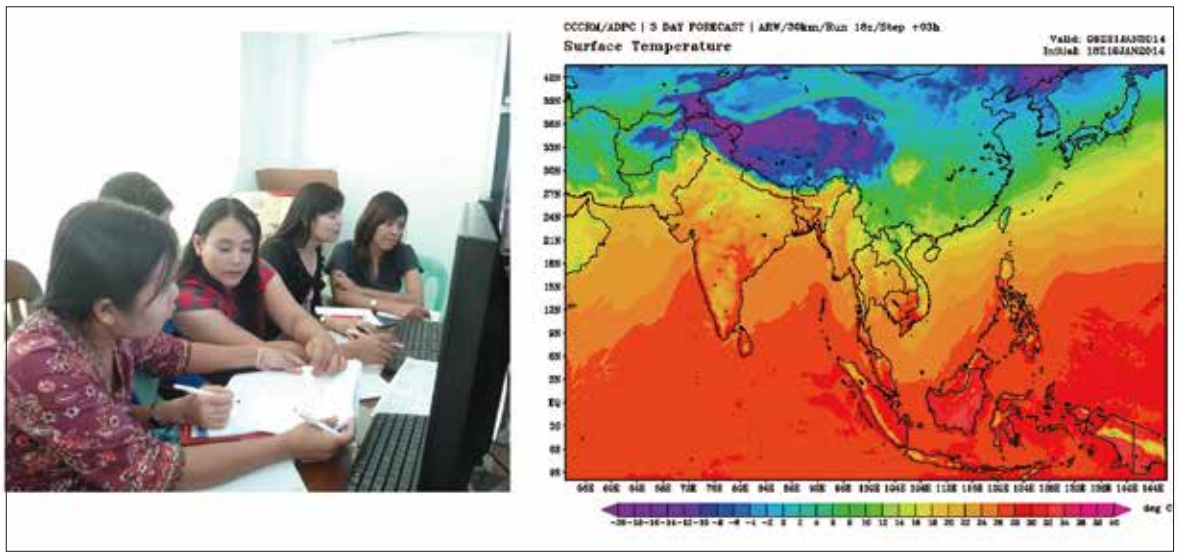


Module 10 - ICT, Climate Change and Green Growth

Examines ICT trends and their implications for tackling climate change, and explores how ICT can be utilized for mitigating and adapting to climate change, and achieving green growth.



Scientists from Myanmar's Department of Meteorology and Hydrology learn how to use weather and climate modeling software, which when combined with data from meteorological stations can be used to study climate patterns and analyze trends into the future. (Image source: Asian Disaster Preparedness Center)

The **APCICT Briefing Note Series** aims to provide at-a-glance information on key information and communication technology for development (ICTD) agendas for high-level policymakers and stakeholders. The series includes: 1. highlights of conventional research papers, assessment and survey reports and publications; 2. policy considerations drawn from the Academy modules; and 3. key challenges and lessons learned based on analyses of best practices and case studies.

Introduction

For the Asia Pacific region in particular and the world in general, the threat of climate change is real. There are many solutions to helping countries mitigate[1] and adapt to climate change. Information and communication technologies (ICTs) are part of these solutions. More specifically, ICTs can be used to:

1. Help countries to better monitor, understand and manage the environment, so that informed decisions can be made on actions for climate change adaptation
2. Reduce material use through dematerialization (e.g. using ICTs such as videoconferencing for travel substitution, and replacing physical goods, services and stores with online equivalents)
3. Optimize and enhance process efficiency to reduce greenhouse gas (GHG) emissions while at the same time offering a unique and innovative opportunity to promote environmentally sustainable economic development and growth (Green Growth)

ICTs are essential for understanding environmental systems and their dynamics. This includes both the natural environment and the human environment such as buildings in cities. ICTs are used for acquiring and sharing environmental data, and for monitoring and modeling weather and environmental systems.

The growth and increasing availability of computer processing power, broadband, mobile and wireless computing, social networking, cloud and grid computing, and Web 2.0 technologies have created vast digital data archives for use in environmental decision-making. The digitization of data streams, the use of geographic information systems (GIS), remote sensing and computerized modeling of climate and climate impacts facilitate weather monitoring, disaster risk management, and planning for adapting to climate change.

[1] Note that climate change mitigation is not the same as disaster mitigation. Climate change mitigation includes actions to reduce greenhouse gas emissions. Disaster risk mitigation is the lessening or limitation of the impact of hazards such as floods and earthquakes. It includes the implementation of structural measures (e.g. flood gates) and non-structural measures (e.g. land-use planning) so that when a disaster strikes, its impact on communities is lessened.

When ICTs are integrated in other technologies, these are often times considered "smart technologies", which can be very useful for helping to mitigate climate change. For example, low power wireless sensor technology are connected to the Internet for sensing environmental and climate related events and phenomena with great detail at the earth's surface and atmosphere.

Smart sensors that measure environmental conditions such as temperature, pollutants and GPS coordinates are being developed and are now diffusing via mobile phones and other wireless devices including sensors organized as nodes in networks. Sensors built into mobile phones and other devices can be used by the public to report on environmental phenomena. These sensors can report the data on websites that are designed to help the public monitor the environment, discuss the arising issues, and hopefully the public will mobilize social and policy change to address these issues.

ICTs are used in the development of "clean technology" and the result is leading to the concept of Green Growth where the Asia Pacific region is now taking the lead.

ICTs are being used in several sectors and at various scales-for example in cities-to reduce GHG emissions. Applications with the greatest potential to tackle climate change effects are the use of ICTs for:

- Environmental management, including agricultural and natural resource management
- Earth and environmental observation and sensing
- Intelligent energy generation, distribution and transmission systems including intelligent energy use systems, monitors and controls also known as smart grids
- Energy efficient buildings (smart buildings)
- Time and energy efficient logistics and transportation systems (smart transportation systems)
- The integration of these technologies into energy efficient cities (smart cities)

These applications or ICT-enabled systems, some of which are considered clean technologies (cleantech), are becoming an important sector in their own right. They are being used in the Asia Pacific region and around the world to help tackle climate change effects and promote sustainable development.

For the developing countries of the region, there is a need to enhance capacity to use ICTs in general (including infrastructure, enabling policies and legislation, organizational change and human capacity) and for tackling environmental and climate change issues.

Climate Change in Asia-Pacific

In the Asia-Pacific region, the heavily industrialized and rapidly industrializing countries are responsible for the greatest amount of GHG emissions. On the other hand, the poorest developing countries are most likely to suffer the gravest consequences of climate change. These negative impacts are likely to come about as a result of changes in natural resource exploitation and land use patterns.

By the 2080s, many million more people living in the densely populated and low-lying deltas and coastal areas are projected to experience floods every year due to sea level rise. Widespread reduction in glacier mass and snow pack formation on major mountain ranges (such as the Hindu-Kush and Himalayas) are projected to accelerate throughout the 21st century, reducing water availability and hydropower potential.

Precipitation and runoff are projected to increase by 10 to 40 per cent by the 2050s at the higher latitudes and some wet tropical areas of East and South-East Asia. Conversely, less rainfall and higher rates of evapotranspiration are expected over some dry regions at mid-latitudes and dry tropics. The reduction of water resources in many small islands is expected to reach the point where they become insufficient to meet demand during low-rainfall periods.

Sea level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities. Deterioration in coastal conditions, for example through erosion of beaches and coral bleaching, is expected to affect local resources.

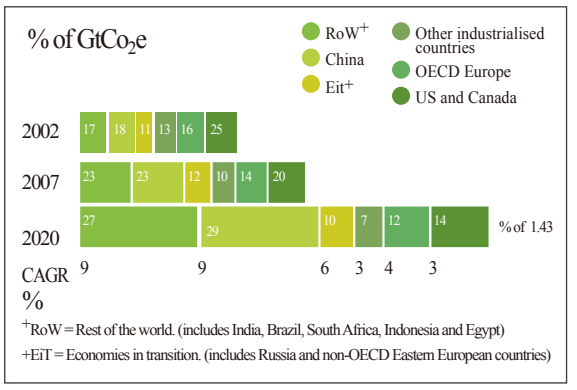
The Asia-Pacific region is sensitive to climate change induced hazards such as sea level rise, an increased occurrence of extreme weather events and flooding. Asia-Pacific countries are especially vulnerable because they have large populations that depend on agriculture or other natural resource based activities for their livelihoods. It is precisely these activities that are most at risk in many developing countries. They also have limited means to deal with environmental disasters and adapt to climate change. Those most at risk are the poor.

GHG Emissions in the ICT Sector

Most ICT GHG generated emissions come from the use of ICTs. 25 per cent of these emissions are generated during manufacturing. PCs account for most of the GHG emissions resulting from ICT use, with 14 per cent coming from data centres and 37 per cent from telecoms infrastructure and services. Emissions from data centres are rising more rapidly with the increased diffusion of cloud computing, video and triple play services and of mobile applications, especially multimedia mobile applications.

Standards still need to be developed to agree on ways to measure the contribution of ICTs to GHG emission. Life cycle analysis (LCA) is a key methodology being developed for the environmental impact assessments of ICTs. The amount of GHG emissions by geography is shown in Figure 1.

Figure 1. The global ICT footprint by geography



The ICT industry is responding and has come together under various initiatives such as the Global e-Sustainability Initiative (GeSI), and various industry and government standards to reduce emissions such as EnergyStar, 80 Plus, the Restriction of Hazardous Substances Directive (RoHS) of the European Union, etc. Other novel approaches to reducing emissions from data centres include moving these centres to low carbon emitting energy generation sites linked to the global IP network by fast fibre optic connections.

ICT Applications for Climate Change Adaptation

Adaptation to climate change requires countries to modify their behaviour in order to reduce the "vulnerability of natural and human systems against actual or perceived climate change effects."[2] Governments and organizations can adapt to climate change by preparing for changing environmental and climatic conditions before their full impacts are felt by the communities, target groups, environments and ecosystems.

Two aspects of adaptation need to be considered:

1. Understanding the relationship between environmental capabilities, human land use, and changing weather and environmental conditions will help to determine what actions may need to be taken to adapt to climate change in a given location
2. Building capacities of organizations to deal with changing climates will enhance local community and organizational self-sufficiency in learning, planning and adapting to changing climate

While ICTs can enable capacities such as earth and weather monitoring, they can more importantly, help to enhance the ability and efficiency of government agencies as well as that of other stakeholders to prepare for and facilitate adaptation to climate change.

Earth observation, environmental monitoring, remote sensing activities, GIS, ICTs for sharing information and for mobilizing action are especially relevant for helping to identify the threats due to climate change, and plan for actions to reduce the impact of these threats.

Participants in discussion during the session on ICT, climate change and green growth at the 4th Academy Partners Meeting organized in Incheon, Republic of Korea. [November 2012]

One of the key ways in which ICTs can be used for adaptation is by enhancing access to and sharing data and information in a timely fashion, especially by people at the local and community levels. ICTs can also be used for enhancing local participation in the environmental decision-making process. In a more general sense, ICTs can help countries adapt to climate change by enhancing their capacity to make sound environmental decisions.

Using remote sensing technologies, it is possible to map soil capability characteristics and then identify appropriate land use practices, crops and livestock, to implement appropriate sustainable agricultural practices. For example, agroforestry technologies and practices can be considered when local climatic and other environmental conditions change.

ICTs also facilitate adaptation efforts by enhancing the capacity of weather and environmental ministries and services to collect data and communicate it to the public. Increasing the number of automatic weather stations that are connected remotely to the national weather information system increases the capacity to gather enough information and thus strengthens the capacity of a country to adapt to climate change. In Africa, mobile communications are being used to achieve this objective. Ericsson, the mobile phone company, is undertaking a major public-private partnership project in Africa - "Weather for All" - that aims to construct 5,000 automatic weather stations at mobile network sites across the continent.[3] At present, only 300 are operating.

In agriculture, ICTs can be used to assist small scale farmers to predict crop yields in relation to seasonal weather and precipitation trends. The Famine Early Warning System, which has been primarily implemented in Africa and Latin America but does include Afghanistan, has been used successfully since the 1970s to help farmers, officials and the international community to prepare for famine and delay growing seasons when drought places farming at risk.[4]

In India, "Nano Ganesh", a mobile phone application that triggers irrigation pumps remotely is saving water and is helping over 10,000 farmers manage pumps that would otherwise require manual control.[5] With changing climatic conditions, such technologies are important for water conservation and management.

In several countries in Africa and in Asia, the availability of this ICT-generated information is being used to provide climate risk insurance for small scale farmers and other economic operators. With the availability of timely, accurate and reliable weather data, insurance companies in Kenya see opportunities to provide farmers with affordable micro-insurance plans.[6]

Participants engaged in discussion at the National Training of Trainers Workshop co-organized by UN-APCICT/ESCAP, the Open Society Institute Assistance Foundation (OSI-AF) and the Association of Internet Service Providers (AISP), in Romit, Tajikistan (August 2013)

ICT Applications for Climate Change Mitigation

According to the Smart 2020 report,[7] the largest influence of using ICTs is in "enabling energy efficiencies in other sectors, an opportunity that could deliver carbon savings five times larger than the total emissions from the entire ICT sector in 2020."

The most significant reductions in energy consumption are related to the use of ICTs in power generation, transmission and use. Dematerialization and the use of virtualization technologies (technologies that use virtual or software based computers instead of real computer hardware) are expected to further enhance the energy efficiency of PCs and data centres.

Building Information Modeling software is being used to design "smart buildings" that reduce material and energy consumption during construction. Various sensor technologies can control environmental and energy variables during the life of the buildings, and therefore reduce GHG emissions associated with energy production.

Smart grids have great potential to increase the efficiency of electricity use, especially in developing countries with older power grids. Smart grids will allow greater use of renewable energy generating technologies and the use of

[2] Intergovernmental Panel on Climate Change, IPCC glossary Working Group III, 2007, p. 809.
[3] Ericsson, "Mobile communications to revolutionize African weather monitoring", press release, 18 June 2009.
[4] Famine Early Warning Systems Network.
[5] Ossian Agro Automation, Nano Ganesh, 2009.
[6] Kilimo Salama, "First micro-insurance plan uses mobile phones and weather stations to shield Kenya's farmers", 5 March 2010.
[7] The Climate Group and GeSI, Smart 2020: Enabling the low carbon economy in the information age (2008).

onsite renewable power generation equipment such as fuel cells, solar stations, wind generators and micro hydro installations, as well as high efficiency energy storage solutions now in development. This will create more control over energy generation, transmission and reduce energy losses.

These as well as other smart applications such as smart logistics, transportation and motors, are made possible because of the intelligent and networked processors that are embedded in control motors, devices and systems.

ICT and the Green Growth Opportunity

The Asia-Pacific region has become the world's largest resource user, consuming about 60 per cent of global resources. This growth is accompanied by increasing demands for energy, land, natural resources and ecosystem services. The projected resources requirements in the Asia Pacific region are such that they will exceed the earth's carrying capacity in the region, and insecurities around food, water and energy supplies remain very high. As a result, several countries are looking at improving the efficiency of energy and natural resource utilization.

In the G-20 countries, massive investment in ICT-enhanced clean technologies is taking place. Although economic stimulus is one reason, governments now also see Green Growth as an opportunity to stimulate economic development and job creation. As an initiative of the Republic of Korea, the Global Green Growth Institute has been created to champion Green Growth for "economic growth and development while reducing carbon emissions, increasing sustainability, and strengthening climate resilience."[8]

A recent PEW report states that worldwide investment in clean energy has experienced a growth of 230 per cent since 2005. Domestic policy decisions are driving this trend.[9] Many governments have made green energy a priority as part of economic stimulus and recovery funding, and are establishing competitive positions in the cleantech economy. In the Asia Pacific region, China, Japan and the Republic of Korea are investing heavily in cleantech.

A major component of this investment will be in Green IT - or observing green principles in the design, manufacture, use and recycling of electronics. Governments are also promoting green public service delivery through green e-government portals, green energy production, and other innovations.

ICTs will enable many of the new clean technologies and practices. Sometimes unreliable or unavailable renewable energy will be more readily accessible through more reliable ICT-enabled smart grids. The benefits and costs for developing countries in the use of ICTs for cleantech and for stimulating Green Growth need to be determined.

A Strategic Approach

Many of these technologies discussed may not be available in developing countries due to prohibitive costs, or because capacity is just not available. Moreover, not all technologies are equally suited when it comes to the needs of the developing world. A strategic planning methodology is needed for assessing which technologies and management practices could have the greatest impact.

Developing countries in the Asia-Pacific region need to be aware of the risks, challenges and opportunities that climate change presents to national development. They need to be able to track and assess the role that ICTs can play in promoting national strategies for environmental sustainability, climate change mitigation and adaptation, and Green Growth.

This step is important to help identify priorities, assess feasibility, and position Asia-Pacific countries to take advantage of funding, aid and investment opportunities. These opportunities are likely to be negotiated within the framework of the United Nations Framework Convention on Climate Change and successor agreements to the Kyoto Protocol, or directly as business deals with investors.

Green ICT strategies and plans are a challenge for developing countries. While the impact of climate change requires that they adapt rapidly to impending change, they have limited infrastructure, and technical and managerial capacity. Moreover, green ICT technologies are costly and depend on significant guarantees, and in many cases, incentives as well as public and private sector investment. On the other hand, developing countries often lack adequate financial resources.

A strategic planning framework that starts with a national sustainability assessment within the context of existing national development planning priorities and strategies is ideal. This involves consulting with key stakeholders and a review of existing policies, priorities and activities / projects. Benchmarking and best practice analysis are part of this exercise. Based on this assessment and consultation, policy priorities can then be reviewed and discussed with a view to developing priorities for reducing energy use and GHG emissions using ICTs.

UN-APCICT / ESCAP

APCICT, a regional institute of the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), was established and inaugurated on 16 June 2006 in Incheon, Republic of Korea. The role and mission of APCICT is to strengthen the efforts of the 62 ESCAP member and associate member countries to use ICTs in their socio-economic development through building the human and institutional capacity for ICT. In pursuit of this mandate, APCICT's work is focused on three inter-related pillars-Training, Advisory Services and Research. The Briefing Note Series is part of the research pillar. Also under the research pillar is a Case Study Series that provides compilations and analyses of best practices and case studies on different aspects of ICTD and capacity building in the Asia Pacific region.
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[8] GGGI, "About Us", 2010.
[9] Pew Charitable Trusts, Who's winning the clean energy race? Growth, Competition and Opportunity in the World's Largest Economies. G-20 Clean energy factbook (Philadelphia, 2010).